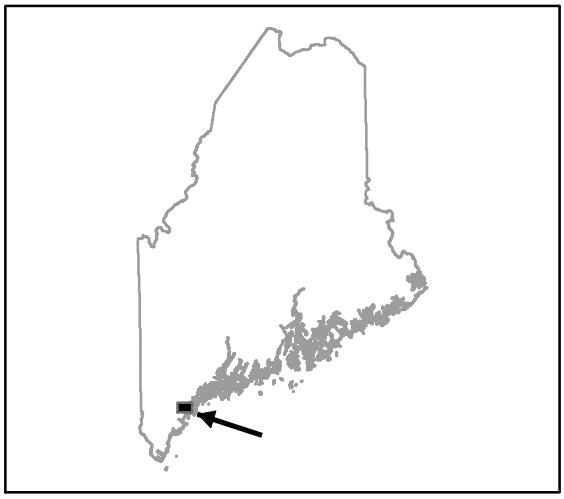
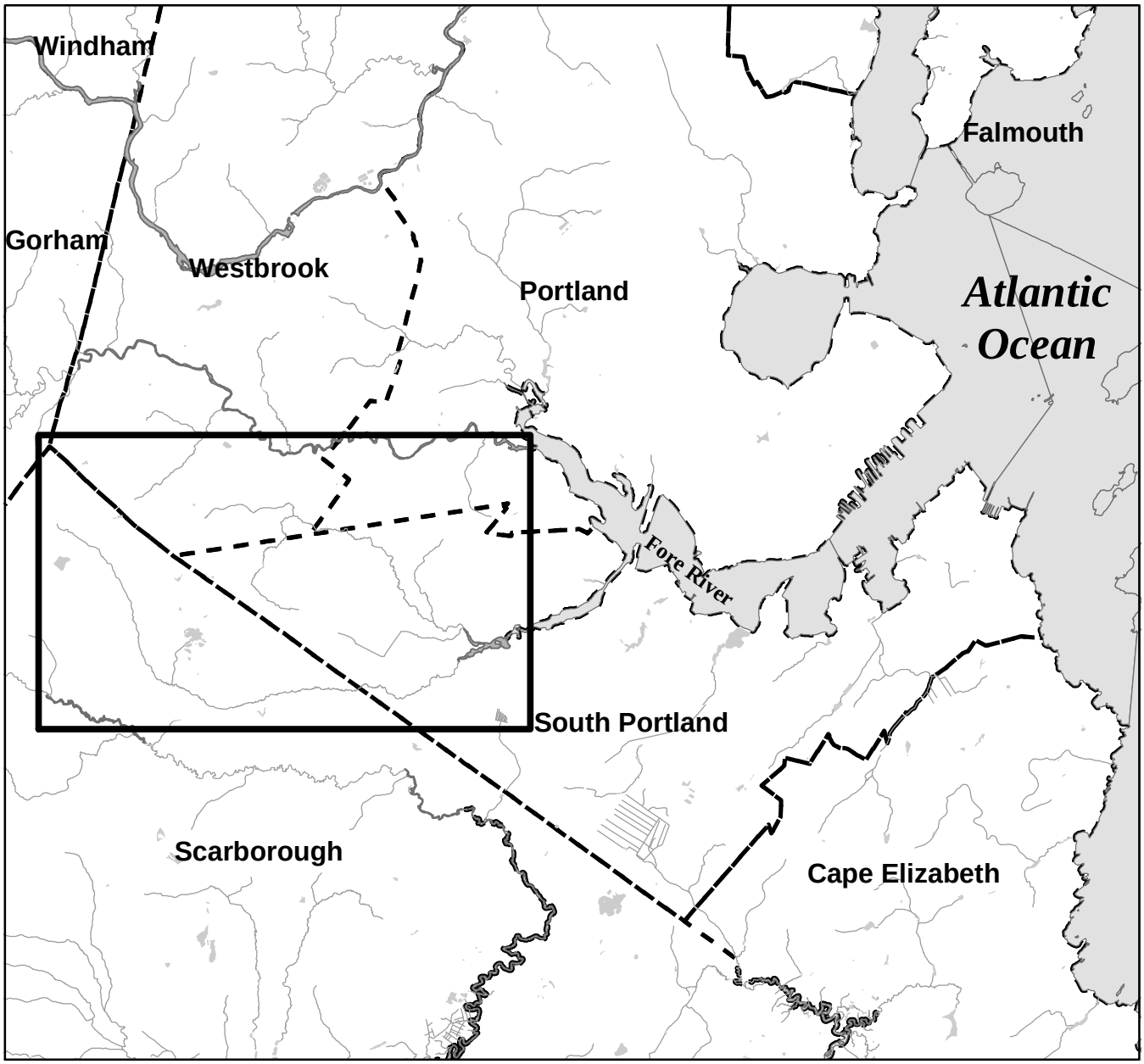




Created by Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

0 0.5 1 2 3 4 Miles

N W E S

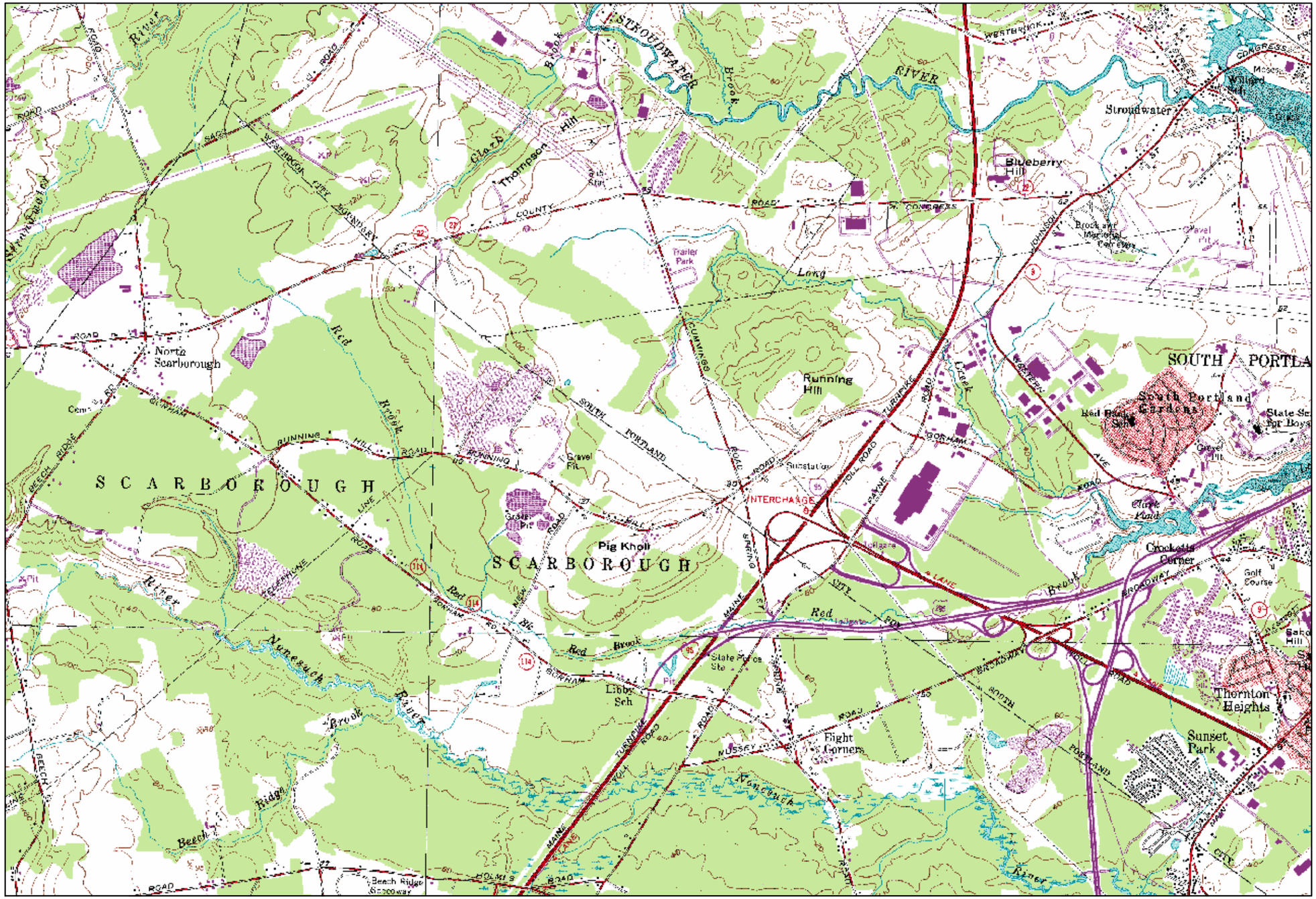
Figure 1.1a. General study area map. The rectangle surrounds the study region. Dashed lines indicate town boundaries.

Figure 1.1.b. Topographic map information for the study area. The sources of the information were digitized, georeferenced USGS 7.5' topographic maps which had been photorevised between 1970 and 1978.

Long Creek-Red Brook

Comprehensive Watershed Assessment

Topographic Map Images



0 0.25 0.5 1 1.5 2 Miles

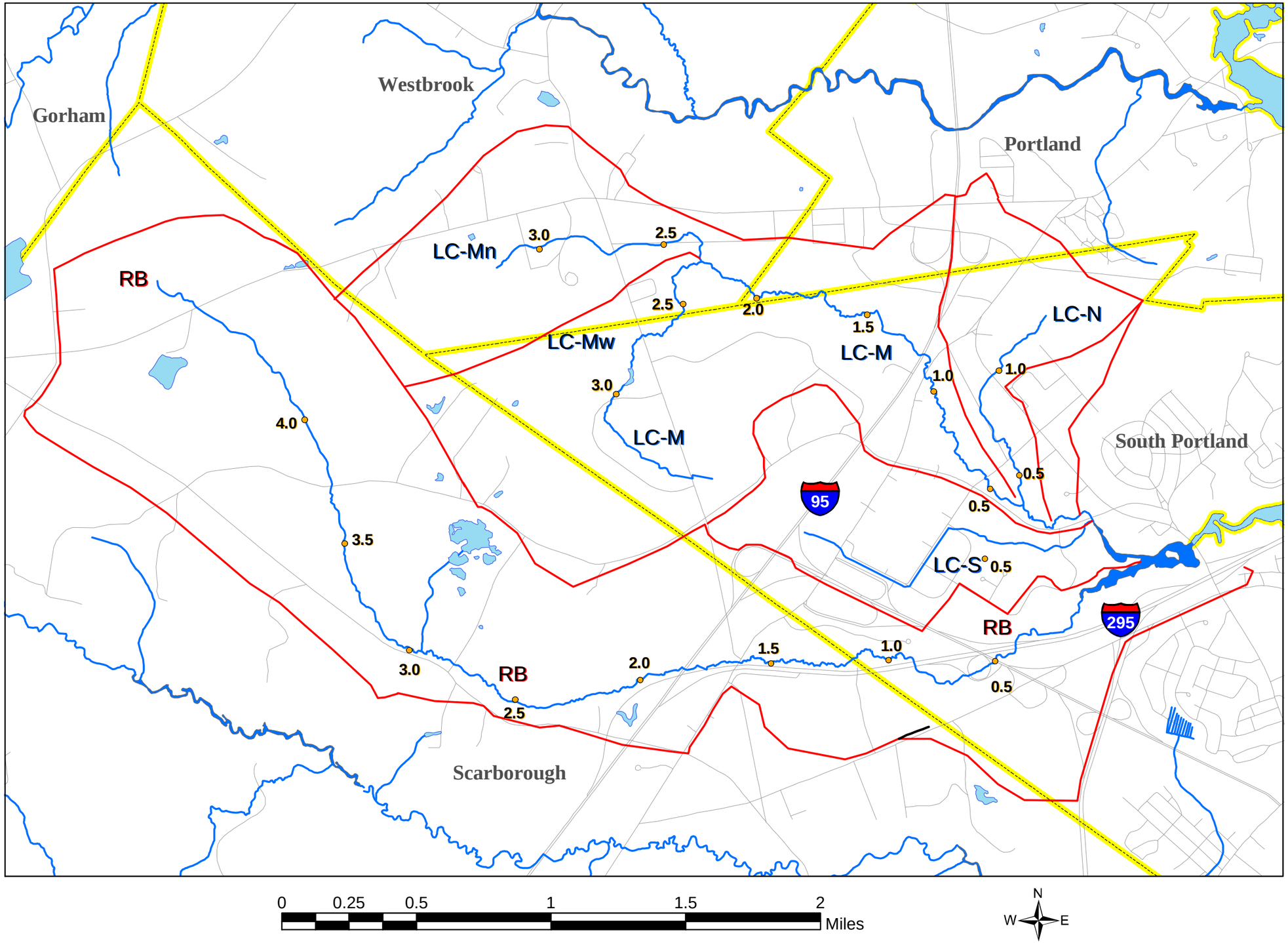
N W E S

Created by Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Figure 1.2. Study area map.

Long Creek-Red Brook

Comprehensive Watershed Assessment



Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Figure 1.1c. Aerial photographs of the study area from 1976. Aerial photo source: Greater Portland Council of Governments / Lockwood Mapping Inc. (Rochester, NY)

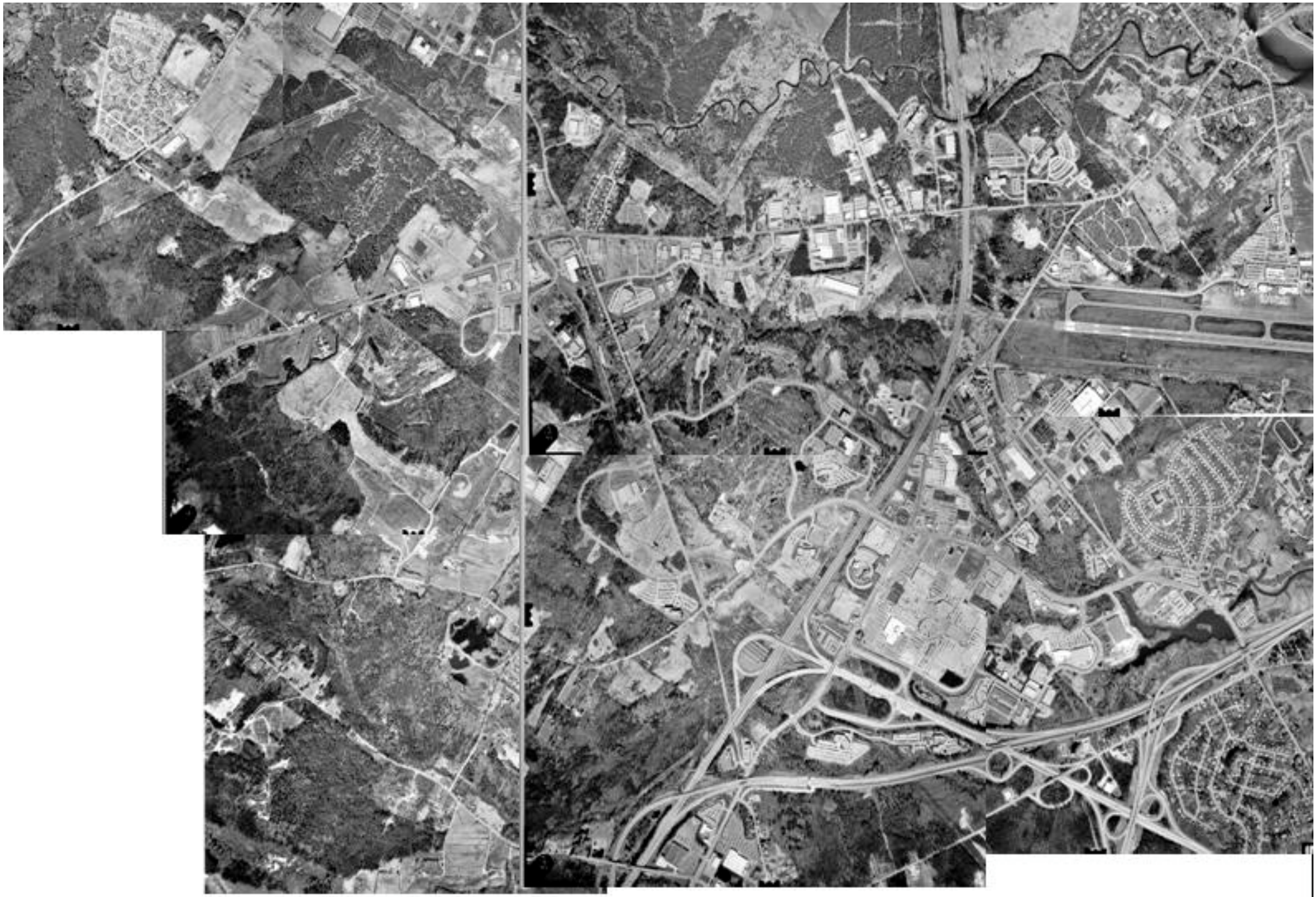


Figure 1.1d. Aerial photographs of the study area from 1995. Aerial photo source: Greater Portland Council of Governments / James Sewall Co. (Portland, ME)

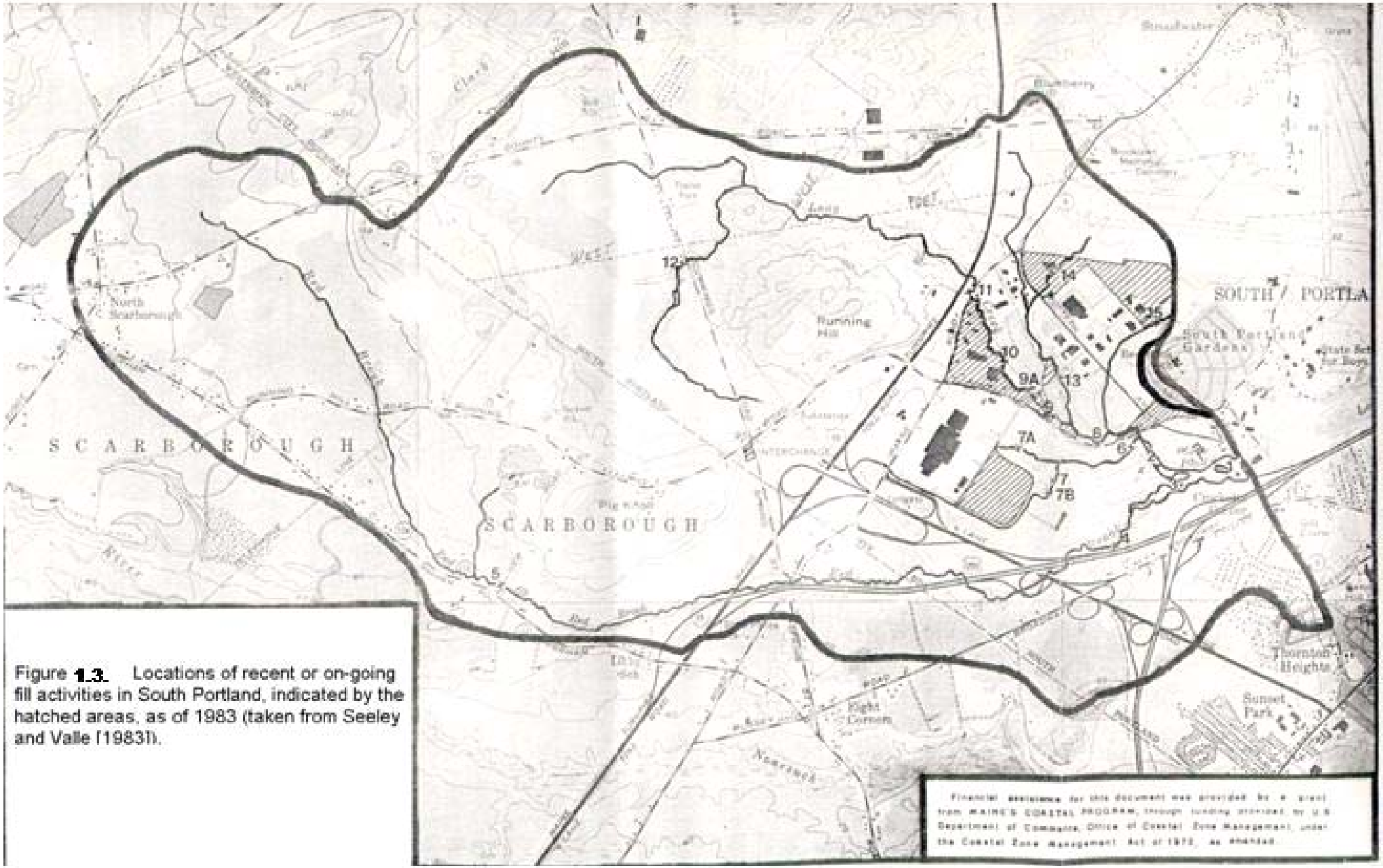


Figure 1.3. Locations of recent or on-going fill activities in South Portland, indicated by the hatched areas, as of 1983 (taken from Seeley and Valle [1983]).

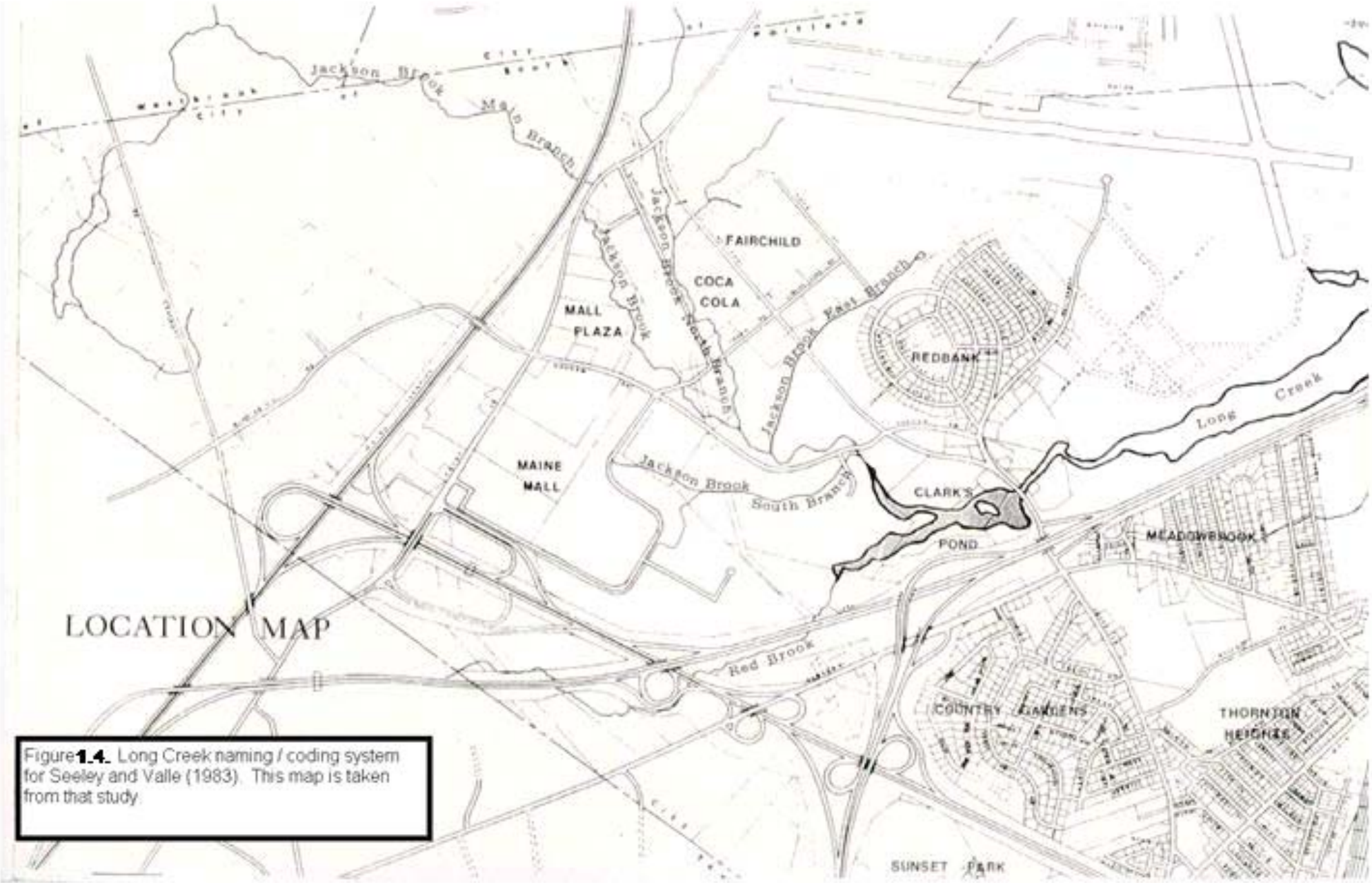
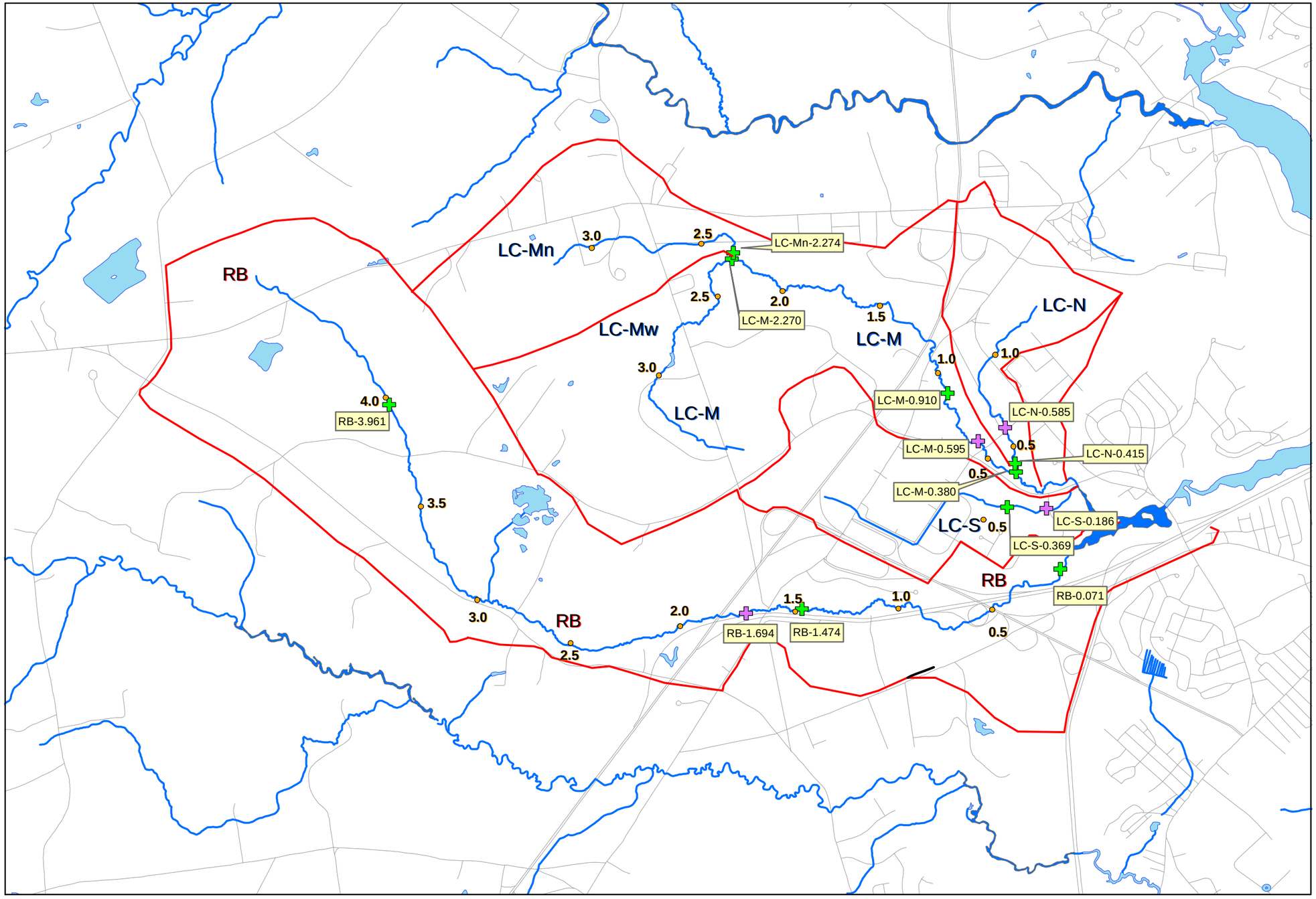


Figure 1.4. Long Creek naming / coding system for Seeley and Valle (1983). This map is taken from that study.

Figure 3.1.1. Locations of the major biological, chemical, and discharge monitoring sites.

Long Creek-Red Brook

Comprehensive Watershed Assessment



Legend

Site_Type

- Major Biological Sampling Site
- Major Water Chemistry & Discharge Site
- GIS.Streams
- GIS.Rivers
- GIS.Ponds_and_Lakes
- GIS.Roads
- GIS.Coast_polys

Additional Legend Items

- Watershed Boundary
- 3.0 Stream Mile

0 0.25 0.5 1 1.5 2 Miles

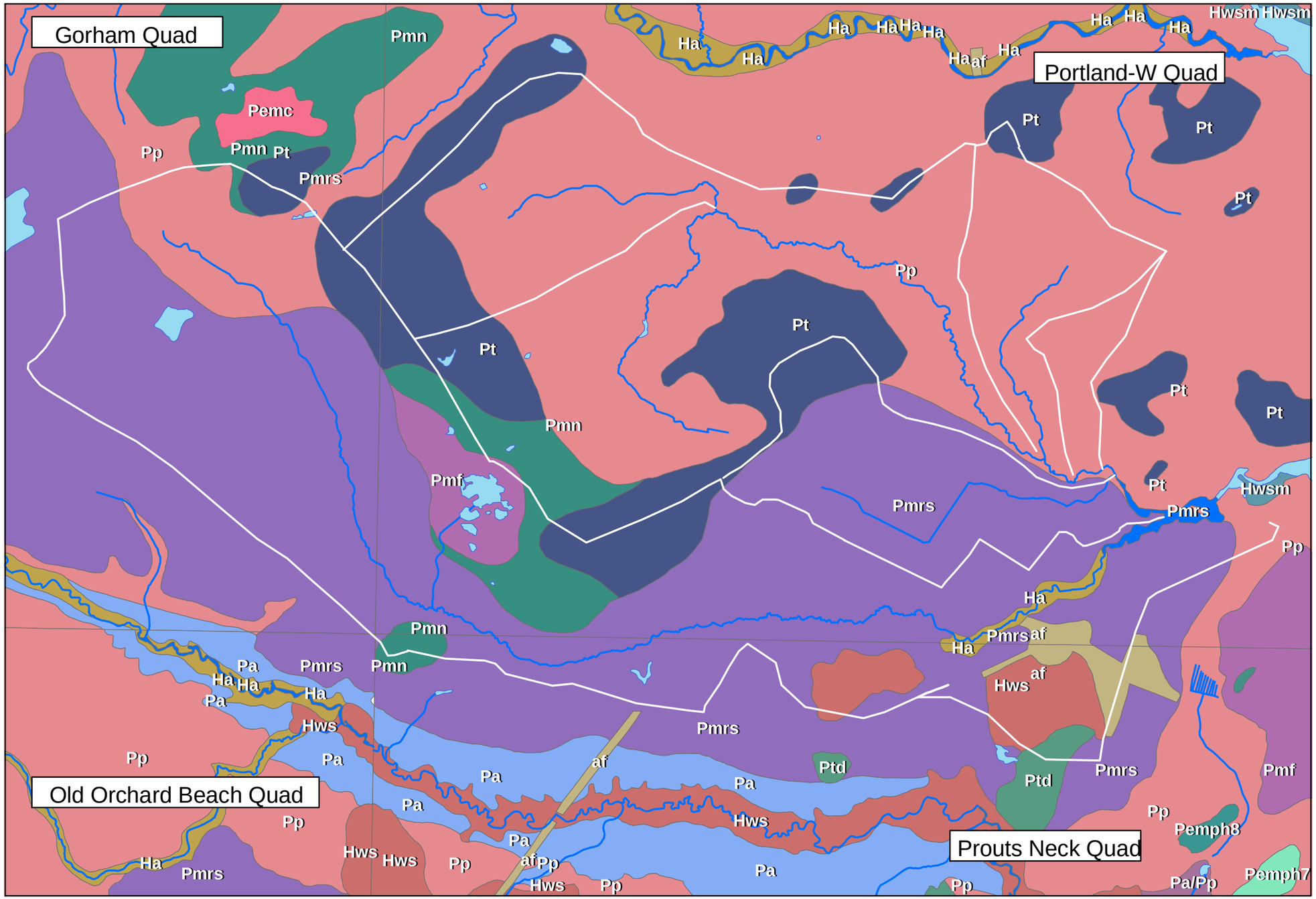
N W E S

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Figure 3.1.2. Surficial geology map of the study area. See Appendix A for the legend and description of the various surficial geology units. Straight black lines delineate the four quadrangles included in this map

Long Creek-Red Brook

Comprehensive Watershed Assessment



Legend

- GIS.Streams
- GIS.Rivers
- GIS.Ponds_and_Lakes
- GIS.Coast_polys

Additional Legend Items

- Watershed Boundary
- 3.0 Stream Mile

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

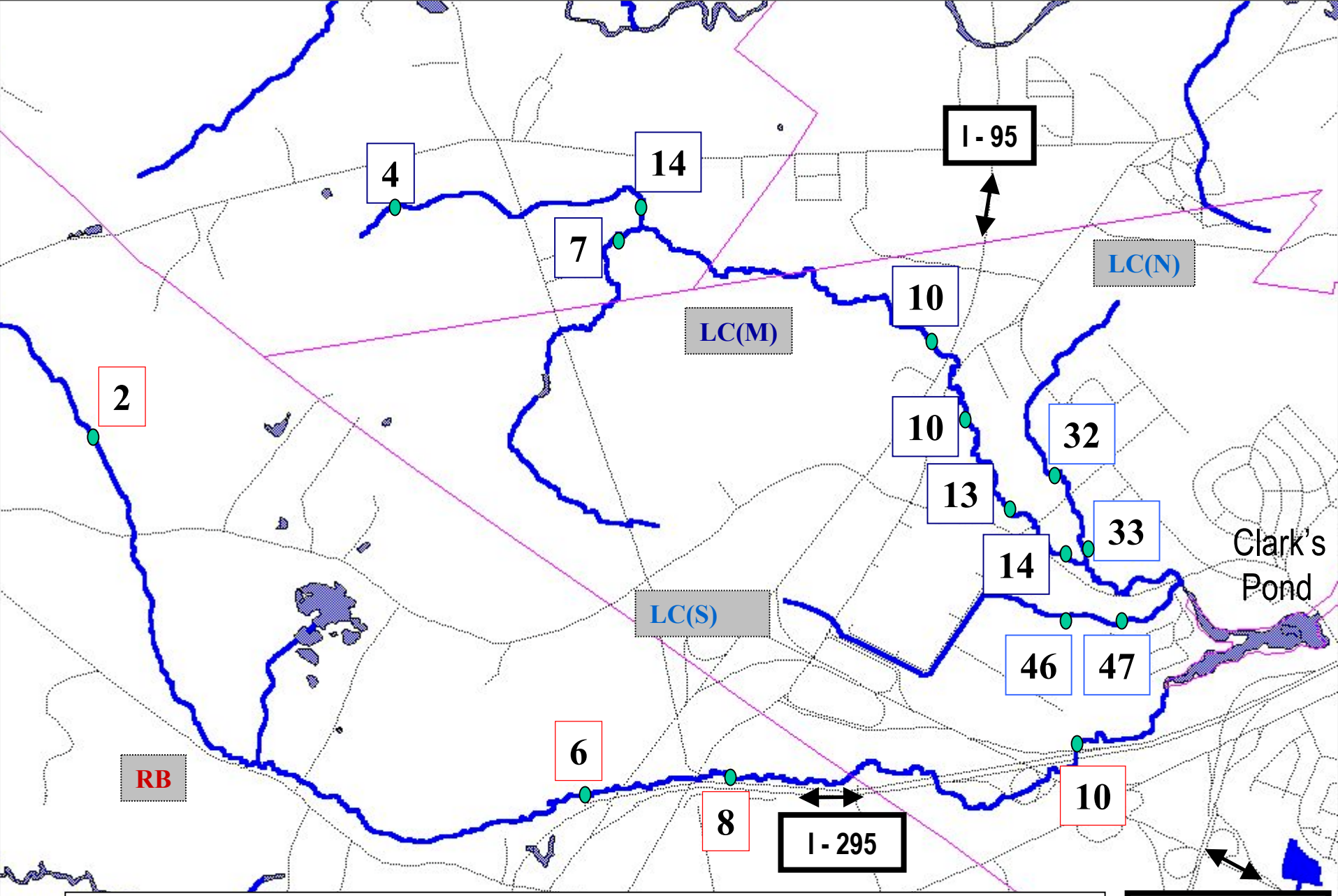
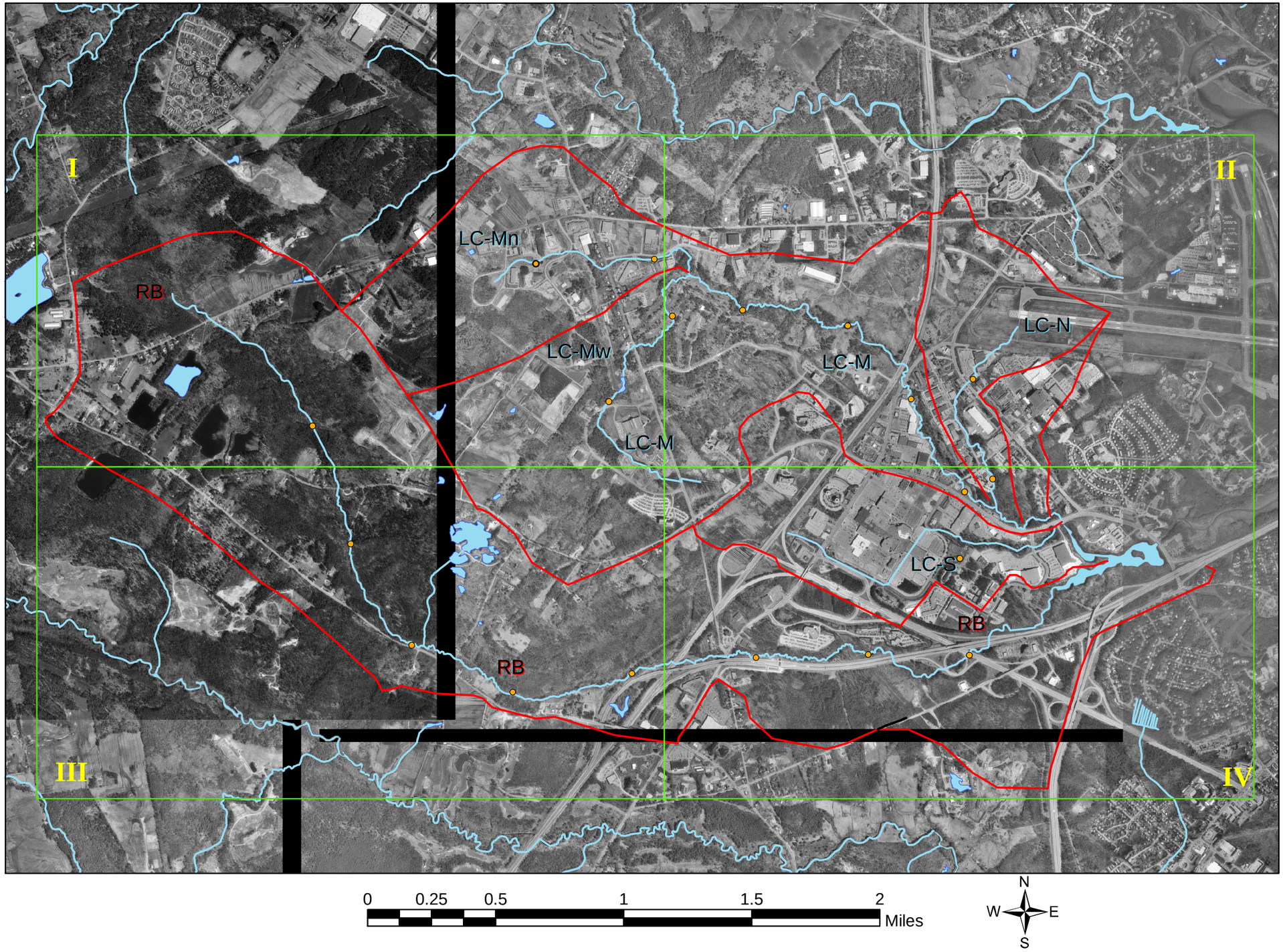


Figure 3.1.3. Percent total impervious area (PTIA) of the various subwatersheds of Long Creek (LC) and Red Brook (RB). PTIA values in the boxes are cumulative values (i.e., they take into account the land included in upstream subwatersheds.

Figure 3.1.4a. Map "key" for smaller-scale watershed survey maps presented in Figures 3.1.4b-e.

Long Creek-Red Brook Comprehensive Watershed Assessment



Legend

Watershed Boundary

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Long Creek-Red Brook Comprehensive Watershed Assessment

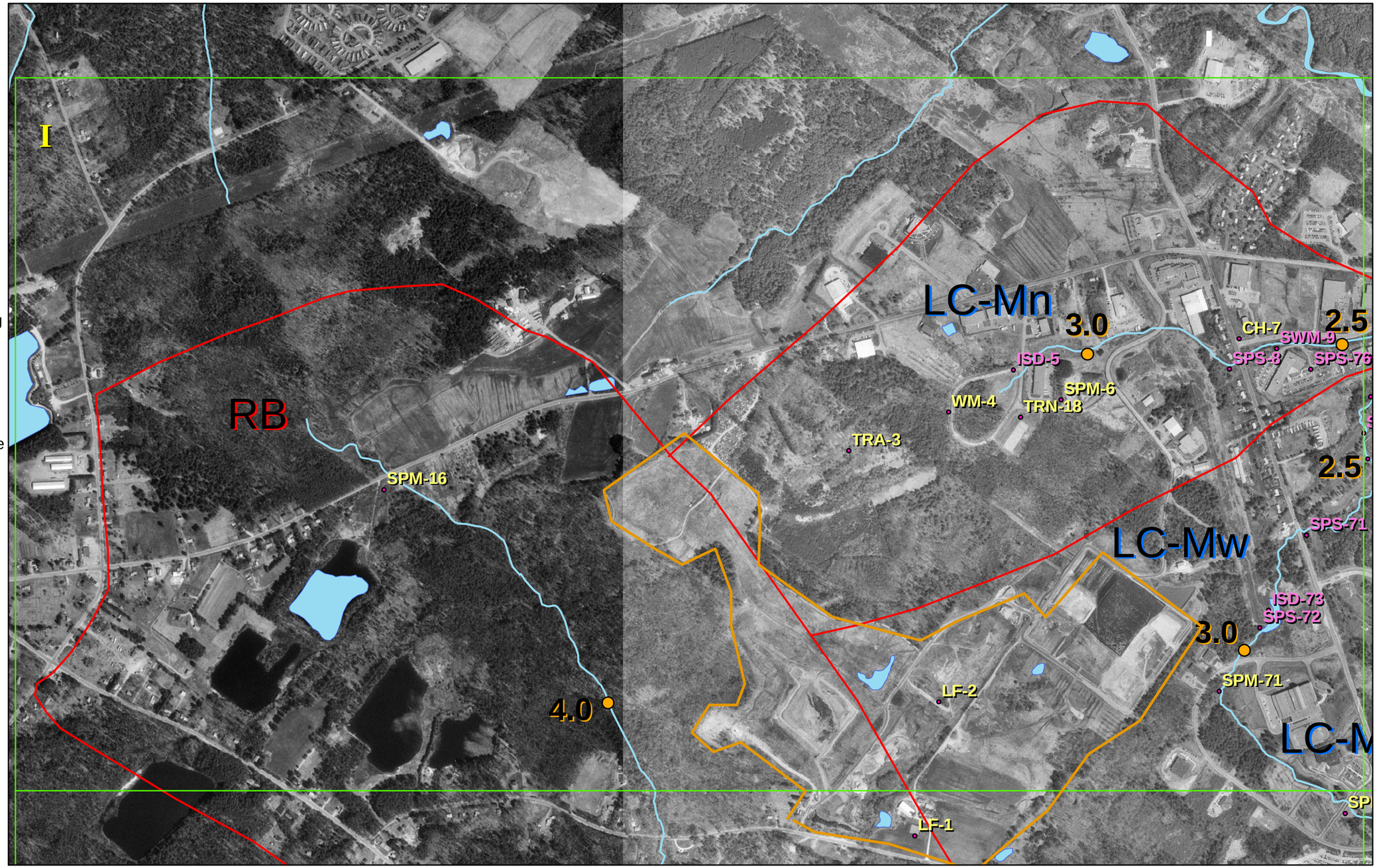
Figure 3.1.4b. Stream habitat walk and watershed survey findings for the Quadrant I (see Figure 3.1.4a). Numbers following the codes depicted on the map represent "survey site number". Site locations are approximated. Red text symbols indicate a major problem location. Aerial photographs dates are 1997-1998.

Legend

CH = channelization or "ditching" of the stream
GC = golf course
ISD = in-stream detention basin
LF = landfill
ND = new development since aerial photograph date
PL = powerline and associated clearing of trees
SCP = semi-conductor plant
SE = severe erosion of streambank, terrace, or valley wall
SPM = shading problems [moderate], sparse riparian tree canopy
SPS = shading problems [severe], sparse riparian tree canopy
SW = significant stormwater input (although not major)
SWM = major stormwater input
TR = trash in fairly heavy volume
TRA = trash; automobile junkyard, although only a moderate presence of debris
TRN = trash not greatly abundant, but noteworthy
WM = stream/ditch converted into open water wetland (mitigation project)

Additional Legend Items

Severe Problem
Moderate Problem
Watershed Boundary
3.0 Stream Mile



0 0.1 0.2 0.4 0.6 0.8 Miles

N W E S

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Long Creek-Red Brook Comprehensive Watershed Assessment

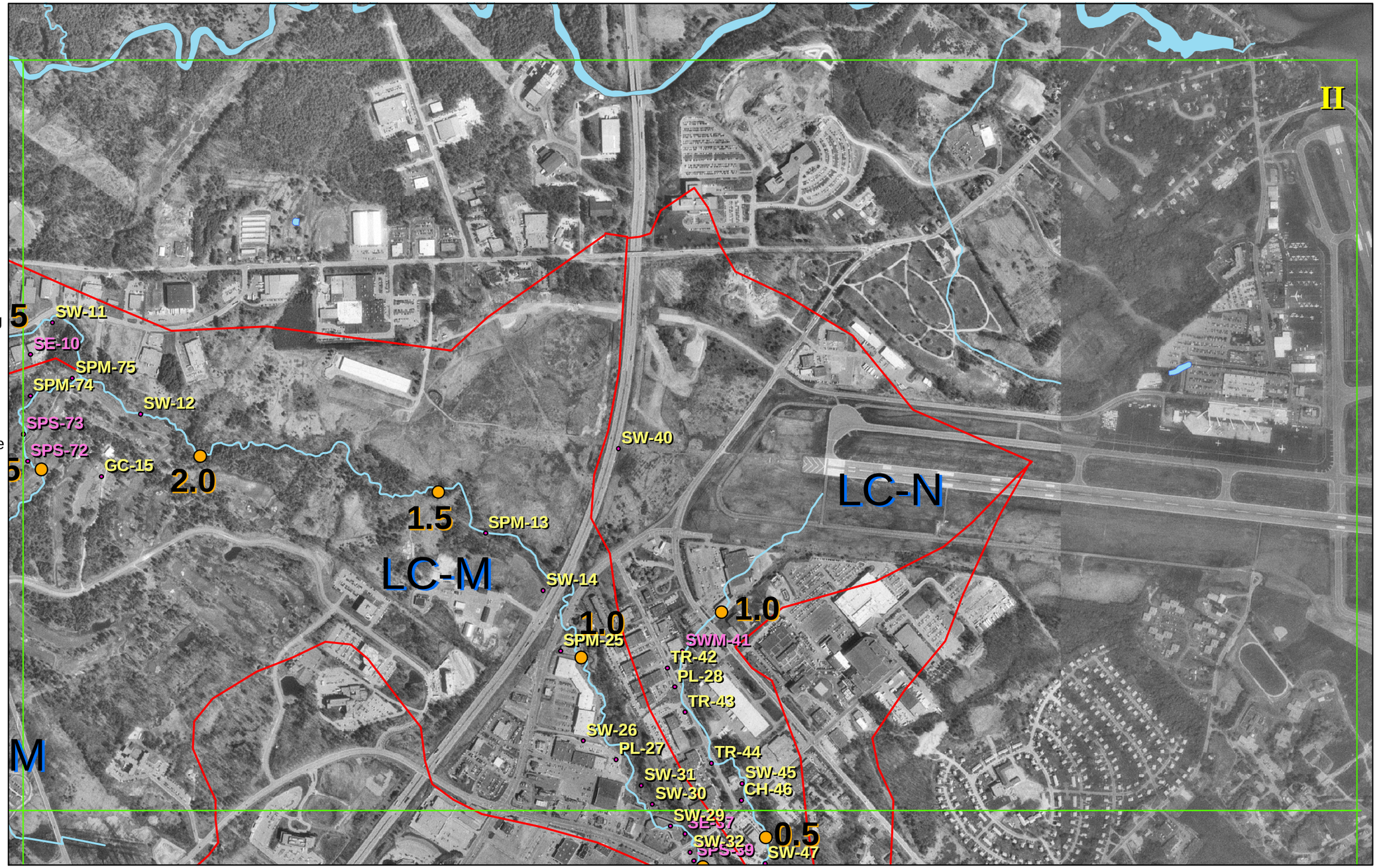
Figure 3.1.4c. Stream habitat walk and watershed survey findings for the Quadrant II (see Figure 3.1.4a). Numbers following the codes depicted on the map represent "survey site number". Site locations are approximated. Red text symbols indicate a major problem location. Aerial photographs dates are 1997-1998.

Legend

CH = channelization or "ditching" of the stream
GC = golf course
ISD = in-stream detention basin
LF = landfill
ND = new development since aerial photograph date
PL = powerline and associated clearing of trees
SCP = semi-conductor plant
SE = severe erosion of streambank, terrace, or valley wall
SPM = shading problems [moderate], sparse riparian tree canopy
SPS = shading problems [severe], sparse riparian tree canopy
SW = significant stormwater input (although not major)
SWM = major stormwater input
TR = trash in fairly heavy volume
TRA = trash; automobile junkyard, although only a moderate presence of debris
TRN = trash not greatly abundant, but noteworthy
WM = stream/ditch converted into open water wetland (mitigation project)

Additional Legend Items

Severe Problem
Moderate Problem
Watershed Boundary
3.0 Stream Mile



0 0.125 0.25 0.5 0.75 1 Miles

N W E S

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Long Creek-Red Brook Comprehensive Watershed Assessment

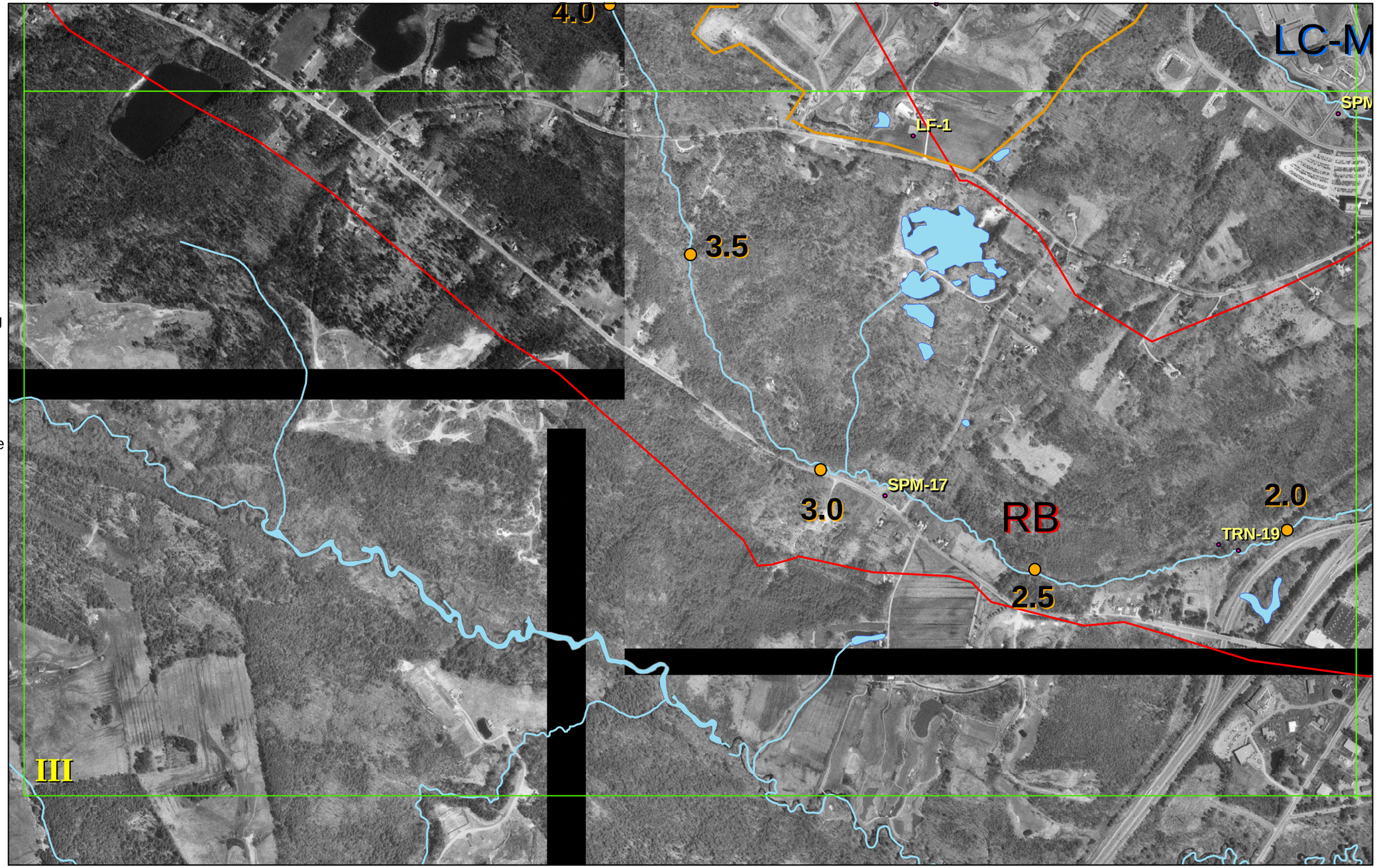
Figure 3.1.4d. Stream habitat walk and watershed survey findings for the Quadrant III (see Figure 3.1.4a). Numbers following the codes depicted on the map represent "survey site number". Site locations are approximated. Red text symbols indicate a major problem location. Aerial photographs dates are 1997-1998.

Legend

CH = channelization or "ditching" of the stream
GC = golf course
ISD = in-stream detention basin
LF = landfill
ND = new development since aerial photograph date
PL = powerline and associated clearing of trees
SCP = semi-conductor plant
SE = severe erosion of streambank, terrace, or valley wall
SPM = shading problems [moderate], sparse riparian tree canopy
SPS = shading problems [severe], sparse riparian tree canopy
SW = significant stormwater input (although not major)
SWM = major stormwater input
TR = trash in fairly heavy volume
TRA = trash; automobile junkyard, although only a moderate presence of debris
TRN = trash not greatly abundant, but noteworthy
WM = stream/ditch converted into open water wetland (mitigation project)

Additional Legend Items

Severe Problem
Moderate Problem
Watershed Boundary
3.0 Stream Mile



0 0.125 0.25 0.5 0.75 1 Miles

N W E S

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Long Creek-Red Brook Comprehensive Watershed Assessment

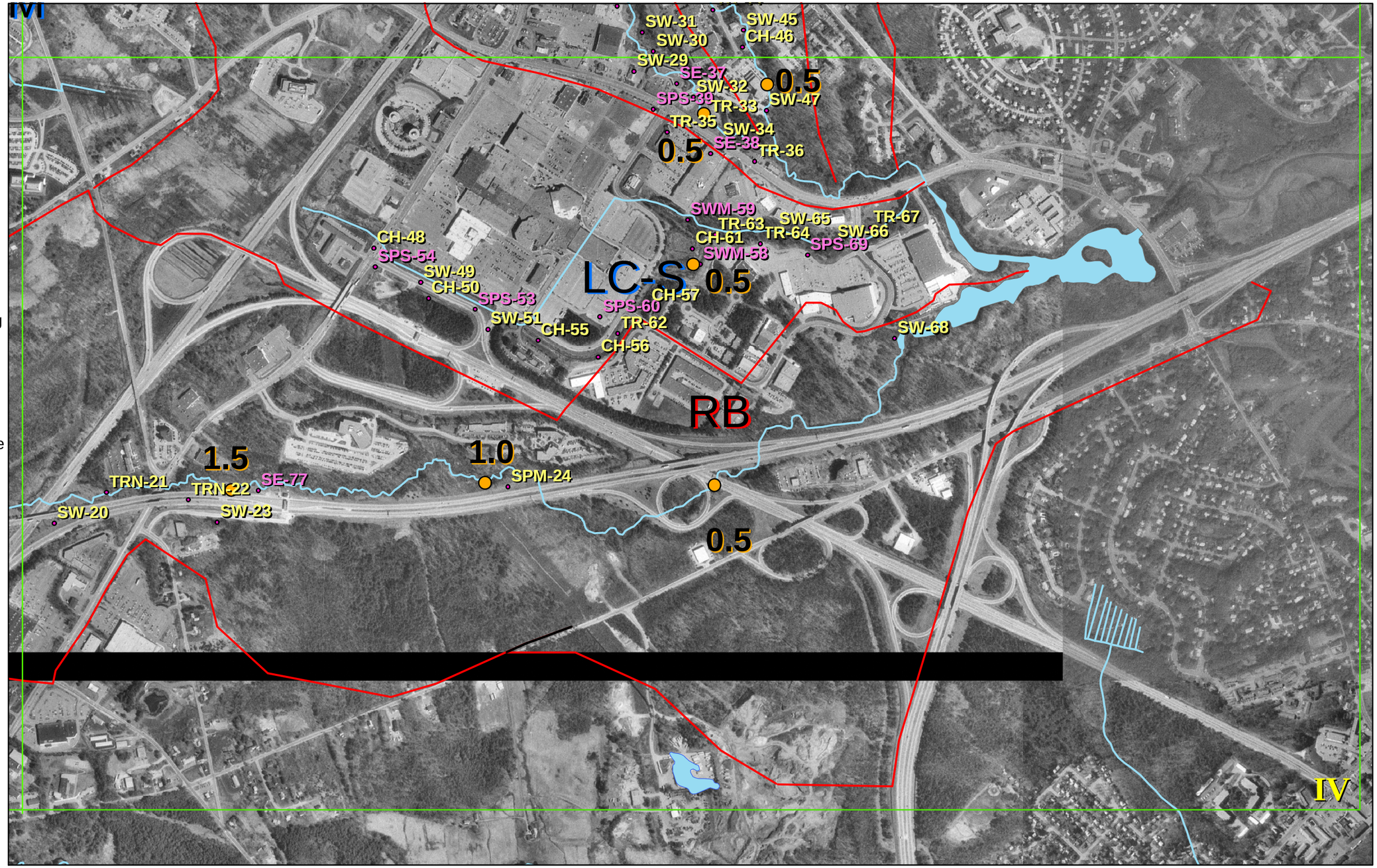
Figure 3.1.4e. Stream habitat walk and watershed survey findings for the Quadrant IV (see Figure 3.1.4a). Numbers following the codes depicted on the map represent "survey site number". Site locations are approximated. Red text symbols indicate a major problem location. Aerial photographs dates are 1997-1998.

Legend

CH = channelization or "ditching" of the stream
GC = golf course
ISD = in-stream detention basin
LF = landfill
ND = new development since aerial photograph date
PL = powerline and associated clearing of trees
SCP = semi-conductor plant
SE = severe erosion of streambank, terrace, or valley wall
SPM = shading problems [moderate], sparse riparian tree canopy
SPS = shading problems [severe], sparse riparian tree canopy
SW = significant stormwater input (although not major)
SWM = major stormwater input
TR = trash in fairly heavy volume
TRA = trash; automobile junkyard, although only a moderate presence of debris
TRN = trash not greatly abundant, but noteworthy
WM = stream/ditch converted into open water wetland (mitigation project)

Additional Legend Items

Severe Problem
Moderate Problem
Watershed Boundary
3.0 Stream Mile



0 0.125 0.25 0.5 0.75 1 Miles

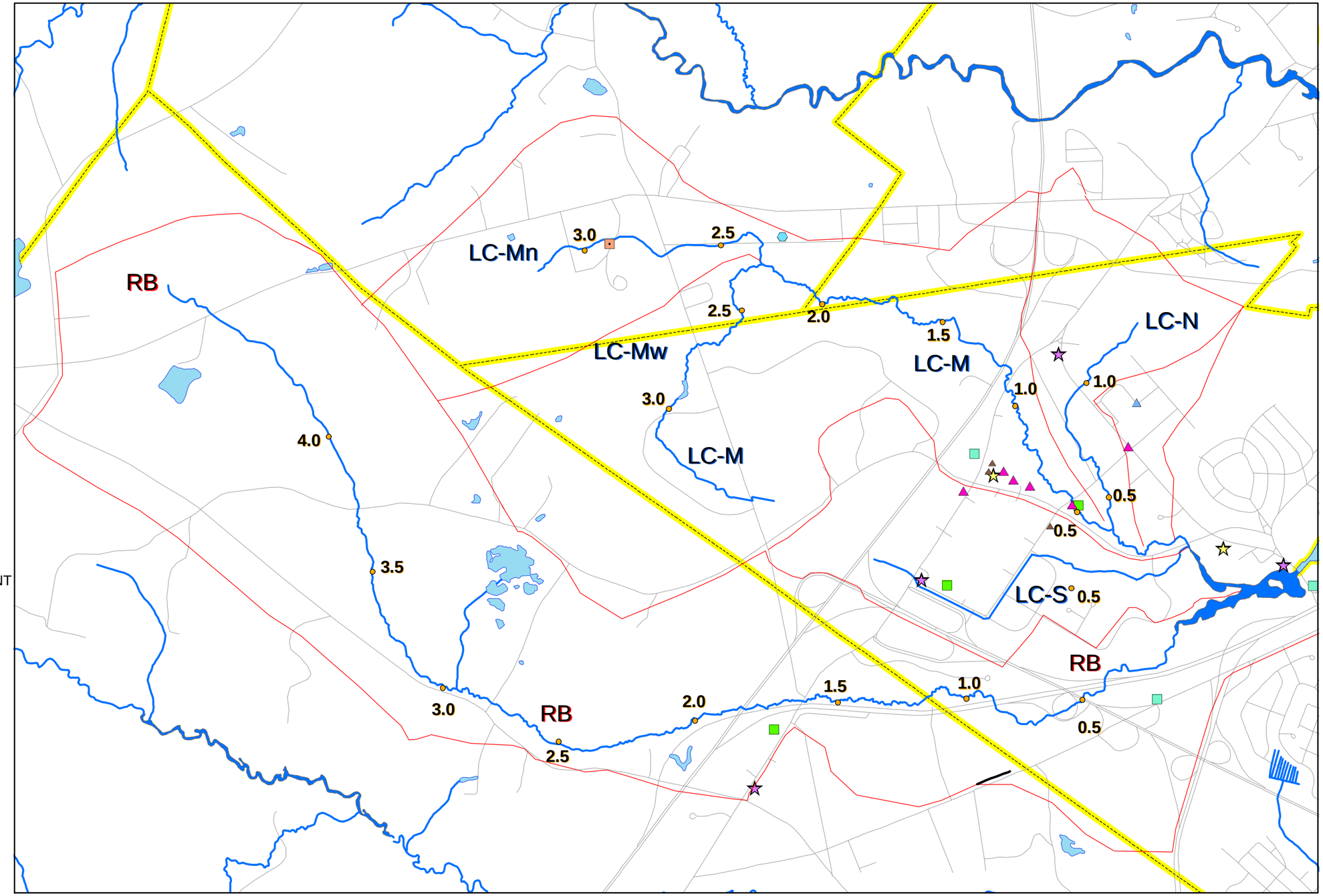
N W E S

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Long Creek-Red Brook

Comprehensive Watershed Assessment

Figure 3.1.5. Pollutant "hotspot" map of the study watersheds. In the legend, "Ti", "Tr", and "S-G" represent tire, truck, and sand/gravel-piles respectively.



Legend

SITE_TYPE

- AUTO SERVICE STATION
- AUTO SERVICE STATION (Ti, B)
- CAR SALES AND MAINTENANCE
- DRIVETHRU-BANK
- DRIVETHRU-FOODBEV
- FARM / CONSTRUCTION EQUIPMENT
- GAS STATION
- GAS STATION / CARWASH
- PUBLIC WORKS FACILITY (Tr, S-G)
- SEMICONDUCTOR PLANT
- TRUCK STORAGE LOT
- GIS.Roads
- GIS.Towns_polys

Additional Legend Items

- Watershed Boundary
- 3.0 Stream Mile

Jeff Varricchione
Maine Dept. Environmental Protection
12/24/02

Figure 3.1.6. Statutory classification of streams and rivers in the vicinity of the study watersheds.

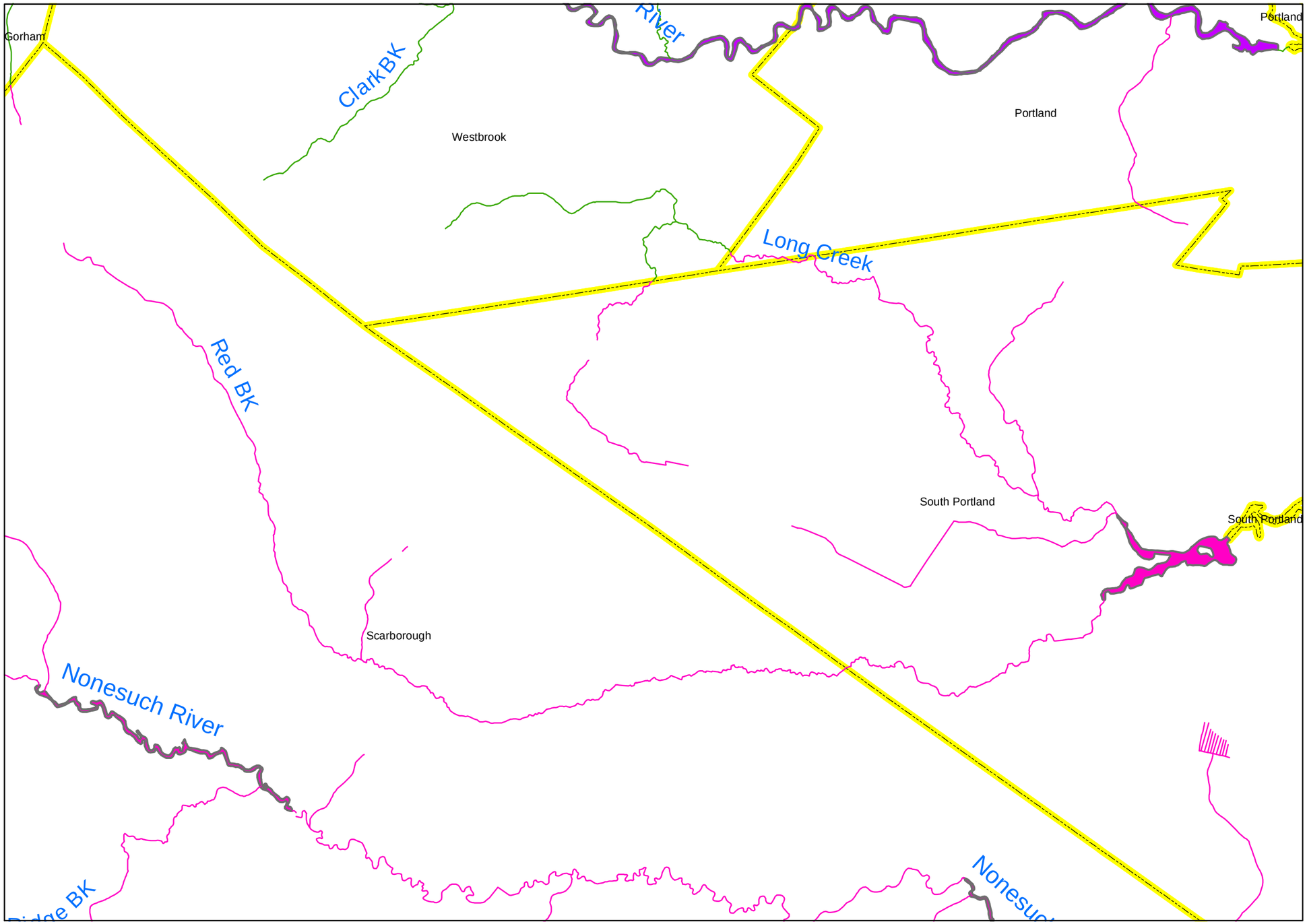
Long Creek & Red Brook

Comprehensive Watershed Assessment

Legend

Stream Class
- A
- AA
- B
- C

River Class
- A
- AA
- B
- C
- ca
- na
- nh
- GIS.Towns_polys



N
W E
S

0 0.25 0.5 1 1.5 2 Miles

Jeff Varricchione
Maine Dept. Environmental Protection
12/23/02

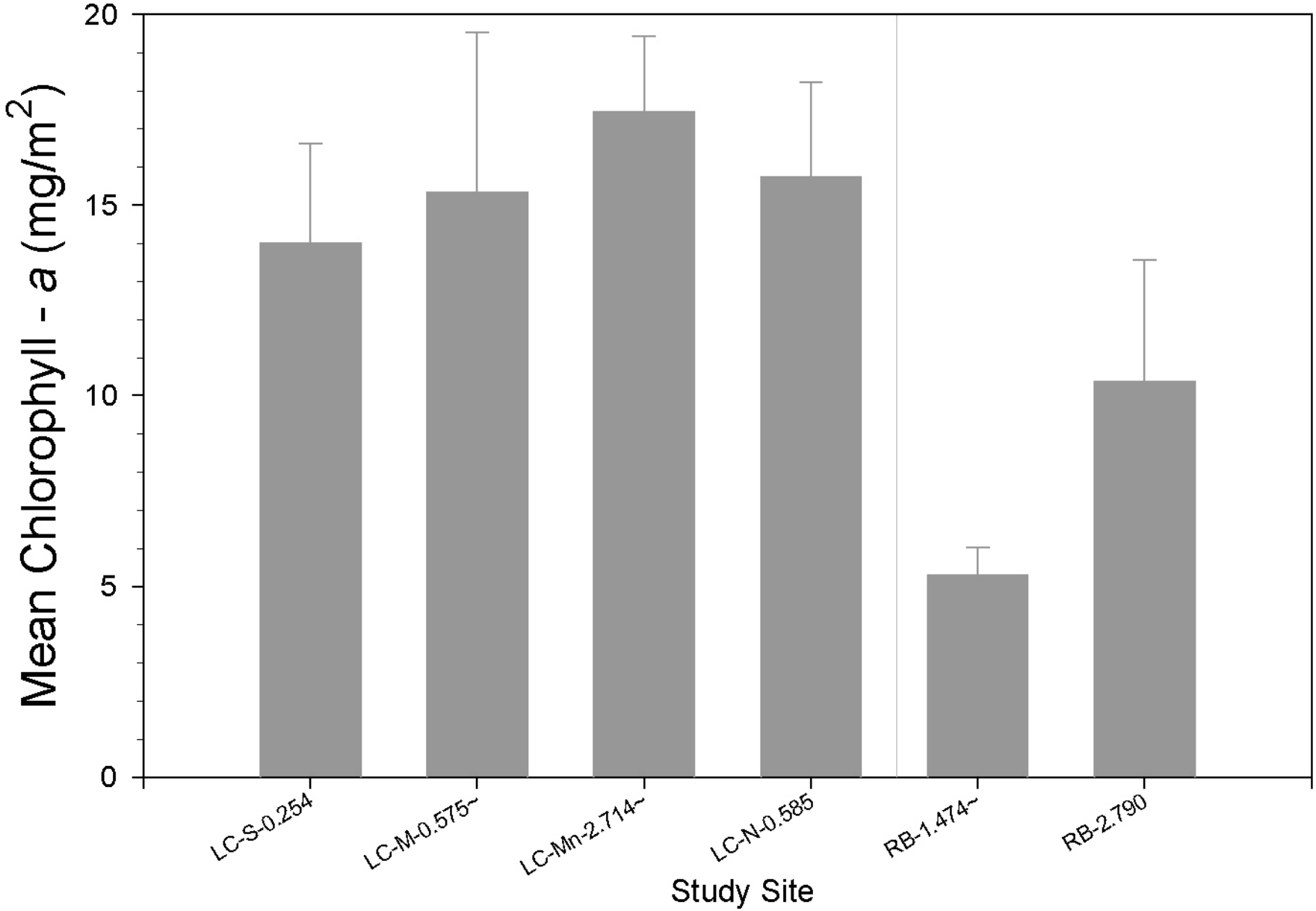


Figure 3.2.1. Mean chlorophyll-a values for sites in the Long Creek and Red Brook watersheds. Errors bars are equal to one standard deviation.

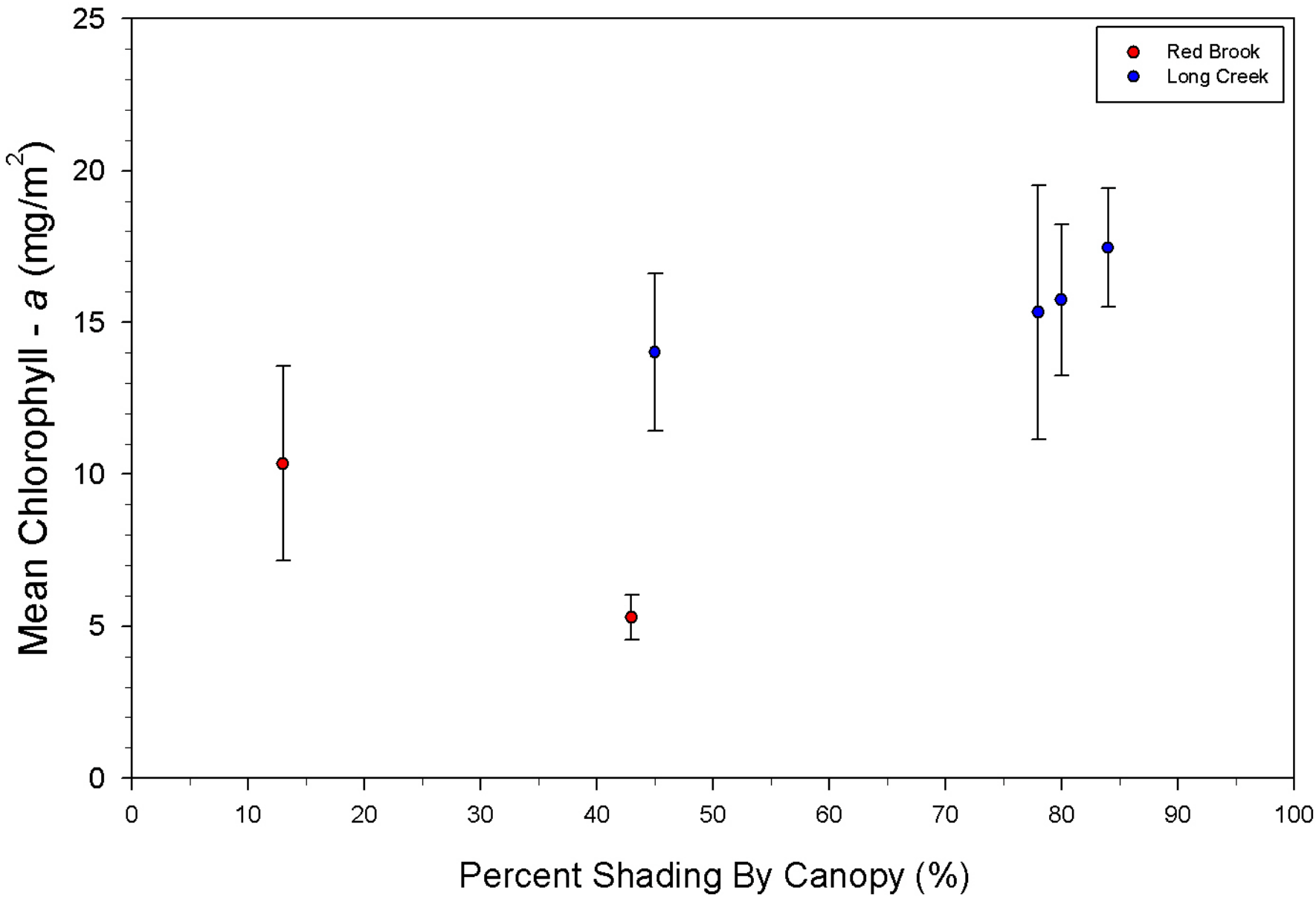


Figure 3.2.2. Mean chlorophyll-a values versus percent shading by canopy for sites in the Long Creek and Red Brook watersheds. Errors bars are equal to ± one standard deviation.

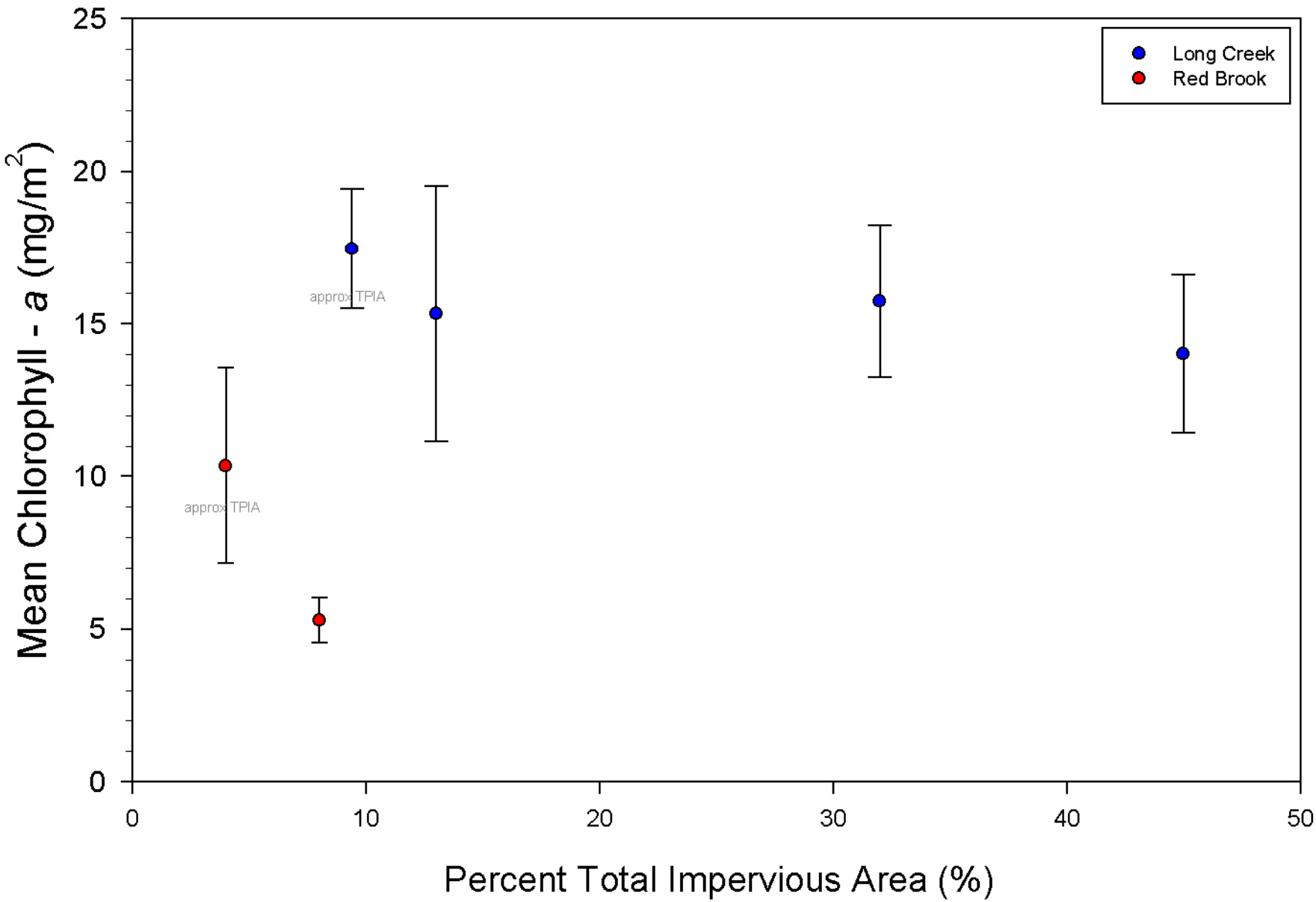


Figure 3.2.3. Mean chlorophyll-a values versus percent total impervious area for sites in the Long Creek and Red Brook watersheds. Errors bars are equal to ± one standard deviation.

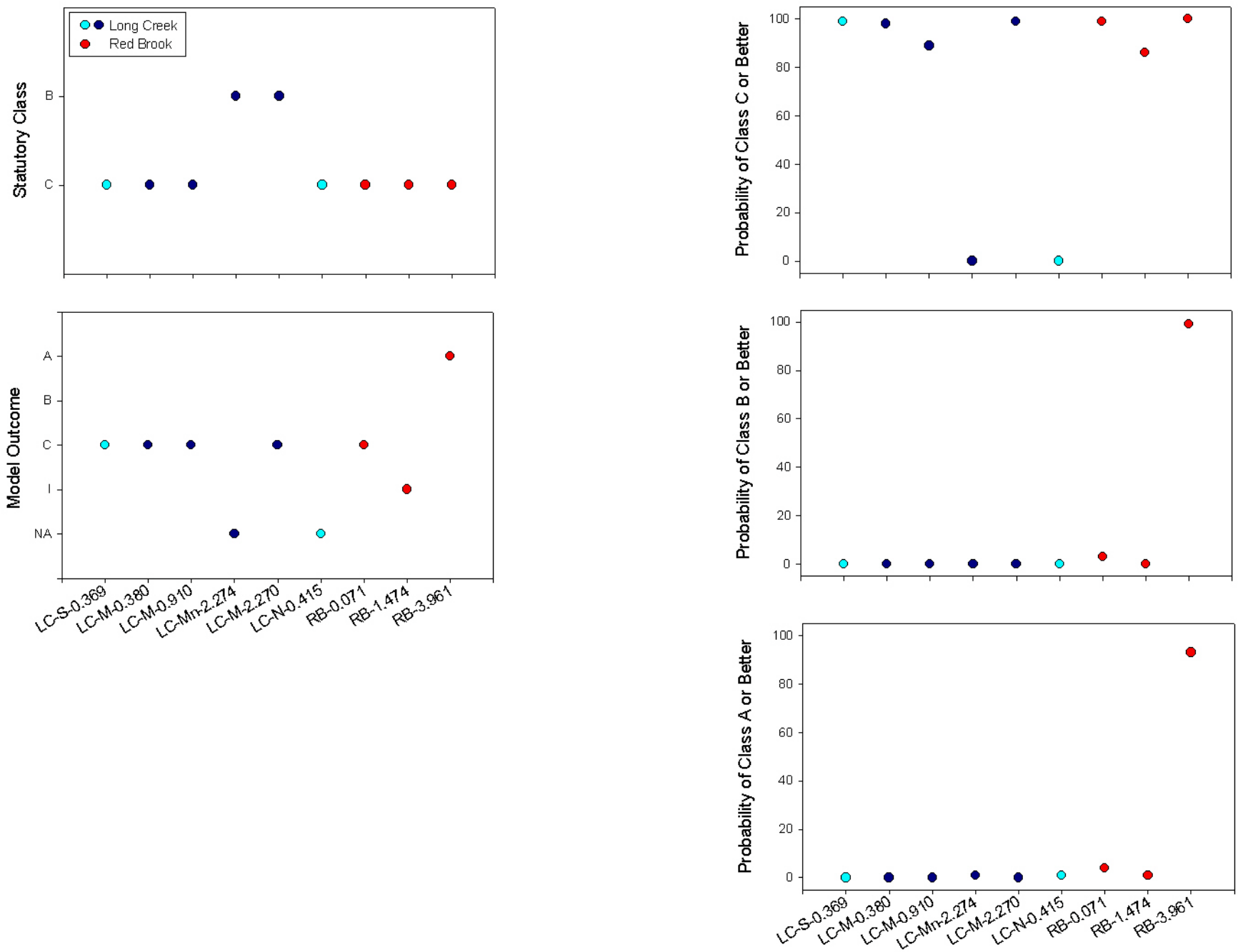


Figure 3.2.4a. Metric results for "rockbag" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999. In the "Model Outcome" panel's y-axis, "NA" indicates that the site was found to be in non-attainment status and "I" indicates that the outcome was indeterminant because the model could not be run with confidence due to low abundances of organisms in the samples.

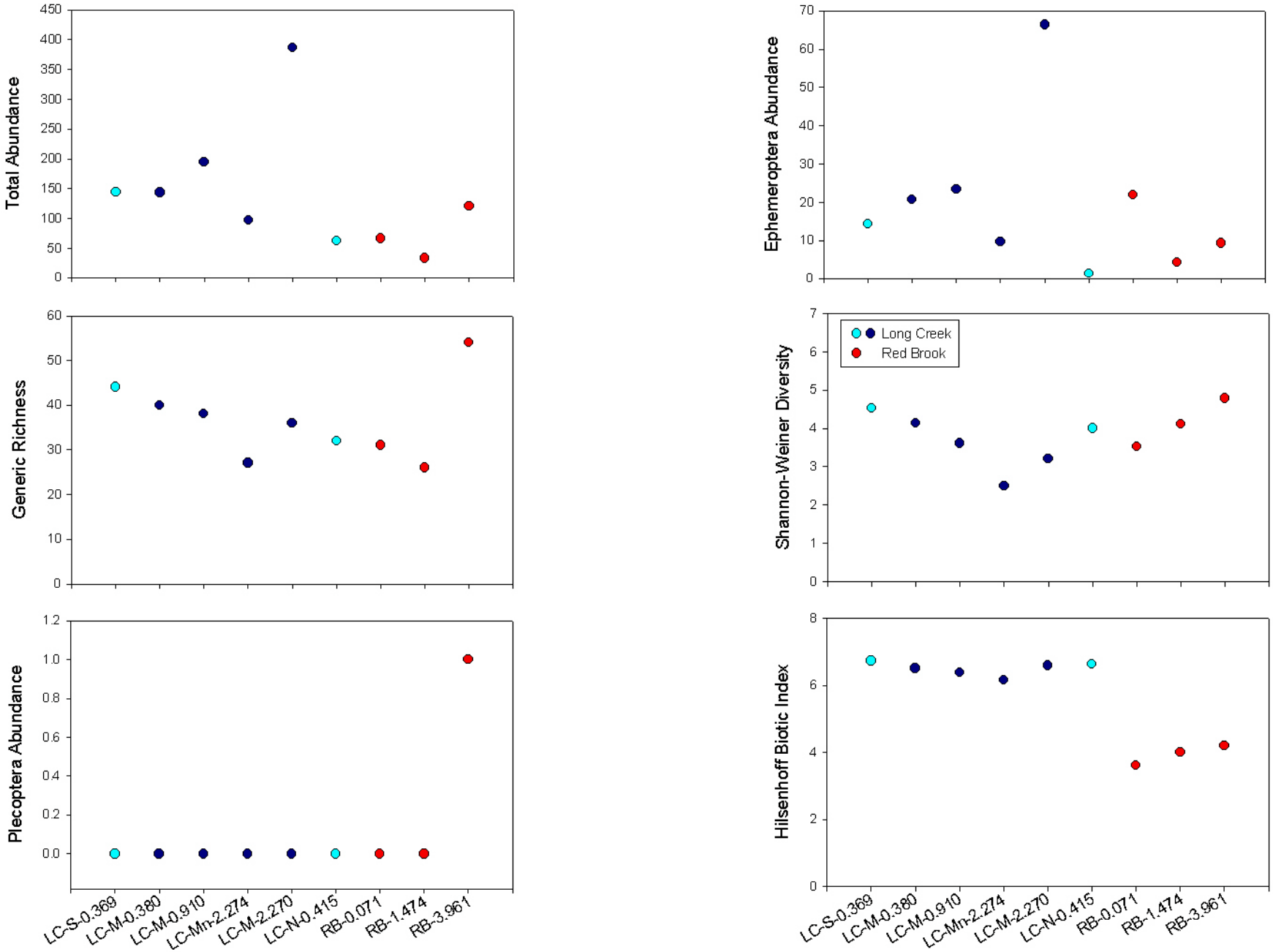


Figure 3.2.4b. Metric results for "rockbag" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999.

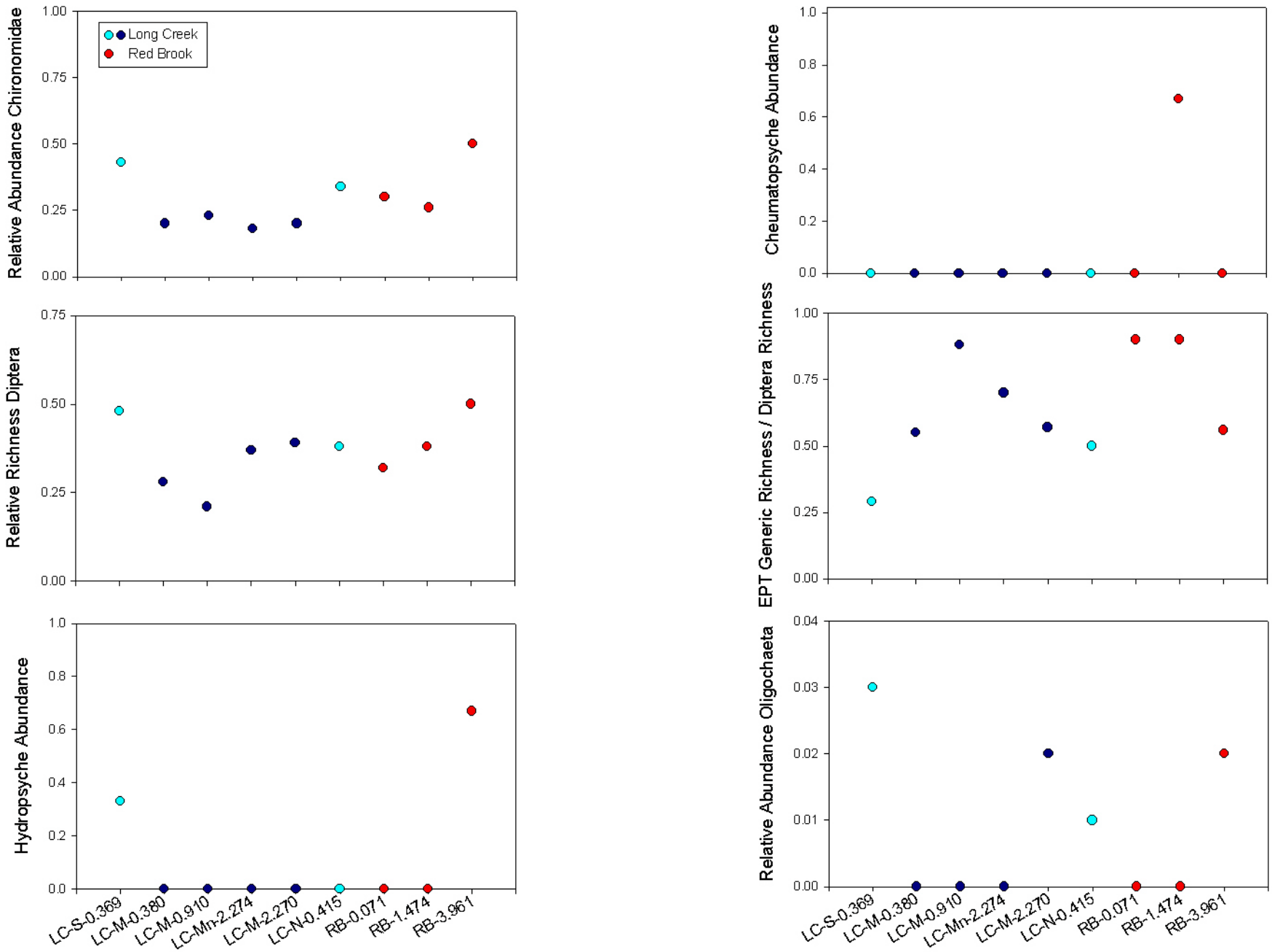


Figure 3.2.4c. Metric results for "rockbag" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999.

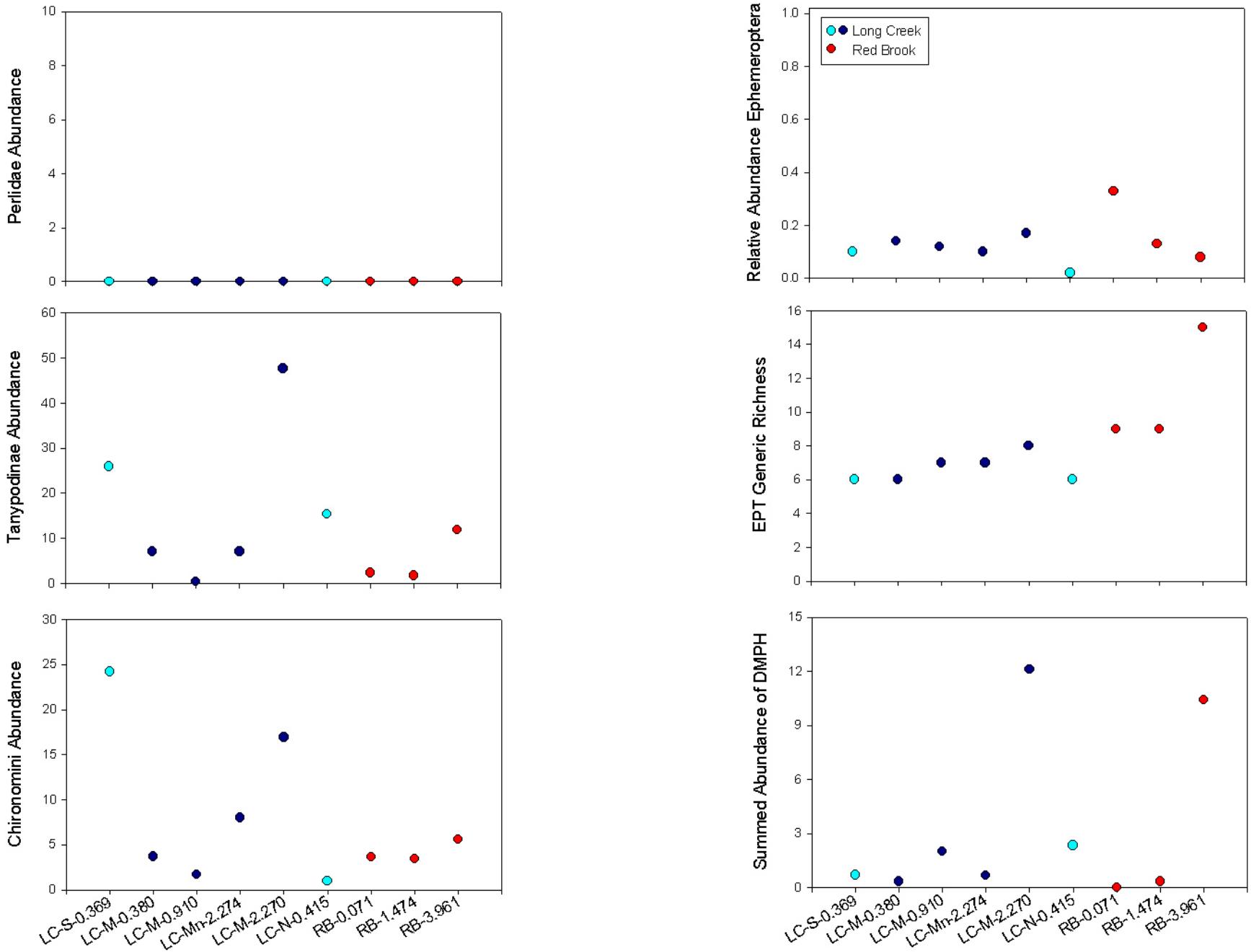


Figure 3.2.4d. Metric results for "rockbag" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999.

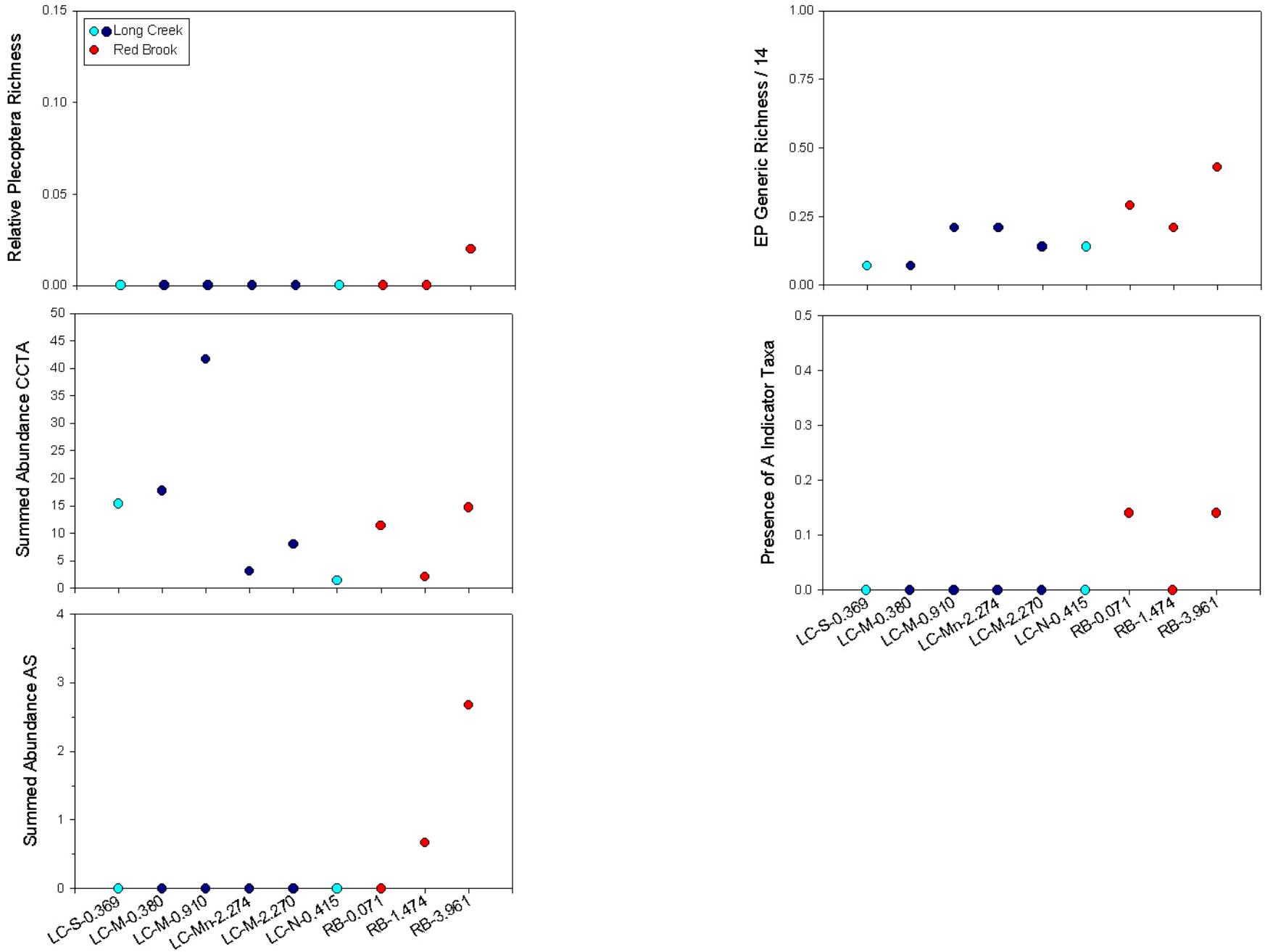


Figure 3.2.4e. Metric results for "rockbag" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999.

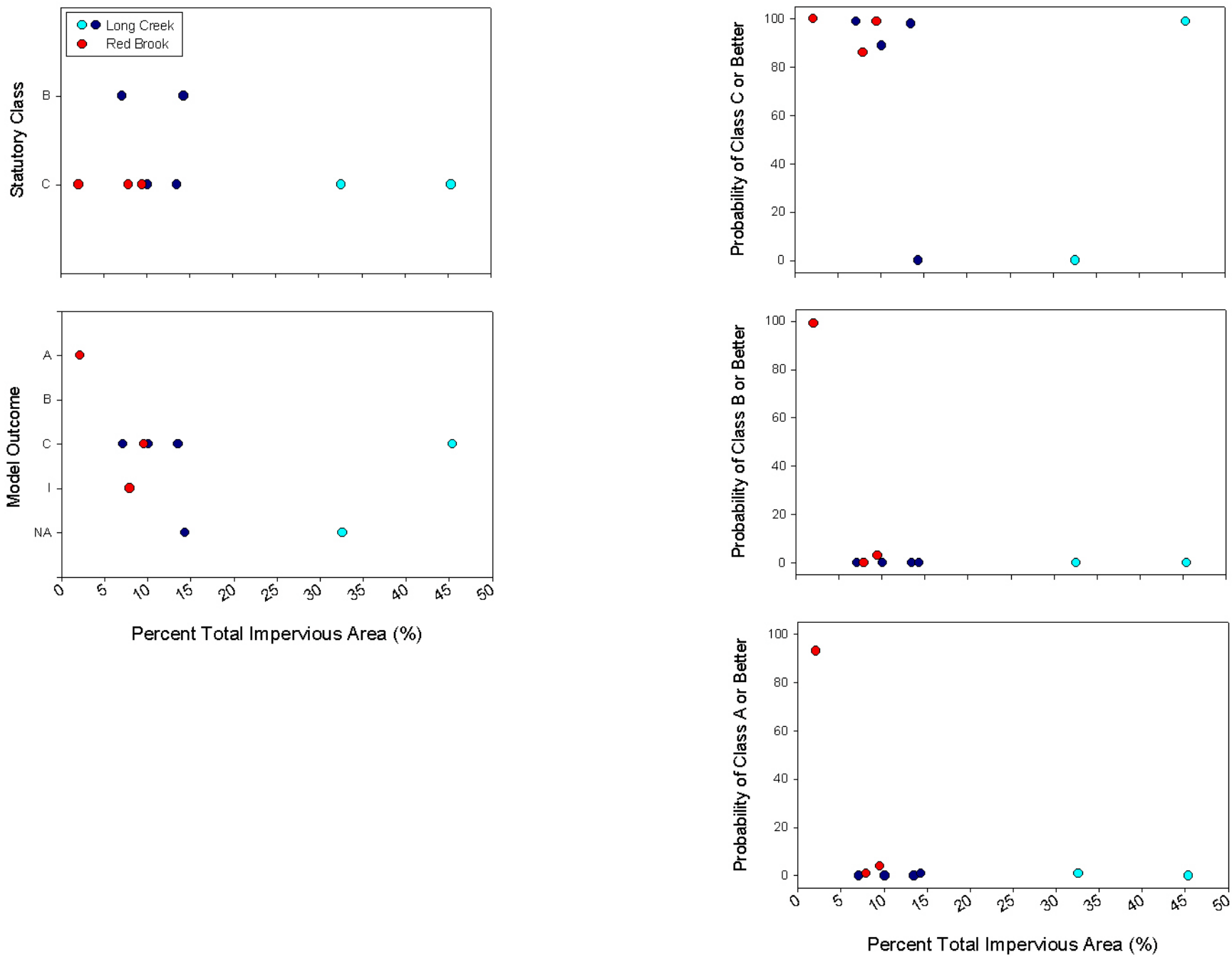


Figure 3.2.5a. Metric results for "rockbag" macroinvertebrate samples versus percent total impervious area. Samples were collected in the Long Creek and Red Brook watersheds during 1999. In the "Model Outcome" panel's y-axis, "NA" indicates that the site was found to be in non-attainment status and "I" indicates that the outcome was indeterminate because the model could not be run with confidence due to low abundances of organisms in the samples.

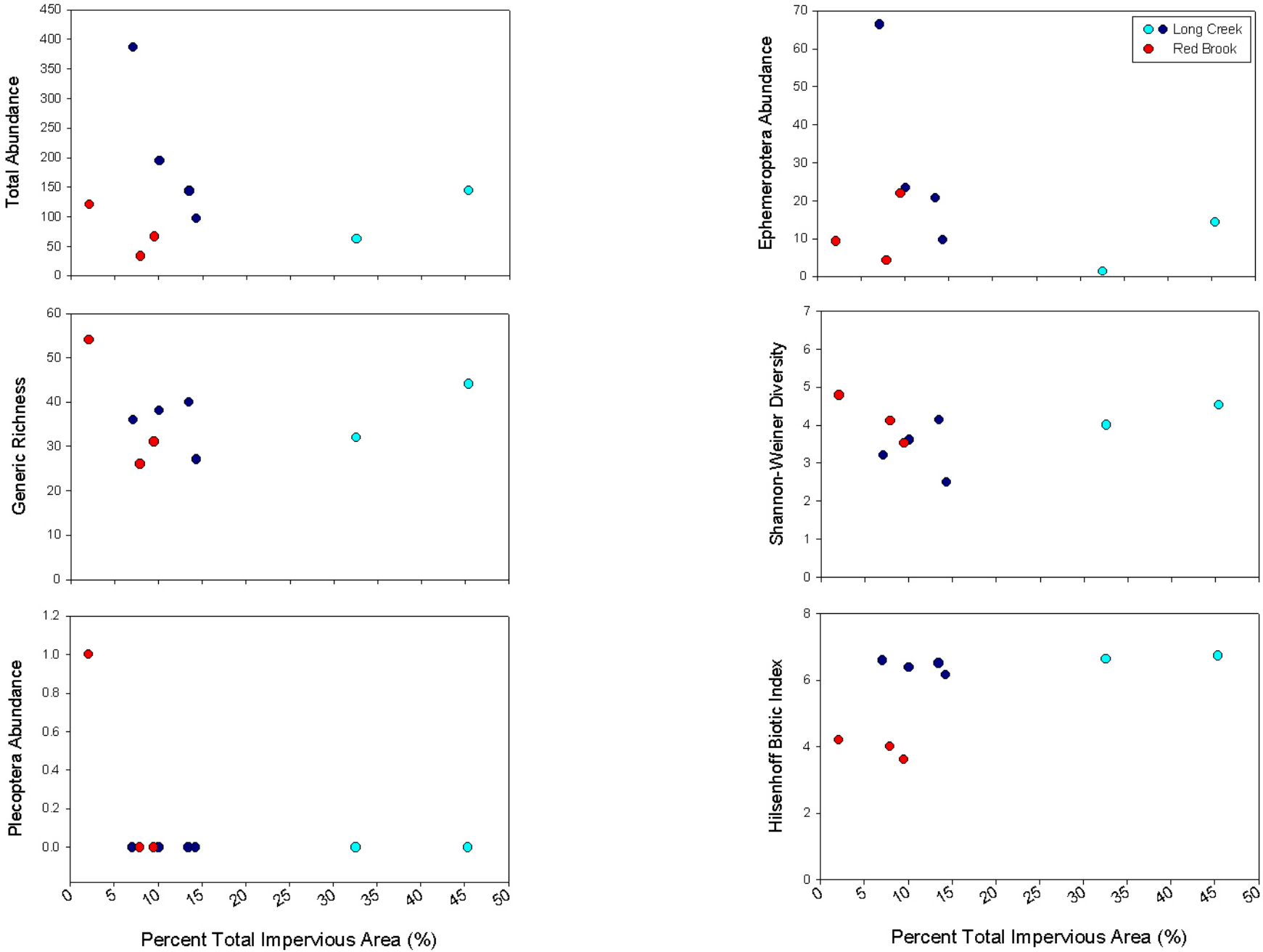


Figure 3.2.5b. Metric results for "rockbag" macroinvertebrate samples versus percent total impervious area. Samples were collected in the Long Creek and Red Brook watersheds during 1999.

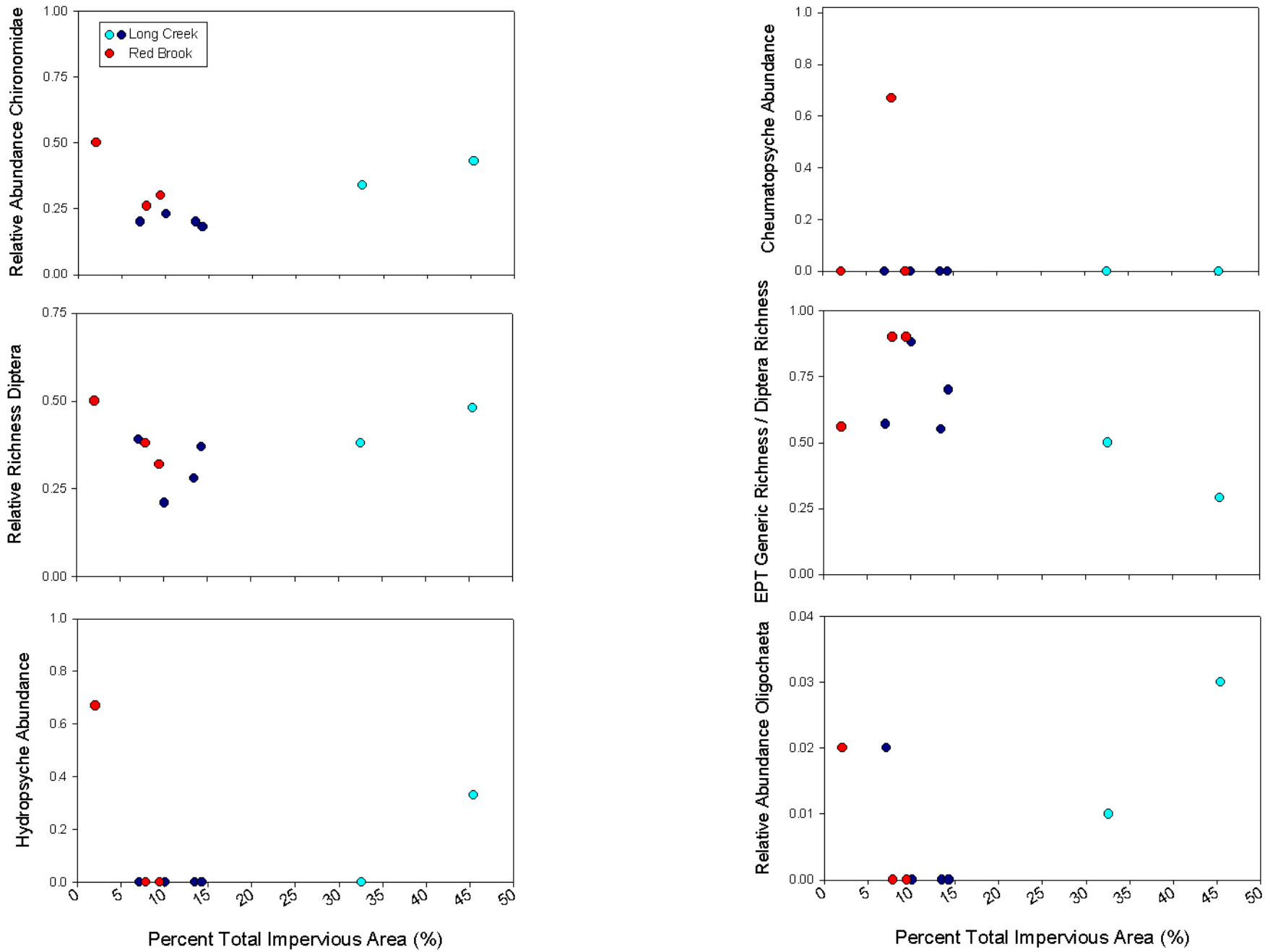


Figure 3.2.5c. Metric results for "rockbag" macroinvertebrate samples versus percent total impervious area. Samples were collected in the Long Creek and Red Brook watersheds during 1999.

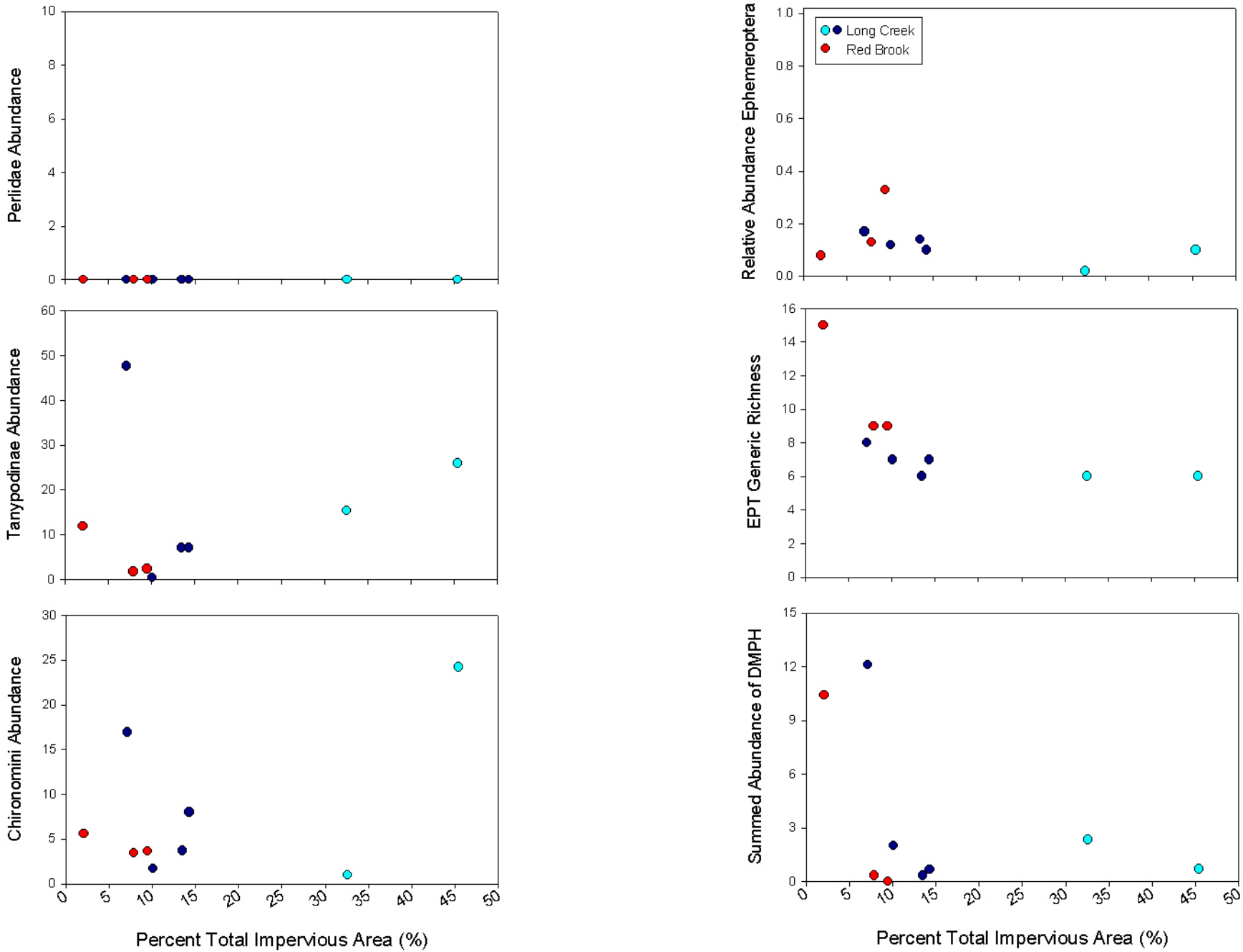


Figure 3.2.5d. Metric results for "rockbag" macroinvertebrate samples versus percent total impervious area. Samples were collected in the Long Creek and Red Brook watersheds during 1999.

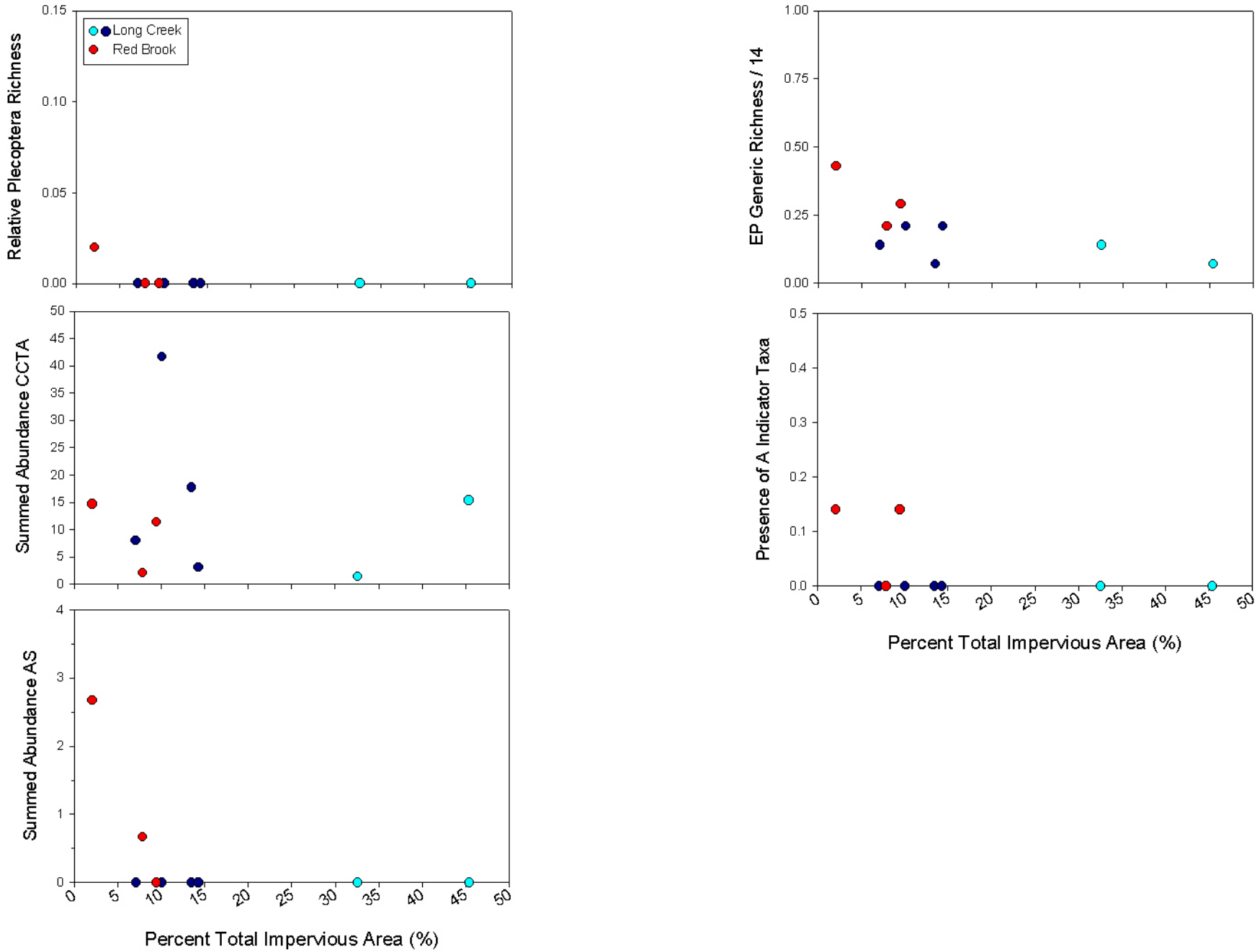


Figure 3.2.5e. Metric results for "rockbag" macroinvertebrate samples versus percent total impervious area. Samples were collected in the Long Creek and Red Brook watersheds during 1999.

Model data not available for the "multihabitat" macroinvertebrate samples.

Figure 3.2.6a. Metric results for "multihabitat" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999.

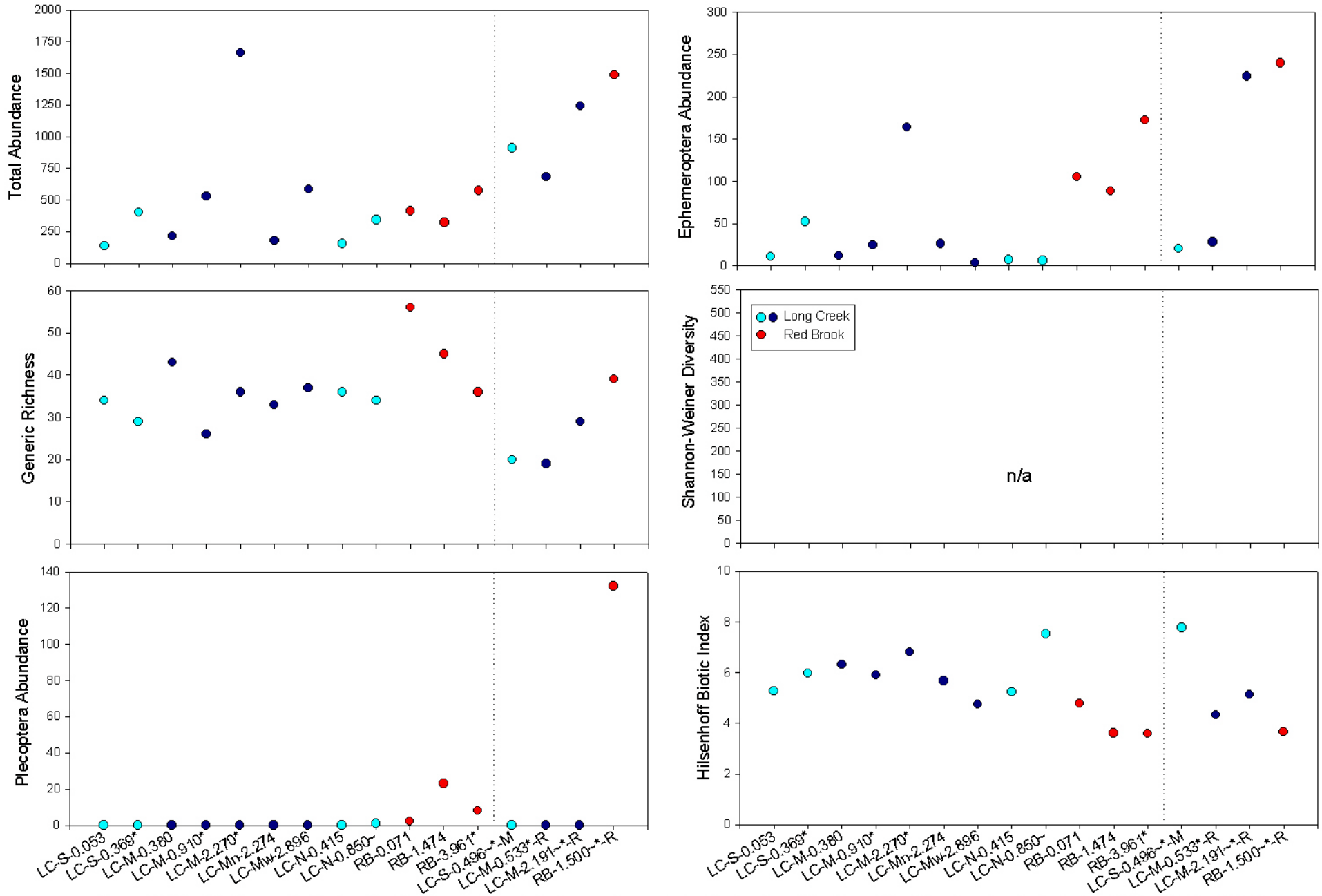


Figure 3.2.6b. Metric results for "multihabitat" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999. A letter "M" at the end of a site code (x-axis) indicates that the stream bottom was covered by a substantial amount of macrophytes, while an "R" indicates that the stream bottom was either a riffle or an accumulation of road debris. Additionally, LC-N-1.000~ contained a small amount of pea gravel within the mostly sand-silt channel bottom. An asterisk indicates that a 25% subsample was used as opposed to an entire sample due to high numbers of animals. Sampling area was approximately 2.359 m^2.

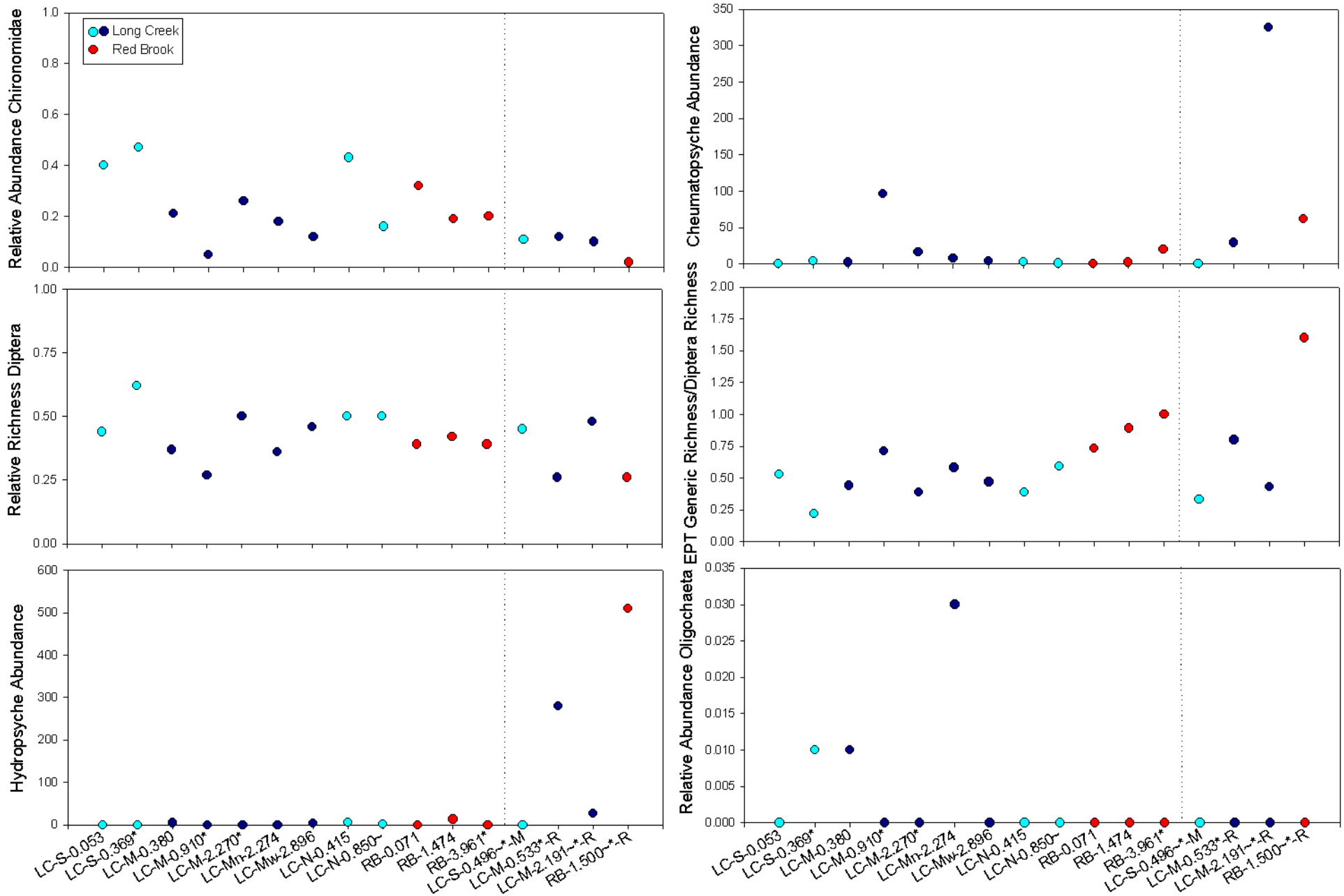


Figure 3.2.6c. Metric results for "multihabitat" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999. A letter "M" at the end of a site code (x-axis) indicates that the stream bottom was covered by a substantial amount of macrophytes, while an "R" indicates that the stream bottom was either a riffle or an accumulation of road debris. Additionally, LC-N-1.000~ contained a small amount of pea gravel within the mostly sand-silt channel bottom. An asterisk indicates that a 25% subsample was used as opposed to an entire sample due to high numbers of animals. Sampling area was approximately 2.359 m^2.

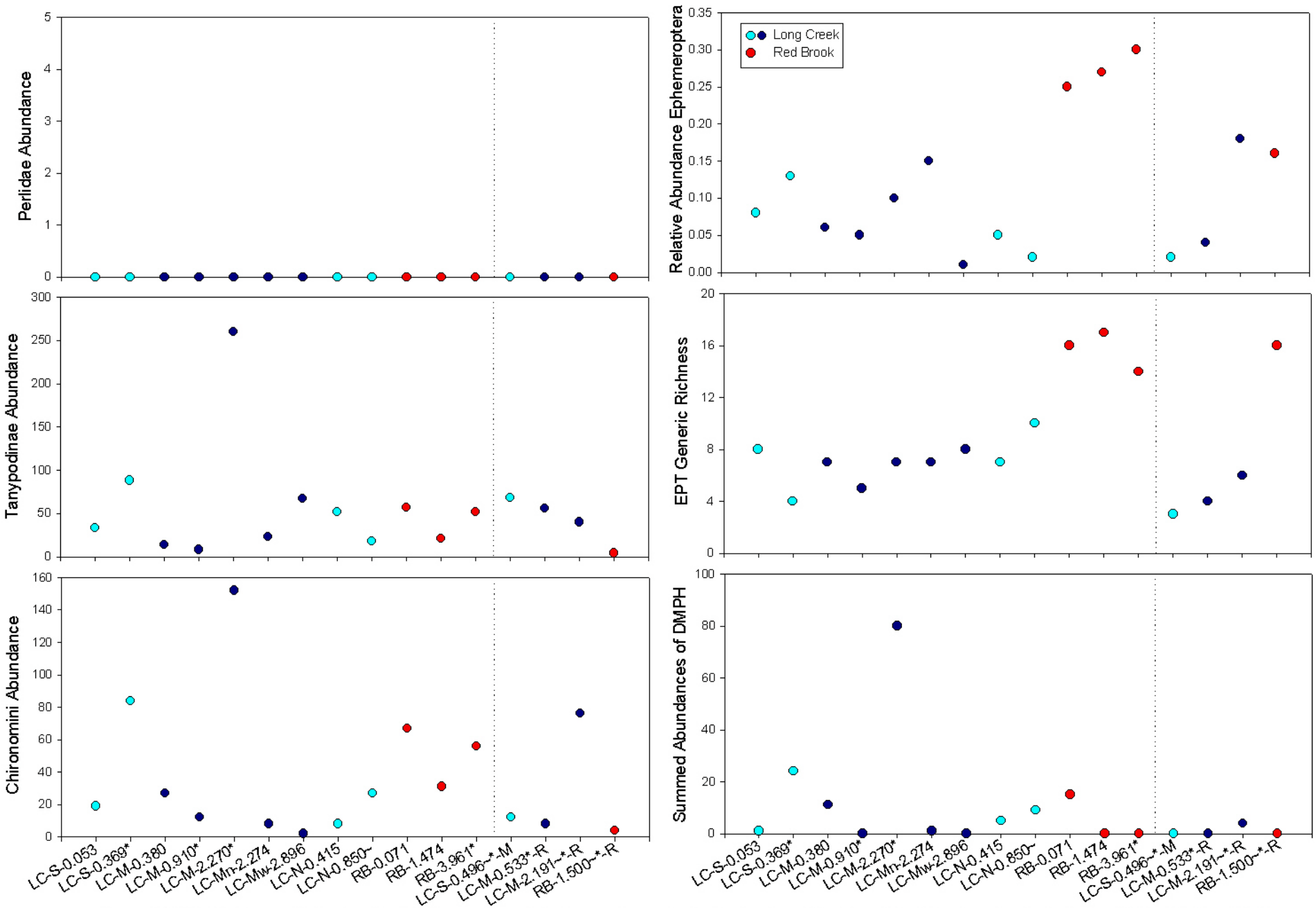


Figure 6.3.6d. Metric results for "multihabitat" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999. A letter "M" at the end of a site code (x-axis) indicates that the stream bottom was covered by a substantial amount of macrophytes, while an "R" indicates that the stream bottom was either a riffle or an accumulation of road debris. Additionally, LC-N-1.000~ contained a small amount of pea gravel within the mostly sand-silt channel bottom. An asterisk indicates that a 25% subsample was used as opposed to an entire sample due to high numbers of animals. Sampling area was approximately 2.359 m^2.

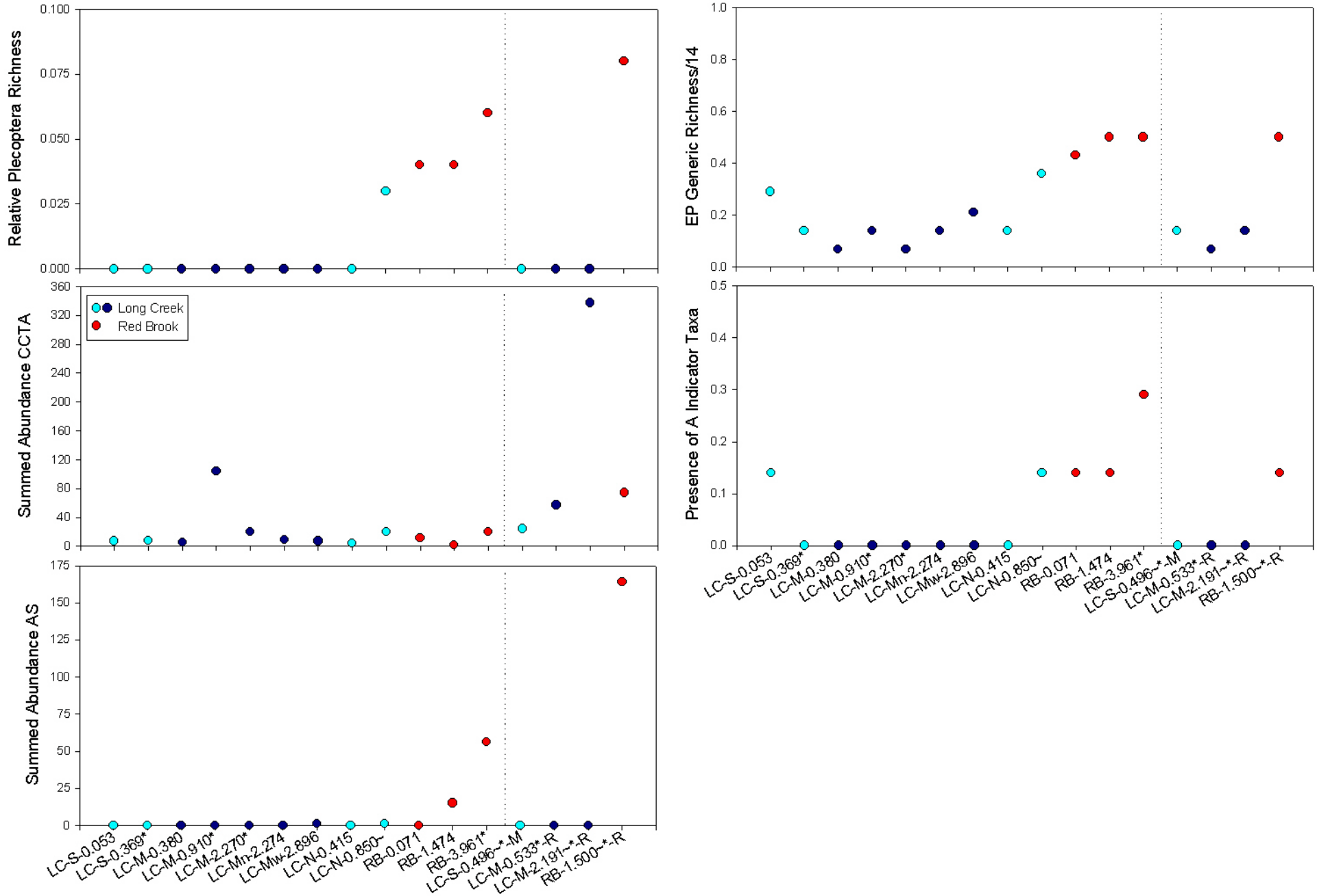


Figure 3.2.6e. Metric results for "multihabitat" macroinvertebrate samples collected in the Long Creek and Red Brook watersheds during 1999. A letter "M" at the end of a site code (x-axis) indicates that the stream bottom was covered by a substantial amount of macrophytes, while an "R" indicates that the stream bottom was either a riffle or an accumulation of road debris. Additionally, LC-N-1.000~ contained a small amount of pea gravel within the mostly sand-silt channel bottom. An asterisk indicates that a 25% subsample was used as opposed to an entire sample due to high numbers of animals. Sampling area was approximately 2.359 m^2.

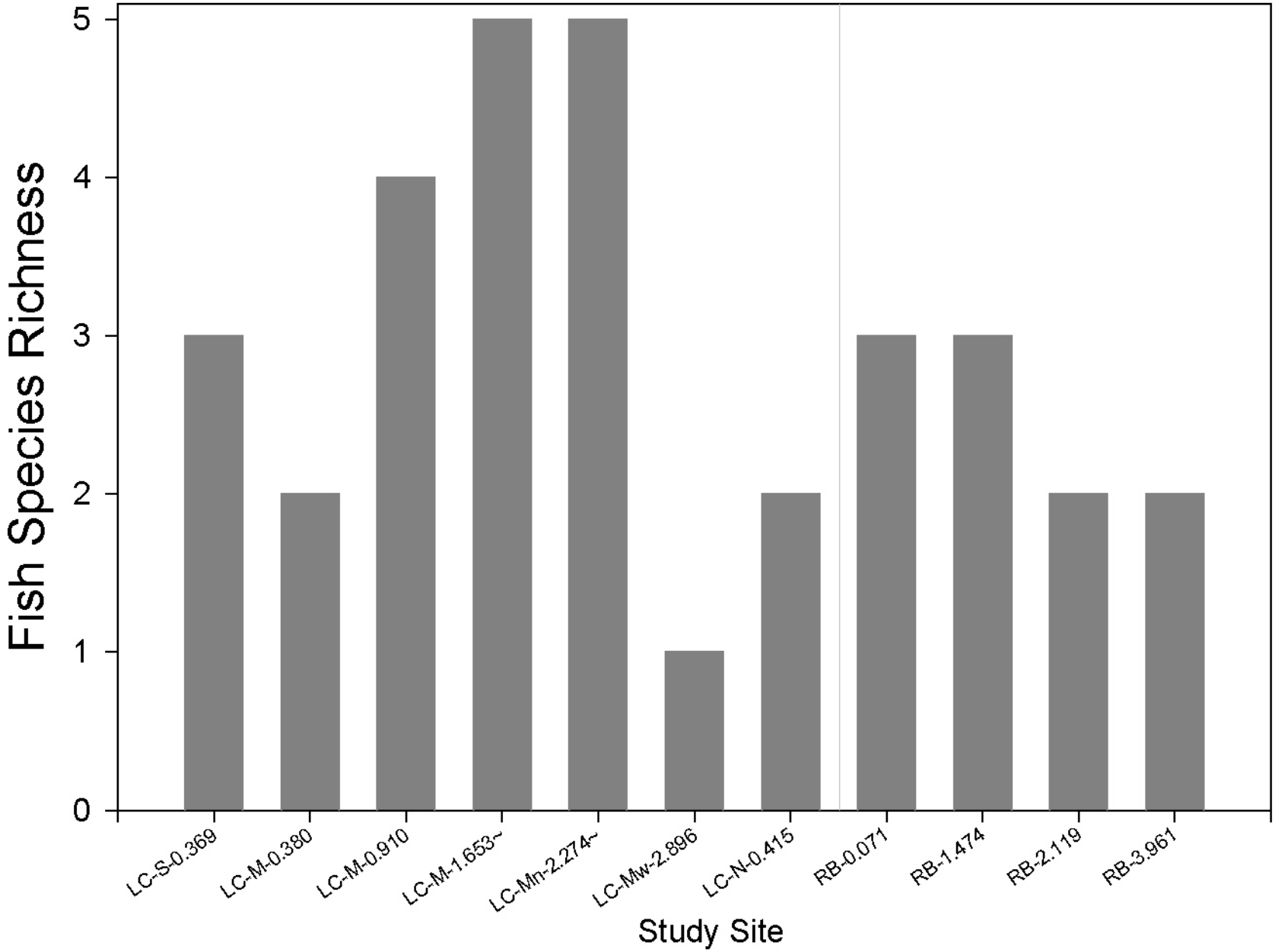


Figure 3.2.7. Fish species richness at the sites in the Long Creek and Red Brook watersheds.

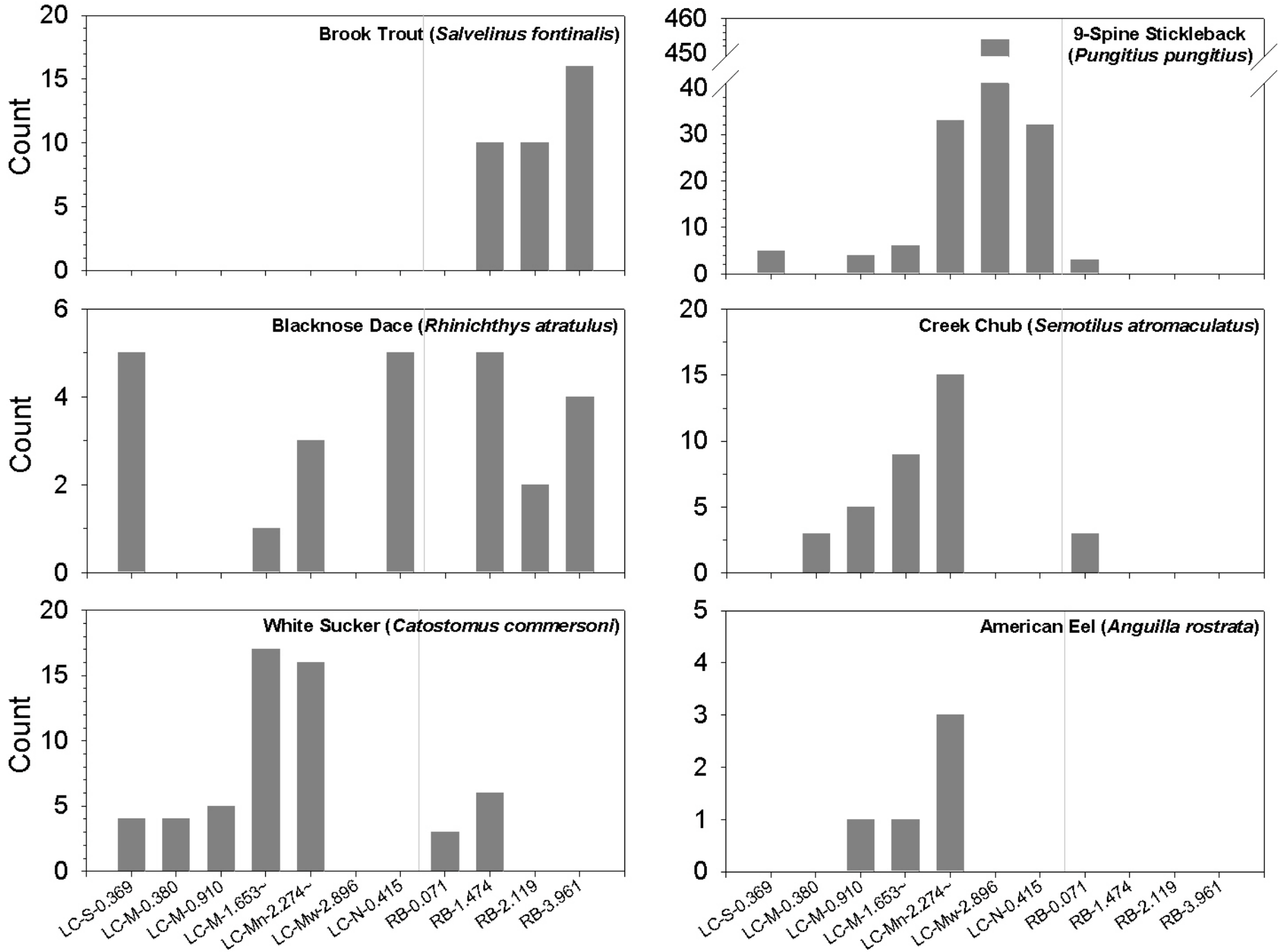


Figure 3.2.8. Abundance of various fish species in the Long Creek and Red Brook watersheds.

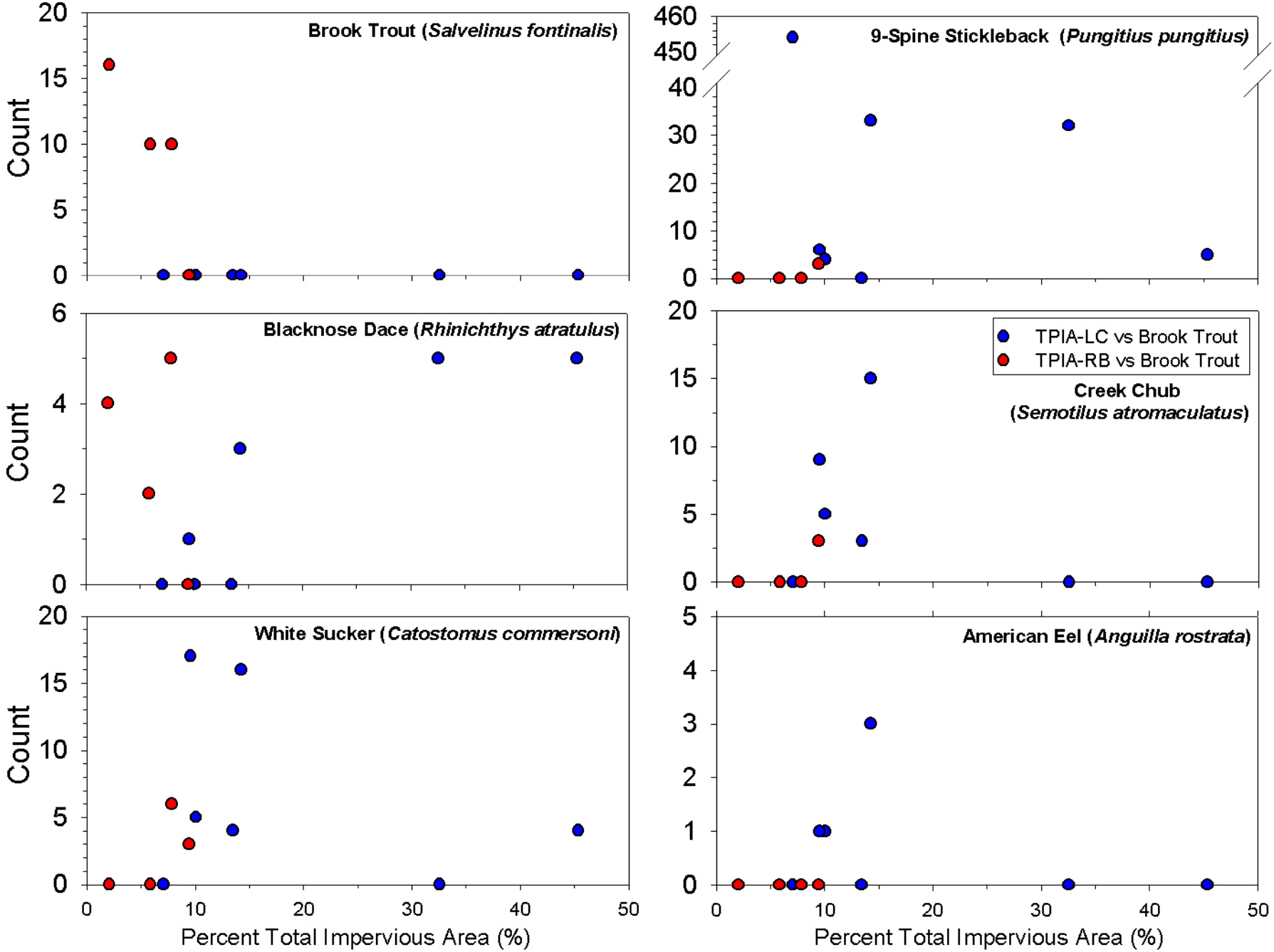


Figure 3.2.9. Fish abundance, by species, versus percent total impervious area at the study sites in the Long Creek and Red Brook watersheds.

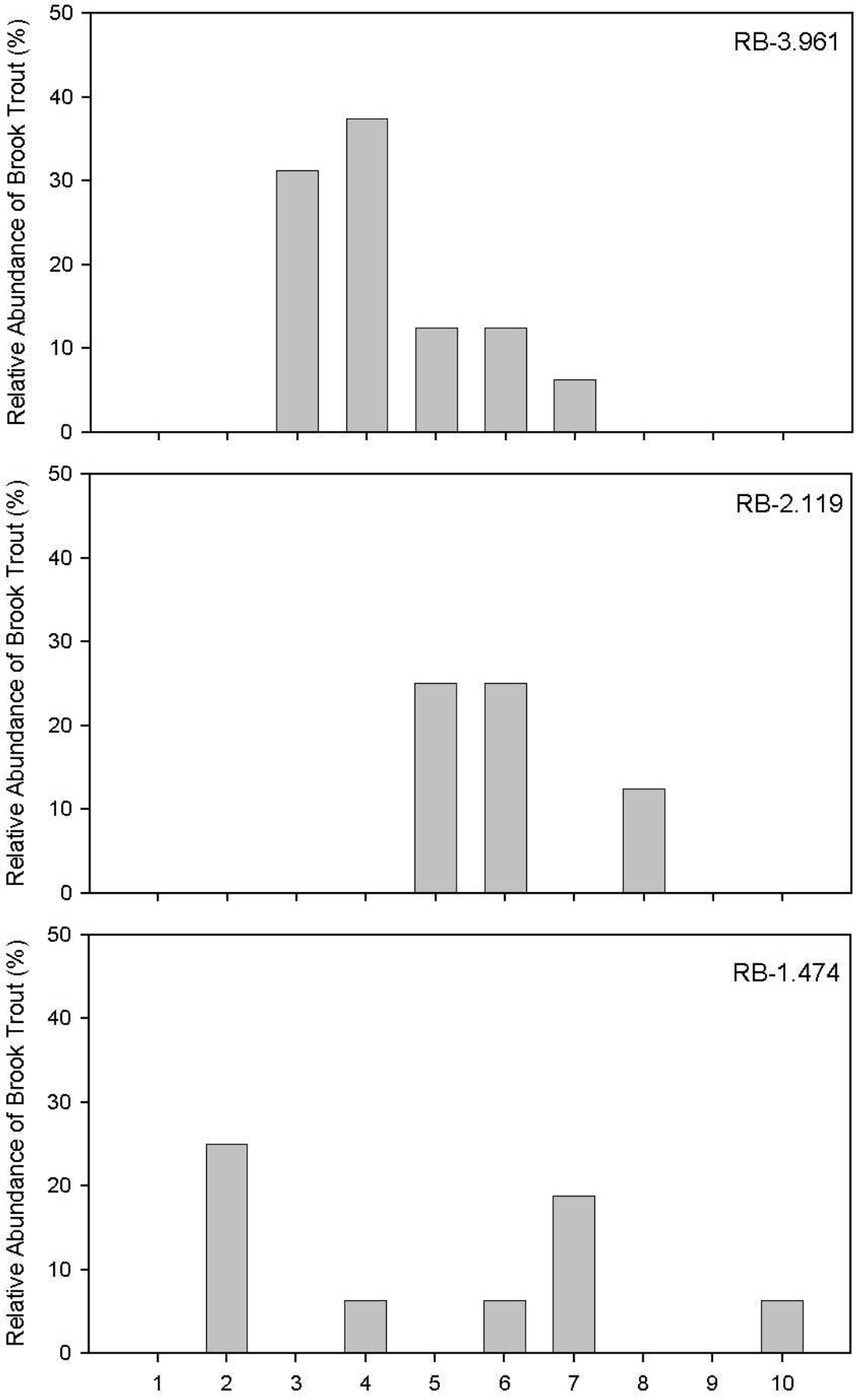


Figure 3.2.10. Relative abundance of brook trout, by size class, found at sites in Red Brook. (Brook trout were not found in Long Creek.)

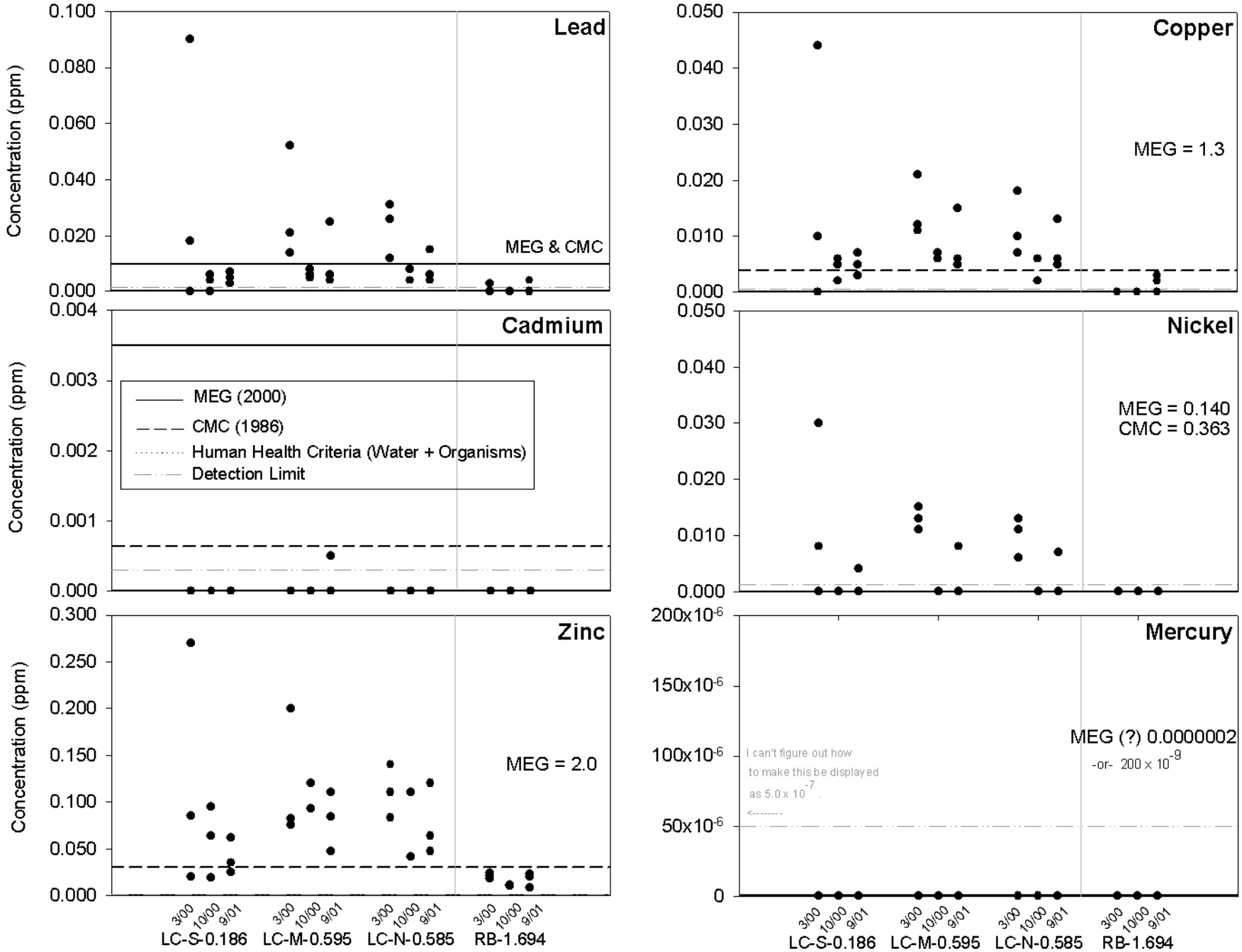


Figure 3.3.1. Concentrations of metals at sites in the Long Creek and Red Brook watersheds during stormflow conditions. The detection limit for mercury was 0.00005 ppm (0.05 ppb or 500×10^{-7} ppm).

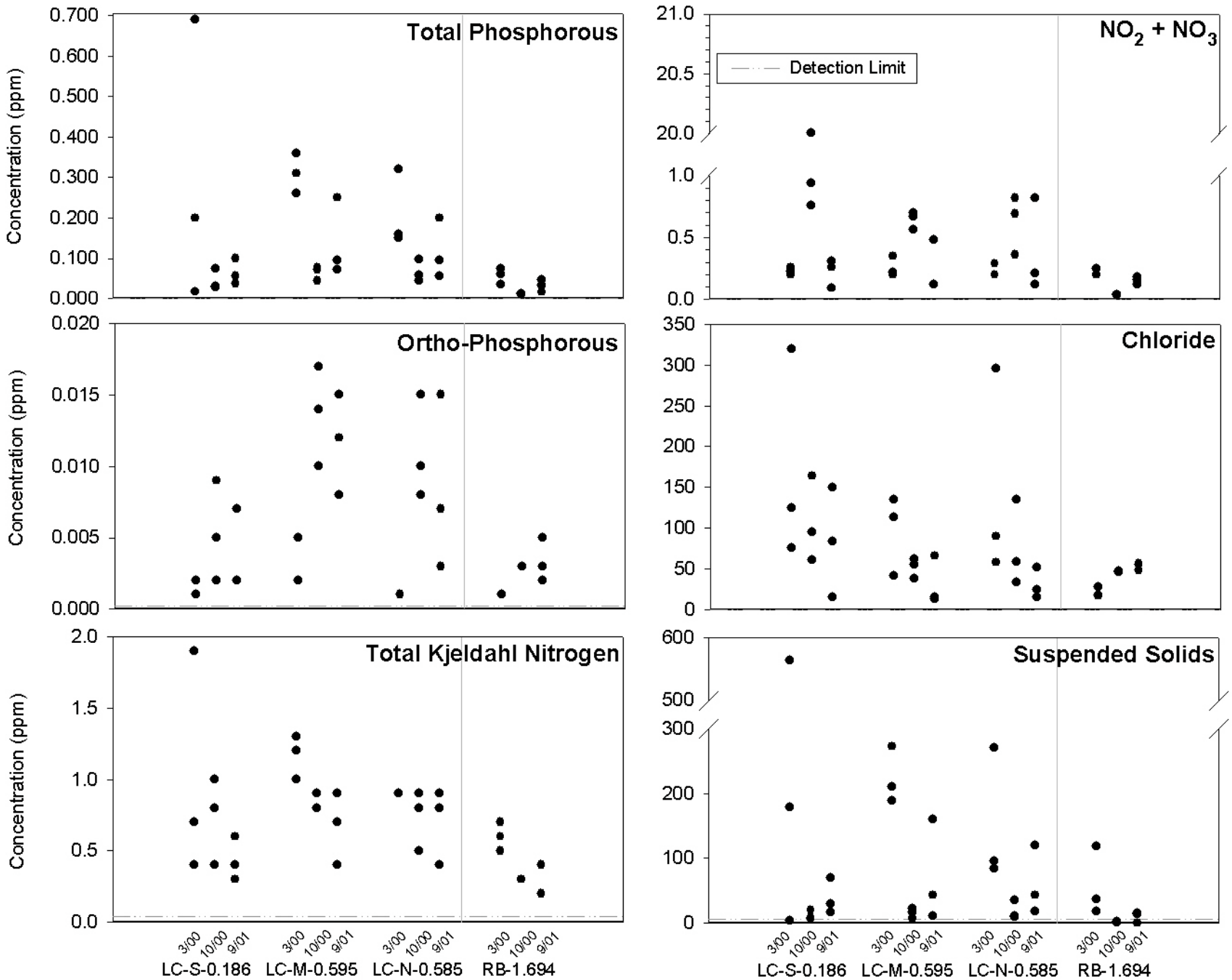


Figure 3.3.2. Concentrations of nutrients and suspended solids at sites in the Long Creek and Red Brook watersheds during stormflow conditions. The detection limit for NO_2 and NO_3 was assumed be the same as that for NO_3 alone.

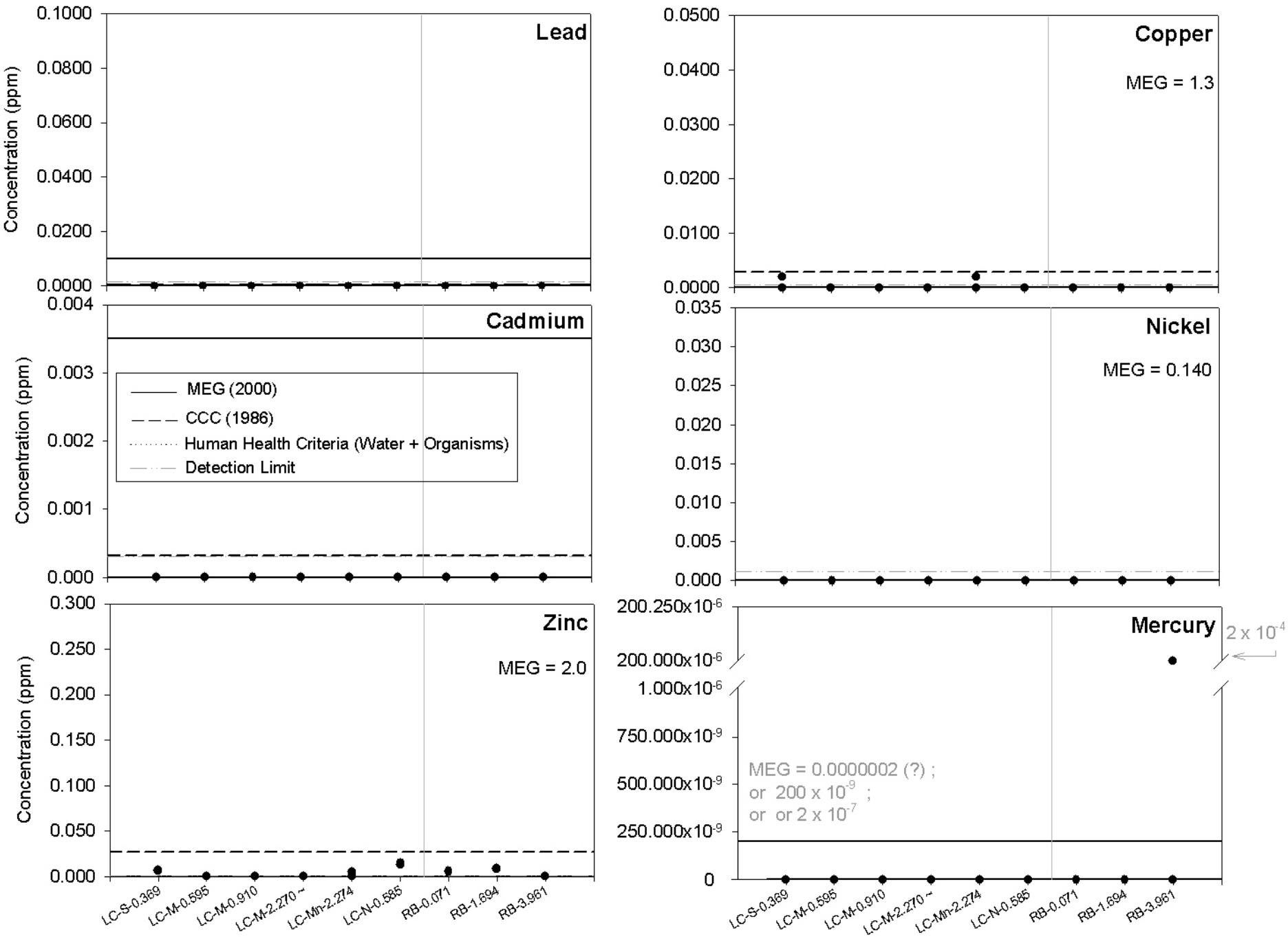


Figure 3.3.3. Concentrations of metals at sites in the Long Creek and Red Brook watersheds during baseflow conditions. The y-axes here are the same as those for storm event plots. The detection limit for mercury was 0.00005 ppm (0.05 ppb, or 50×10^{-6} ppm).

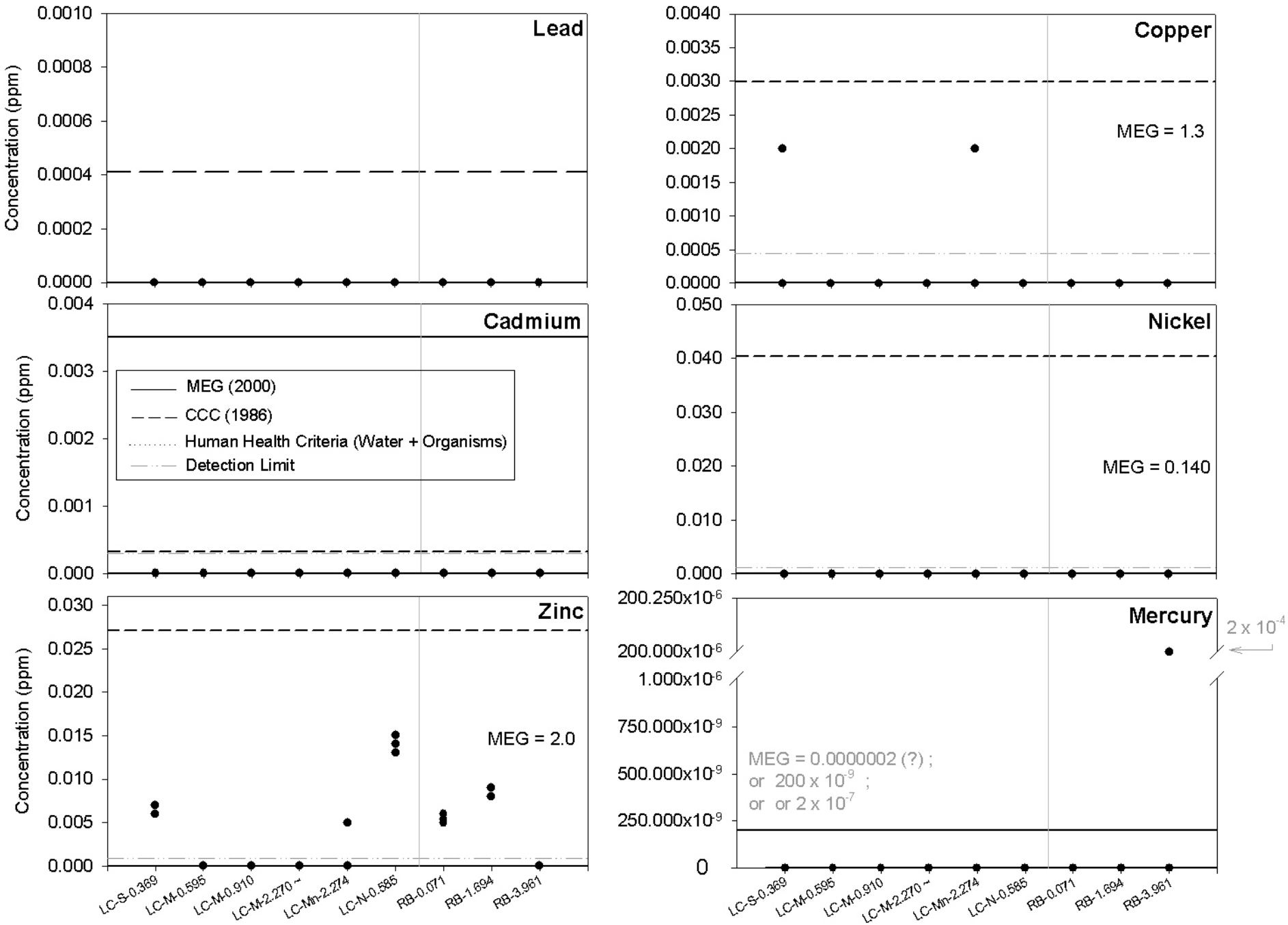


Figure 3.3.4. Concentrations of metals at sites in the Long Creek and Red Brook watersheds during baseflow conditions. Note that the y-axes on these plots are different from those on the storm-event plots. The detection limit for mercury was 0.00005 ppm (0.05 ppb or 50×10^{-6} ppm).

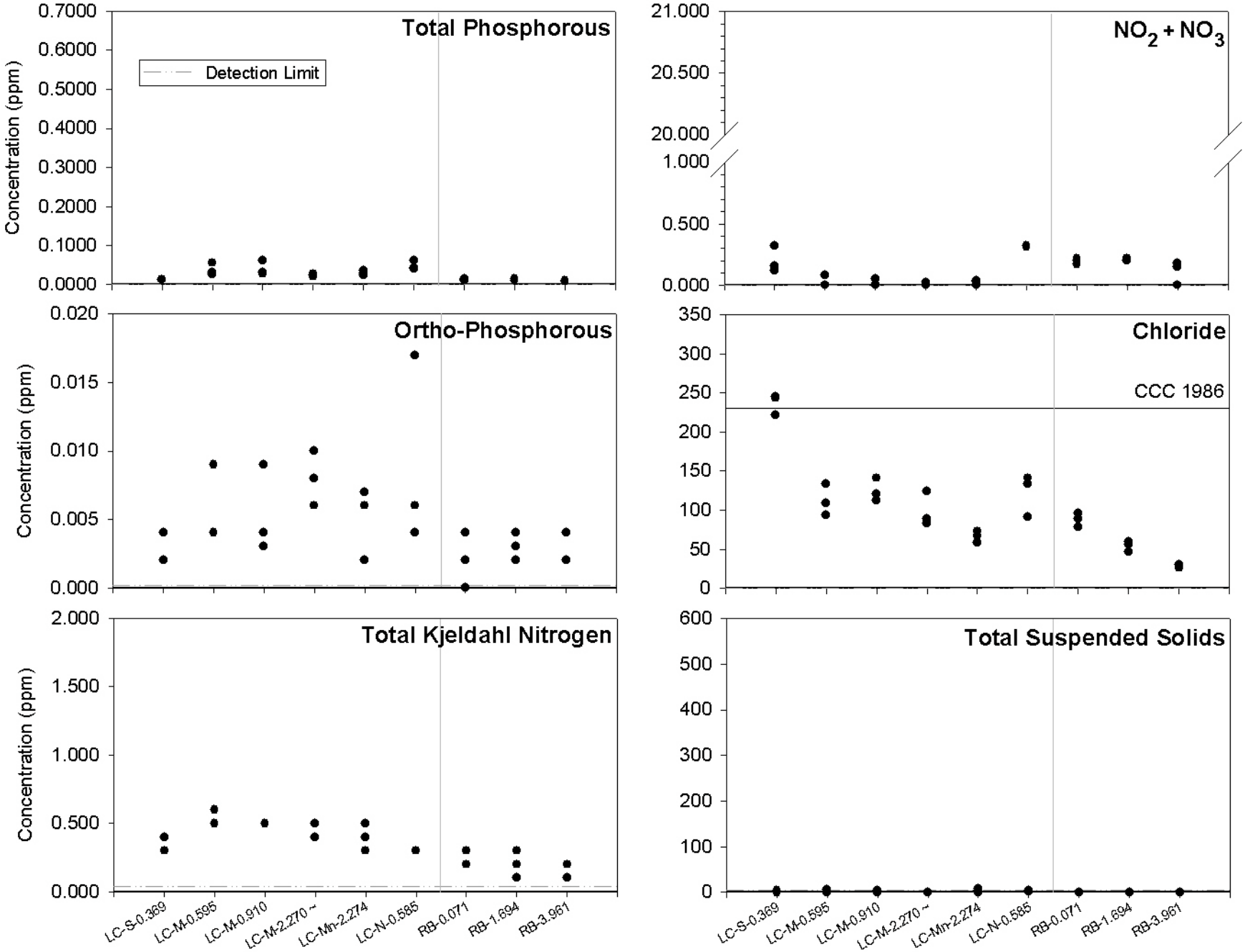


Figure 3.3.5. Concentrations of nutrients and suspended solids at sites in the Long Creek and Red Brook watersheds during baseflow conditions. The y-axes here are the same as those for storm event plots. The detection limit for NO_2 and NO_3 was assumed be the same as that for NO_3 alone.

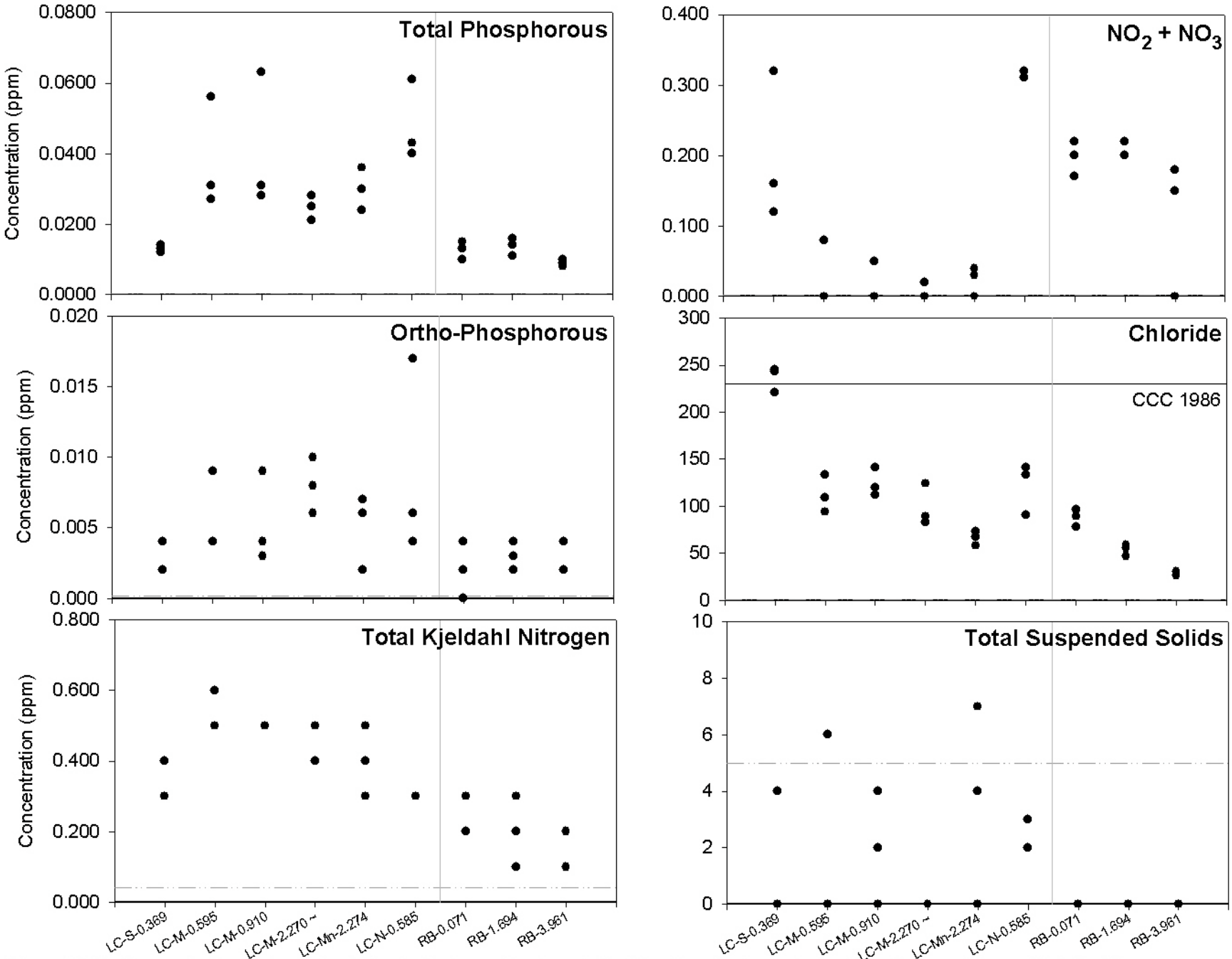


Figure 3.3.6. Concentrations of metals at sites in the Long Creek and Red Brook watersheds during baseflow conditions. Note that the y-axes on these plots are different from those on the storm-event plots. The detection limit for $NO_2 + NO_3$ was assumed to be the same as that for NO_3 alone. Also, values below the detection limit line of total suspended solids are considered approximate values.

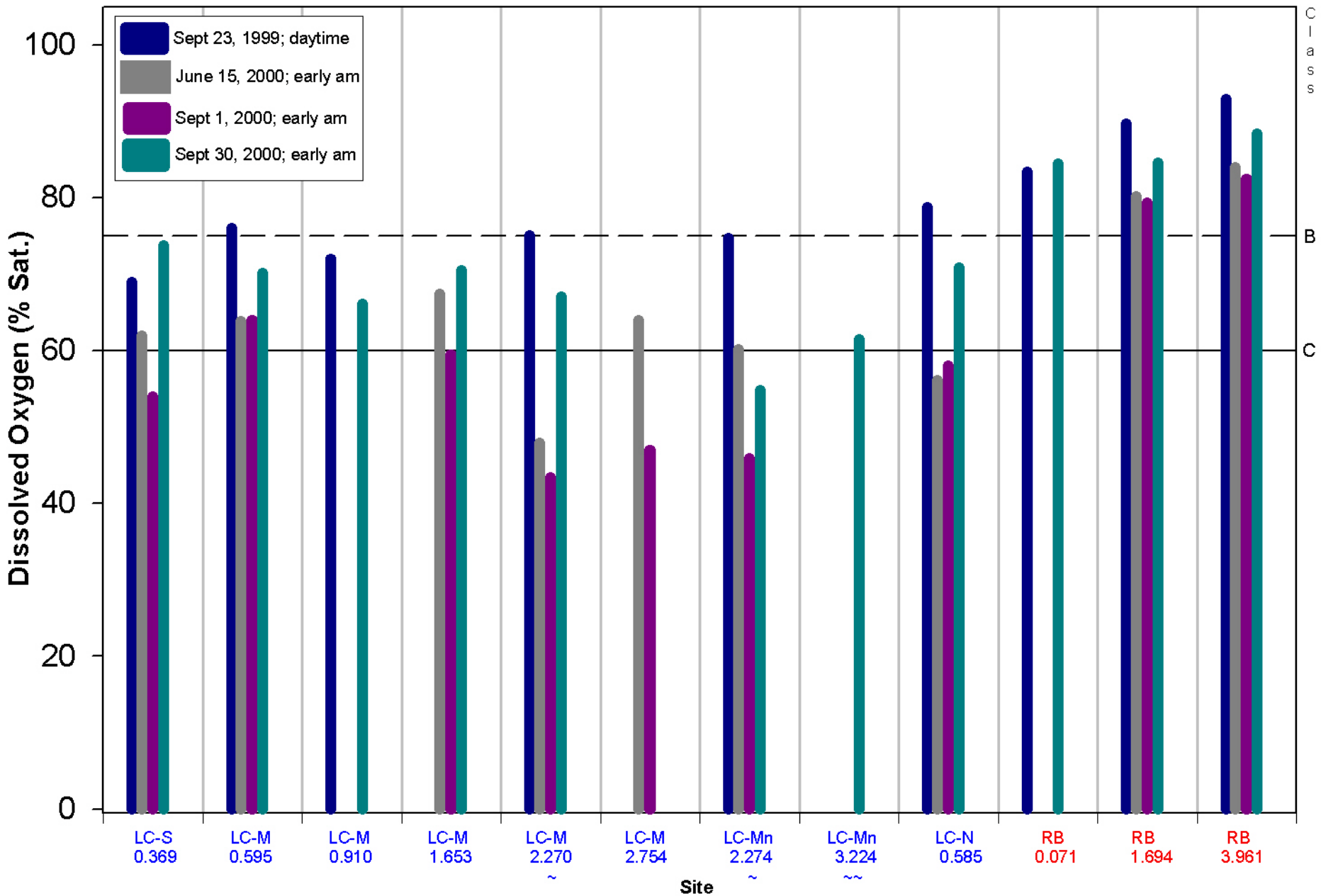


Figure 3.3.7. Percent saturation of dissolved oxygen at study sites in the Long Creek and Red Brook watersheds. Note: (LC-M-0.380) was used as a surrogate for (LC-M-0.595), (LC-N-0.415) was used as a surrogate for (LC-N-0.585), and (RB-1.474) was used as a surrogate for (RB-1.694) during 9/99 sampling.

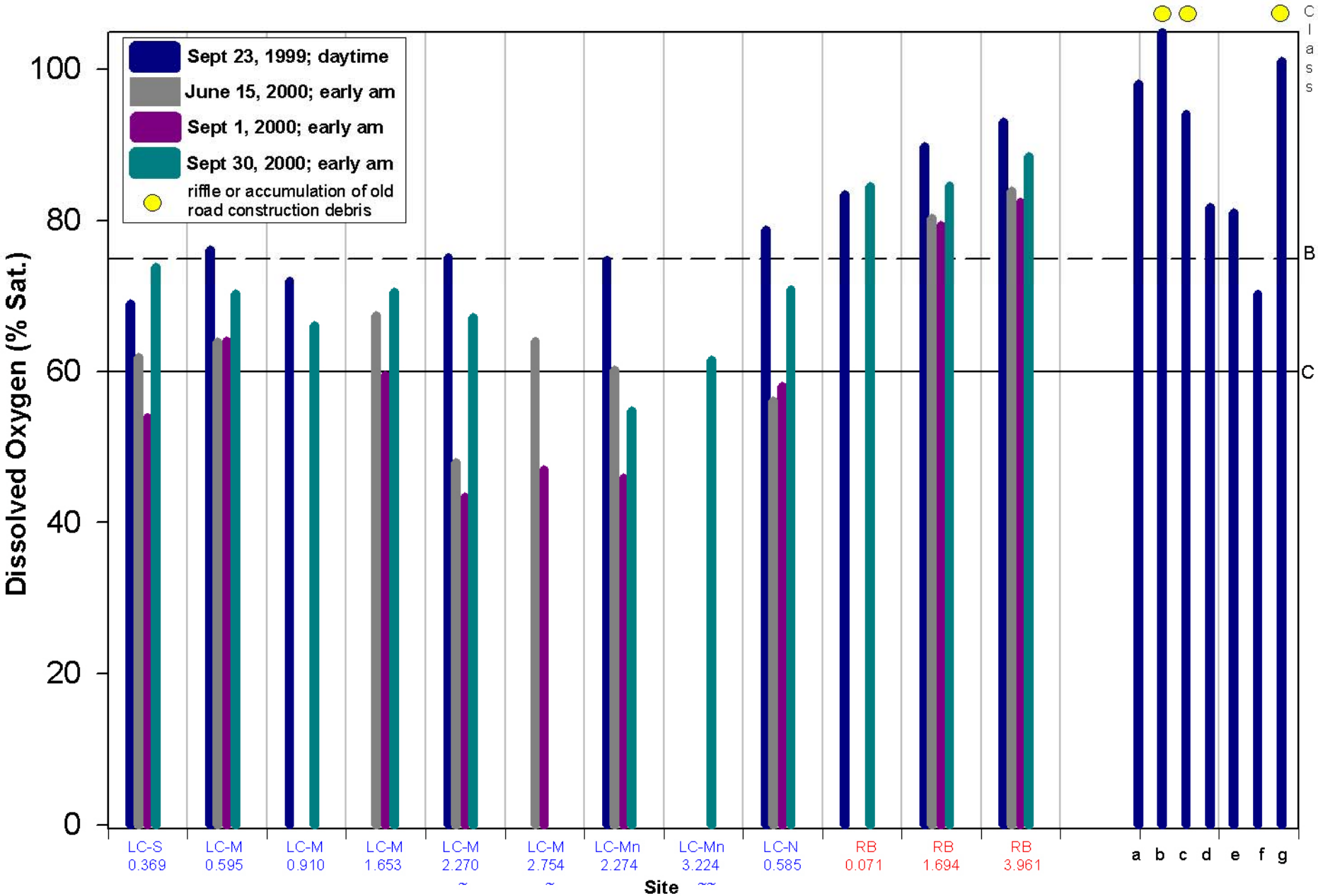


Figure 3.3.8. Percent saturation of dissolved oxygen at study sites, including some riffles, in the Long Creek and Red Brook watersheds. Note: (LC-M-0.380) was used as a surrogate for (LC-M-0.595), (LC-N-0.415) was used as a surrogate for (LC-N-0.585), and (RB-1.474) was used as a surrogate for (RB-1.694) during 9/99 sampling. Riffle sites: a = LC-S- 0.496, b = LC-M- 0.533, c = LC-M- 2.191~, d = LC-S- 0.016, e = LC-Mw- 2.896, f = LC-N- 0.850~~, and g = RB-1.500~~.

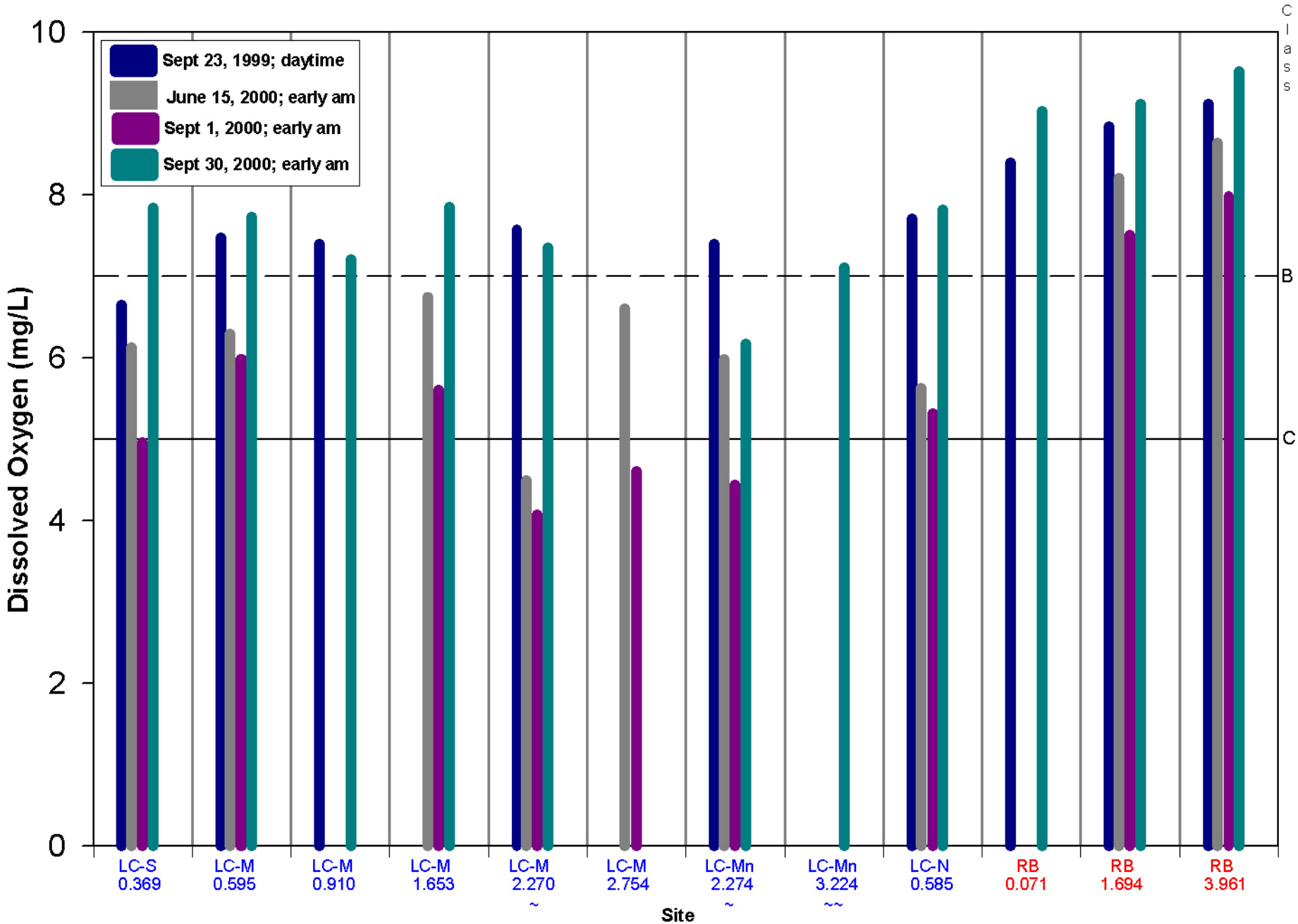


Figure 3.3.9. Concentration of dissolved oxygen at study sites in the Long Creek and Red Brook watersheds. Note: (LC-M-0.380) was used as a surrogate for (LC-M-0.595), (LC-N-0.415) was used as a surrogate for (LC-N-0.585), and (RB-1.474) was used as a surrogate for (RB-1.694) during 9/99 sampling.

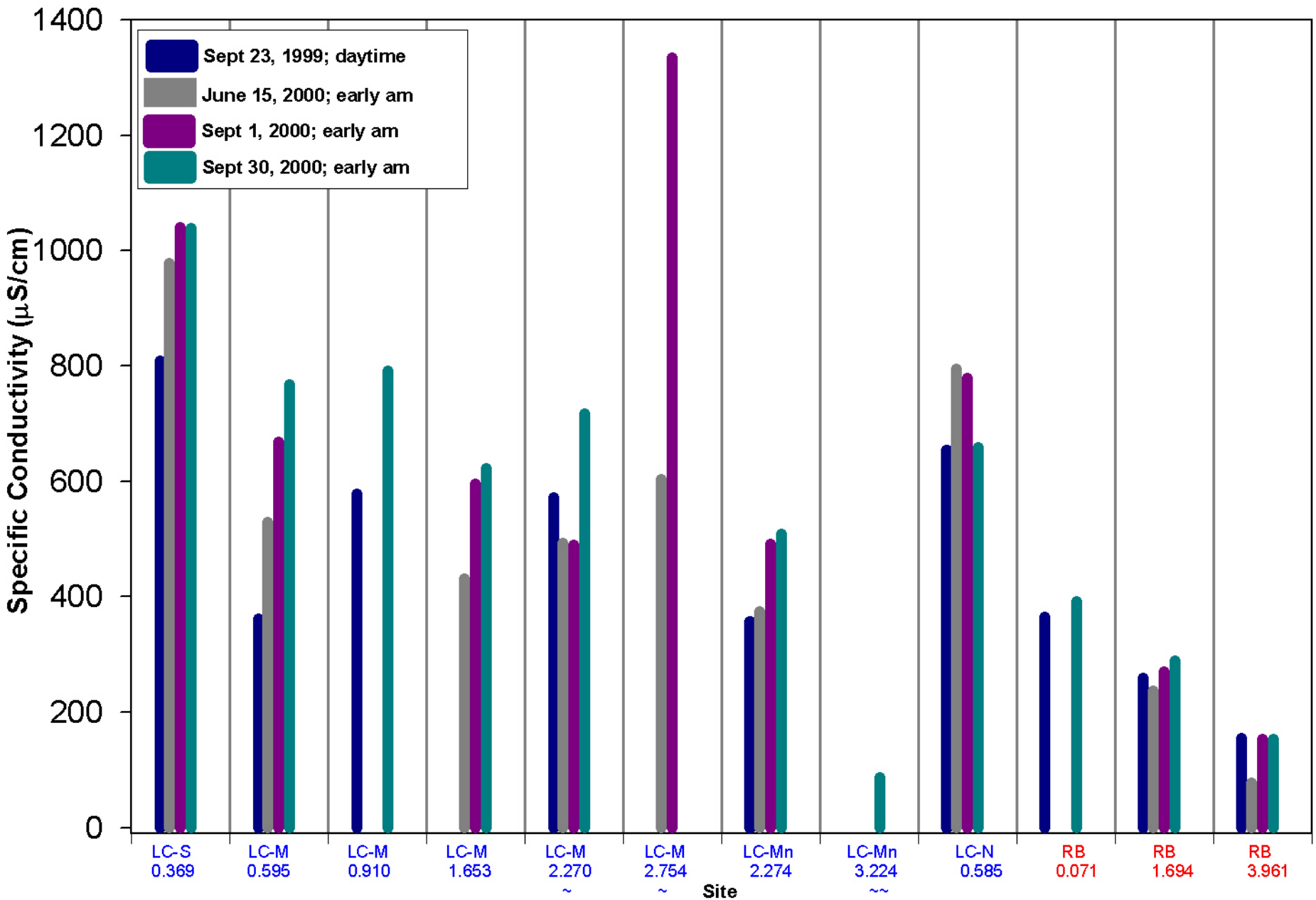


Figure 3.3.10. Specific conductivity at study sites in the Long Creek and Red Brook watersheds. Note: (LC-M-0.380) was used as a surrogate for (LC-M-0.595), (LC-N-0.415) was used as a surrogate for (LC-N-0.585), and (RB-1.474) was used as a surrogate for (RB-1.694) during 9/99 sampling.

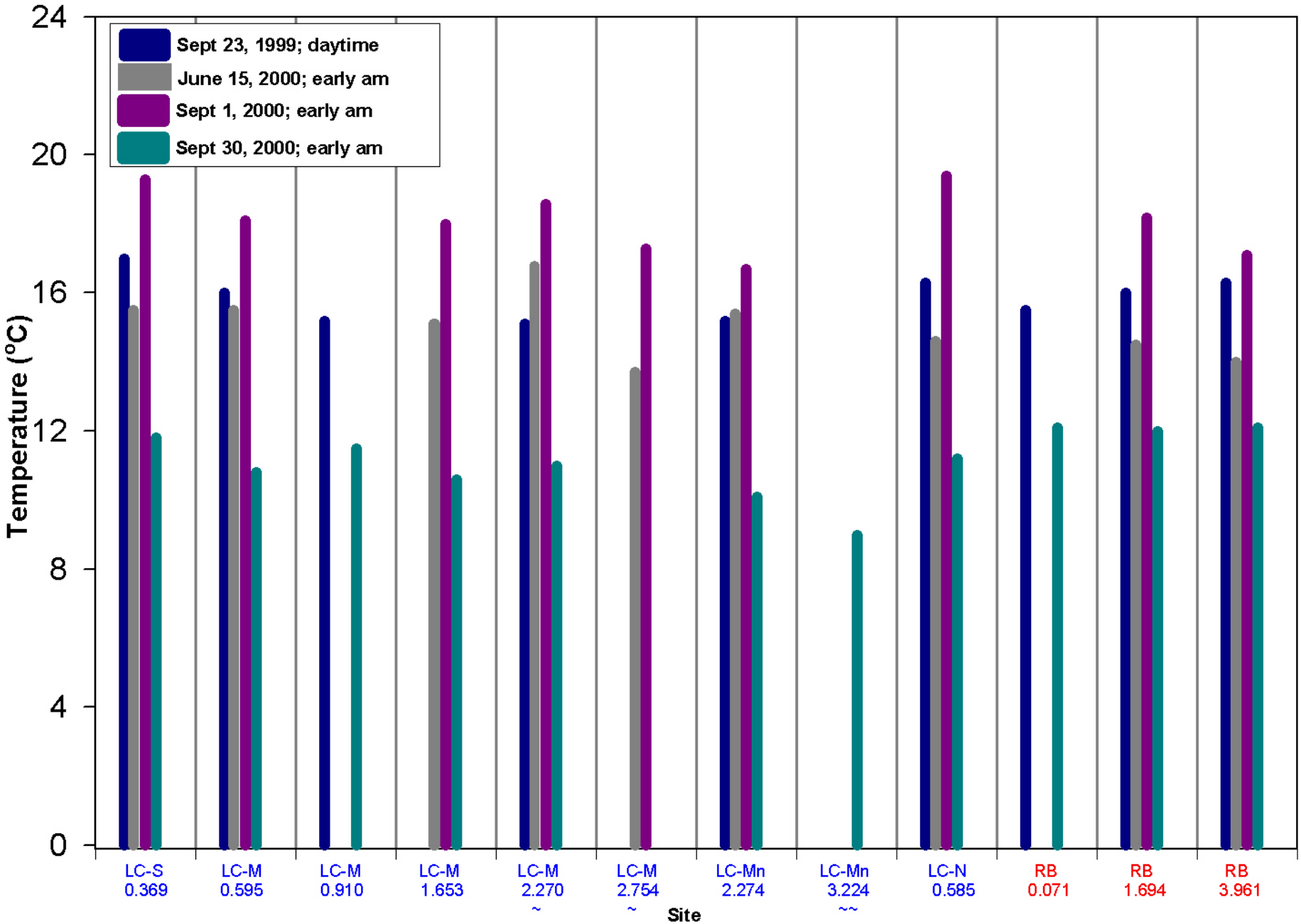


Figure 3.3.11. Water temperature at study sites in the Long Creek and Red Brook watersheds. Note: (LC-M-0.380) was used as a surrogate for (LC-M-0.595), (LC-N-0.415) was used as a surrogate for (LC-N-0.585), and (RB-1.474) was used as a surrogate for (RB-1.694) during 9/99 sampling.

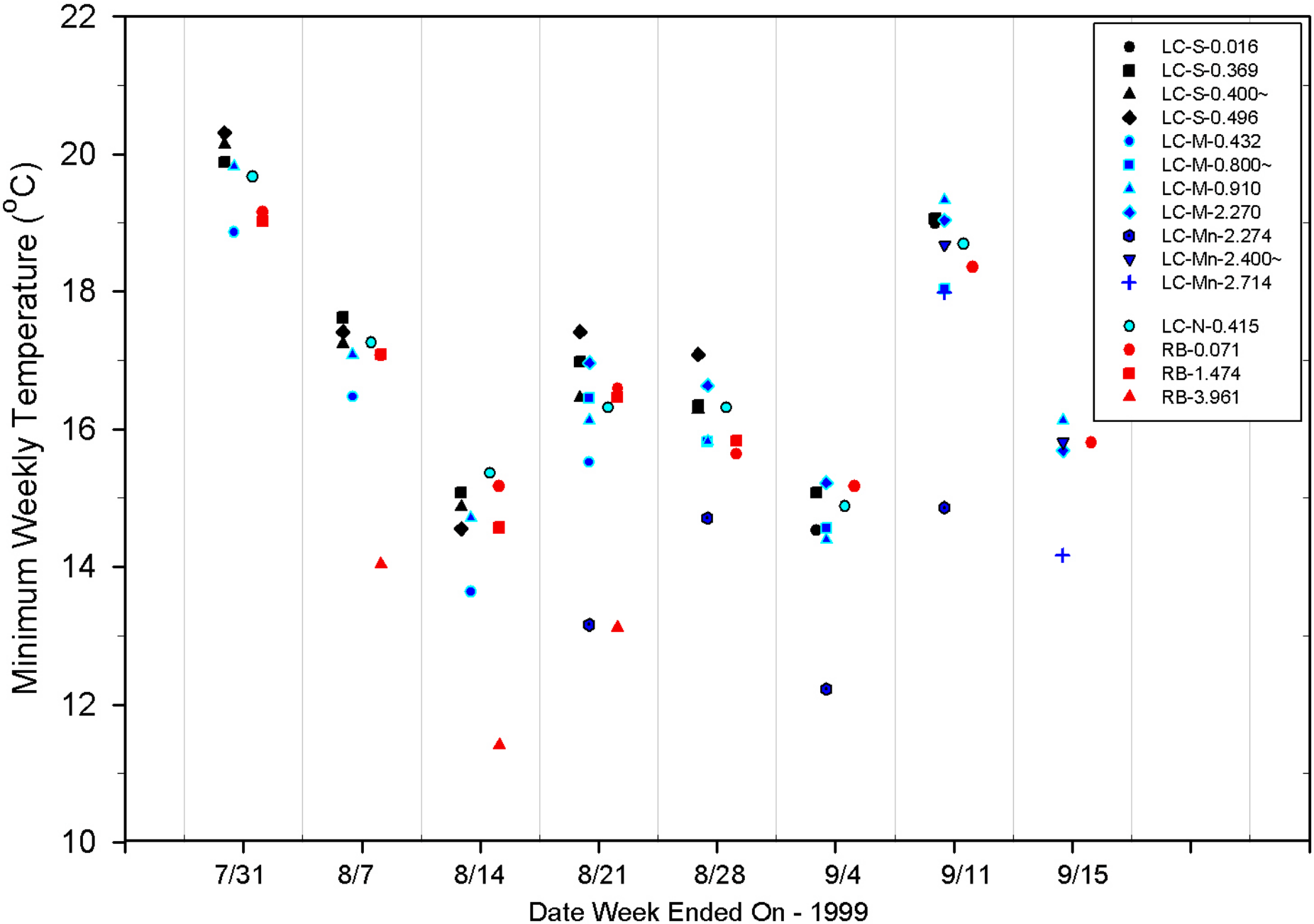


Figure 3.4.1. Minimum weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Please note that, in the legend, the space between LC-Mn-2.714 and LC-N-0.415 is an artifact of the software program and nothing else.

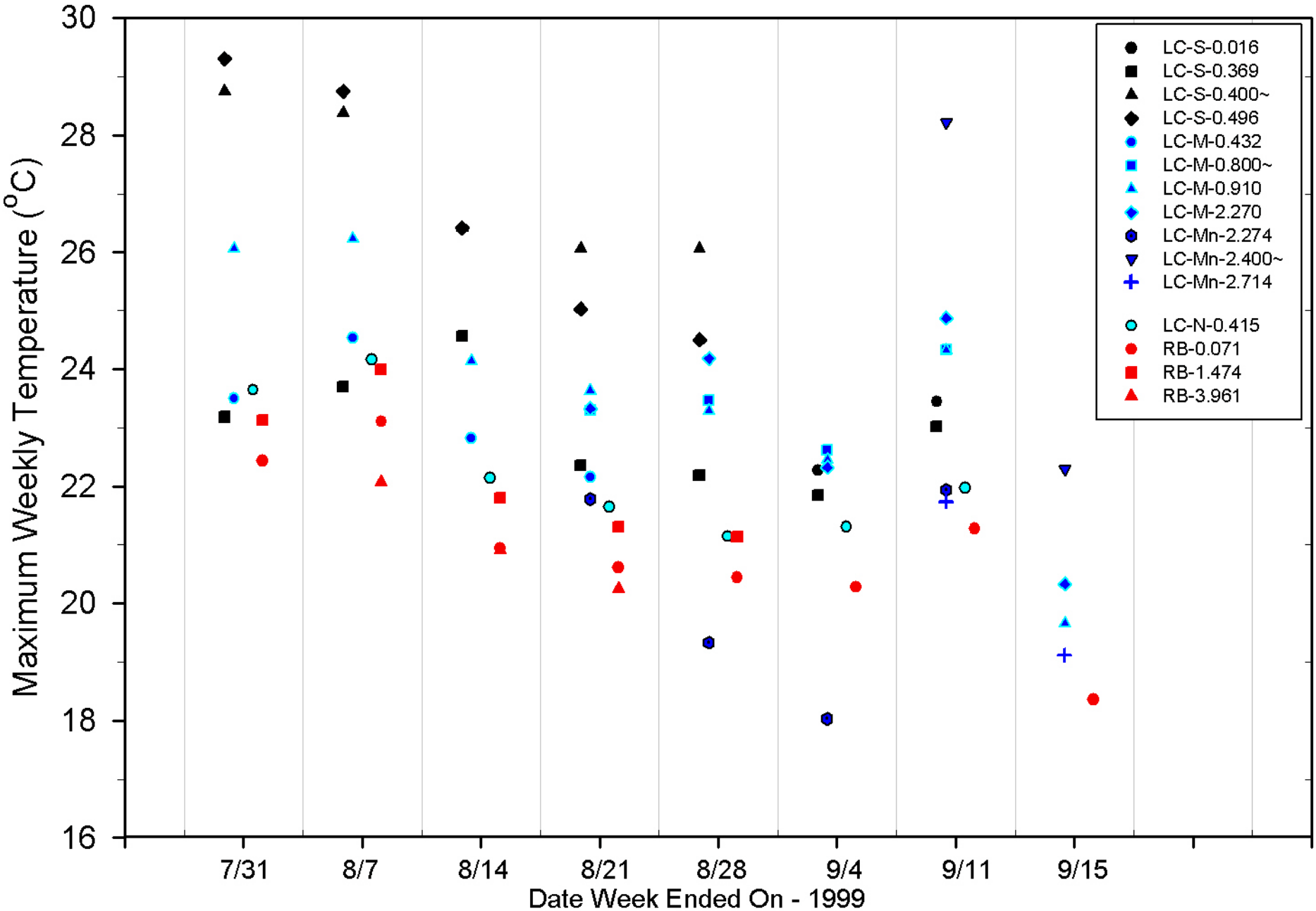


Figure 3.4.2. Maximum weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Please note that, in the legend, the space between LC-Mn-2.714 and LC-N-0.415 is an artifact of the software program and nothing else.

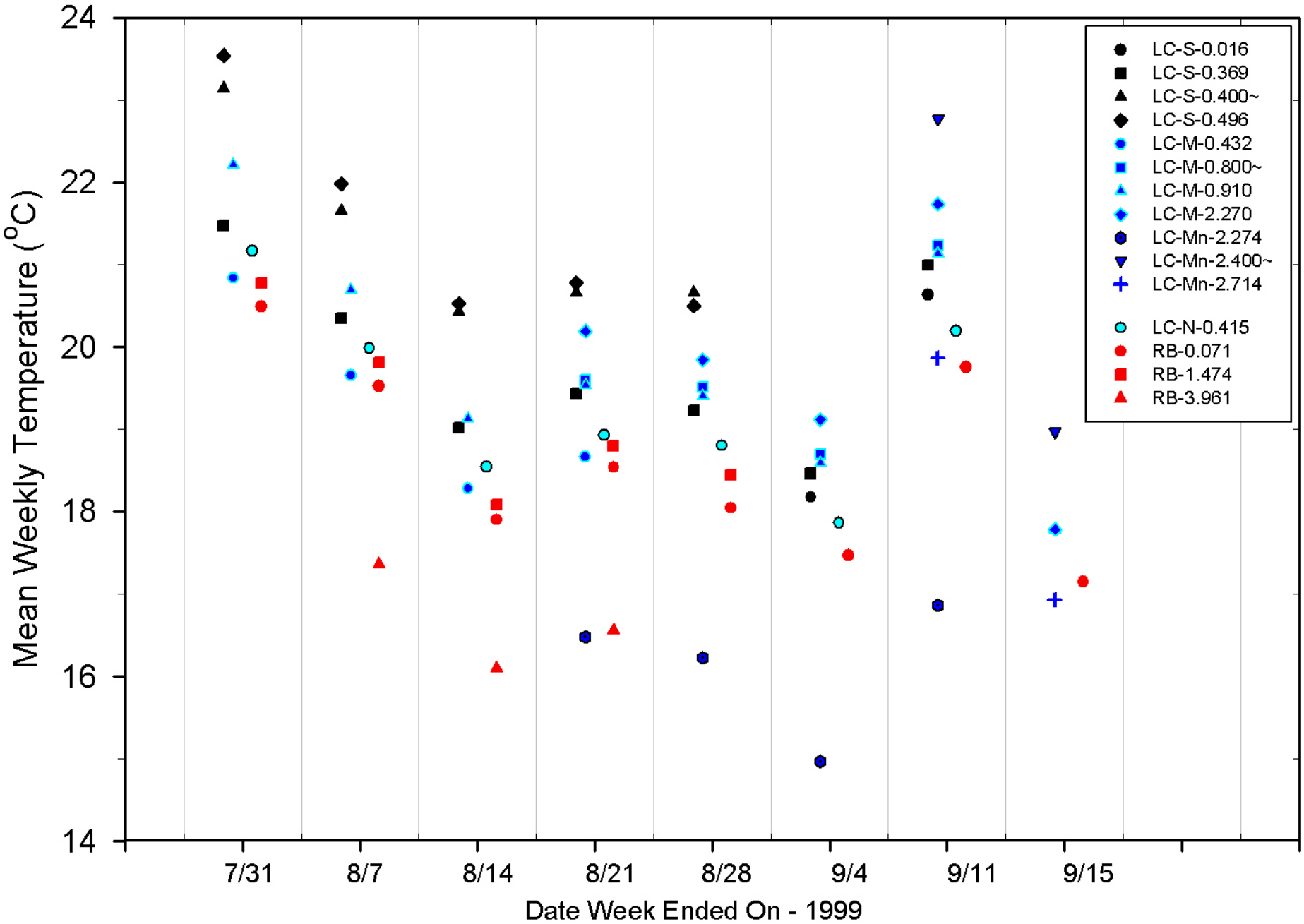


Figure 3.4.3. Mean weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Please note that, in the legend, the space between LC-Mn-2.714 and LC-N-0.415 is an artifact of the software program and nothing else.

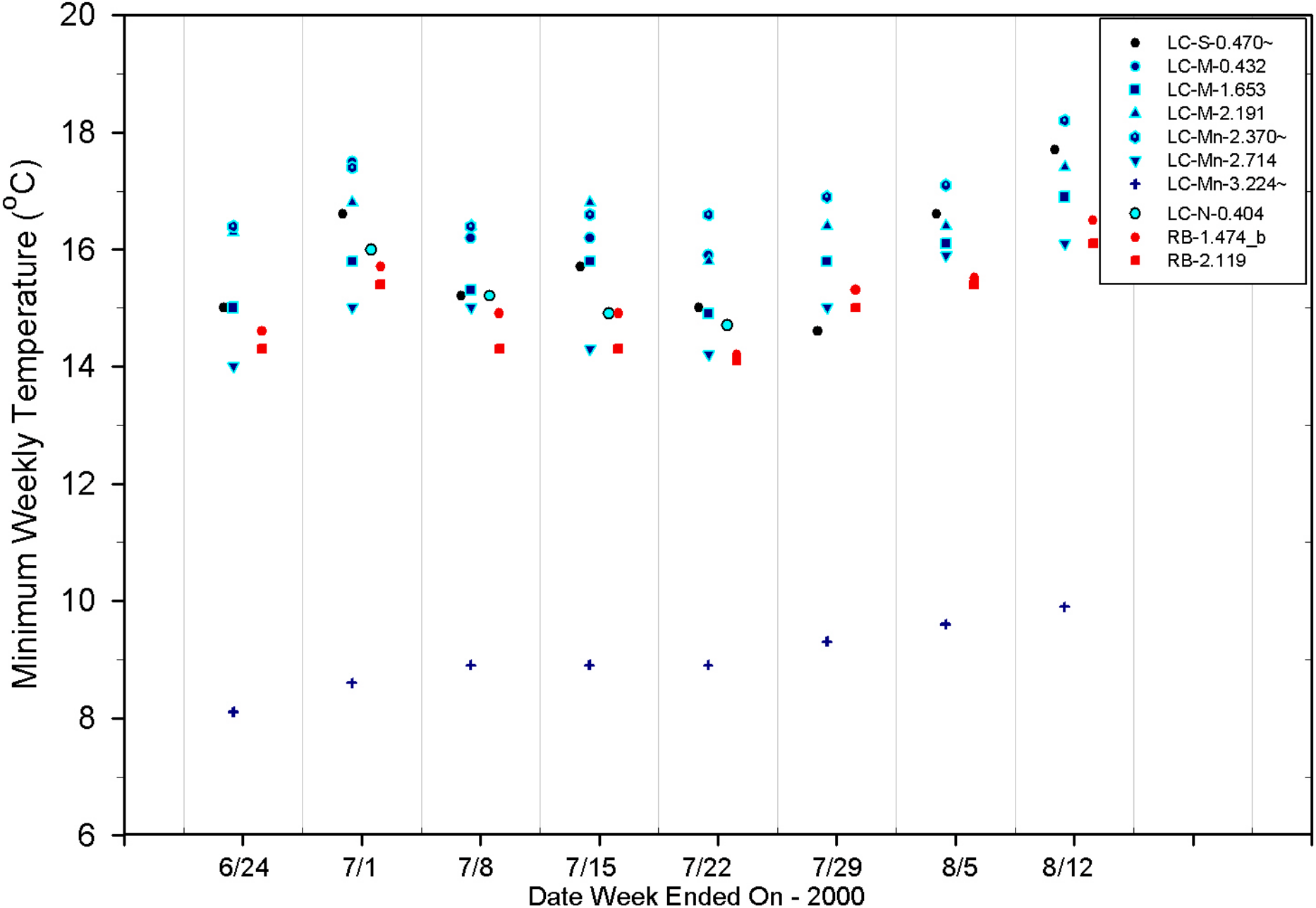


Figure 3.4.4. Minimum weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Note that symbols in this figure for 2000 do not exactly match those used in the 1999 minimum temperature figure.

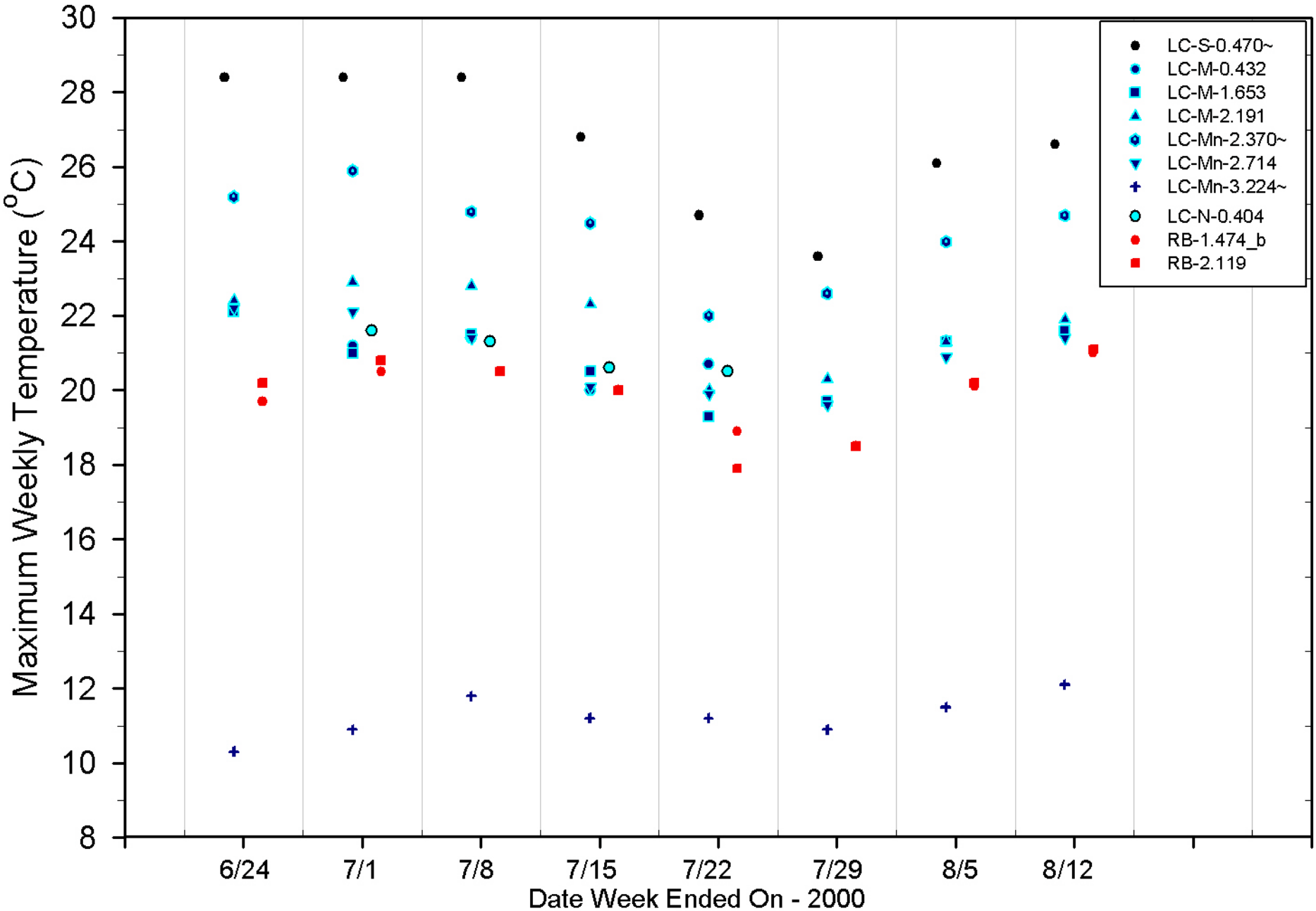


Figure 3.4.5. Maximum weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Note that symbols in this figure for 2000 do not exactly match those used in the 1999 maximum temperature figure.

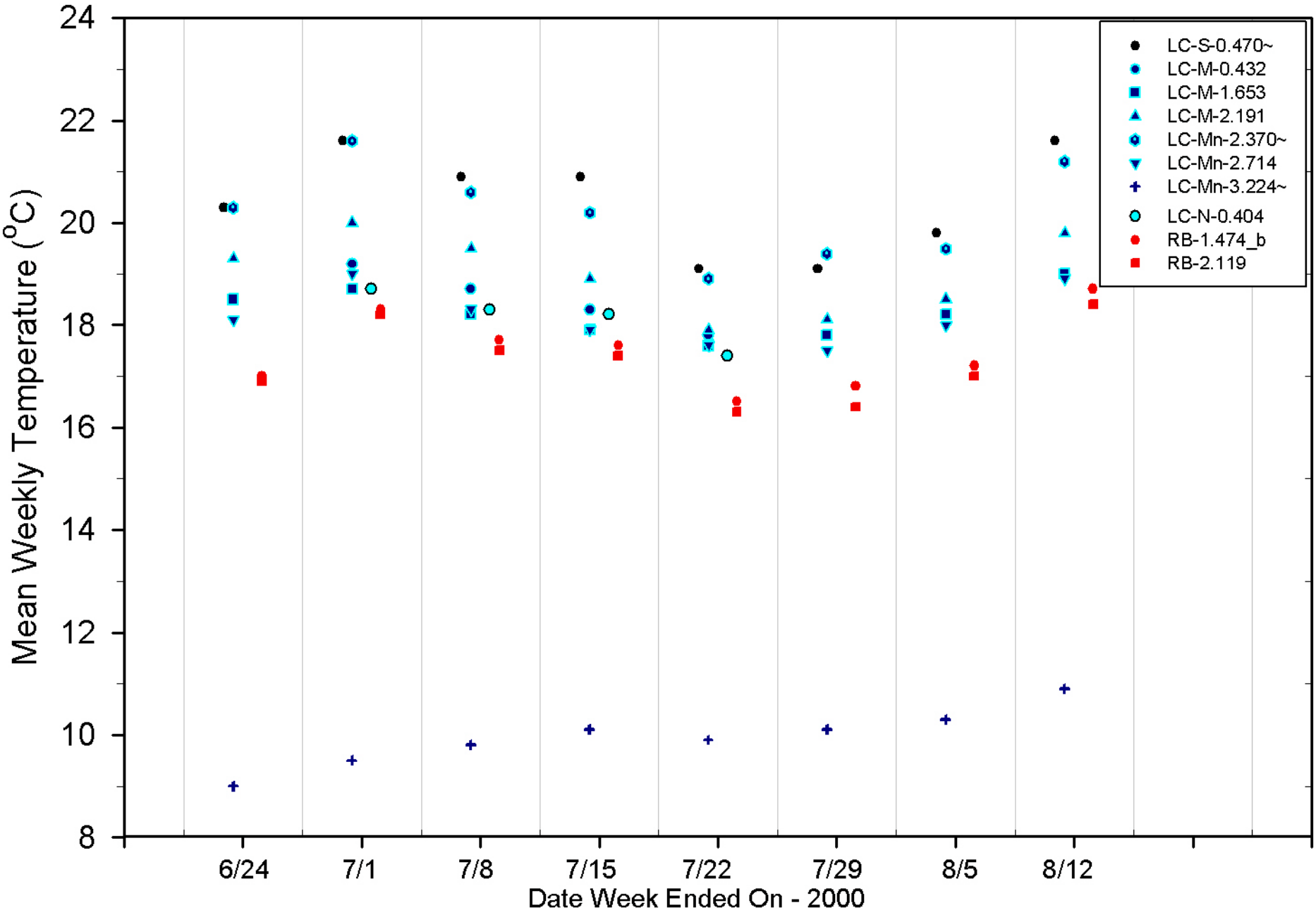


Figure 3.4.6. Mean weekly temperatures at various sites throughout the Long Creek and Red Brook watersheds. Note that symbols in this figure for 2000 do not exactly match those used in the 1999 mean temperature figure.

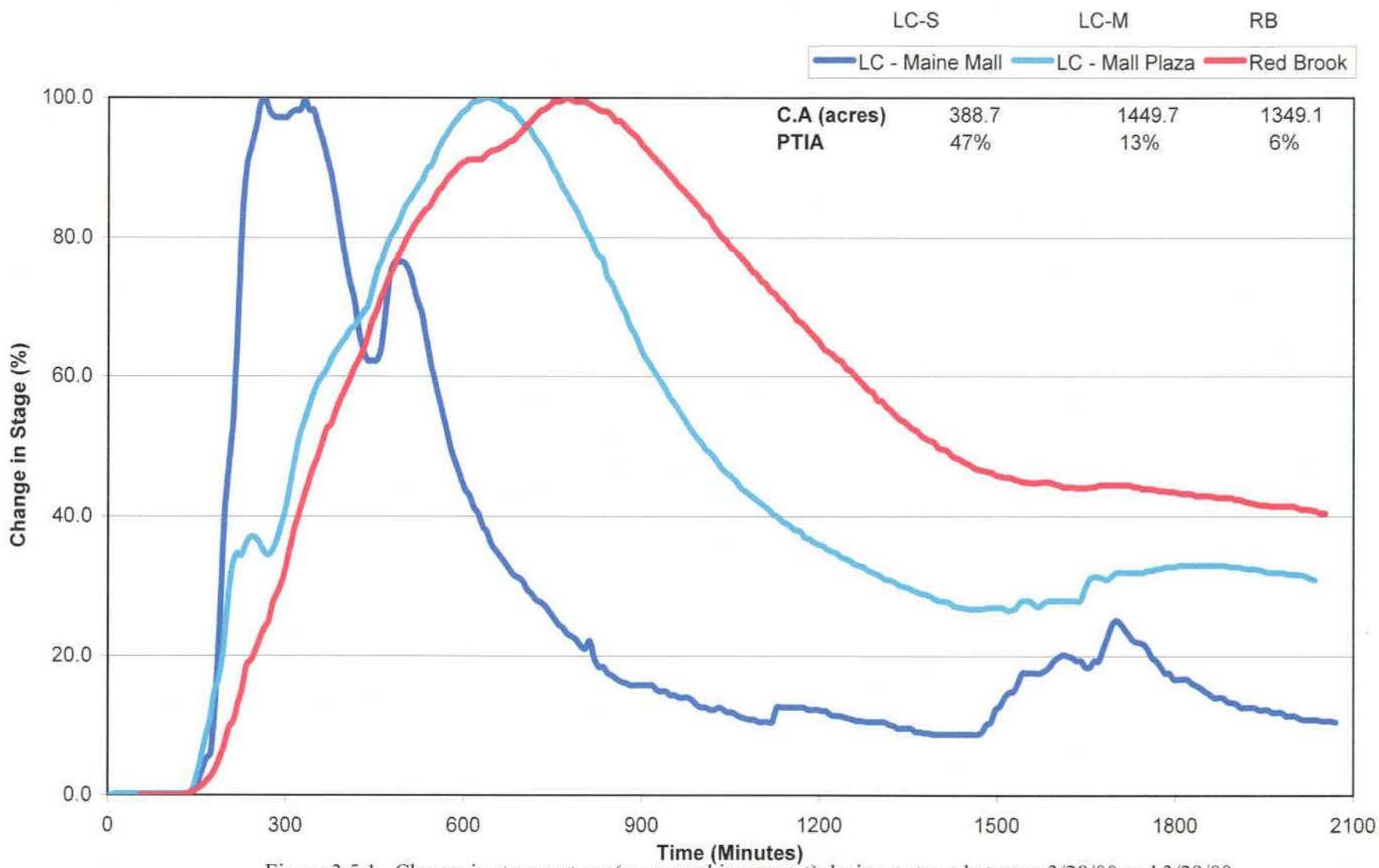
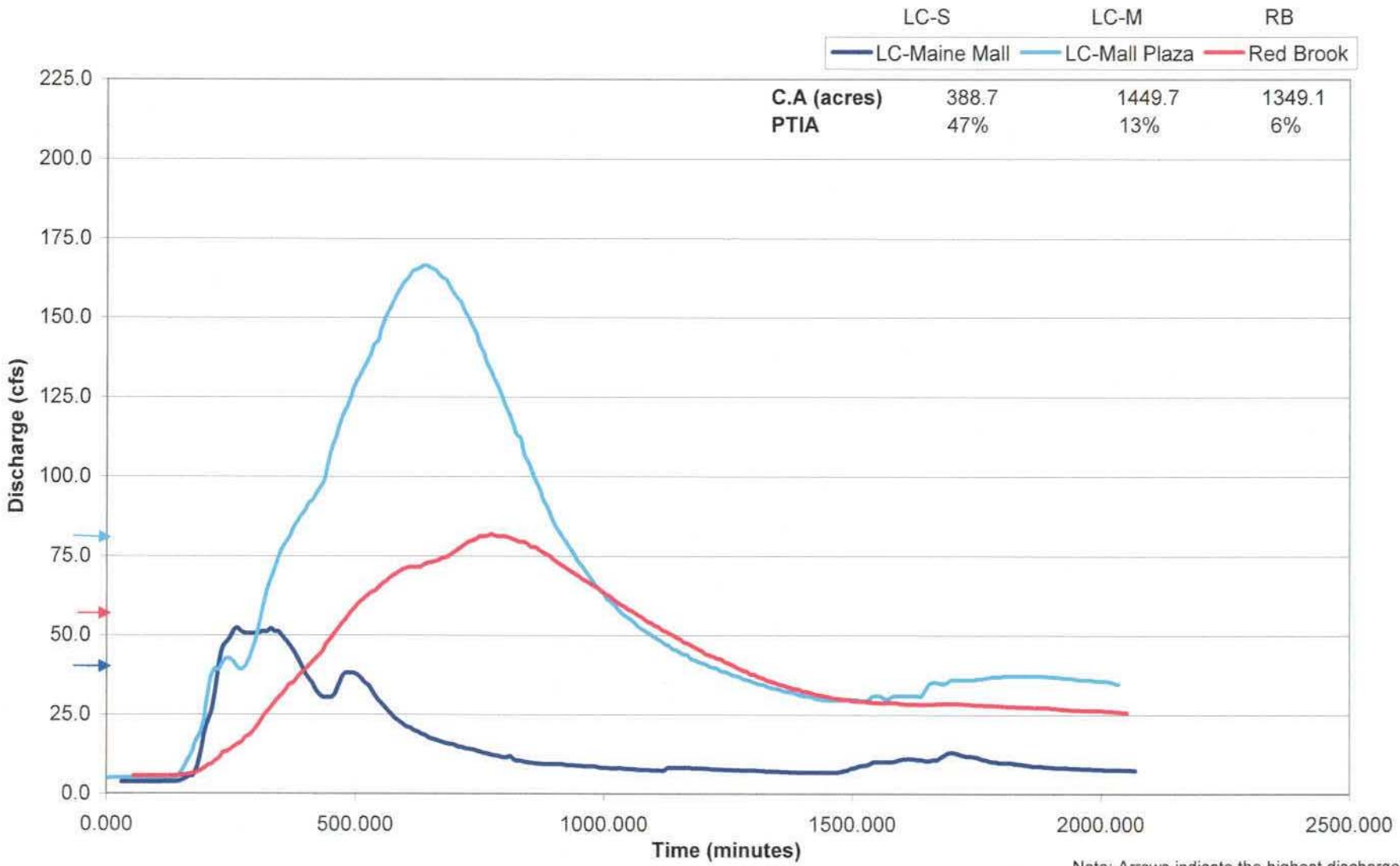


Figure 3.5.1. Change in stream stage (expressed in percent) during a storm between 3/28/00 and 3/29/00. C.A. = catchment area in acres and PTIA = percent total impervious area.



Note: Arrows indicate the highest discharge measured during ISCO meter calibrations.

Figure 3.5.2. Change in discharge during a storm between 3/28/00 and 3/29/00. C.A. = catchment area in acres and PTIA = percent total impervious area.

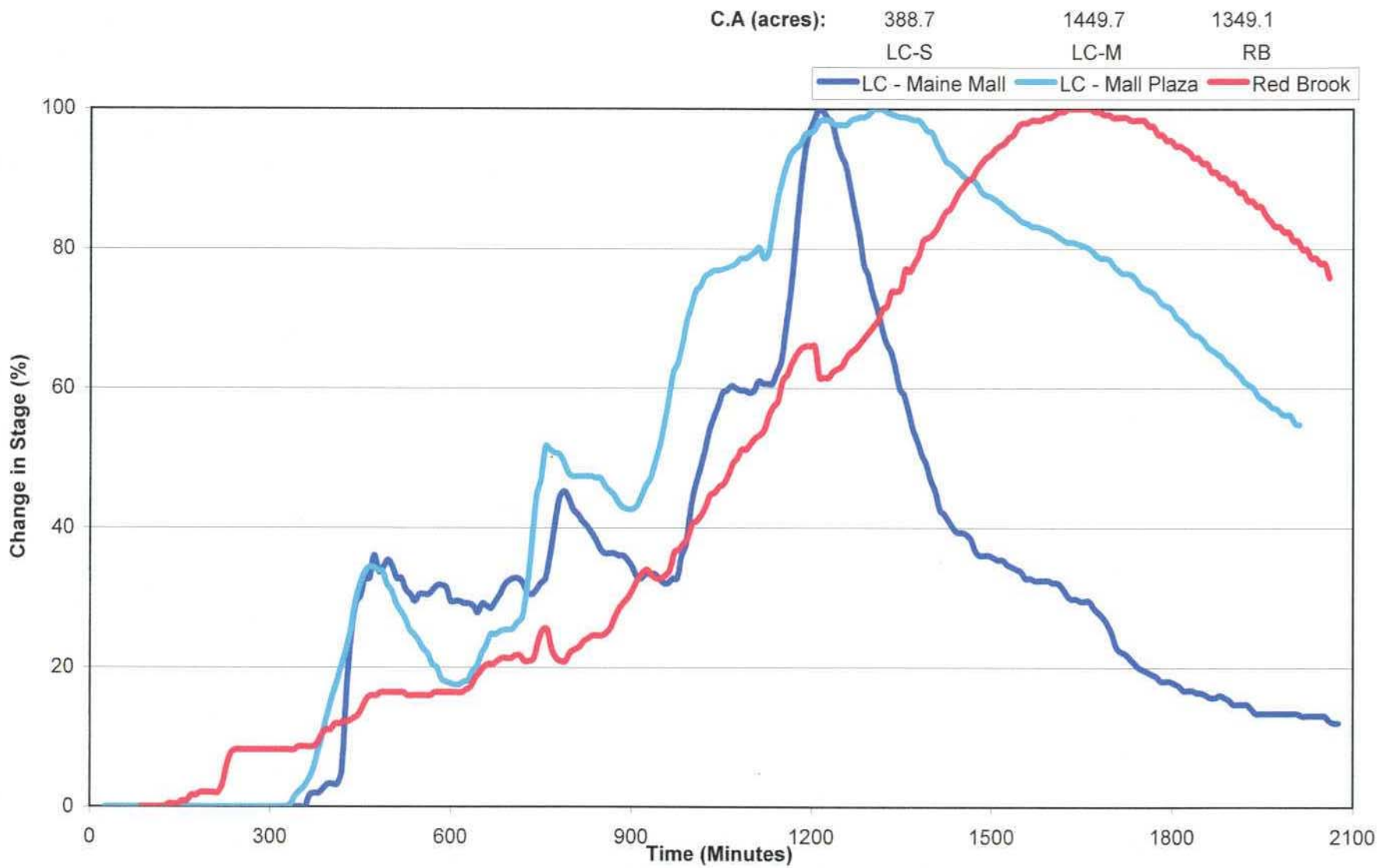
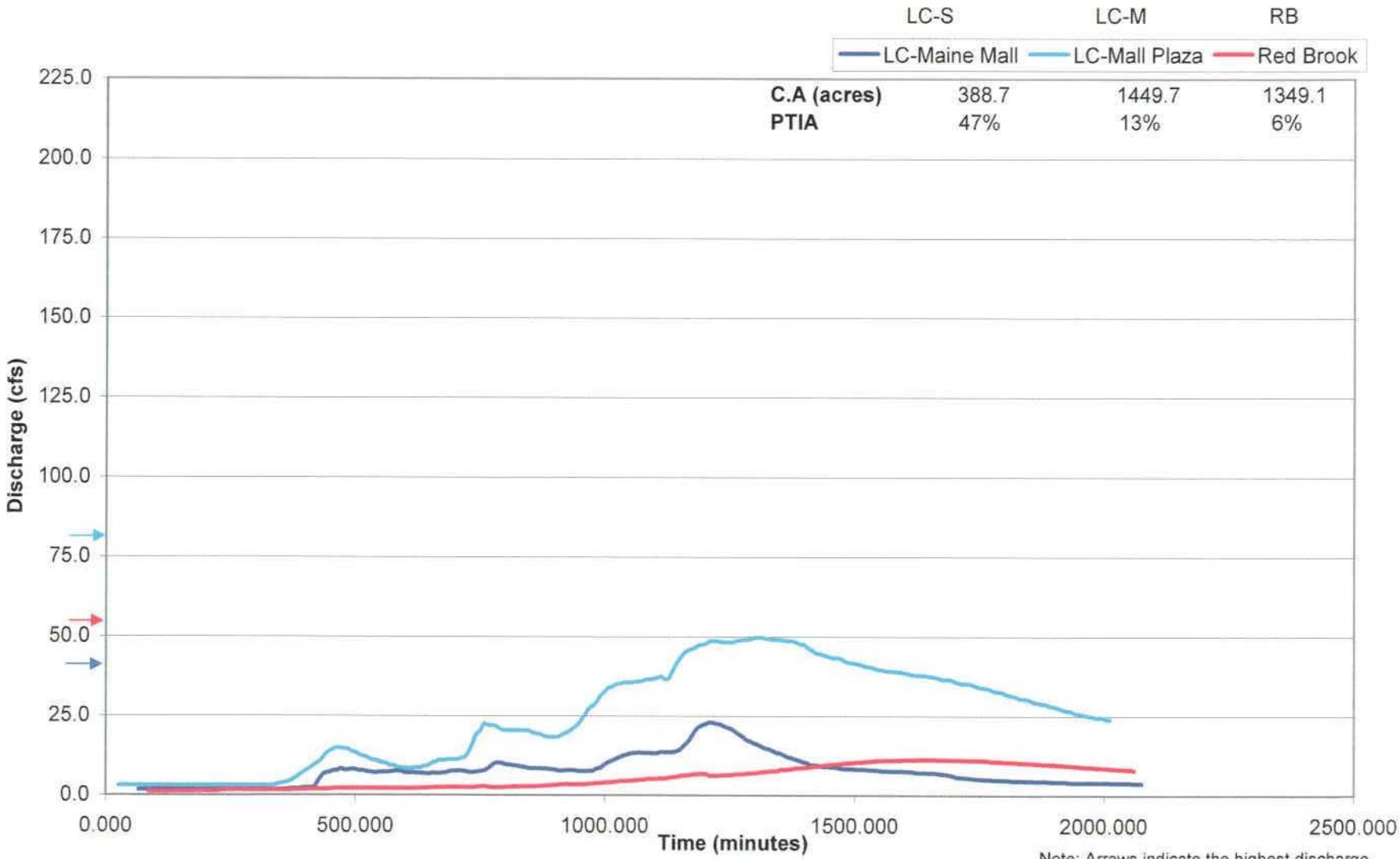
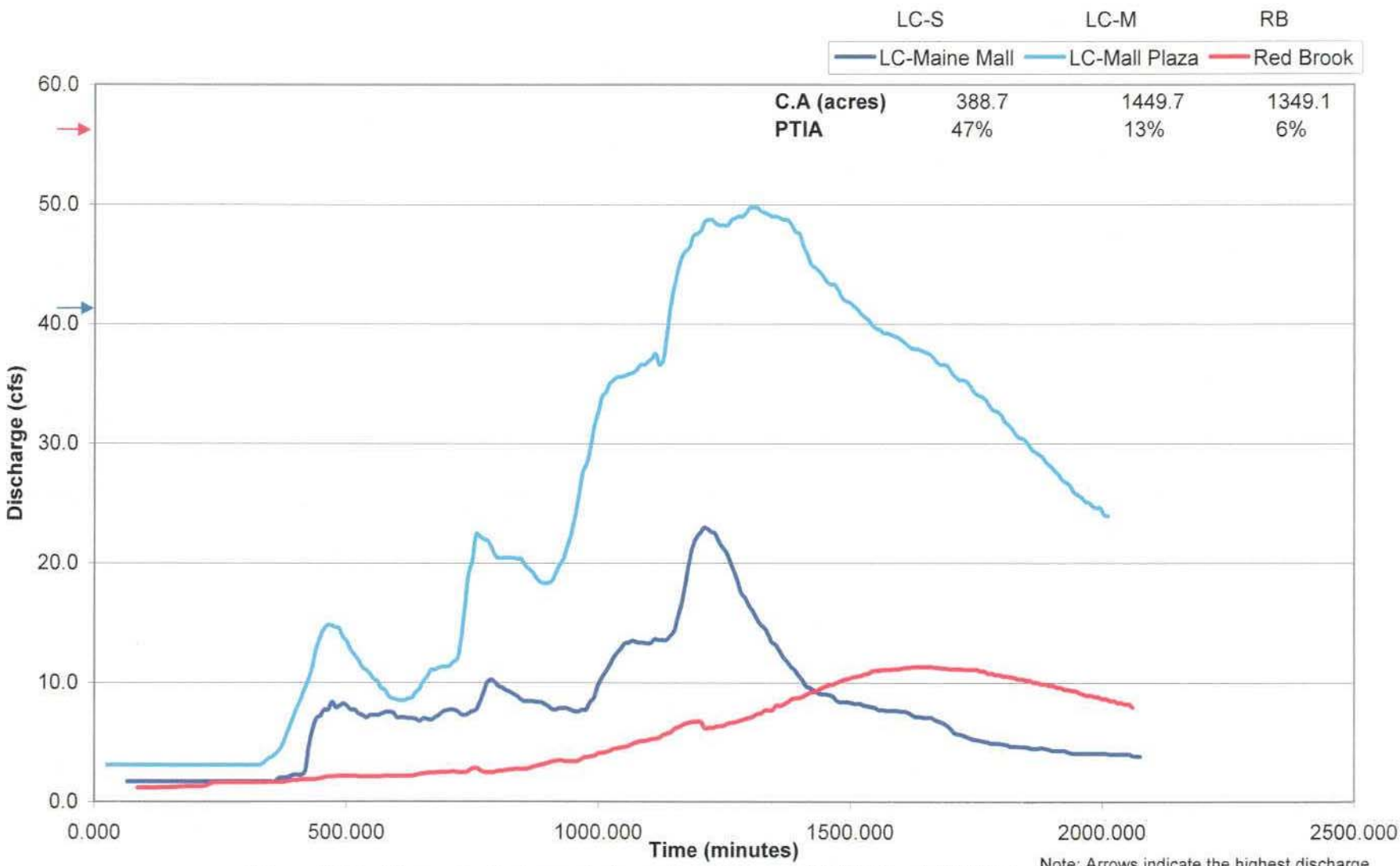


Figure 3.5.3. Change in stream stage (expressed in percent) during a storm between 10/18/00 and 10/19/00. C.A. = catchment area in acres and PTIA = percent total impervious area.



Note: Arrows indicate the highest discharge measured during ISCO meter calibrations.

Figure 3.5.4. Change in discharge during a storm between 10/18/00 and 10/19/00. C.A. = catchment area in acres and PTIA = percent total impervious area.



Note: Arrows indicate the highest discharge measured during ISCO meter calibrations.

Figure 3.5.5. Change in discharge during a storm between 10/18/00 and 10/19/00. C.A. = catchment area in acres and PTIA = percent total impervious area.

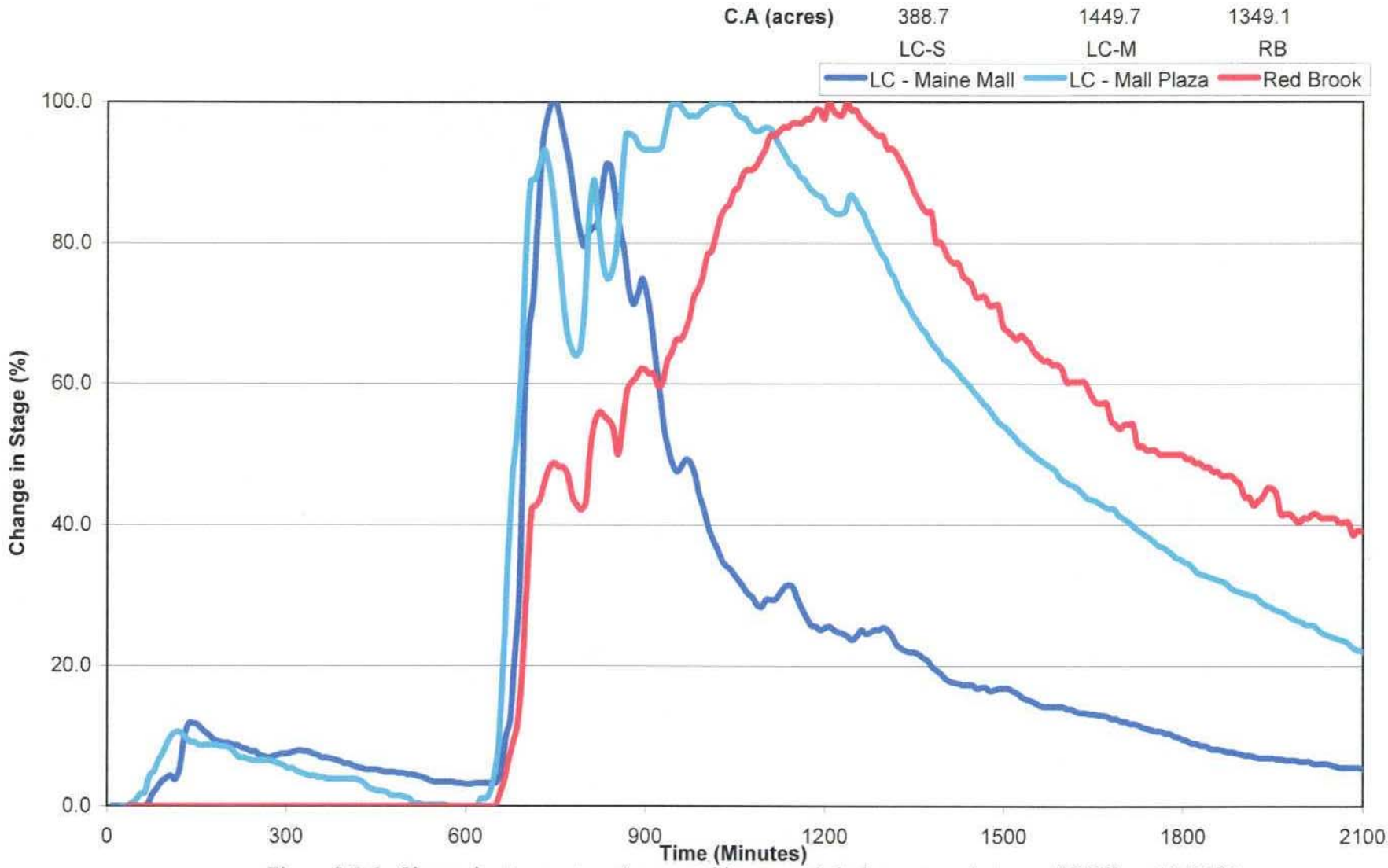


Figure 3.5.6. Change in stream stage (expressed in percent) during a storm between 9/25/01 and 9/26/01. C.A. = catchment area in acres and PTIA = percent total impervious area.

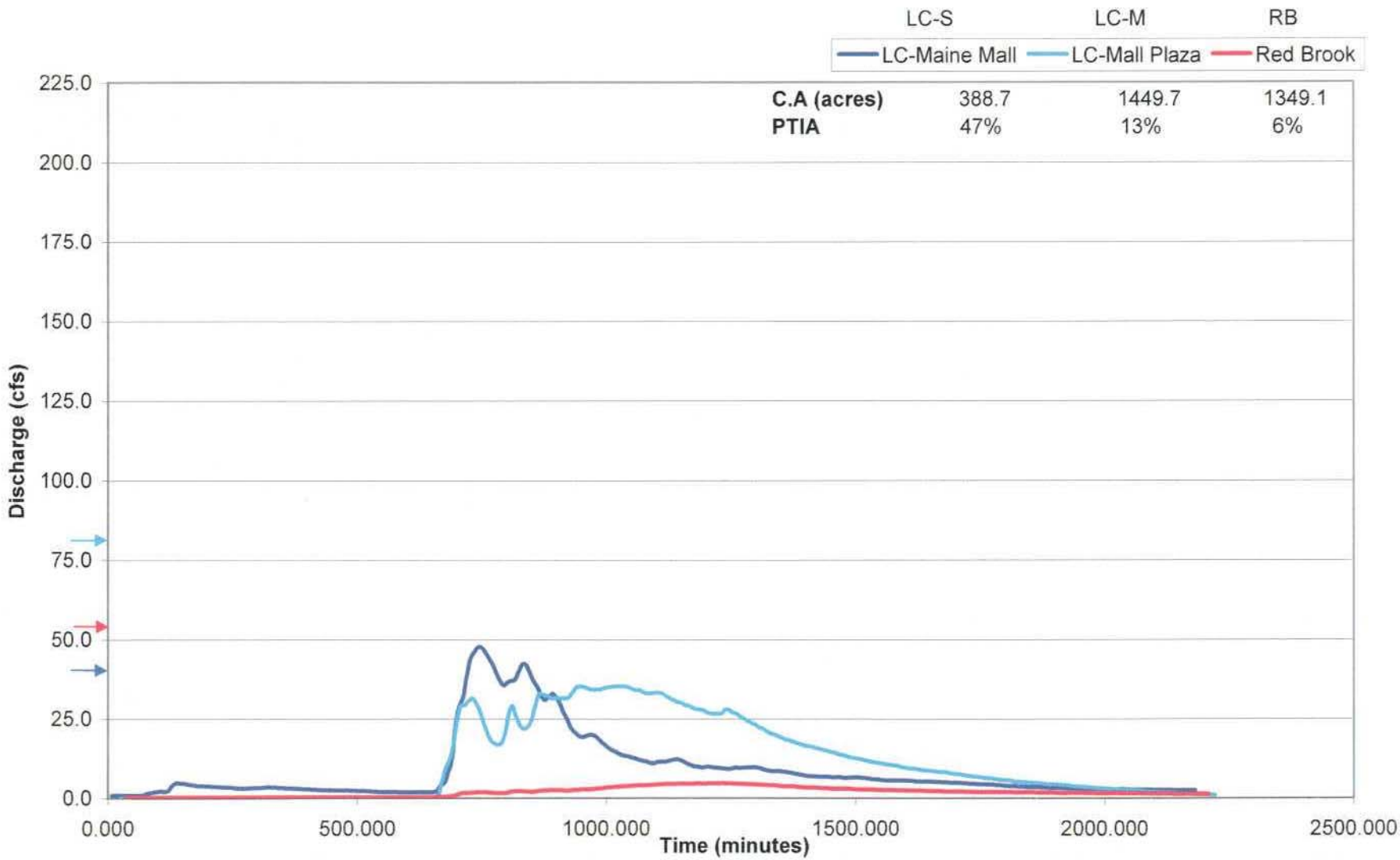


Figure 3.5.7. Change in discharge during a storm between 9/25/01 and 9/26/01. C.A. = catchment area in acres and PTIA = percent total impervious area.

Note: Arrows indicate the highest discharge measured during ISCO meter calibrations.

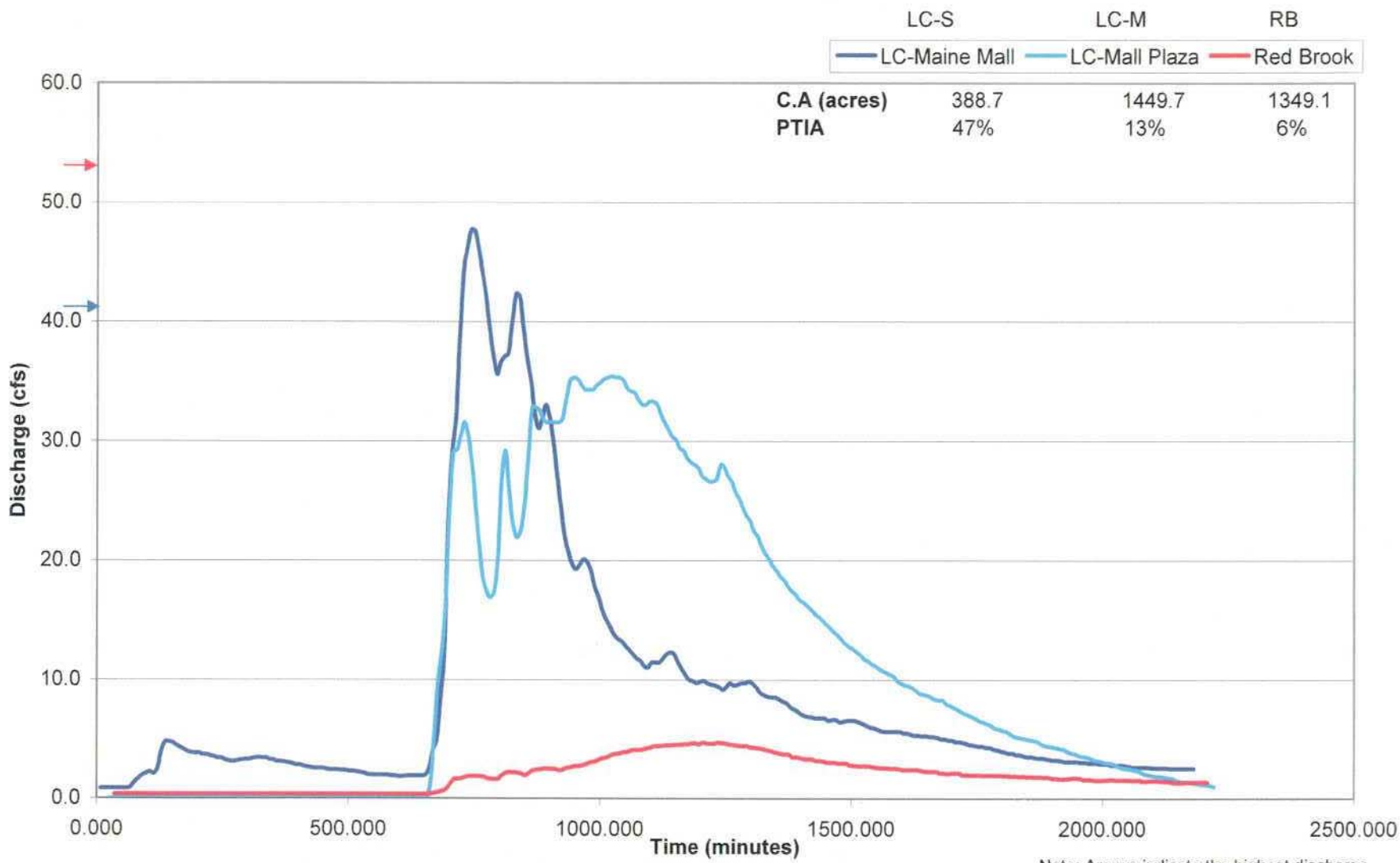


Figure 3.5.8. Change in discharge during a storm between 9/25/01 and 9/26/01. C.A. = catchment area in acres and PTIA = percent total impervious area.

Note: Arrows indicate the highest discharge measured during ISCO meter calibrations.

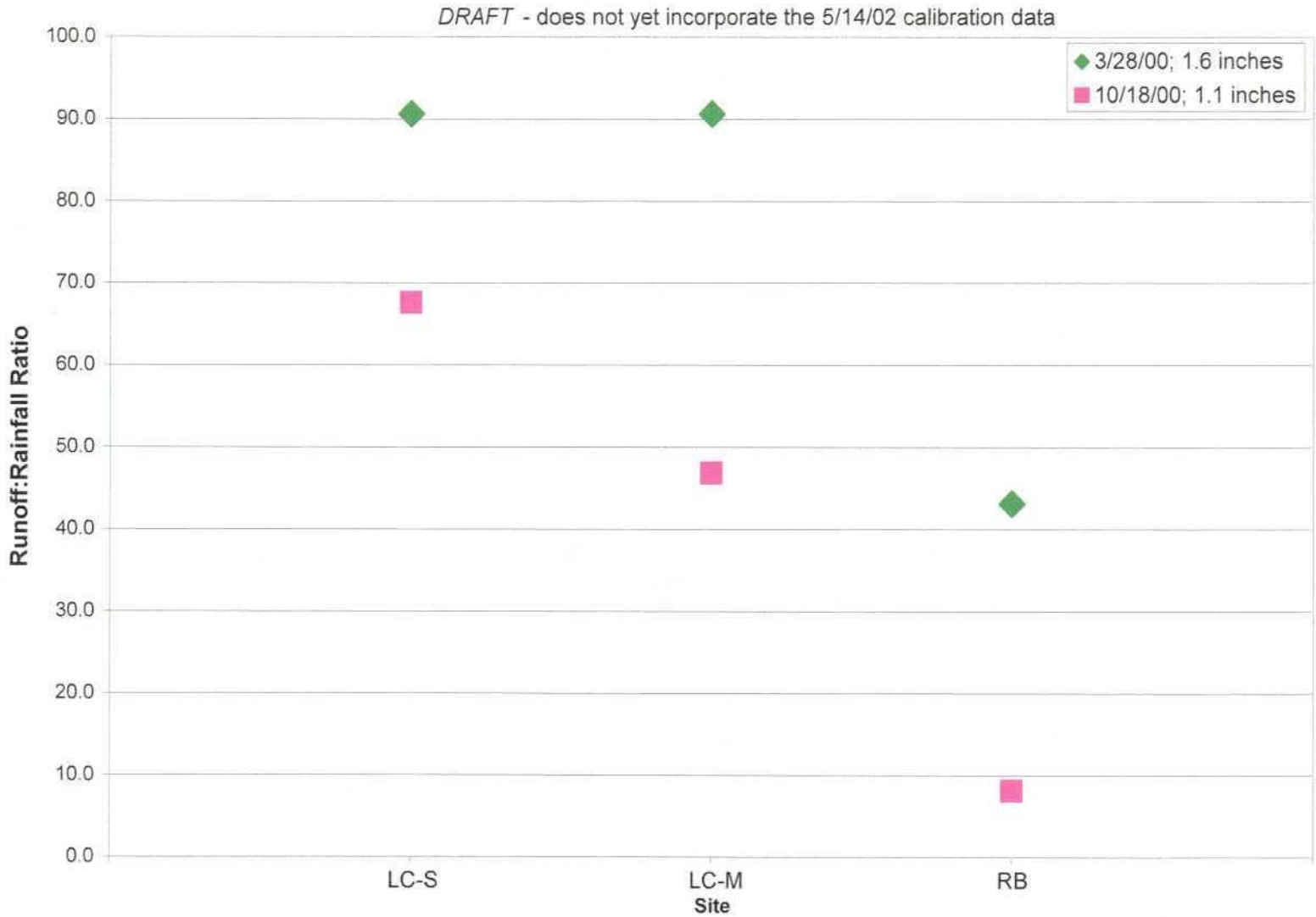


Figure 3.5.9. The ratios of runoff volume to total rainfall volume (corrected for each stations watershed size) at storm discharge monitoring stations in the study watersheds.

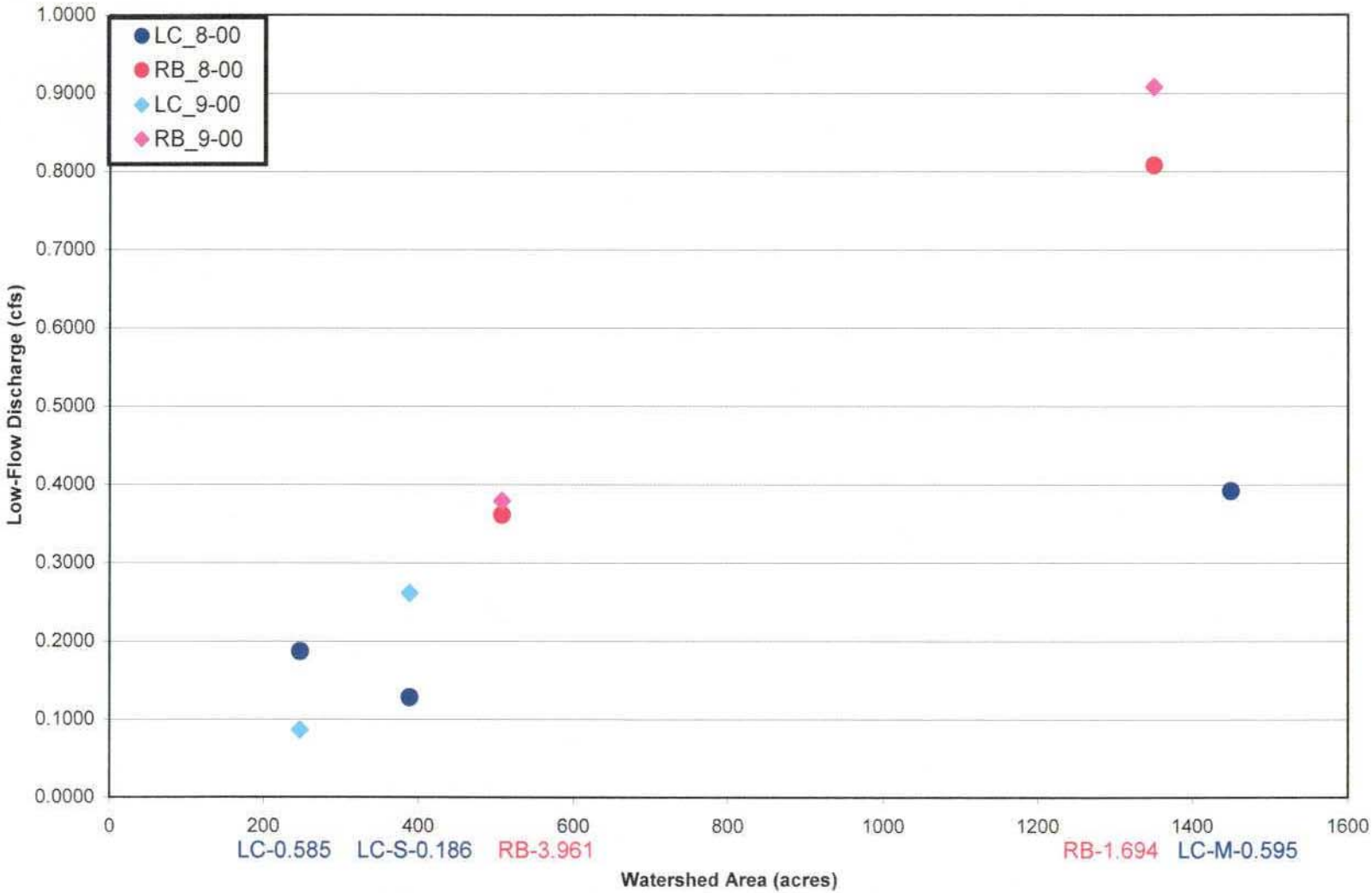


Figure 3.5.10. Low-flow discharge versus watershed area for discharge monitoring sites in the study watersheds.

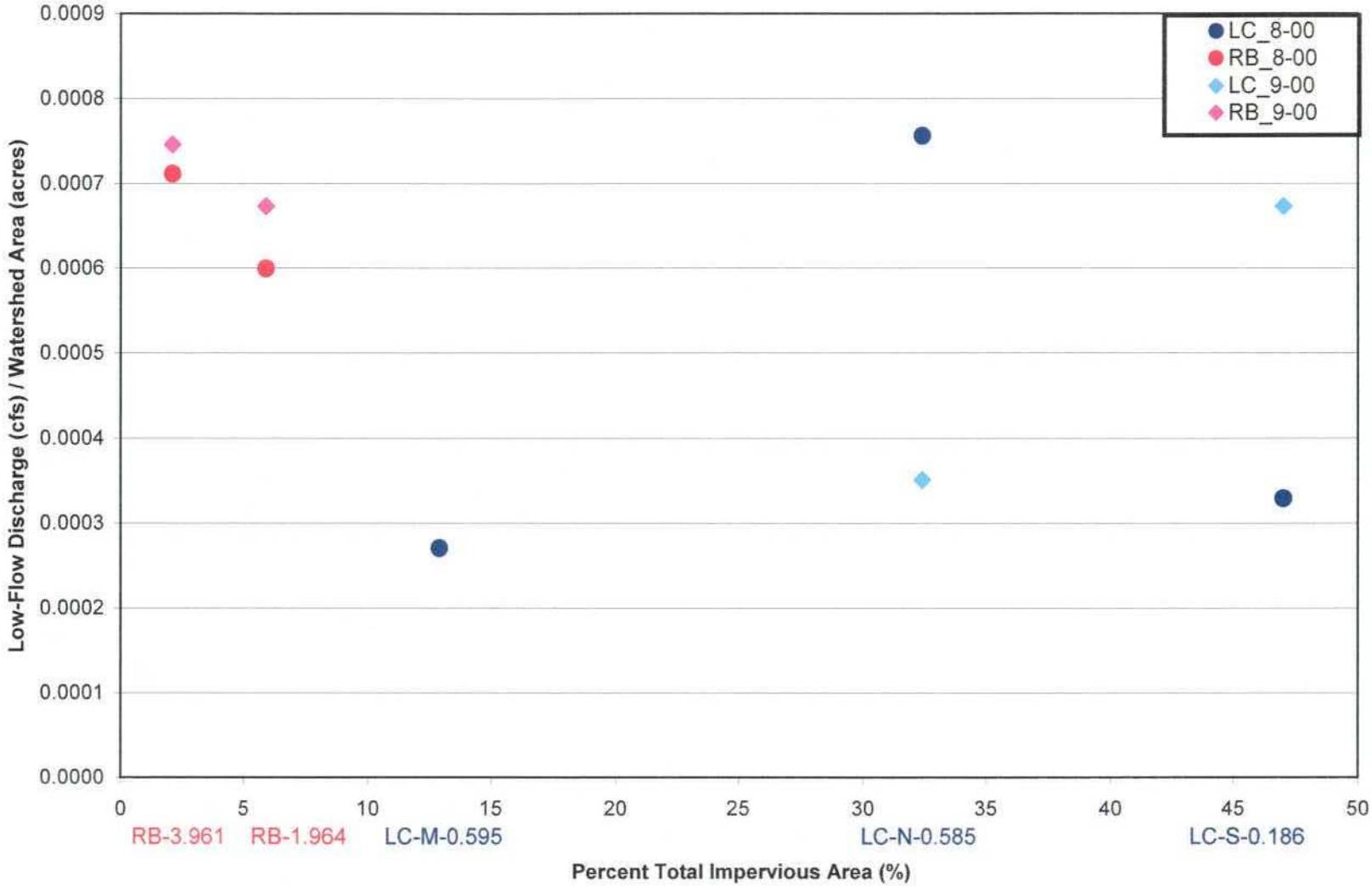


Figure 3.5.11. Low-flow discharge : watershed area ratios versus percent total impervious area for discharge monitoring sites in the study watersheds.

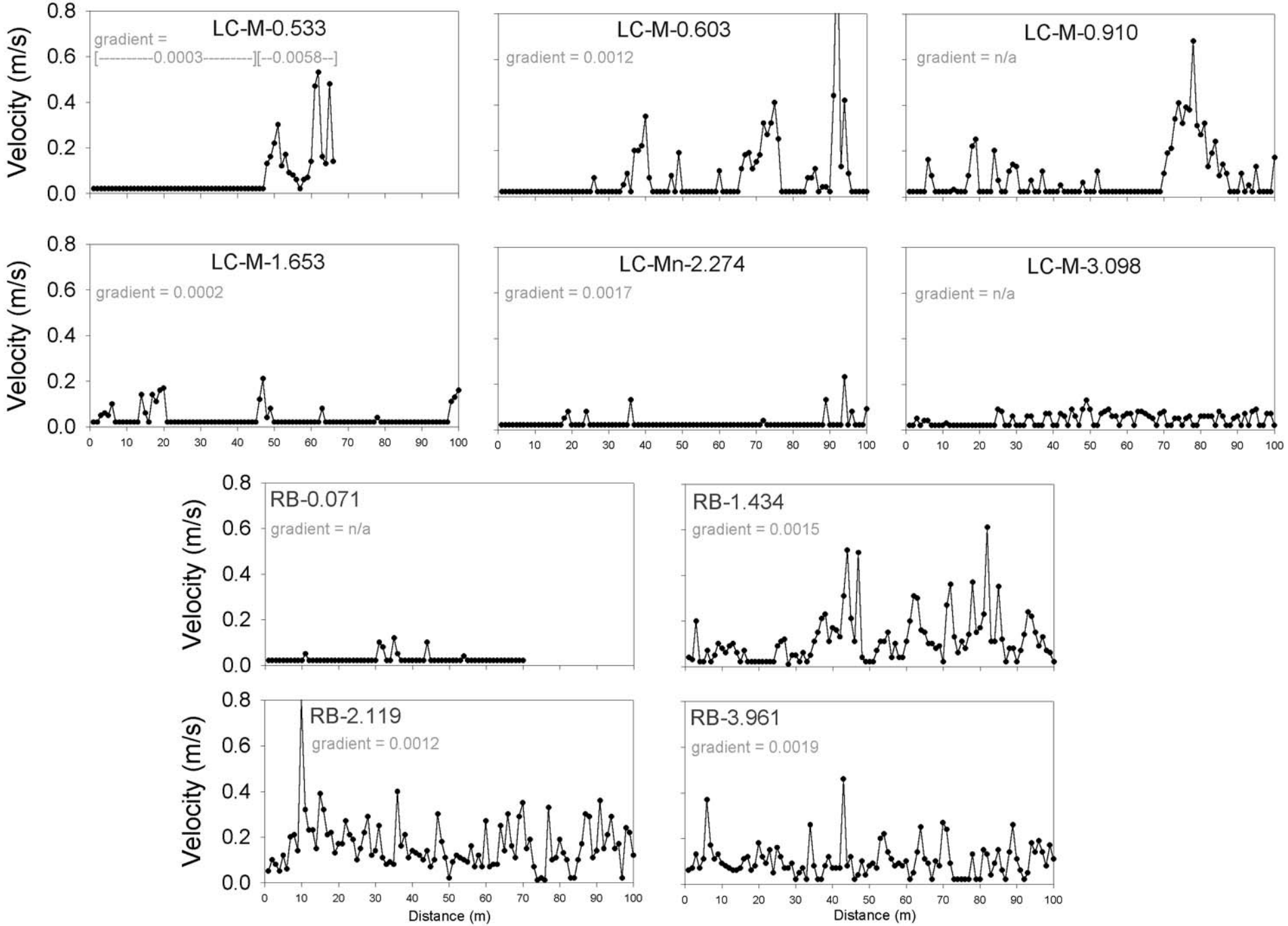


Figure 3.6.1. Diversity of flows in the thalweg at sites throughout the Long Creek and Red Brook watersheds. Velocity was measured at 2-m intervals walking up the channel. Gradient, in this case water surface slope, is expressed in terms of ft/ft.

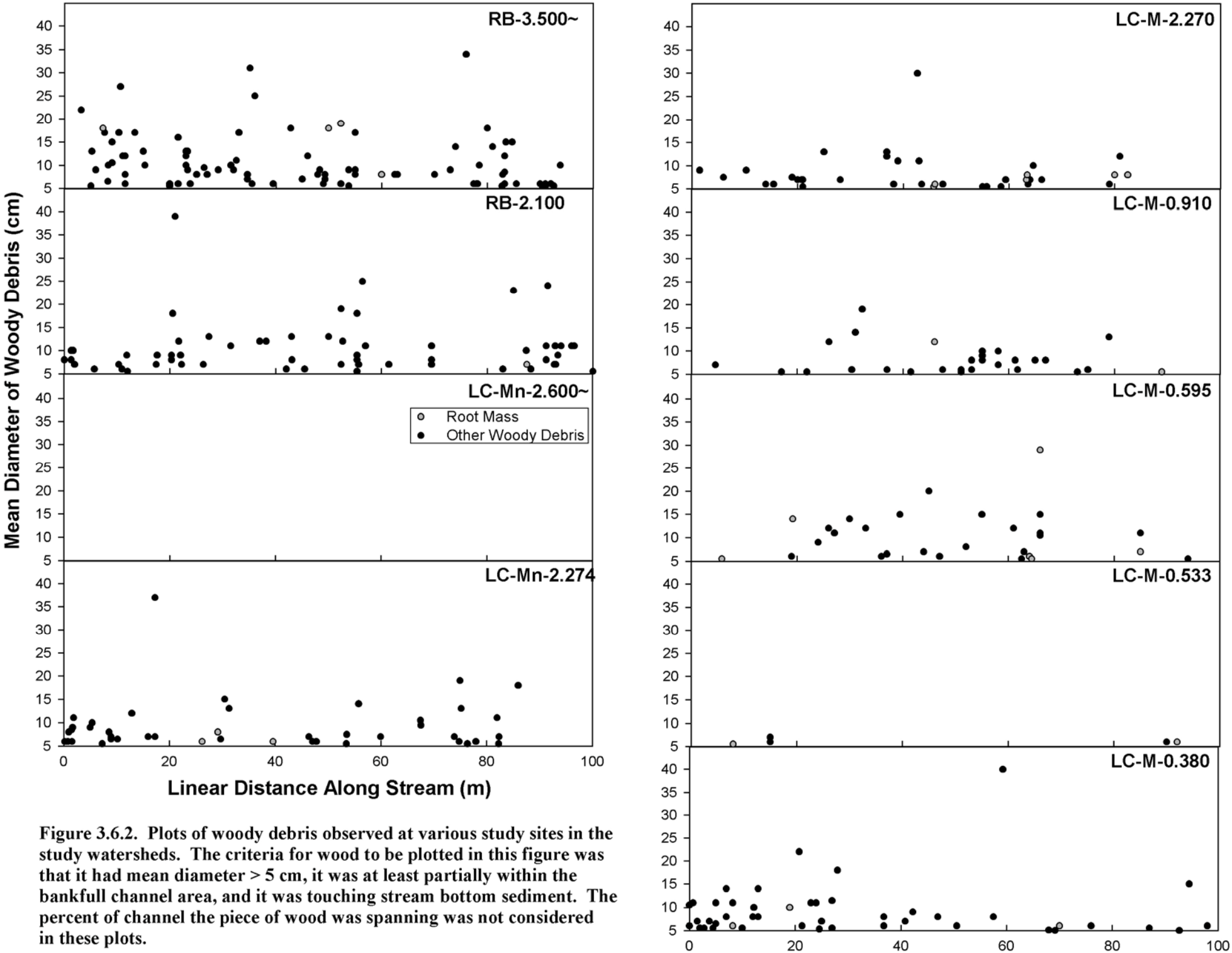


Figure 3.6.2. Plots of woody debris observed at various study sites in the study watersheds. The criteria for wood to be plotted in this figure was that it had mean diameter > 5 cm, it was at least partially within the bankfull channel area, and it was touching stream bottom sediment. The percent of channel the piece of wood was spanning was not considered in these plots.