# Appendix for Model 03110206

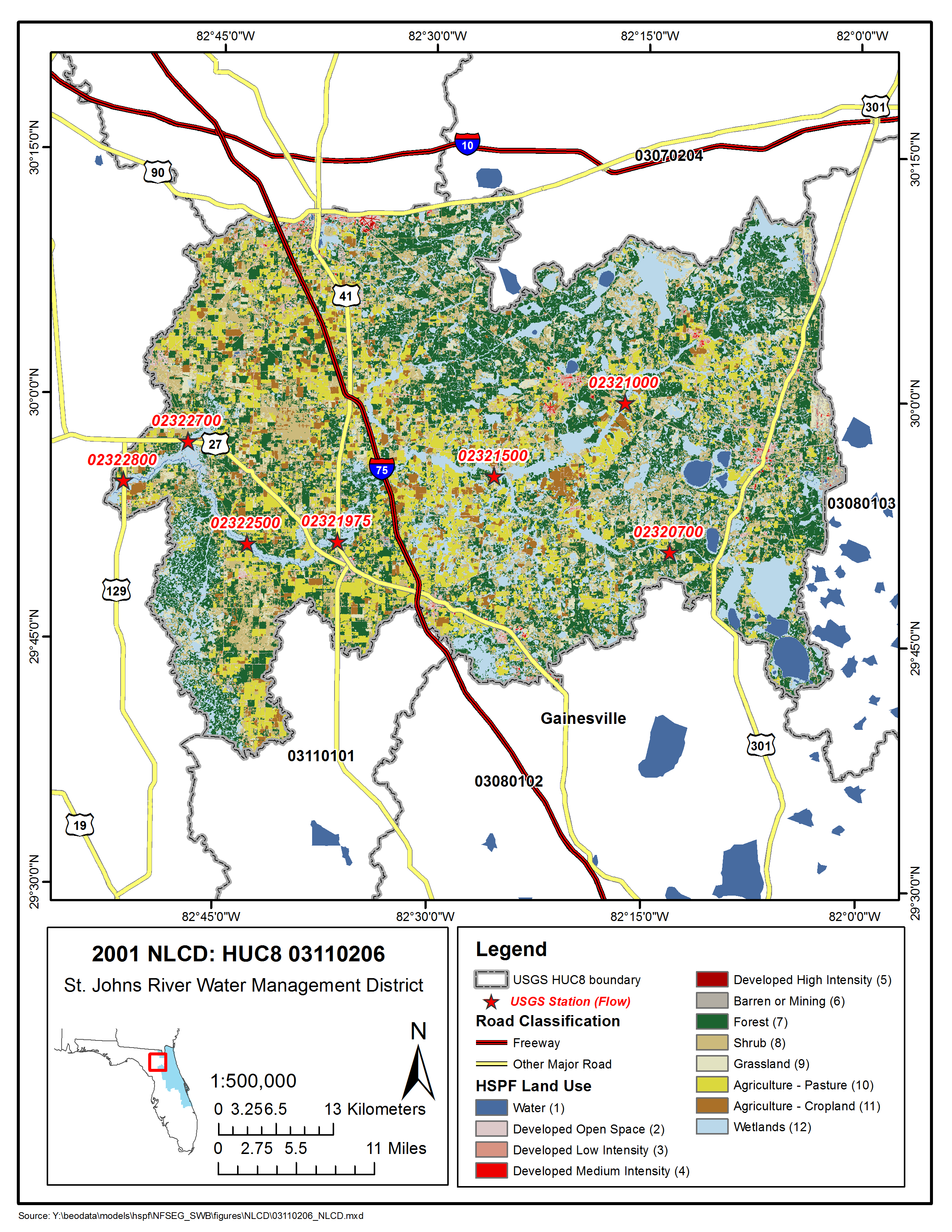


Figure 03110206-1: Land Cover from the National Land Cover Database.

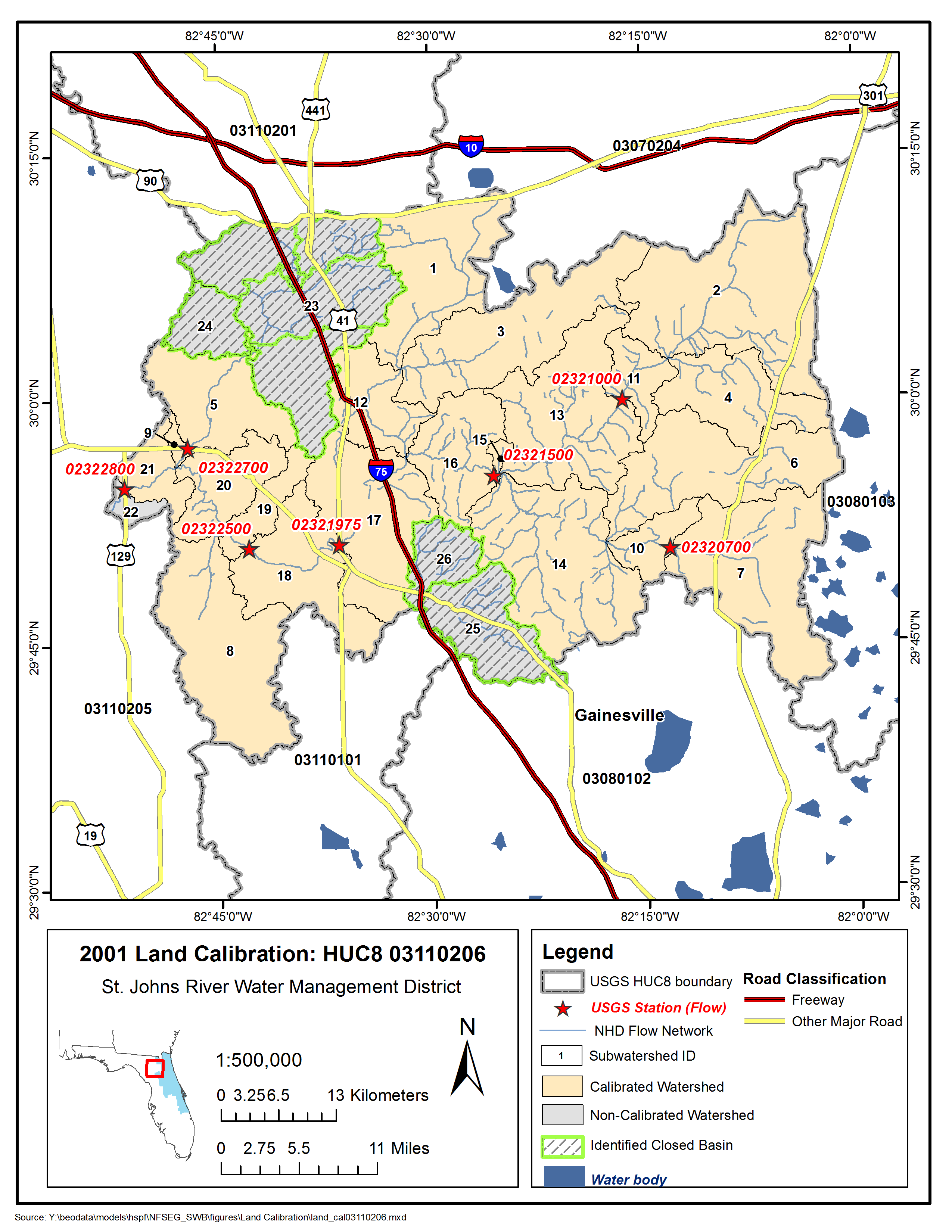


Figure 03110206-2: Calibrated sub-watersheds.

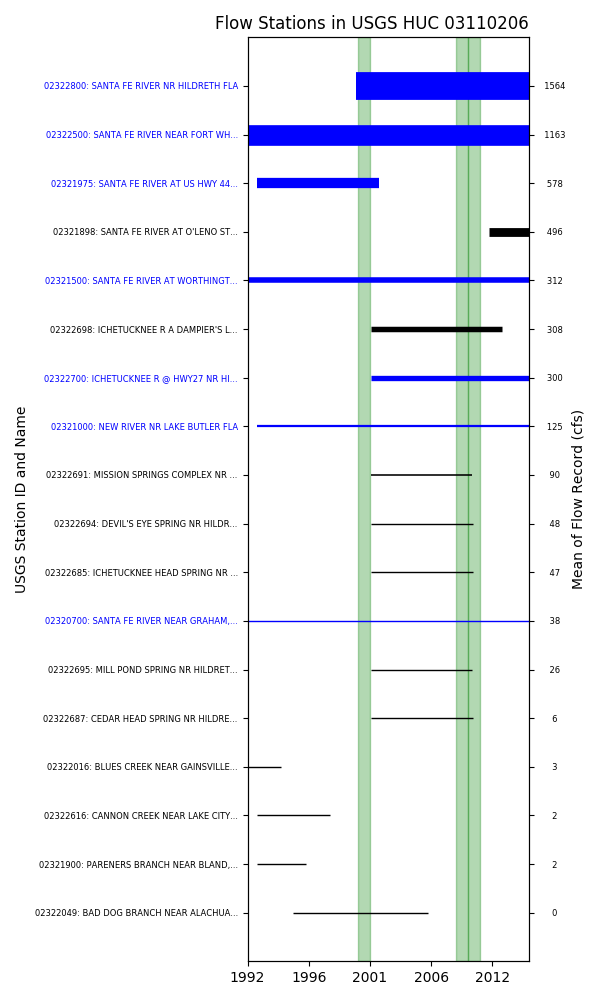


Figure 03110206-3: Station period of record. Blue color identifies gauges used for calibration.

## HSPF Reach 05, USGS Gauge 02322700

Table 03110206-1: Comparison Statistics Between HSPF Reach 05 and USGS Gauge 02322700.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -2.41 |
| Standard error | 48.12 |
| Relative bias | -0.01 |
| Relative standard error | 0.64 |
| Nash-Sutcliffe coefficient | 0.59 |
| Kling-Gupta coefficient | 0.74 |
| Coefficient of efficiency | 0.43 |
| Index of agreement | 0.71 |

Table 03110206-2: Hydrologic Indices Between USGS Gauge 02322700 and HSPF Reach 05.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02322700 | Simulated Reach 05 | Percent Difference |
| MA1: Mean, all daily flows | 298.67 | 295.76 | -0.98 |
| MA2: Median, all daily flows | 285.00 | 283.91 | -0.38 |
| MA3: CV, all daily flows | 14.28 | 13.82 | -3.21 |
| MA4: CV, log of all daily flows | 23.78 | 21.71 | -8.72 |
| MA5: Mean daily flow / median daily flow | 1.05 | 1.04 | -0.60 |
| MA9: (Q10 - Q90) / median daily flow | 0.73 | 0.66 | -8.99 |
| MA10: (Q20 - Q80) / median daily flow | 0.42 | 0.41 | -2.39 |
| MA11: (Q25 - Q75) / median daily flow | 0.36 | 0.34 | -4.80 |
| MA12: Mean monthly flow, January | 276.66 | 272.85 | -1.38 |
| MA13: Mean monthly flow, February | 262.07 | 258.81 | -1.24 |
| MA14: Mean monthly flow, March | 266.18 | 271.05 | 1.83 |
| MA15: Mean monthly flow, April | 250.52 | 267.32 | 6.71 |
| MA16: Mean monthly flow, May | 281.00 | 256.31 | -8.79 |
| MA17: Mean monthly flow, June | 279.03 | 266.90 | -4.35 |
| MA18: Mean monthly flow, July | 291.53 | 276.82 | -5.05 |
| MA19: Mean monthly flow, August | 291.96 | 290.03 | -0.66 |
| MA20: Mean monthly flow, September | 296.75 | 294.10 | -0.89 |
| MA21: Mean monthly flow, October | 268.67 | 284.04 | 5.72 |
| MA22: Mean monthly flow, November | 268.04 | 270.53 | 0.93 |
| MA23: Mean monthly flow, December | 273.73 | 270.72 | -1.10 |
| ML1: Mean minimum monthly flow, January | 286.50 | 278.92 | -2.64 |
| ML2: Mean minimum monthly flow, February | 262.50 | 265.54 | 1.16 |
| ML3: Mean minimum monthly flow, March | 233.67 | 273.60 | 17.09 |
| ML4: Mean minimum monthly flow, April | 244.92 | 276.09 | 12.73 |
| ML5: Mean minimum monthly flow, May | 278.83 | 268.36 | -3.76 |
| ML6: Mean minimum monthly flow, June | 284.50 | 268.78 | -5.53 |
| ML7: Mean minimum monthly flow, July | 290.58 | 285.10 | -1.89 |
| ML8: Mean minimum monthly flow, August | 299.33 | 293.11 | -2.08 |
| ML9: Mean minimum monthly flow, September | 291.75 | 298.11 | 2.18 |
| ML10: Mean minimum monthly flow, October | 278.58 | 294.95 | 5.87 |
| ML11: Mean minimum monthly flow, November | 272.17 | 284.24 | 4.44 |
| ML12: Mean minimum monthly flow, December | 288.50 | 279.23 | -3.21 |
| ML13: CV of minimum monthly flows | 27.15 | 22.08 | -18.69 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.71 | 0.86 | 21.85 |
| ML15: Mean minimum annual flow / mean annual flow | 0.70 | 0.84 | 20.89 |
| ML16: Median minimum annual flow / median annual flow | 0.80 | 0.87 | 9.70 |
| ML20: Ratio of baseflow volume to total flow volume | 0.97 | 0.97 | -0.45 |
| ML22: Mean annual minimum flow divided by catchment area | 2.05 | 2.52 | 23.26 |
| RA1: Mean of positive changes from one day to next (rise rate) | 5.43 | 10.03 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 187.64 | 226.42 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 3.75 | 2.45 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 263.43 | 251.89 |  |
| RA5: Ratio of days that are higher than previous day | 0.30 | 0.20 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.01 | 0.01 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.01 | 0.00 |  |
| RA8: Number of flow reversals from one day to the next | 85.77 | 68.08 |  |
| RA9: CV, number of flow reversals from one day to the next | 33.94 | 30.07 |  |

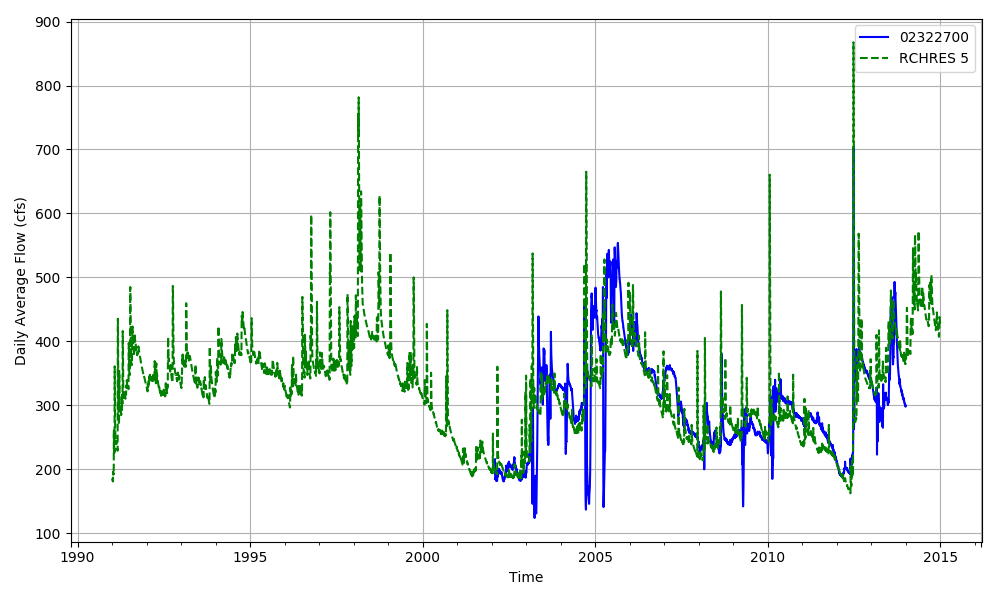


Figure 03110206-4: Daily flow for HSFP reach 05 and USGS station 02322700.

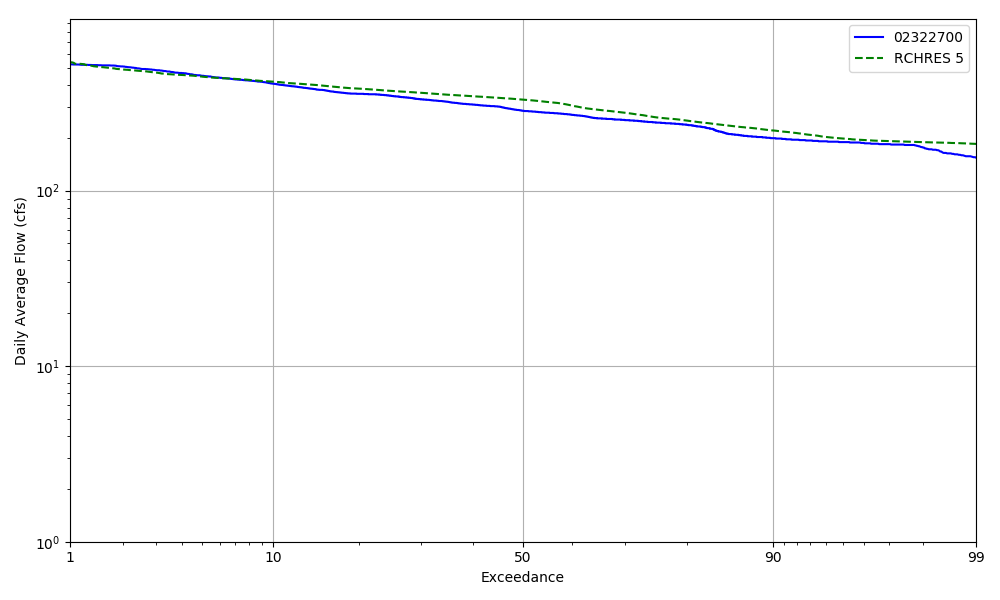


Figure 03110206-5: Daily exceedance for HSFP reach 05 and USGS station 02322700.

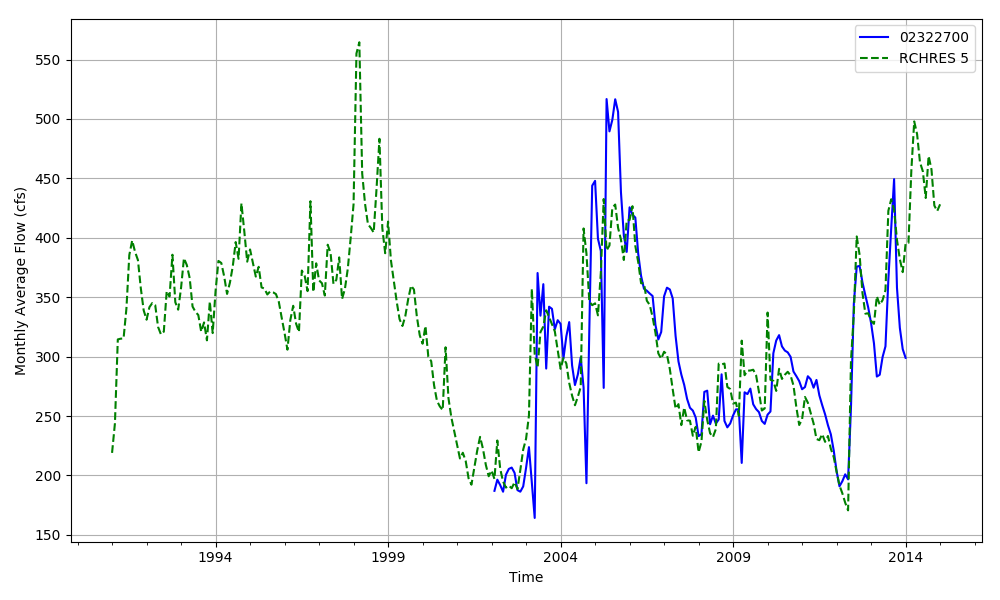


Figure 03110206-6: Monthly flow for HSFP reach 05 and USGS station 02322700.

## HSPF Reach 07, USGS Gauge 02320700

Table 03110206-3: Comparison Statistics Between HSPF Reach 07 and USGS Gauge 02320700.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 0.28 |
| Standard error | 31.80 |
| Relative bias | 0.01 |
| Relative standard error | 0.83 |
| Nash-Sutcliffe coefficient | 0.32 |
| Kling-Gupta coefficient | 0.67 |
| Coefficient of efficiency | 0.28 |
| Index of agreement | 0.64 |

Table 03110206-4: Hydrologic Indices Between USGS Gauge 02320700 and HSPF Reach 07.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02320700 | Simulated Reach 07 | Percent Difference |
| MA1: Mean, all daily flows | 34.67 | 34.75 | 0.24 |
| MA2: Median, all daily flows | 19.00 | 16.76 | -11.80 |
| MA3: CV, all daily flows | 89.09 | 86.91 | -2.45 |
| MA4: CV, log of all daily flows | 114.37 | 118.46 | 3.57 |
| MA5: Mean daily flow / median daily flow | 1.82 | 2.07 | 13.65 |
| MA9: (Q10 - Q90) / median daily flow | 4.32 | 5.28 | 22.17 |
| MA10: (Q20 - Q80) / median daily flow | 2.38 | 2.65 | 11.21 |
| MA11: (Q25 - Q75) / median daily flow | 1.87 | 2.03 | 8.42 |
| MA12: Mean monthly flow, January | 17.18 | 24.08 | 40.19 |
| MA13: Mean monthly flow, February | 21.78 | 19.61 | -9.98 |
| MA14: Mean monthly flow, March | 31.17 | 26.02 | -16.53 |
| MA15: Mean monthly flow, April | 28.84 | 17.71 | -38.60 |
| MA16: Mean monthly flow, May | 10.19 | 8.94 | -12.29 |
| MA17: Mean monthly flow, June | 19.19 | 18.36 | -4.33 |
| MA18: Mean monthly flow, July | 16.95 | 16.61 | -2.05 |
| MA19: Mean monthly flow, August | 26.12 | 18.99 | -27.30 |
| MA20: Mean monthly flow, September | 13.73 | 15.89 | 15.76 |
| MA21: Mean monthly flow, October | 31.78 | 46.06 | 44.93 |
| MA22: Mean monthly flow, November | 10.51 | 12.15 | 15.66 |
| MA23: Mean monthly flow, December | 6.63 | 9.71 | 46.53 |
| ML1: Mean minimum monthly flow, January | 9.49 | 11.71 | 23.33 |
| ML2: Mean minimum monthly flow, February | 14.76 | 11.35 | -23.08 |
| ML3: Mean minimum monthly flow, March | 16.54 | 8.49 | -48.69 |
| ML4: Mean minimum monthly flow, April | 11.29 | 6.50 | -42.42 |
| ML5: Mean minimum monthly flow, May | 5.10 | 6.45 | 26.62 |
| ML6: Mean minimum monthly flow, June | 6.25 | 8.10 | 29.54 |
| ML7: Mean minimum monthly flow, July | 9.16 | 9.79 | 6.86 |
| ML8: Mean minimum monthly flow, August | 11.27 | 7.93 | -29.69 |
| ML9: Mean minimum monthly flow, September | 8.05 | 8.67 | 7.76 |
| ML10: Mean minimum monthly flow, October | 11.73 | 12.76 | 8.72 |
| ML11: Mean minimum monthly flow, November | 13.39 | 10.09 | -24.66 |
| ML12: Mean minimum monthly flow, December | 8.64 | 5.52 | -36.10 |
| ML13: CV of minimum monthly flows | 109.60 | 110.18 | 0.53 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.03 | 0.03 | -4.05 |
| ML15: Mean minimum annual flow / mean annual flow | 0.02 | 0.02 | -21.15 |
| ML16: Median minimum annual flow / median annual flow | 0.01 | 0.03 | 211.25 |
| ML20: Ratio of baseflow volume to total flow volume | 0.42 | 0.41 | -3.74 |
| ML22: Mean annual minimum flow divided by catchment area | 41666.68 | 41666.67 | -0.00 |
| RA1: Mean of positive changes from one day to next (rise rate) | 13.98 | 10.44 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 288.37 | 300.31 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 4.86 | 4.27 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 232.95 | 226.69 |  |
| RA5: Ratio of days that are higher than previous day | 0.24 | 0.29 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.18 | 0.15 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.11 | 0.09 |  |
| RA8: Number of flow reversals from one day to the next | 45.42 | 37.17 |  |
| RA9: CV, number of flow reversals from one day to the next | 89.95 | 88.91 |  |

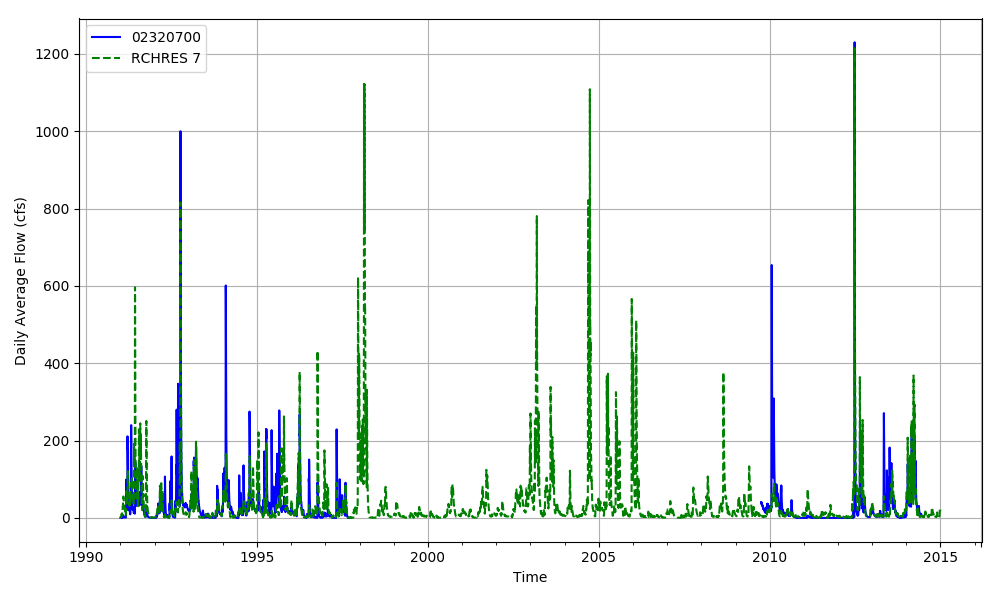


Figure 03110206-7: Daily flow for HSFP reach 07 and USGS station 02320700.

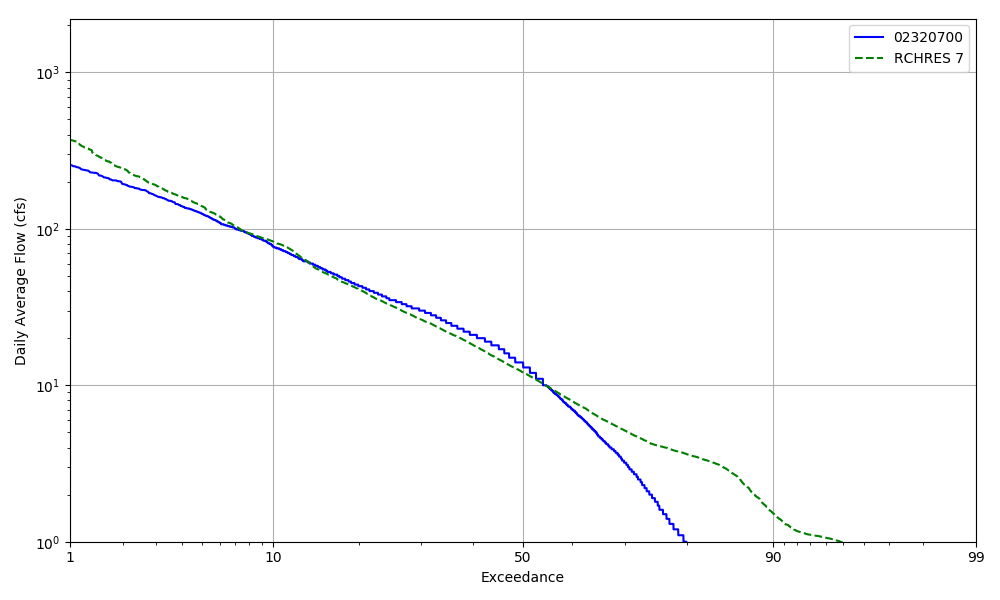


Figure 03110206-8: Daily exceedance for HSFP reach 07 and USGS station 02320700.

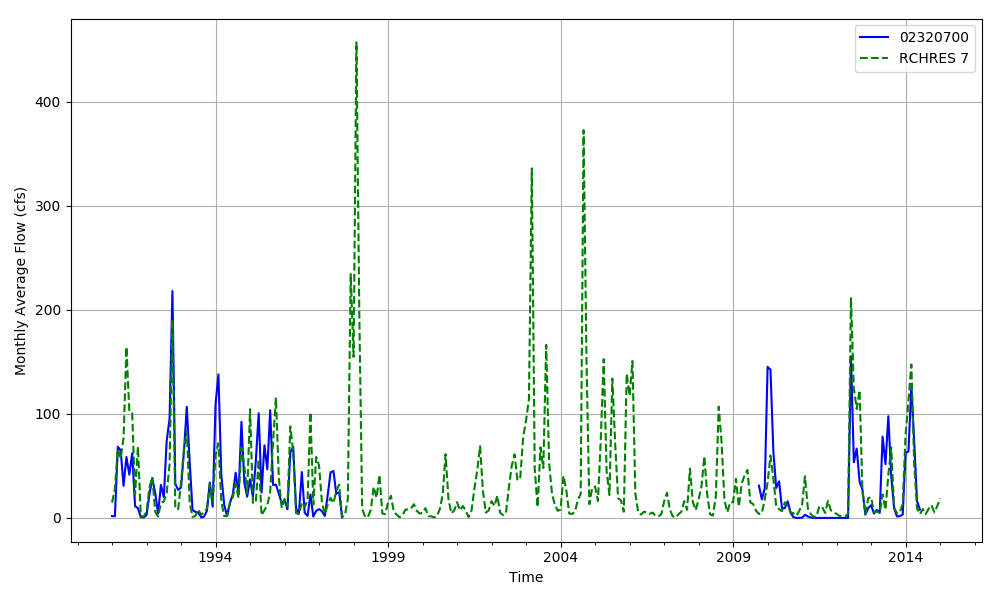


Figure 03110206-9: Monthly flow for HSFP reach 07 and USGS station 02320700.

## HSPF Reach 11, USGS Gauge 02321000

Table 03110206-5: Comparison Statistics Between HSPF Reach 11 and USGS Gauge 02321000.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -22.90 |
| Standard error | 131.38 |
| Relative bias | -0.17 |
| Relative standard error | 0.52 |
| Nash-Sutcliffe coefficient | 0.72 |
| Kling-Gupta coefficient | 0.64 |
| Coefficient of efficiency | 0.59 |
| Index of agreement | 0.76 |

Table 03110206-6: Hydrologic Indices Between USGS Gauge 02321000 and HSPF Reach 11.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02321000 | Simulated Reach 11 | Percent Difference |
| MA1: Mean, all daily flows | 135.50 | 112.84 | -16.72 |
| MA2: Median, all daily flows | 22.00 | 31.50 | 43.16 |
| MA3: CV, all daily flows | 255.02 | 217.37 | -14.77 |
| MA4: CV, log of all daily flows | 179.26 | 143.24 | -20.09 |
| MA5: Mean daily flow / median daily flow | 6.16 | 3.58 | -41.83 |
| MA9: (Q10 - Q90) / median daily flow | 13.52 | 7.76 | -42.64 |
| MA10: (Q20 - Q80) / median daily flow | 5.69 | 4.17 | -26.71 |
| MA11: (Q25 - Q75) / median daily flow | 4.13 | 3.24 | -21.40 |
| MA12: Mean monthly flow, January | 93.40 | 119.20 | 27.63 |
| MA13: Mean monthly flow, February | 191.30 | 154.51 | -19.23 |
| MA14: Mean monthly flow, March | 194.64 | 158.29 | -18.68 |
| MA15: Mean monthly flow, April | 115.57 | 86.72 | -24.96 |
| MA16: Mean monthly flow, May | 79.42 | 54.16 | -31.81 |
| MA17: Mean monthly flow, June | 143.98 | 113.22 | -21.36 |
| MA18: Mean monthly flow, July | 103.99 | 96.68 | -7.03 |
| MA19: Mean monthly flow, August | 195.95 | 134.14 | -31.54 |
| MA20: Mean monthly flow, September | 136.21 | 129.63 | -4.83 |
| MA21: Mean monthly flow, October | 192.36 | 117.12 | -39.12 |
| MA22: Mean monthly flow, November | 25.85 | 36.79 | 42.35 |
| MA23: Mean monthly flow, December | 70.12 | 81.84 | 16.72 |
| ML1: Mean minimum monthly flow, January | 25.66 | 23.69 | -7.70 |
| ML2: Mean minimum monthly flow, February | 33.82 | 34.28 | 1.37 |
| ML3: Mean minimum monthly flow, March | 36.35 | 34.27 | -5.73 |
| ML4: Mean minimum monthly flow, April | 13.18 | 15.18 | 15.13 |
| ML5: Mean minimum monthly flow, May | 12.58 | 9.03 | -28.23 |
| ML6: Mean minimum monthly flow, June | 13.97 | 13.47 | -3.59 |
| ML7: Mean minimum monthly flow, July | 19.01 | 20.21 | 6.34 |
| ML8: Mean minimum monthly flow, August | 25.15 | 25.49 | 1.35 |
| ML9: Mean minimum monthly flow, September | 20.47 | 20.84 | 1.78 |
| ML10: Mean minimum monthly flow, October | 14.33 | 16.02 | 11.79 |
| ML11: Mean minimum monthly flow, November | 11.65 | 11.37 | -2.46 |
| ML12: Mean minimum monthly flow, December | 14.20 | 14.51 | 2.16 |
| ML13: CV of minimum monthly flows | 150.33 | 148.19 | -1.43 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.05 | 0.07 | 22.80 |
| ML15: Mean minimum annual flow / mean annual flow | 0.01 | 0.02 | 42.96 |
| ML16: Median minimum annual flow / median annual flow | 0.02 | 0.05 | 146.76 |
| ML20: Ratio of baseflow volume to total flow volume | 0.25 | 0.28 | 8.34 |
| ML22: Mean annual minimum flow divided by catchment area | 0.02 | 0.02 | -1.59 |
| RA1: Mean of positive changes from one day to next (rise rate) | 76.89 | 83.58 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 467.41 | 358.12 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 29.42 | 24.84 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 405.28 | 424.98 |  |
| RA5: Ratio of days that are higher than previous day | 0.25 | 0.23 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.22 | 0.26 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.12 | 0.13 |  |
| RA8: Number of flow reversals from one day to the next | 61.33 | 62.08 |  |
| RA9: CV, number of flow reversals from one day to the next | 25.93 | 24.92 |  |

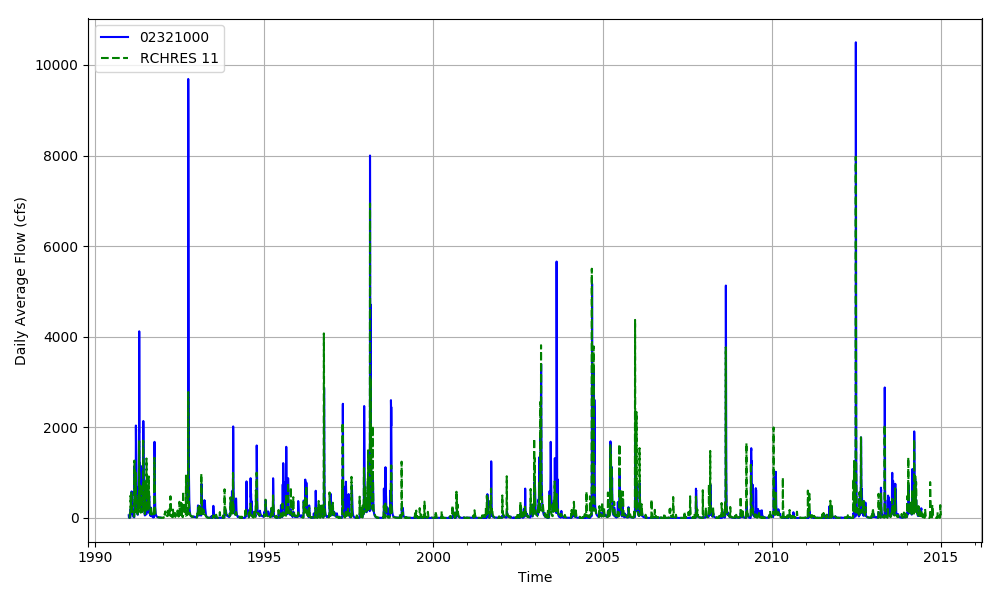


Figure 03110206-10: Daily flow for HSFP reach 11 and USGS station 02321000.

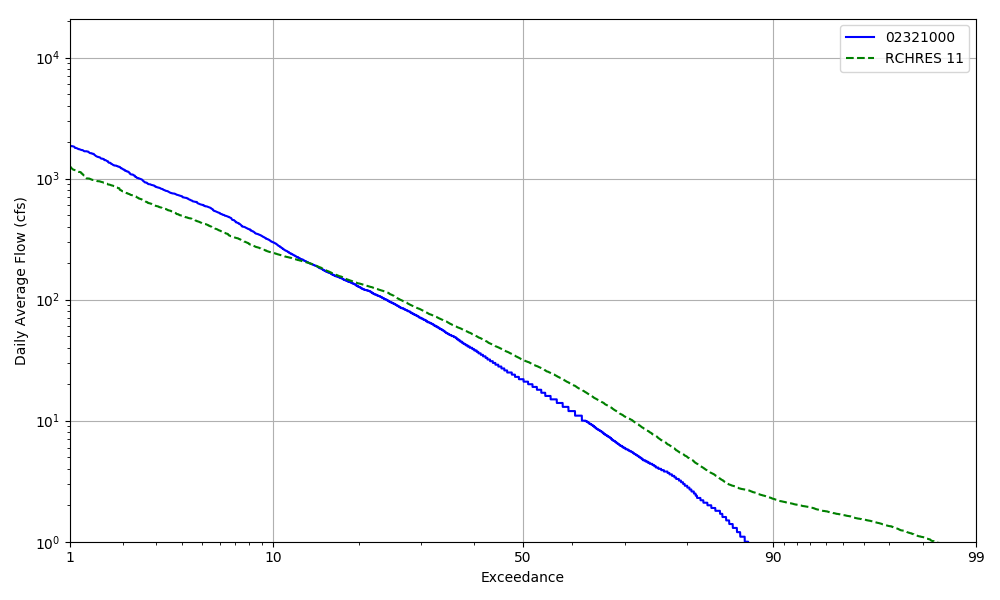


Figure 03110206-11: Daily exceedance for HSFP reach 11 and USGS station 02321000.

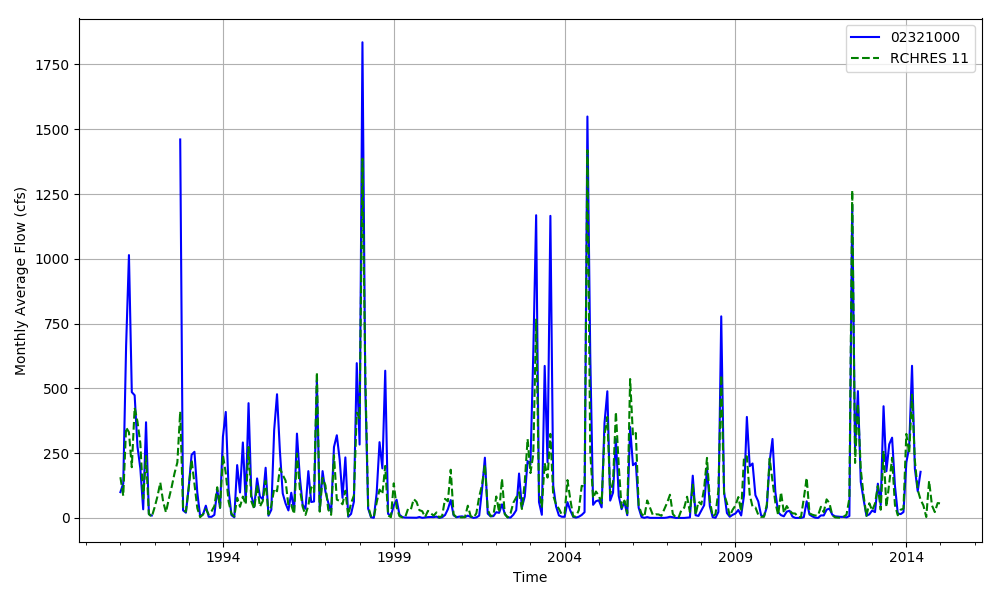


Figure 03110206-12: Monthly flow for HSFP reach 11 and USGS station 02321000.

## HSPF Reach 15, USGS Gauge 02321500

Table 03110206-7: Comparison Statistics Between HSPF Reach 15 and USGS Gauge 02321500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | -32.01 |
| Standard error | 235.83 |
| Relative bias | -0.10 |
| Relative standard error | 0.46 |
| Nash-Sutcliffe coefficient | 0.79 |
| Kling-Gupta coefficient | 0.76 |
| Coefficient of efficiency | 0.60 |
| Index of agreement | 0.78 |

Table 03110206-8: Hydrologic Indices Between USGS Gauge 02321500 and HSPF Reach 15.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02321500 | Simulated Reach 15 | Percent Difference |
| MA1: Mean, all daily flows | 324.35 | 292.96 | -9.68 |
| MA2: Median, all daily flows | 79.00 | 121.59 | 53.91 |
| MA3: CV, all daily flows | 181.85 | 157.41 | -13.44 |
| MA4: CV, log of all daily flows | 154.45 | 121.96 | -21.03 |
| MA5: Mean daily flow / median daily flow | 4.11 | 2.41 | -41.31 |
| MA9: (Q10 - Q90) / median daily flow | 10.82 | 5.46 | -49.48 |
| MA10: (Q20 - Q80) / median daily flow | 5.03 | 3.10 | -38.23 |
| MA11: (Q25 - Q75) / median daily flow | 3.73 | 2.35 | -37.09 |
| MA12: Mean monthly flow, January | 261.51 | 308.90 | 18.12 |
| MA13: Mean monthly flow, February | 486.73 | 411.34 | -15.49 |
| MA14: Mean monthly flow, March | 521.95 | 440.28 | -15.65 |
| MA15: Mean monthly flow, April | 313.83 | 242.70 | -22.67 |
| MA16: Mean monthly flow, May | 181.01 | 127.07 | -29.80 |
| MA17: Mean monthly flow, June | 319.34 | 242.56 | -24.04 |
| MA18: Mean monthly flow, July | 311.83 | 277.95 | -10.86 |
| MA19: Mean monthly flow, August | 402.48 | 368.35 | -8.48 |
| MA20: Mean monthly flow, September | 348.11 | 371.33 | 6.67 |
| MA21: Mean monthly flow, October | 413.54 | 322.06 | -22.12 |
| MA22: Mean monthly flow, November | 83.89 | 114.98 | 37.06 |
| MA23: Mean monthly flow, December | 176.92 | 217.46 | 22.91 |
| ML1: Mean minimum monthly flow, January | 86.10 | 102.04 | 18.51 |
| ML2: Mean minimum monthly flow, February | 138.53 | 140.04 | 1.09 |
| ML3: Mean minimum monthly flow, March | 168.97 | 139.61 | -17.37 |
| ML4: Mean minimum monthly flow, April | 61.91 | 63.36 | 2.35 |
| ML5: Mean minimum monthly flow, May | 40.14 | 33.75 | -15.93 |
| ML6: Mean minimum monthly flow, June | 56.78 | 46.43 | -18.22 |
| ML7: Mean minimum monthly flow, July | 102.87 | 90.10 | -12.41 |
| ML8: Mean minimum monthly flow, August | 107.02 | 122.54 | 14.50 |
| ML9: Mean minimum monthly flow, September | 70.75 | 104.62 | 47.87 |
| ML10: Mean minimum monthly flow, October | 72.29 | 77.09 | 6.64 |
| ML11: Mean minimum monthly flow, November | 47.63 | 51.62 | 8.37 |
| ML12: Mean minimum monthly flow, December | 40.17 | 54.29 | 35.17 |
| ML13: CV of minimum monthly flows | 158.18 | 133.47 | -15.62 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.06 | 0.07 | 21.45 |
| ML15: Mean minimum annual flow / mean annual flow | 0.02 | 0.03 | 31.37 |
| ML16: Median minimum annual flow / median annual flow | 0.03 | 0.06 | 88.61 |
| ML20: Ratio of baseflow volume to total flow volume | 0.41 | 0.46 | 11.84 |
| ML22: Mean annual minimum flow divided by catchment area | 0.10 | 0.09 | -3.26 |
| RA1: Mean of positive changes from one day to next (rise rate) | 108.05 | 111.23 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 361.87 | 368.97 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 44.80 | 37.23 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 331.51 | 330.35 |  |
| RA5: Ratio of days that are higher than previous day | 0.27 | 0.25 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.16 | 0.15 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.10 | 0.09 |  |
| RA8: Number of flow reversals from one day to the next | 60.71 | 55.88 |  |
| RA9: CV, number of flow reversals from one day to the next | 13.93 | 13.93 |  |

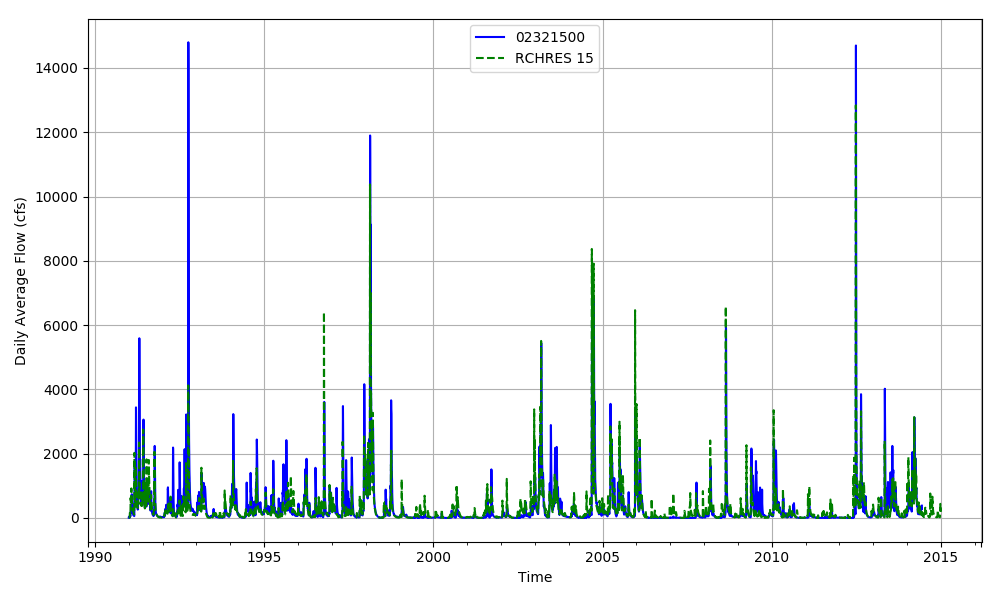


Figure 03110206-13: Daily flow for HSFP reach 15 and USGS station 02321500.

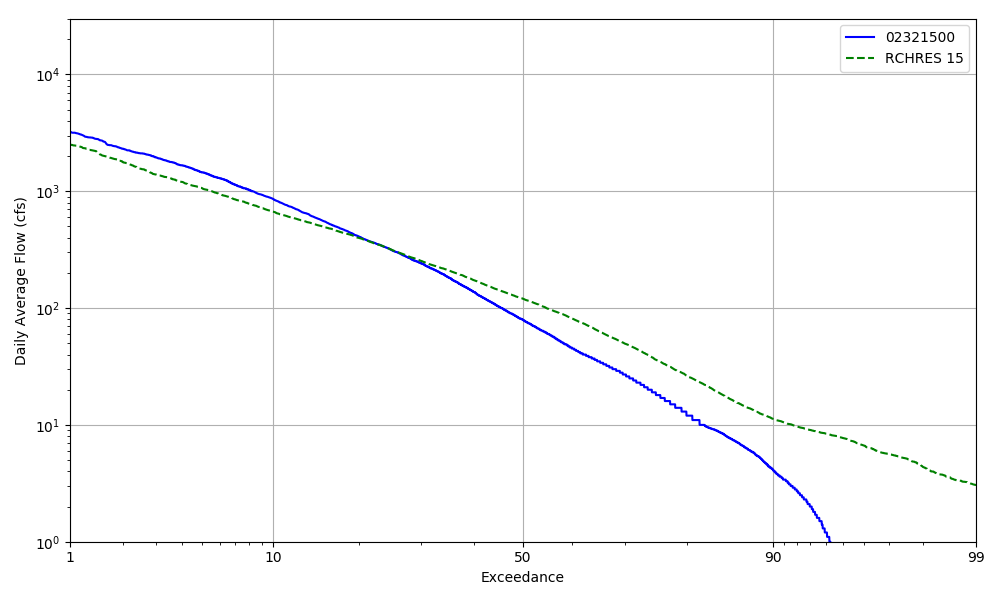


Figure 03110206-14: Daily exceedance for HSFP reach 15 and USGS station 02321500.

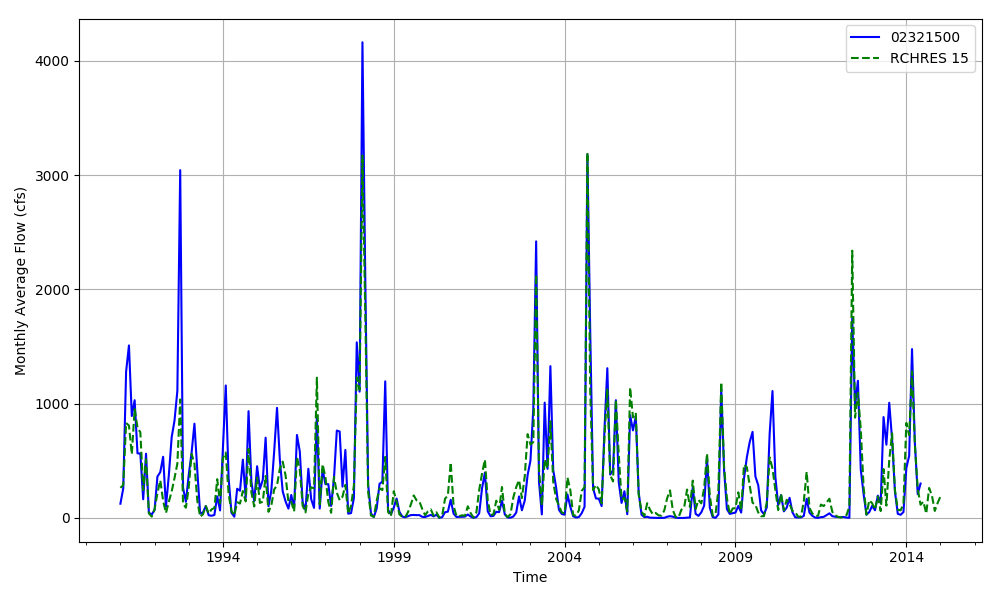


Figure 03110206-15: Monthly flow for HSFP reach 15 and USGS station 02321500.

## HSPF Reach 17, USGS Gauge 02321975

Table 03110206-9: Comparison Statistics Between HSPF Reach 17 and USGS Gauge 02321975.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 22.71 |
| Standard error | 359.23 |
| Relative bias | 0.03 |
| Relative standard error | 0.51 |
| Nash-Sutcliffe coefficient | 0.74 |
| Kling-Gupta coefficient | 0.86 |
| Coefficient of efficiency | 0.43 |
| Index of agreement | 0.70 |

Table 03110206-10: Hydrologic Indices Between USGS Gauge 02321975 and HSPF Reach 17.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02321975 | Simulated Reach 17 | Percent Difference |
| MA1: Mean, all daily flows | 769.97 | 792.21 | 2.89 |
| MA2: Median, all daily flows | 568.00 | 537.58 | -5.36 |
| MA3: CV, all daily flows | 91.55 | 84.14 | -8.09 |
| MA4: CV, log of all daily flows | 60.28 | 63.84 | 5.90 |
| MA5: Mean daily flow / median daily flow | 1.36 | 1.47 | 8.71 |
| MA9: (Q10 - Q90) / median daily flow | 1.85 | 1.92 | 3.63 |
| MA10: (Q20 - Q80) / median daily flow | 1.12 | 1.03 | -8.07 |
| MA11: (Q25 - Q75) / median daily flow | 0.84 | 0.79 | -6.16 |
| MA12: Mean monthly flow, January | 615.63 | 828.73 | 34.62 |
| MA13: Mean monthly flow, February | 1138.00 | 1215.54 | 6.81 |
| MA14: Mean monthly flow, March | 1066.19 | 995.54 | -6.63 |
| MA15: Mean monthly flow, April | 692.27 | 603.76 | -12.79 |
| MA16: Mean monthly flow, May | 484.36 | 388.15 | -19.86 |
| MA17: Mean monthly flow, June | 393.35 | 367.74 | -6.51 |
| MA18: Mean monthly flow, July | 467.54 | 488.71 | 4.53 |
| MA19: Mean monthly flow, August | 562.84 | 559.55 | -0.59 |
| MA20: Mean monthly flow, September | 459.14 | 522.61 | 13.82 |
| MA21: Mean monthly flow, October | 1348.29 | 1174.88 | -12.86 |
| MA22: Mean monthly flow, November | 521.07 | 643.66 | 23.53 |
| MA23: Mean monthly flow, December | 527.64 | 730.72 | 38.49 |
| ML1: Mean minimum monthly flow, January | 470.33 | 612.87 | 30.31 |
| ML2: Mean minimum monthly flow, February | 653.33 | 650.93 | -0.37 |
| ML3: Mean minimum monthly flow, March | 841.50 | 662.94 | -21.22 |
| ML4: Mean minimum monthly flow, April | 528.17 | 407.21 | -22.90 |
| ML5: Mean minimum monthly flow, May | 348.50 | 339.03 | -2.72 |
| ML6: Mean minimum monthly flow, June | 342.50 | 331.28 | -3.28 |
| ML7: Mean minimum monthly flow, July | 393.83 | 389.62 | -1.07 |
| ML8: Mean minimum monthly flow, August | 415.83 | 422.77 | 1.67 |
| ML9: Mean minimum monthly flow, September | 414.83 | 427.82 | 3.13 |
| ML10: Mean minimum monthly flow, October | 552.71 | 459.88 | -16.80 |
| ML11: Mean minimum monthly flow, November | 439.43 | 462.15 | 5.17 |
| ML12: Mean minimum monthly flow, December | 352.00 | 432.93 | 22.99 |
| ML13: CV of minimum monthly flows | 68.92 | 51.18 | -25.74 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.40 | 0.56 | 39.34 |
| ML15: Mean minimum annual flow / mean annual flow | 0.31 | 0.41 | 31.83 |
| ML16: Median minimum annual flow / median annual flow | 0.33 | 0.56 | 67.22 |
| ML20: Ratio of baseflow volume to total flow volume | 0.70 | 0.69 | -1.89 |
| ML22: Mean annual minimum flow divided by catchment area | 2.42 | 2.99 | 23.81 |
| RA1: Mean of positive changes from one day to next (rise rate) | 78.29 | 110.42 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 342.72 | 299.83 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 42.46 | 43.49 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 257.73 | 228.15 |  |
| RA5: Ratio of days that are higher than previous day | 0.31 | 0.28 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.04 | 0.05 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.03 | 0.03 |  |
| RA8: Number of flow reversals from one day to the next | 40.14 | 38.71 |  |
| RA9: CV, number of flow reversals from one day to the next | 46.39 | 40.17 |  |

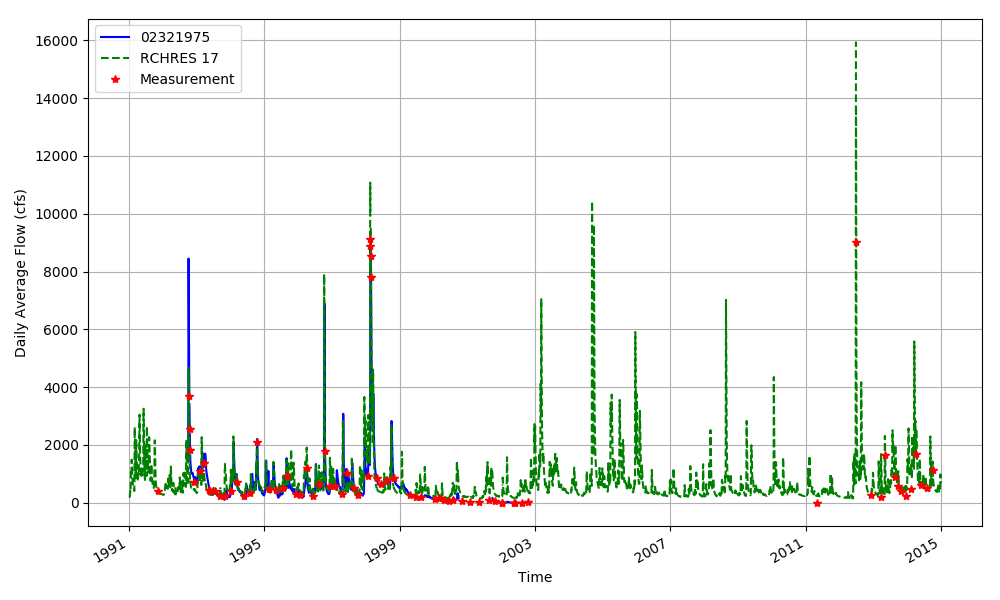


Figure 03110206-16: Daily flow for HSFP reach 17 and USGS station 02321975.

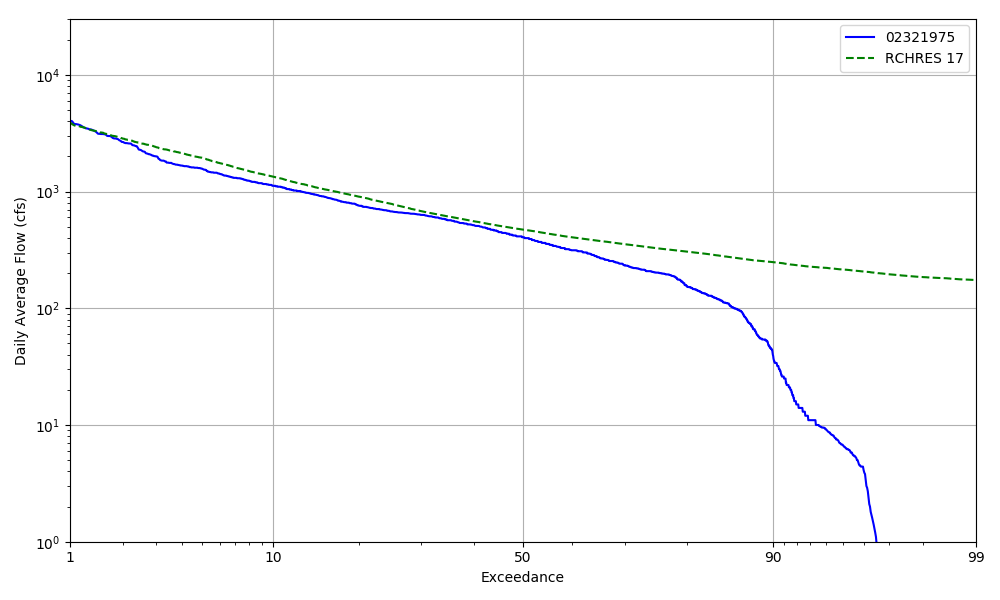


Figure 03110206-17: Daily exceedance for HSFP reach 17 and USGS station 02321975.

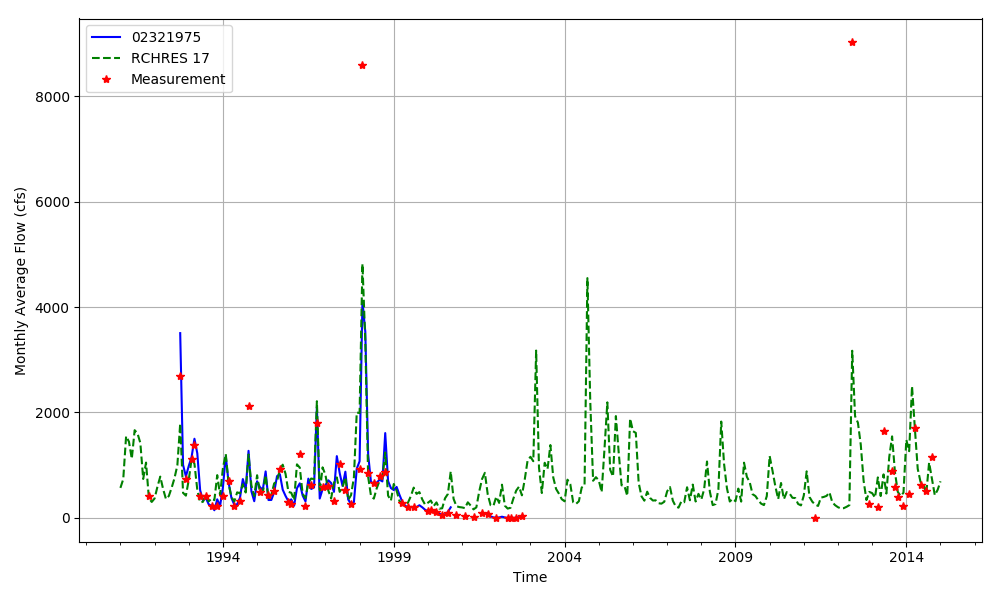


Figure 03110206-18: Monthly flow for HSFP reach 17 and USGS station 02321975.

## HSPF Reach 18, USGS Gauge 02322500

Table 03110206-11: Comparison Statistics Between HSPF Reach 18 and USGS Gauge 02322500.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 11.01 |
| Standard error | 372.87 |
| Relative bias | 0.01 |
| Relative standard error | 0.49 |
| Nash-Sutcliffe coefficient | 0.76 |
| Kling-Gupta coefficient | 0.83 |
| Coefficient of efficiency | 0.52 |
| Index of agreement | 0.75 |

Table 03110206-12: Hydrologic Indices Between USGS Gauge 02322500 and HSPF Reach 18.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02322500 | Simulated Reach 18 | Percent Difference |
| MA1: Mean, all daily flows | 1170.38 | 1180.30 | 0.85 |
| MA2: Median, all daily flows | 955.00 | 958.52 | 0.37 |
| MA3: CV, all daily flows | 48.43 | 54.23 | 11.98 |
| MA4: CV, log of all daily flows | 44.62 | 44.61 | -0.03 |
| MA5: Mean daily flow / median daily flow | 1.23 | 1.23 | 0.48 |
| MA9: (Q10 - Q90) / median daily flow | 1.41 | 1.32 | -6.09 |
| MA10: (Q20 - Q80) / median daily flow | 0.82 | 0.75 | -8.86 |
| MA11: (Q25 - Q75) / median daily flow | 0.66 | 0.57 | -13.50 |
| MA12: Mean monthly flow, January | 962.60 | 1147.38 | 19.20 |
| MA13: Mean monthly flow, February | 1182.01 | 1254.87 | 6.16 |
| MA14: Mean monthly flow, March | 1378.29 | 1323.42 | -3.98 |
| MA15: Mean monthly flow, April | 1195.50 | 1058.49 | -11.46 |
| MA16: Mean monthly flow, May | 1019.39 | 868.46 | -14.81 |
| MA17: Mean monthly flow, June | 1015.16 | 993.54 | -2.13 |
| MA18: Mean monthly flow, July | 1170.68 | 1153.48 | -1.47 |
| MA19: Mean monthly flow, August | 1170.97 | 1292.66 | 10.39 |
| MA20: Mean monthly flow, September | 1242.83 | 1317.17 | 5.98 |
| MA21: Mean monthly flow, October | 1336.93 | 1284.60 | -3.91 |
| MA22: Mean monthly flow, November | 938.84 | 921.94 | -1.80 |
| MA23: Mean monthly flow, December | 887.40 | 1011.65 | 14.00 |
| ML1: Mean minimum monthly flow, January | 865.79 | 856.48 | -1.08 |
| ML2: Mean minimum monthly flow, February | 966.04 | 910.68 | -5.73 |
| ML3: Mean minimum monthly flow, March | 1085.48 | 956.74 | -11.86 |
| ML4: Mean minimum monthly flow, April | 975.61 | 826.24 | -15.31 |
| ML5: Mean minimum monthly flow, May | 895.39 | 751.02 | -16.12 |
| ML6: Mean minimum monthly flow, June | 888.17 | 765.80 | -13.78 |
| ML7: Mean minimum monthly flow, July | 980.52 | 885.86 | -9.65 |
| ML8: Mean minimum monthly flow, August | 995.78 | 966.54 | -2.94 |
| ML9: Mean minimum monthly flow, September | 960.57 | 962.45 | 0.20 |
| ML10: Mean minimum monthly flow, October | 1017.74 | 914.09 | -10.18 |
| ML11: Mean minimum monthly flow, November | 891.26 | 832.02 | -6.65 |
| ML12: Mean minimum monthly flow, December | 826.04 | 805.90 | -2.44 |
| ML13: CV of minimum monthly flows | 42.85 | 34.93 | -18.48 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.73 | 0.68 | -5.84 |
| ML15: Mean minimum annual flow / mean annual flow | 0.64 | 0.58 | -8.78 |
| ML16: Median minimum annual flow / median annual flow | 0.78 | 0.71 | -8.41 |
| ML20: Ratio of baseflow volume to total flow volume | 0.88 | 0.82 | -7.42 |
| ML22: Mean annual minimum flow divided by catchment area | 7.02 | 6.58 | -6.33 |
| RA1: Mean of positive changes from one day to next (rise rate) | 59.59 | 101.61 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 389.42 | 288.56 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 28.97 | 40.40 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 350.70 | 249.53 |  |
| RA5: Ratio of days that are higher than previous day | 0.28 | 0.28 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.01 | 0.03 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.01 | 0.01 |  |
| RA8: Number of flow reversals from one day to the next | 66.33 | 39.46 |  |
| RA9: CV, number of flow reversals from one day to the next | 37.96 | 23.56 |  |

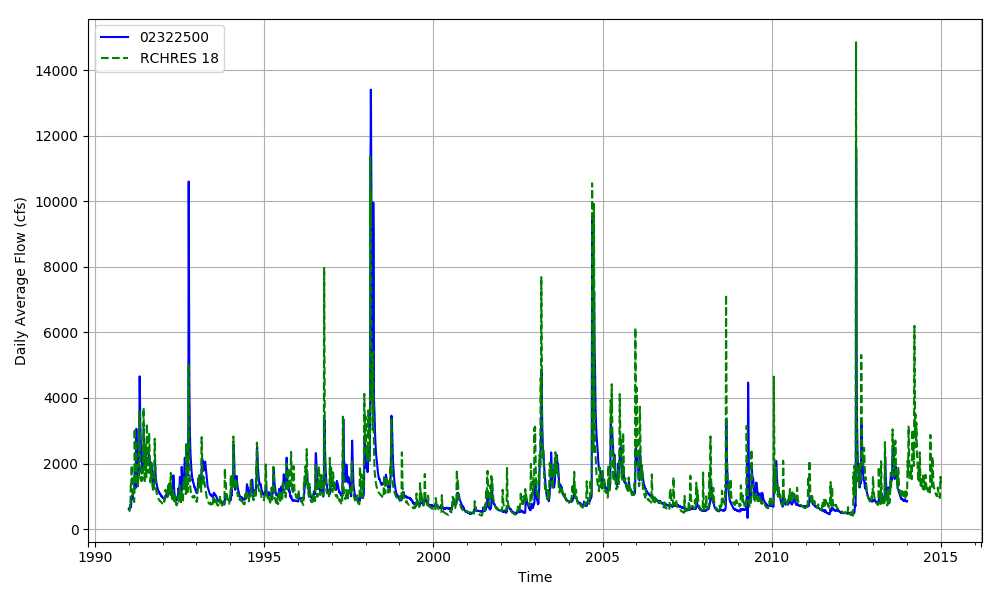


Figure 03110206-19: Daily flow for HSFP reach 18 and USGS station 02322500.

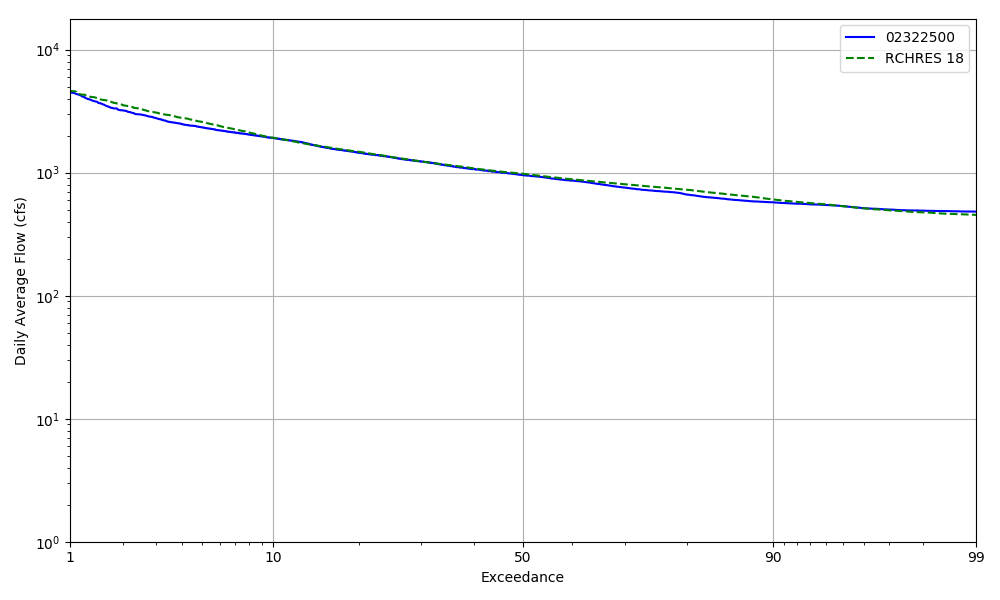


Figure 03110206-20: Daily exceedance for HSFP reach 18 and USGS station 02322500.

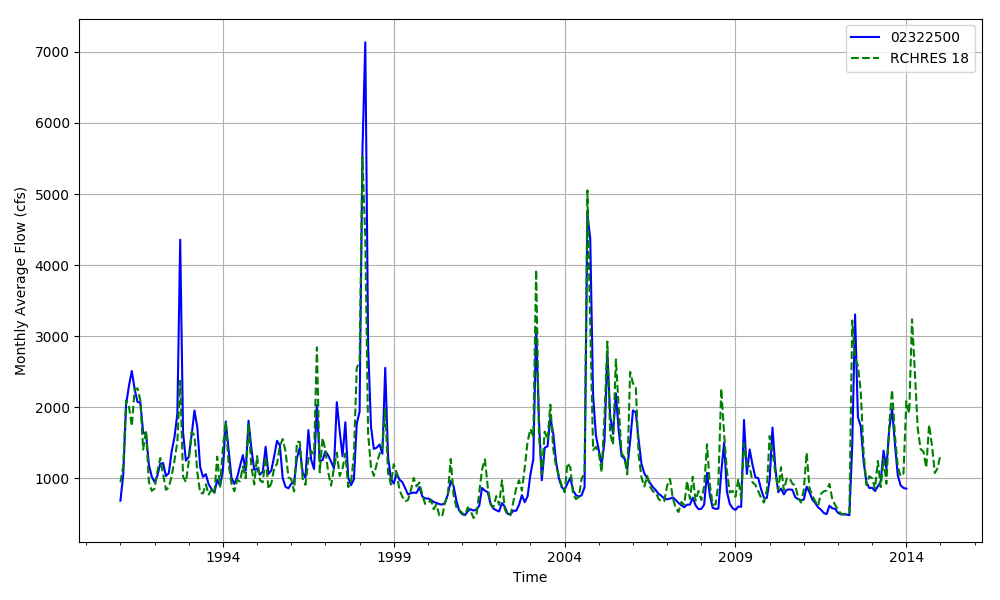


Figure 03110206-21: Monthly flow for HSFP reach 18 and USGS station 02322500.

## HSPF Reach 21, USGS Gauge 02322800

Table 03110206-13: Comparison Statistics Between HSPF Reach 21 and USGS Gauge 02322800.

|  |  |
| --- | --- |
| Statistic | Value |
| Bias | 229.12 |
| Standard error | 462.37 |
| Relative bias | 0.15 |
| Relative standard error | 0.59 |
| Nash-Sutcliffe coefficient | 0.65 |
| Kling-Gupta coefficient | 0.79 |
| Coefficient of efficiency | 0.40 |
| Index of agreement | 0.70 |

Table 03110206-14: Hydrologic Indices Between USGS Gauge 02322800 and HSPF Reach 21.

|  |  |  |  |
| --- | --- | --- | --- |
| Hydrologic Index and description (Olden and Poff, 2003) | Observed 02322800 | Simulated Reach 21 | Percent Difference |
| MA1: Mean, all daily flows | 1511.81 | 1736.10 | 14.84 |
| MA2: Median, all daily flows | 1220.00 | 1447.60 | 18.66 |
| MA3: CV, all daily flows | 34.74 | 40.05 | 15.28 |
| MA4: CV, log of all daily flows | 41.08 | 39.39 | -4.11 |
| MA5: Mean daily flow / median daily flow | 1.24 | 1.20 | -3.22 |
| MA9: (Q10 - Q90) / median daily flow | 1.29 | 1.16 | -10.10 |
| MA10: (Q20 - Q80) / median daily flow | 0.83 | 0.70 | -15.38 |
| MA11: (Q25 - Q75) / median daily flow | 0.64 | 0.53 | -16.46 |
| MA12: Mean monthly flow, January | 1006.89 | 1267.95 | 25.93 |
| MA13: Mean monthly flow, February | 1133.48 | 1284.59 | 13.33 |
| MA14: Mean monthly flow, March | 1270.60 | 1593.75 | 25.43 |
| MA15: Mean monthly flow, April | 1281.35 | 1408.61 | 9.93 |
| MA16: Mean monthly flow, May | 1240.85 | 1194.38 | -3.75 |
| MA17: Mean monthly flow, June | 1245.26 | 1350.83 | 8.48 |
| MA18: Mean monthly flow, July | 1497.86 | 1707.82 | 14.02 |
| MA19: Mean monthly flow, August | 1396.32 | 1863.00 | 33.42 |
| MA20: Mean monthly flow, September | 1706.91 | 1982.91 | 16.17 |
| MA21: Mean monthly flow, October | 1442.66 | 1604.26 | 11.20 |
| MA22: Mean monthly flow, November | 1131.58 | 1181.09 | 4.38 |
| MA23: Mean monthly flow, December | 1021.80 | 1195.93 | 17.04 |
| ML1: Mean minimum monthly flow, January | 1079.55 | 1215.15 | 12.56 |
| ML2: Mean minimum monthly flow, February | 1145.00 | 1286.18 | 12.33 |
| ML3: Mean minimum monthly flow, March | 1040.55 | 1410.25 | 35.53 |
| ML4: Mean minimum monthly flow, April | 1167.09 | 1302.45 | 11.60 |
| ML5: Mean minimum monthly flow, May | 1247.27 | 1193.85 | -4.28 |
| ML6: Mean minimum monthly flow, June | 1225.73 | 1264.38 | 3.15 |
| ML7: Mean minimum monthly flow, July | 1393.73 | 1493.27 | 7.14 |
| ML8: Mean minimum monthly flow, August | 1413.36 | 1681.67 | 18.98 |
| ML9: Mean minimum monthly flow, September | 1377.55 | 1692.48 | 22.86 |
| ML10: Mean minimum monthly flow, October | 1460.36 | 1514.03 | 3.67 |
| ML11: Mean minimum monthly flow, November | 1211.64 | 1268.56 | 4.70 |
| ML12: Mean minimum monthly flow, December | 1114.45 | 1235.33 | 10.85 |
| ML13: CV of minimum monthly flows | 41.13 | 32.02 | -22.15 |
| ML14: Mean minimum daily flow / mean median annual flow | 0.58 | 0.69 | 19.84 |
| ML15: Mean minimum annual flow / mean annual flow | 0.52 | 0.61 | 18.09 |
| ML16: Median minimum annual flow / median annual flow | 0.71 | 0.76 | 7.18 |
| ML20: Ratio of baseflow volume to total flow volume | 0.90 | 0.87 | -4.16 |
| ML22: Mean annual minimum flow divided by catchment area | 7700.15 | 7702.92 | 0.04 |
| RA1: Mean of positive changes from one day to next (rise rate) | 57.25 | 97.44 |  |
| RA2: CV, mean of positive changes from one day to next (rise rate) | 272.02 | 290.60 |  |
| RA3: Mean of negative changes from one day to next (fall rate) | 46.48 | 44.07 |  |
| RA4: CV, mean of negative changes from one day to next (fall rate) | 157.10 | 265.23 |  |
| RA5: Ratio of days that are higher than previous day | 0.40 | 0.31 |  |
| RA6: Median of difference in log of flows over two consecutive days of rising | 0.02 | 0.02 |  |
| RA7: Median of difference in log of flows over two consecutive days of falling | 0.02 | 0.01 |  |
| RA8: Number of flow reversals from one day to the next | 123.08 | 31.00 |  |
| RA9: CV, number of flow reversals from one day to the next | 49.03 | 46.36 |  |

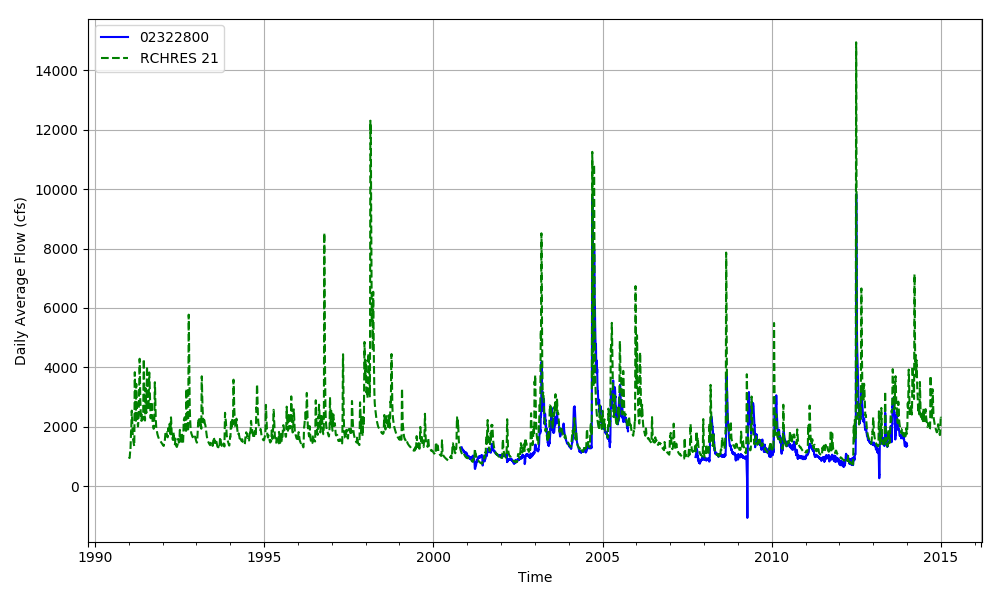


Figure 03110206-22: Daily flow for HSFP reach 21 and USGS station 02322800.

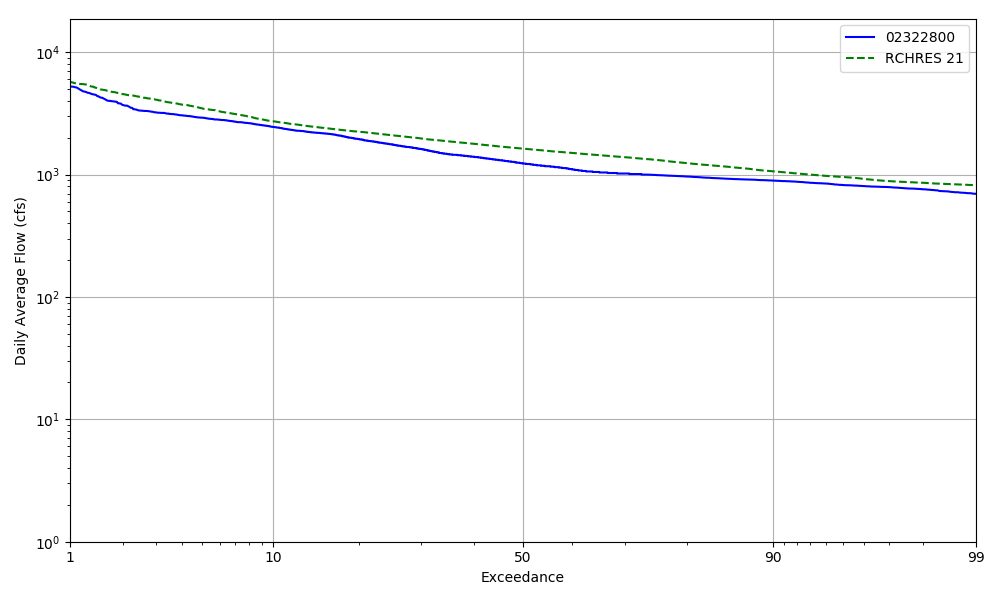


Figure 03110206-23: Daily exceedance for HSFP reach 21 and USGS station 02322800.

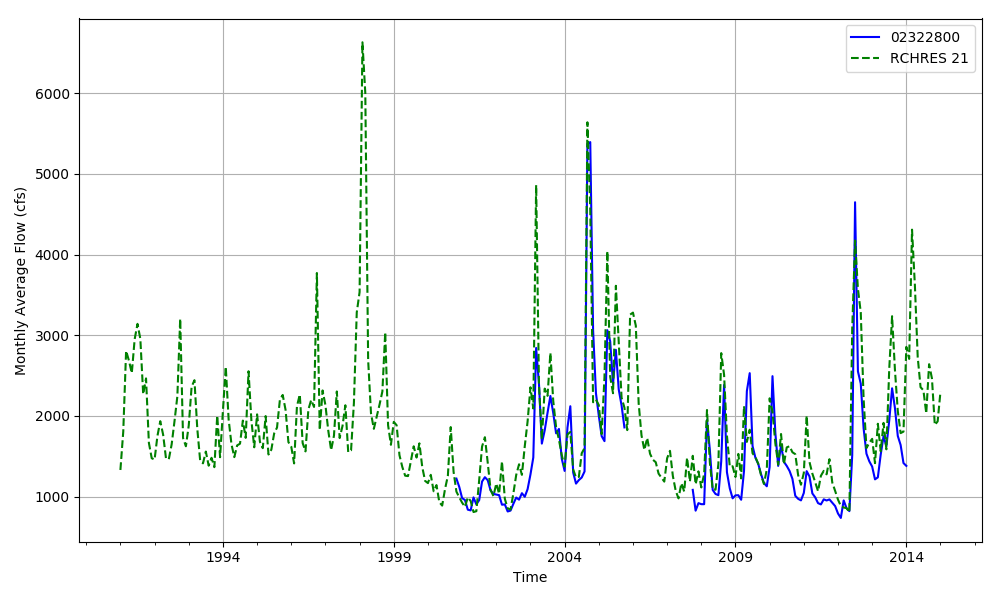


Figure 03110206-24: Monthly flow for HSFP reach 21 and USGS station 02322800.