Pequannock River Temperature Impairment:

Characterization, Assessment and Management Plan

DRAFT

Prepared by

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1 – Introduction

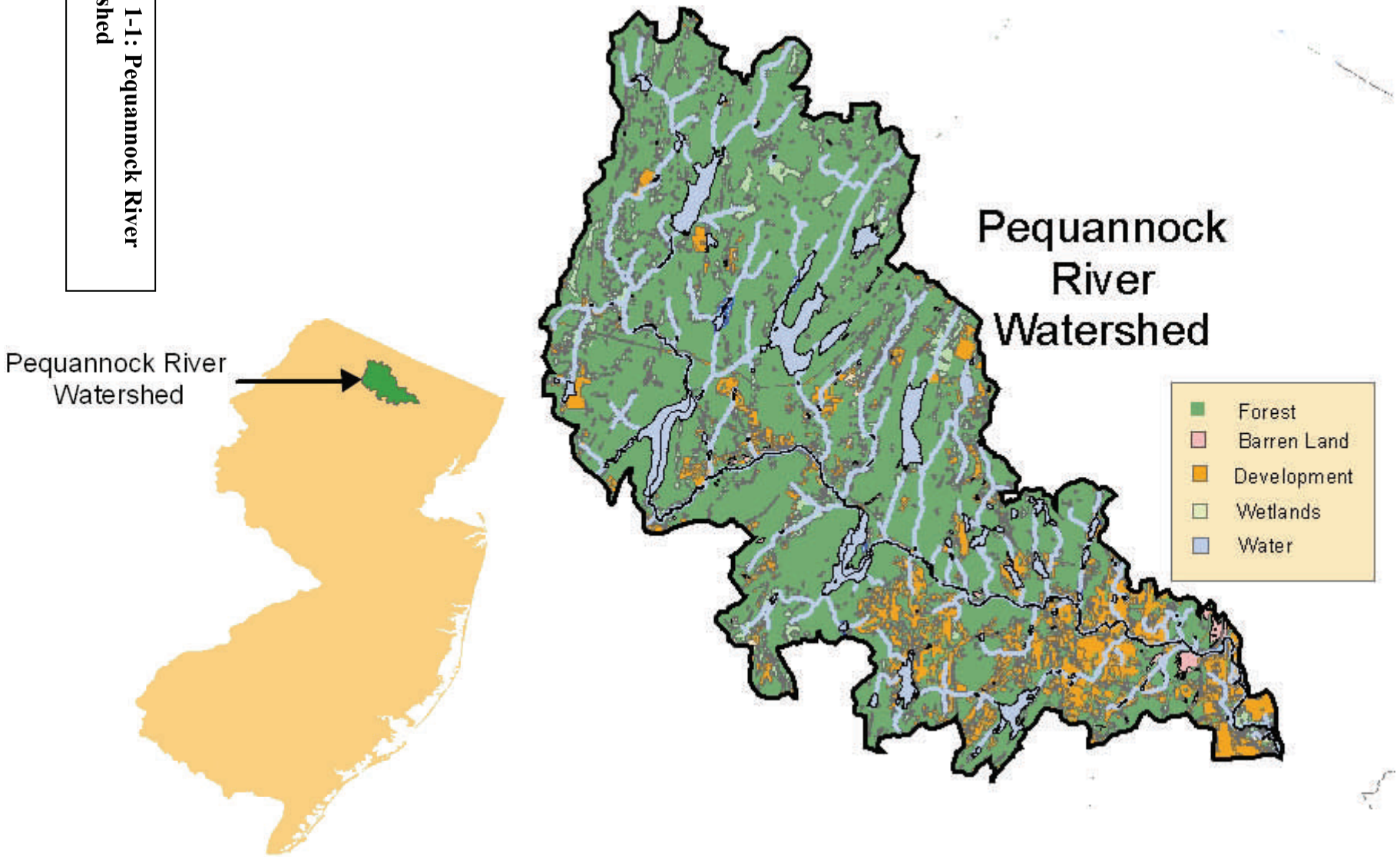
The Pequannock River Watershed in northeast New Jersey serves as a source of potable water for hundreds of thousands of citizens, provides habitat for a vast array of wildlife and offers an abundance of outdoor recreation (see Figure 1-1). Most sections of the Pequannock River and most river tributaries are classified as FW2-TP(C1) "trout production" or FW2-TM "trout maintenance" earning specific water temperature protections under the New Jersey Surface Water Quality Standards, since trout, as the established biota, are extremely sensitive to high water temperatures.

In recent years concern has grown over elevated water temperatures in the Pequannock River. These elevated water temperatures triggered a substantial fish kill in 1994 and a less-severe kill in 2002. The Pequannock River Coalition initiated a temperature monitoring program in 1994 to determine the sources and extent of these problems and collect baseline data . The Pequannock River Coalition was licensed by the NJDEP as a laboratory for this work in 2001. Based on data submitted by the Pequannock River Coalition in 2001 and 2003 several portions of the Pequannock River and several Pequannock River tributaries were listed as "impaired" for temperature in the 2002 and 2004 NJDEP Integrated Lists.

Funding was provided by the NJDEP to develop a Characterization and Assessment Report and a Management Plan for the Priority Water segment of the Pequannock River. The Priority Water segment was defined as that portion of the Pequannock River from the Macopin Reservoir outlet to the border of the Borough of Butler. However, temperature impairment is not limited to the Priority Water segment, and the entire Pequannock drainage is a complex and, at times, confusing system. Therefore, it was decided that this report should incorporate available information on all impaired segments of the Pequannock River (see Figure 1-2). To simplify the watershed somewhat, it was divided for this report into three major areas – the "Headwaters Section" above the Newark-owned reservoirs, the "Reservoir Section" where the river flows between reservoirs and the "Lower Section" below these reservoirs (see Figure 1-3).

To achieve its purpose this report is intended to answer several basic questions:

Figure 1-1: Pequannock River Watershed



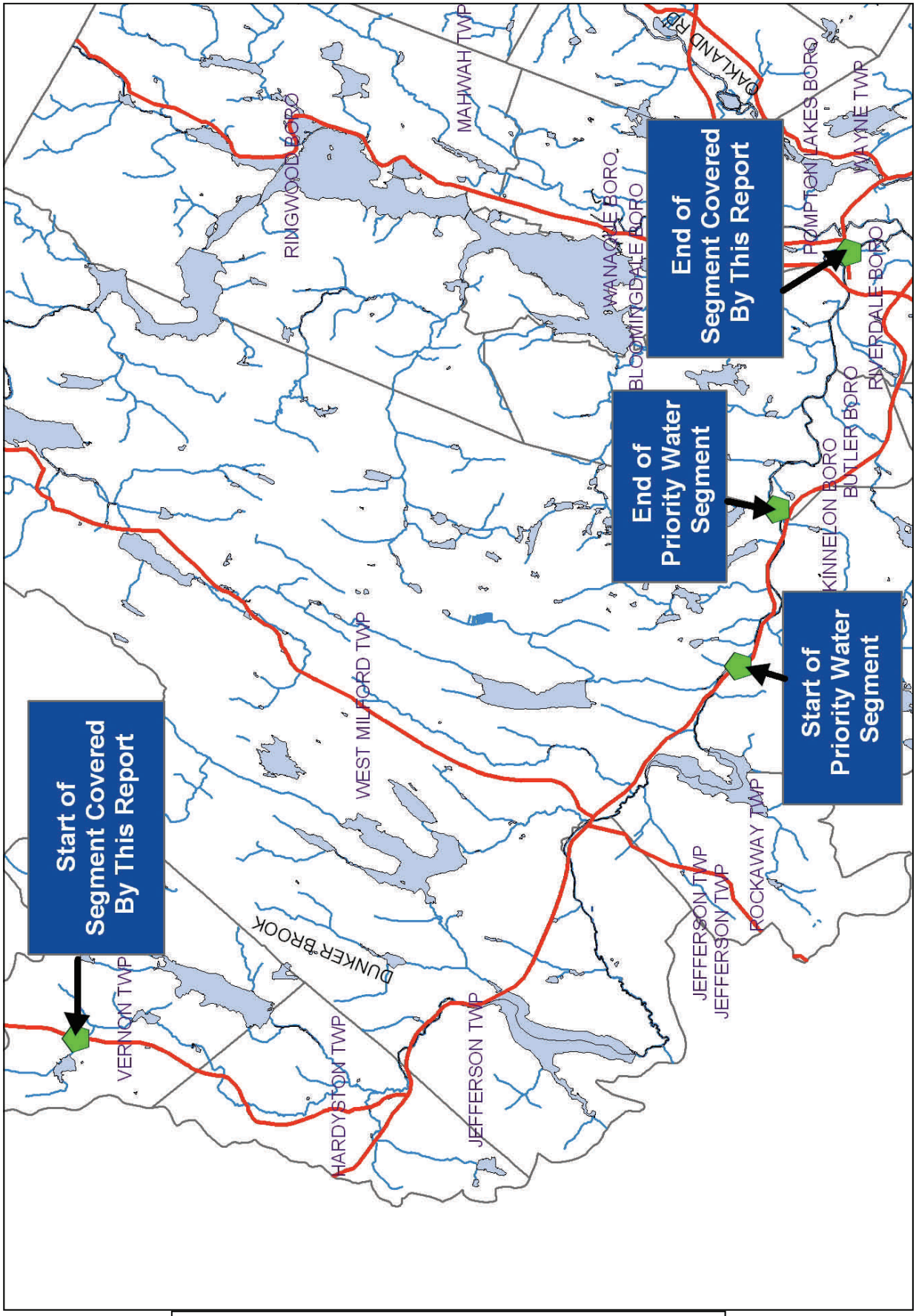


Figure 1-2: Priority Water and Report Boundaries

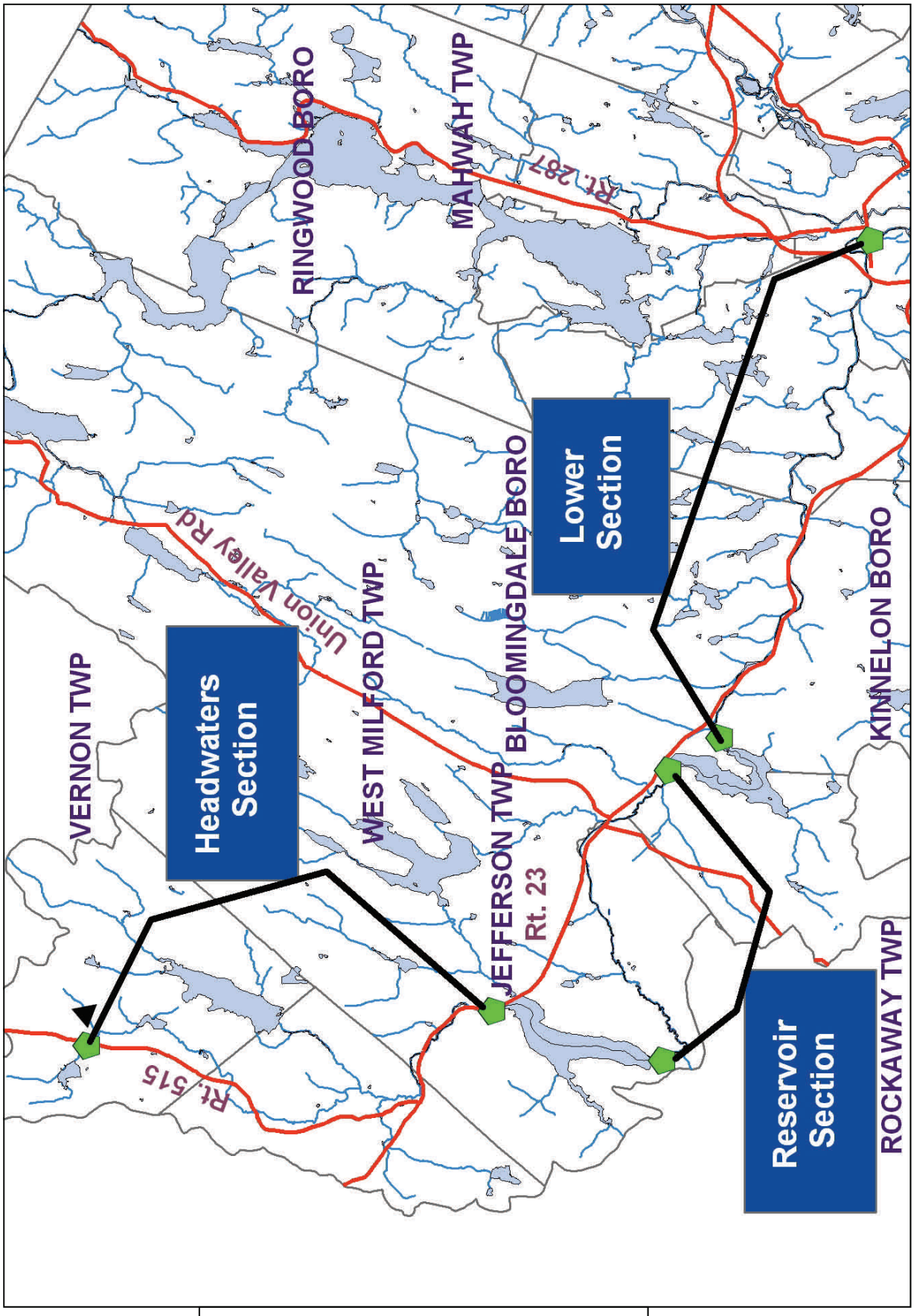


Figure 1-3 – Pequannock River Sections

What is known about the causes and potential cures of temperature impairment in the Pequannock River Watershed? (See Section 2—Factors Influencing River and Stream Temperatures in the Priority Water Segment of the Pequannock River)

What information is currently lacking that would assist in understanding this impairment? (See Section 4—Summary of Remaining Data Gaps)

How can potential cures be implemented and what are the costs involved? (See Section 5—Prioritization and Action Plan)

While the objective of this process is elimination of temperature impairment in the Pequannock River Watershed, there will clearly be other far-reaching benefits. From a biological standpoint, for example, waterways in our State capable of sustaining New Jersey's native trout, the Brook trout, are becoming rare. In many cases our waterways still support wild trout, but these are non-native trout, like the Brown trout, that are able to withstand slightly higher temperatures than our native Brook trout. Several wild Brook trout populations remain in the Pequannock River Watershed. We believe it is imperative to protect these populations and to bring water temperatures throughout the Pequannock system to a level that can sustain native Brook trout.

In addition, angling is important, not only as a "designated use" but also as a substantial social and recreational resource. It is obvious that improvement of the Pequannock system as trout habitat will yield huge benefits in this regard.

Finally, we have come to recognize that, in cold water ecosystems, water temperature is a reliable indicator of overall watershed health, just as human body temperature is an indicator of our own health. Although water temperature is known to be a critical factor for trout survival and health, it is also important for other organisms such as Stoneflies (*Plecoptera sp*) and Caddisflies (*Trichoptera sp*) which have maximum temperature requirements similar to trout. In general, high water temperatures in trout-associated waterways can tell us that something is "wrong."

For all these reasons we are convinced that our attempts to understand and correct the temperature impairment of the Pequannock River are an important, rewarding and worthwhile endeavor.

This report represents a considerable investment of time, effort and funding. However, conditions in the Pequannock River Watershed are dynamic. It is our intent that this report be updated periodically as these conditions change and new information becomes available. To this end we have included with this printed report a variety of supplemental source materials such as Arcview GIS objects, Microsoft Access database files, a copy of this report in Microsoft Publisher format, photographs, and a variety of associated reference materials. These files are provided on compact disks, and are as integral to this report as the printed pages.

2– Factors Influencing River and Stream Temperatures

There are a number of potential sources of increased water temperatures in this watershed, including loss of riparian canopy (both anthropogenic and natural), low flows (especially during the critical summer months), stormwater generated runoff, impacts of tributary waters, and impoundments. In this section each of these influences is explored in detail.

A) Tributaries

Tributaries of the Pequannock River are an important influence on river water temperatures. The extent of this influence is determined by the relative amount of tributary flow and the difference between the temperature of tributary flows and temperatures in the receiving river segment. This relationship was studied intensively by the Pequannock River Coalition in the Lower Section of the Pequannock River under a study funded through the 319(h) program in 2004 (Pequannock River Thermal Mitigation, Monitoring and Assessment Project, RP04-003.) A report of this study (Pequannock River Tributary Flow and Temperature Monitoring) is attached as Appendix A.

The study showed that a large amount of the total river flow in the Lower Section of the Pequannock River does not come from the upper watershed but from tributaries in the Lower Section. In fact , only 29% of the river flow measured in Riverdale was derived from the watershed upstream of Macopin Reservoir. Tributaries entering the river between the Macopin Reservoir and the Riverdale site provided, on average, 71% of the river flow. These figures underline the enormous importance of tributaries to flows and temperatures within the Lower Section of the Pequannock River.

In the study, 11 major tributaries within this river section were monitored for flow and temperature. These tributaries exhibited a broad range of flow rates and temperatures. Most tributaries had lower summer temperatures than the mainstem Pequannock River. However, there were exceptions. Figure 2A-1 depicts a summary of flows and temperatures recorded in this study. Detailed findings are provided in the attached report "Pequannock River Tributary Flow and Temperature Monitoring" (Appendix A).

In the Headwaters Section and the Reservoir Section far less is known regarding the impact of tributaries. In general, tributaries of these river sections are fewer (see Figure 2A-2). Only two – Clinton Brook and Pacock Brook - have been monitored for temperature and no flow data for

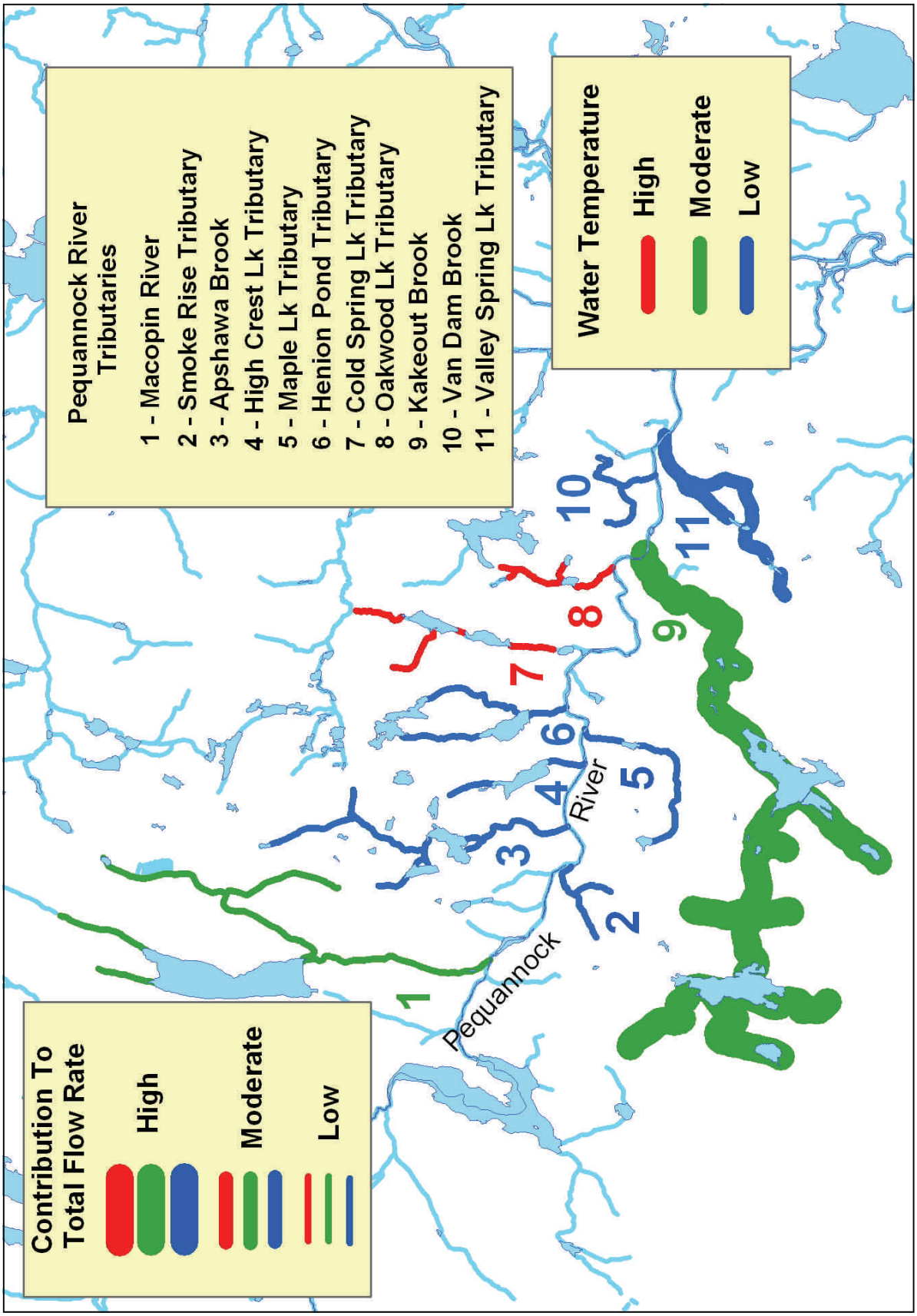


Figure 2A-1: Pequannock River Tributaries - Comparative Flows and Temperatures for 2004

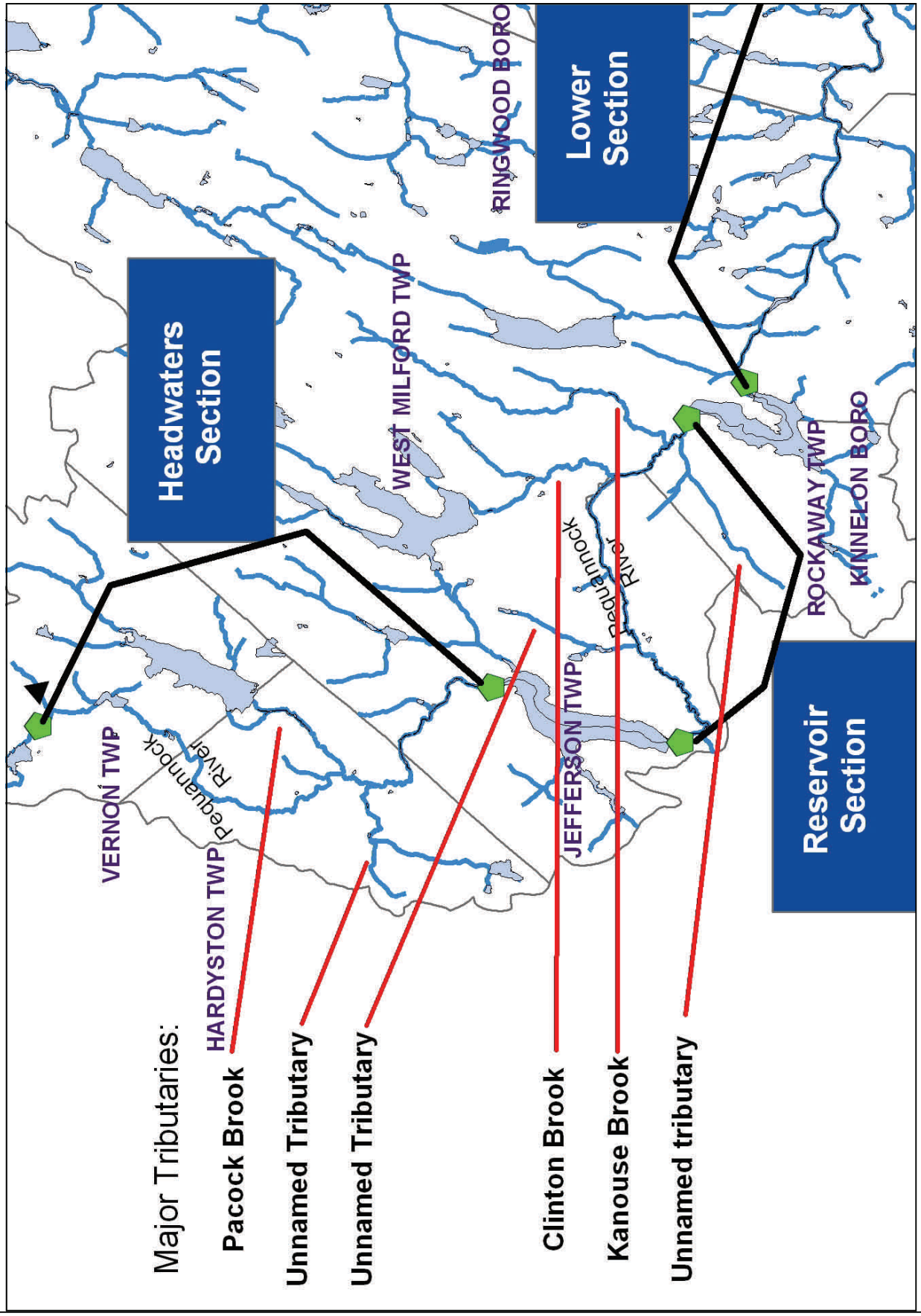


Figure 2A-2 – Major Pequannock River Tributaries of Headwaters and Reservoir Sections

these streams is available.

Since tributaries are so significant, the following sections of this report will examine potential temperature influences in Pequannock River tributaries as well as the mainstem river. BMPs and mitigation approaches described are equally applicable to river tributaries.

B) Sunlight and Riparian Canopy

a) Current conditions

Direct sunlight or solar radiation is a major influence on stream and river temperatures. Three factors affect the extent of this influence – length of day, atmospheric conditions (cloud cover), and riparian conditions (shade, primarily from vegetation). For this reason clear days in summer months typically show the greatest elevation in water temperature from these sources since the long hours of direct sunlight serve to raise water temperatures.

The highest water temperatures on any given day usually occur in the late afternoon and evening after sunlight has had the greatest length of time to increase temperatures. Within the Pequannock River Watershed, Matthews Brook is a good case study for these influences since the brook has no impoundments above the monitoring site, its drainage basin is relatively undeveloped and the brook is not impacted by beaver activity. Figure 2B-1 shows temperatures recorded in Matthews Brook during a typical clear day. The substantial swing from morning low to evening high is apparent. Figure 2B-2 shows detail during a period of cloud cover. Note the nearly flat line from morning to evening in temperatures recorded. It must also be recognized that cloud cover often reduces daytime air temperatures, thereby creating an additional influence. This is explored in section 2-G of this report.

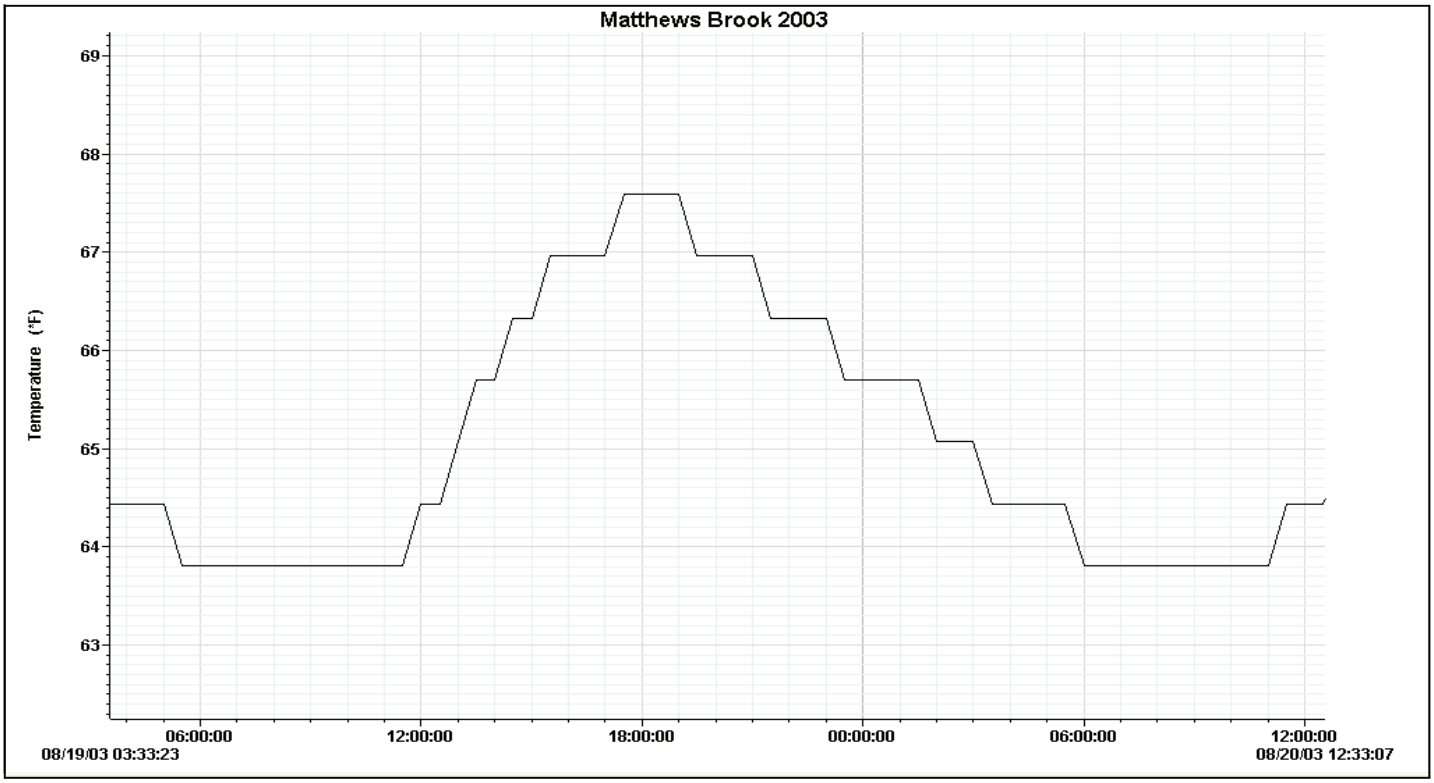


Figure 2B-1 – Matthews Brook temperatures during clear day

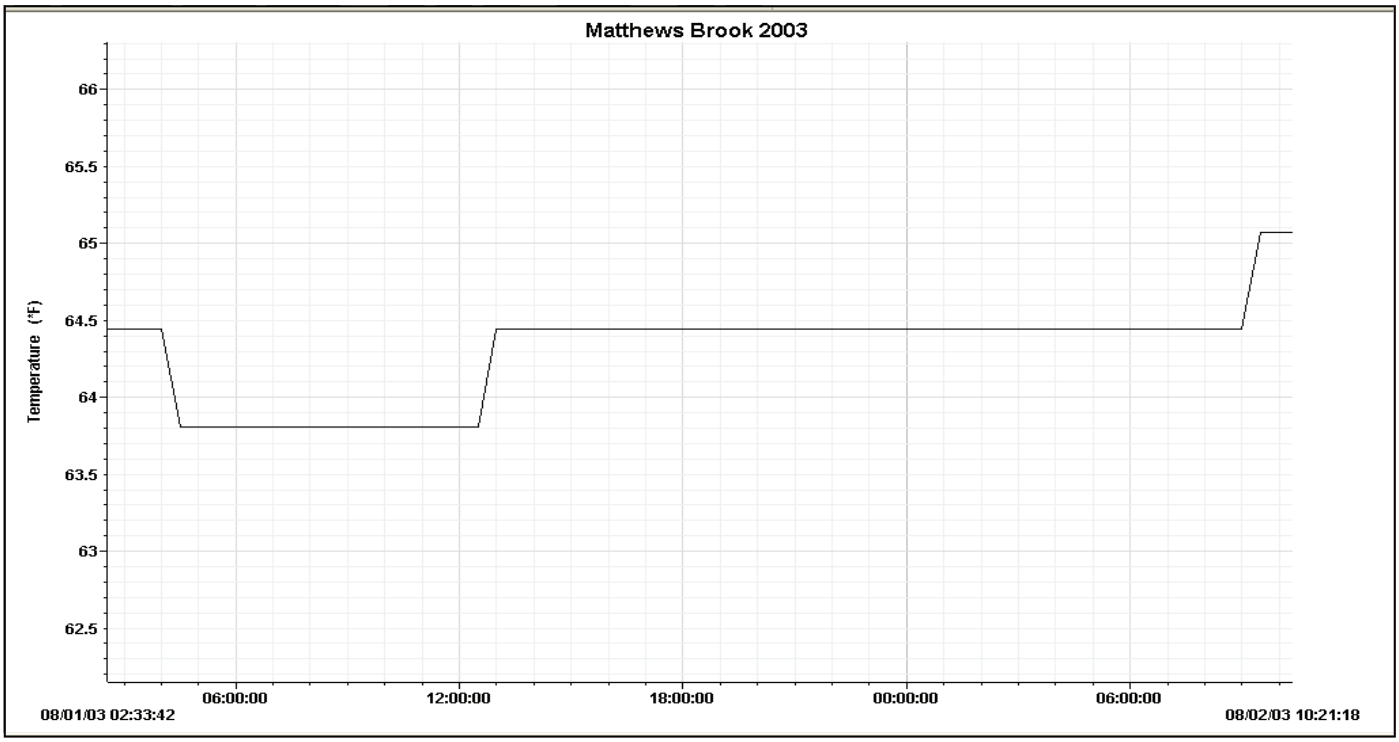


Figure 2B-2 – Matthews Brook temperatures during cloud cover

While such factors as the length of day or cloud cover cannot be controlled, the amount of shading canopy adjacent to waterways can be altered. Given the influence of sunlight on temperature elevation, the existence and condition of this shading riparian vegetation is important in maintaining reduced water temperatures.

Extensive surveys of canopy loss were conducted in the Headwaters Section and the Lower Section of the Pequannock River in 2004. In the Lower Section a total of 10 sites were identified where significant losses (> 50 linear feet) had occurred. Each site was identified with a unique code—a 2-character watershed code ("pq" for Pequannock), a 2-character resource code ("cl" for canopy loss), a 2-character municipal code ("bl" - Bloomingdale; "bt" - Butler; "kn" - Kinnelon; "rv" - Riverdale) and a 3-digit sequential site number. These sites are mapped in Figure 2B-3 and photos are provided in Figures 2B-4 through 2B-14. Overall, in the Lower Section, these sites were few in number. The riparian canopy in this portion of the Pequannock River Watershed was remarkably intact. However, there are certainly many sites where minor losses have occurred, and these sites collectively degrade water temperatures.

In the Headwaters Section and the Reservoir Section the major factor contributing to canopy loss is the removal of shading tree canopy by beaver colonies along the river and river tributaries. Past flooding by beaver dams has converted extensive land areas from forest to meadows. This topic is explored in Section 2-F of this report.

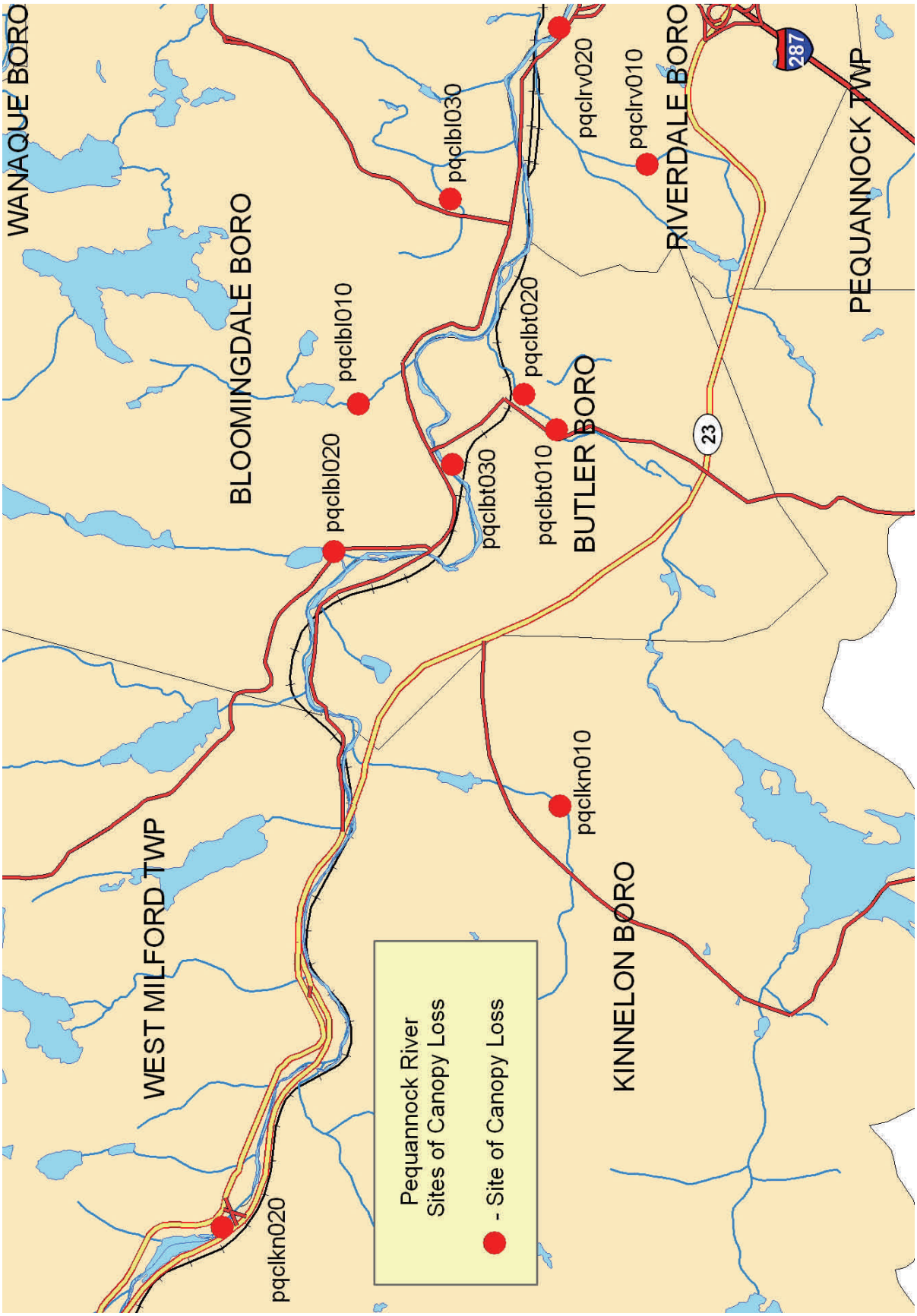


Figure 2B-3 – Sites of Canopy Loss

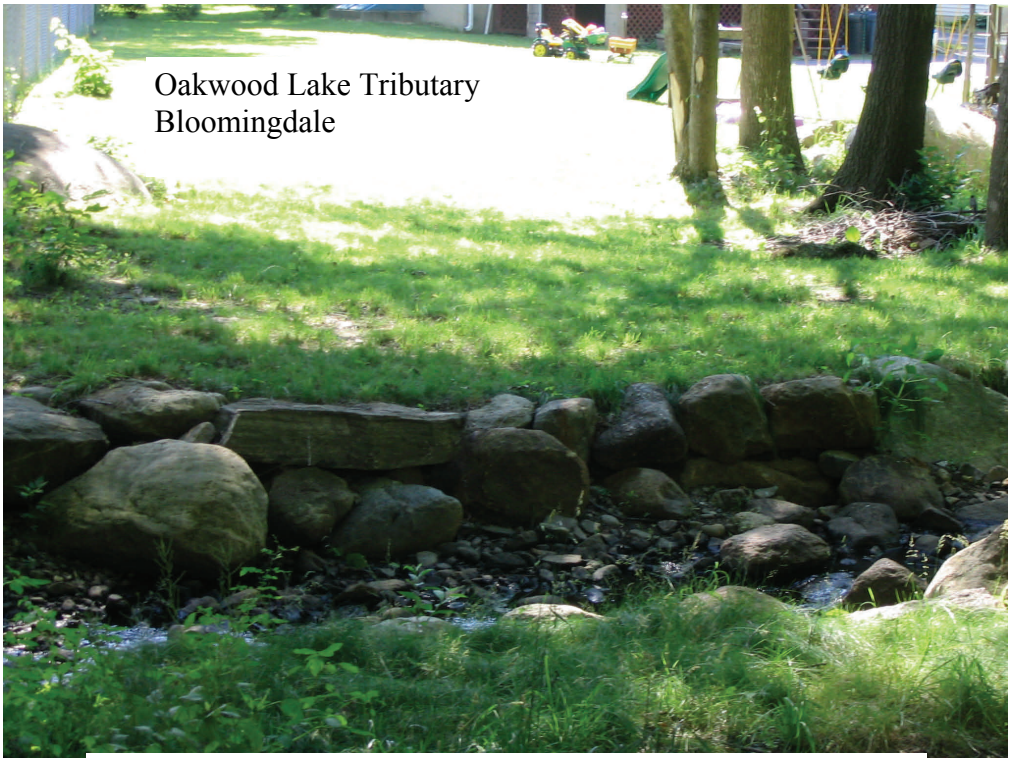


Figure 2B-4 - Canopy Loss Site pqclbl010

Figure 2B-5 - Canopy Loss Site pqclbl020

Figure 2B-6 - Canopy Loss Site pqclbl030

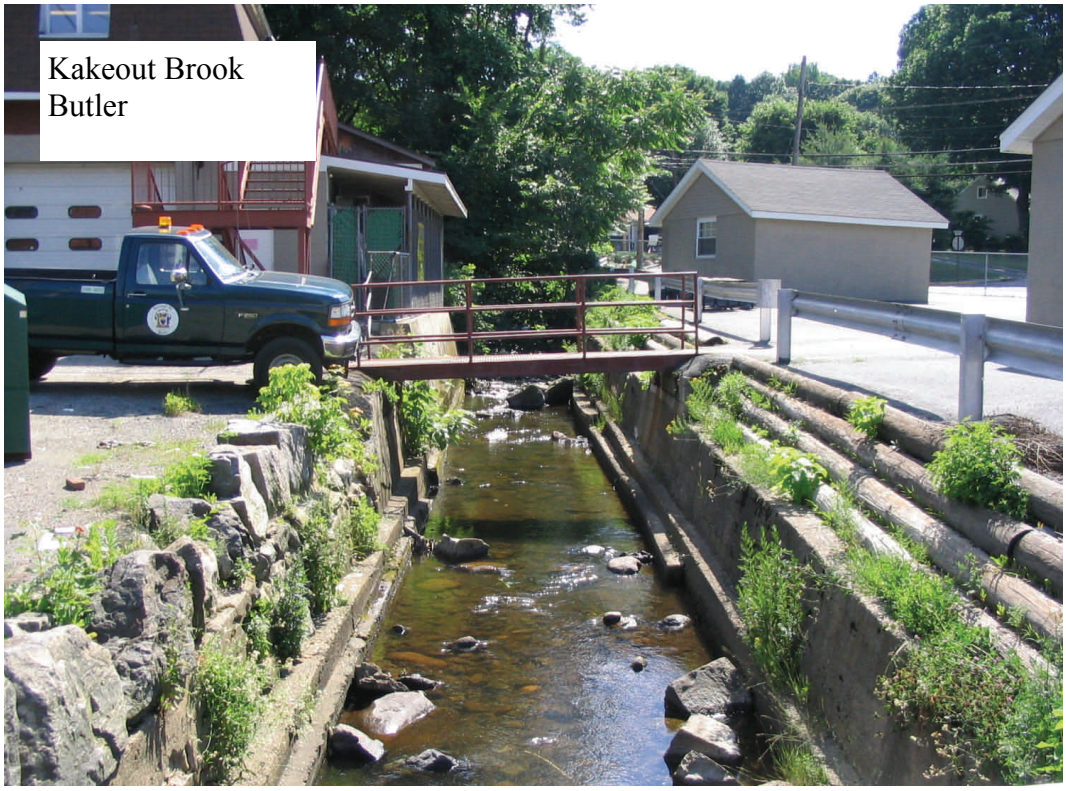


Figure 2B-7 - Canopy Loss Site pqclbt010

Figure 2B-9 - Canopy Loss Site pqclbt020

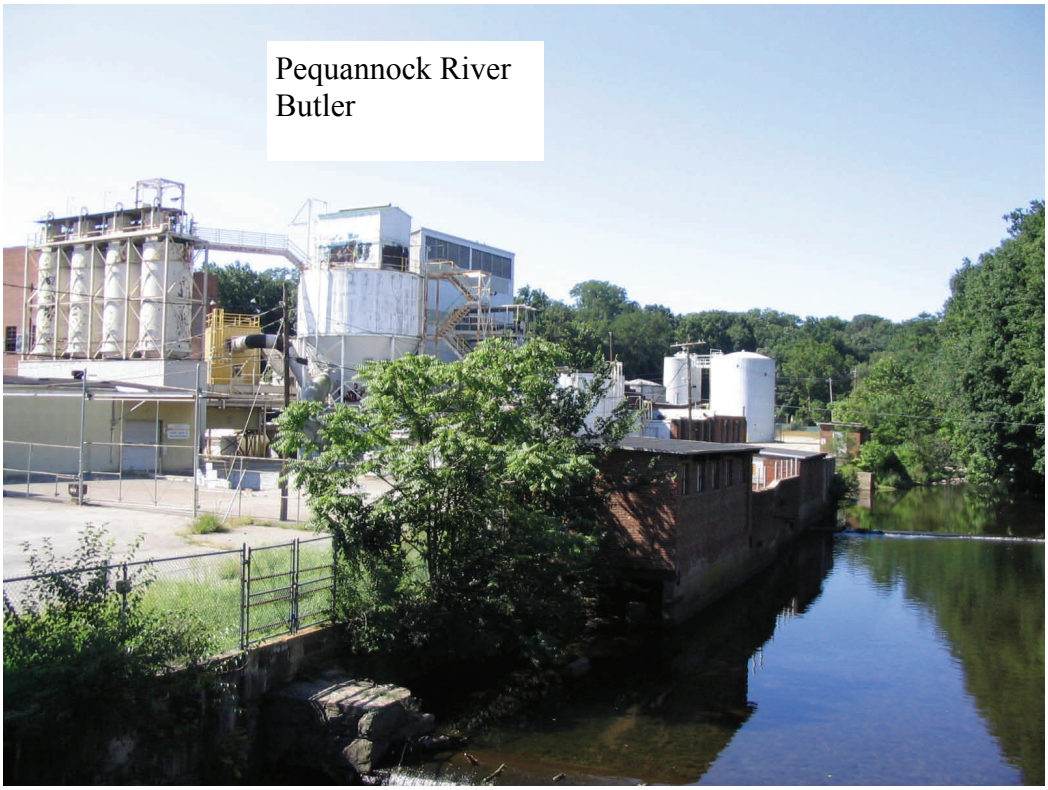


Figure 2B-10 - Canopy Loss Site pqclbt030

Figure 2B-11 - Canopy Loss Site pqclkn010

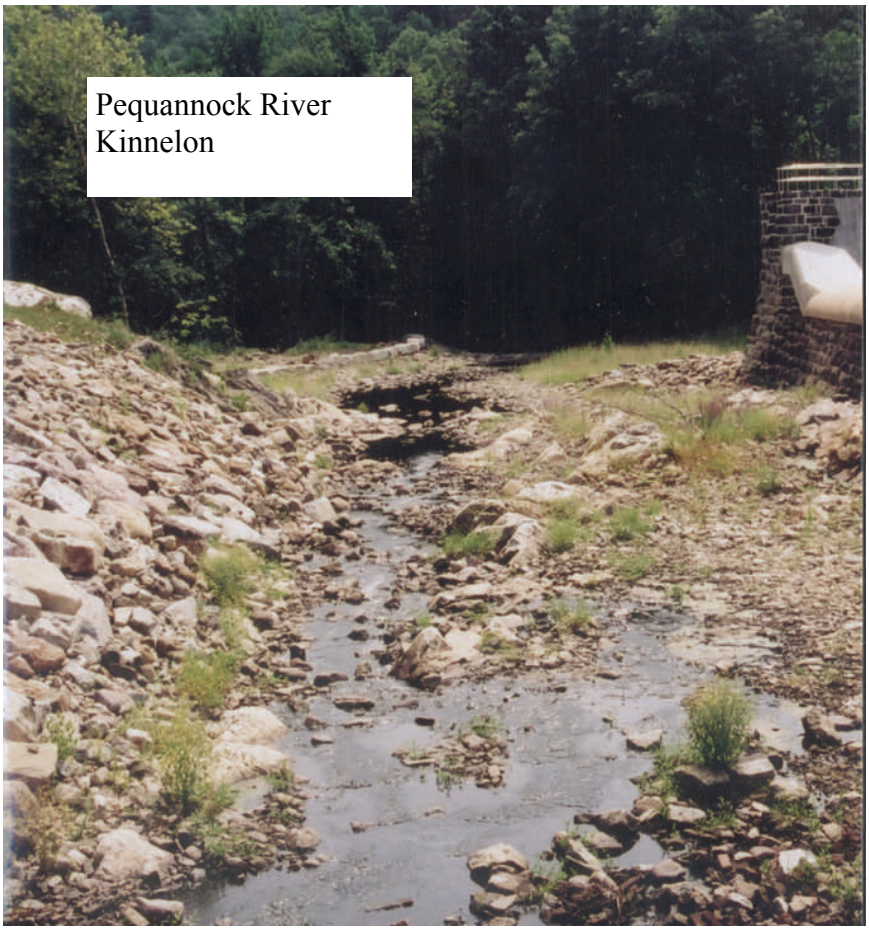


Figure 2B-12 - Canopy Loss Site pqclkn020

Figure 2B-13 - Canopy Loss Site pqclrv010

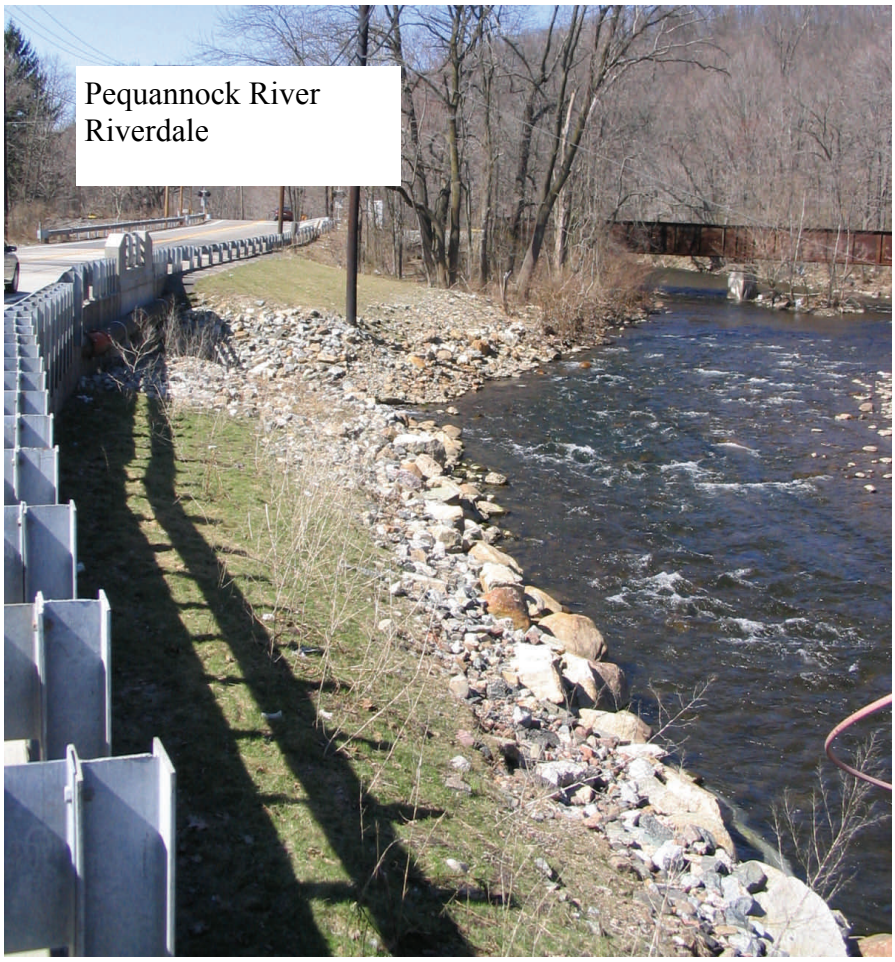


Figure 2B-14 - Canopy Loss Site pqclrv020

b) Applicable BMPs and Mitigation Approaches

Protection of the existing riparian canopy, and restoration of that canopy where losses have occurred, are the only applicable BMPs. Protection of the existing canopy may be achieved through regulation, education and acquisition.

i) Canopy protection - regulation

The New Jersey Flood Hazard Control Act Rules (N.J.A.C. 7:13) mandate protection of "near watercourse vegetation" for trout-associated waterways and define this as vegetation within 50 feet of stream and river banks. In addition, the recently adopted Stormwater Rules (N.J.A.C. 7:8) apply a 300-foot protective buffer to new major development adjacent to trout production waterways. Violations of these rules are commonplace in the Lower Section of the Pequannock Watershed (see Figure 2B-15). Stricter enforcement of these regulations could help to protect the riparian canopy on the Pequannock River and river tributaries.

Figure 2B-15: Riparian canopy loss from illegal flood plain filling in Butler NJ

Unfortunately such regulations have little impact on existing losses in older developments and offer minimal protection for smaller developments that fall below the regulated threshold for the new Stormwater Rules (>1/4 acre of new impervious cover or > 1 acre of disturbance). A good example of existing loss is site pqclrv010, shown in Figure 2B-13.

Also, it is difficult to enforce these prohibitions on existing private homes and businesses. In 2004 the NJDEP issued a Notice of Violation at several sites in the Pequannock River floodplain for placement of fill that had caused vegetation losses . However, at none of these sites has the fill been removed or any vegetation restored. This issue is important since such privately-owned sites are where the greatest canopy loss has occurred in the Pequannock

Watershed.

Local regulation through a municipal ordinance can be a viable approach. This is explored under "Applicable Model Ordinances."

ii) Canopy protection - education

An educational effort directed toward private landowners might achieve substantial protection of existing vegetation as well as promoting some canopy restoration. We suspect many landowners may not be aware of the critical nature of the riparian canopy in protecting water quality and are likely to respond favorably to a targeted educational effort. As noted, small privately owned tracts are where the greatest canopy loss has occurred in the Pequannock Watershed. Examples include sites pqclbl010, pqclbl020, pqclkn010 and pqclrv010.

iii) Canopy protection – acquisition

Preservation of riparian lands through acquisition is the most successful method of insuring long-term canopy protection. Section 4 of this report provides a detailed land acquisition plan for the lower Pequannock River Watershed.

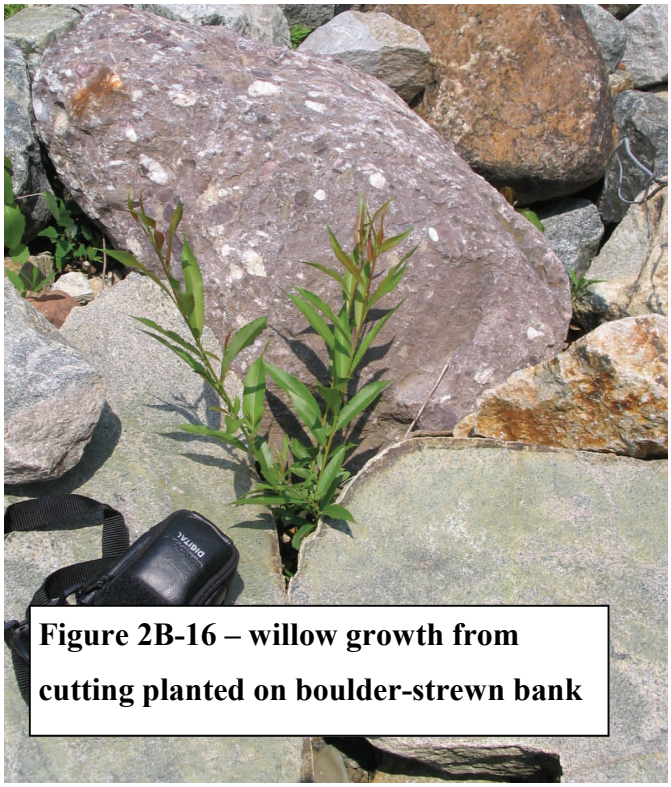


Figure 2B-16 – willow growth from cutting planted on boulder-strewn bank

iv) Canopy restoration

Restoration of the riparian canopy through re-planting can be accomplished by a variety of methods including tree planting, use of cuttings, fascines and other planting practices. Generally, sites on smaller tributaries are easier to address than sites on the mainstem Pequannock River. Narrow tributary channels can be shaded effectively by shrubs rather than large trees and their milder flows make the installation and maintenance of plantings much easier. The Pequannock River Coalition is using this approach to address site pqclbl030. The site is shown, prior to restoration, in Figure 2B-

6, prior to restoration. On the mainstem Pequannock, larger trees are needed to fully shade the wide river channel. In some areas steep, boulder-lined banks can restrict the range of planting options. Re-planting such areas with sizable trees can be difficult or impossible and is very costly. Where bank conditions render tree plantings impractical, the installation of cuttings of flood-resistant trees like Black Willow is a sensible and inexpensive option. The Pequannock River Coalition is using this method to address site pqclrv020 (see Figures 2B-14 and 2B-16). Additional sites that could be addressed through replanting are pqclkn010, pqclkn020, pqclbl010, and pqclbl020.

c) Applicable Model Ordinances

A number of model ordinances exist that promote protection of stream and river buffers. One example, the NJDEP "Stream Buffer Conservation Zone Model Ordinance," is attached in Appendix B. Since these ordinances are enforced at the local level and can be tailored to local needs they are more likely to achieve positive results on previously developed properties than current State regulations. In addition, they address sites that fall below the threshold for "major development" under the NJ Stormwater Management Rules.

Restoration of riparian canopy can only be addressed through redevelopment in some areas of the Pequannock River Watershed. A good example of a suitable site for this approach is pqclbt030, depicted in Figure 2B-10. The Borough of Butler has established a Redevelopment Zone at this location. Working with the Borough and a private development company the Pequannock River Coalition has created a proposed project plan that will implement a 50-foot riparian buffer on this tract, planted with shade trees, replacing asphalt that currently extends to the river bank. A prime example of a site where a similar approach could be useful is pqclbt010 (Figure 2B-7).

Such improvements may be mandated during redevelopment by municipal ordinance. A good example of an ordinance mandating buffer restoration during redevelopment is the "*Design and Construction Standards for Sanitary Sewer and Surface Water Management*" created by Clean Water Services of Hillsboro, Oregon for the Tualatin River Watershed. The most pertinent sections are 1.02.47, 3.02 and 3.02.4. Excerpts of these sections are included in Appendix C.

C) Impoundments

a) Current conditions

The impoundment of rivers and streams can cause enormous changes in the temperatures of the impounded waterways. Impoundments tend to increase the impact of sunlight by widening flow channels, thereby reducing shade cover, and by decreasing flow speed which exposes water passing through the impoundment to sunlight for longer periods. The stratification of water within impoundments can also cause temperature changes in the waterway downstream. In summer months warmer water is found at the surface of impoundments with colder water in the depths. Deep impoundments may show more than a 40°F difference between temperatures at the surface and temperatures well below the surface. This is due to the fact that water has its greatest density at approximately 39.2°F. A description of this phenomenon is as follows[1]:

"*As summer progresses, the temperature (and density) differences between upper and lower water layers become more distinct. Deep lakes generally become physically stratified into three identifiable layers, known as the epilimnion, metalimnion and hypolimnion. The epilimnion is the upper, warm layer, and is typically well mixed. Below the epilimnion is the metalimnion or thermocline region, a layer of water in which the temperature declines rapidly with depth. The hypolimnion is the bottom layer of colder water, isolated from the epilimnion by the metalimnion. The density change at the metalimnion acts as a physical barrier that prevents mixing of the upper and lower layers for several months during the summer."*

Preliminary monitoring by the Pequannock River Coalition has shown that even small impoundments 3-6 feet deep can show a 5F or 6F difference between surface and bottom temperatures. Mid-sized impoundments (10-20 feet deep) can yield bottom water up to 10F cooler than spillway flows. This is illustrated in Figures 2C-1 and 2C-2. Large impoundments can exhibit up to a 40F difference between surface and bottom water temperatures.

For this reason, impoundments with spillway outfalls raise downstream temperatures by passing only the warmest upper surface water over the outfall structure (see Figure 2C-3). At the opposite extreme are impoundments with bottom release outfalls. When utilized these bottom release structures greatly reduce downstream temperatures.

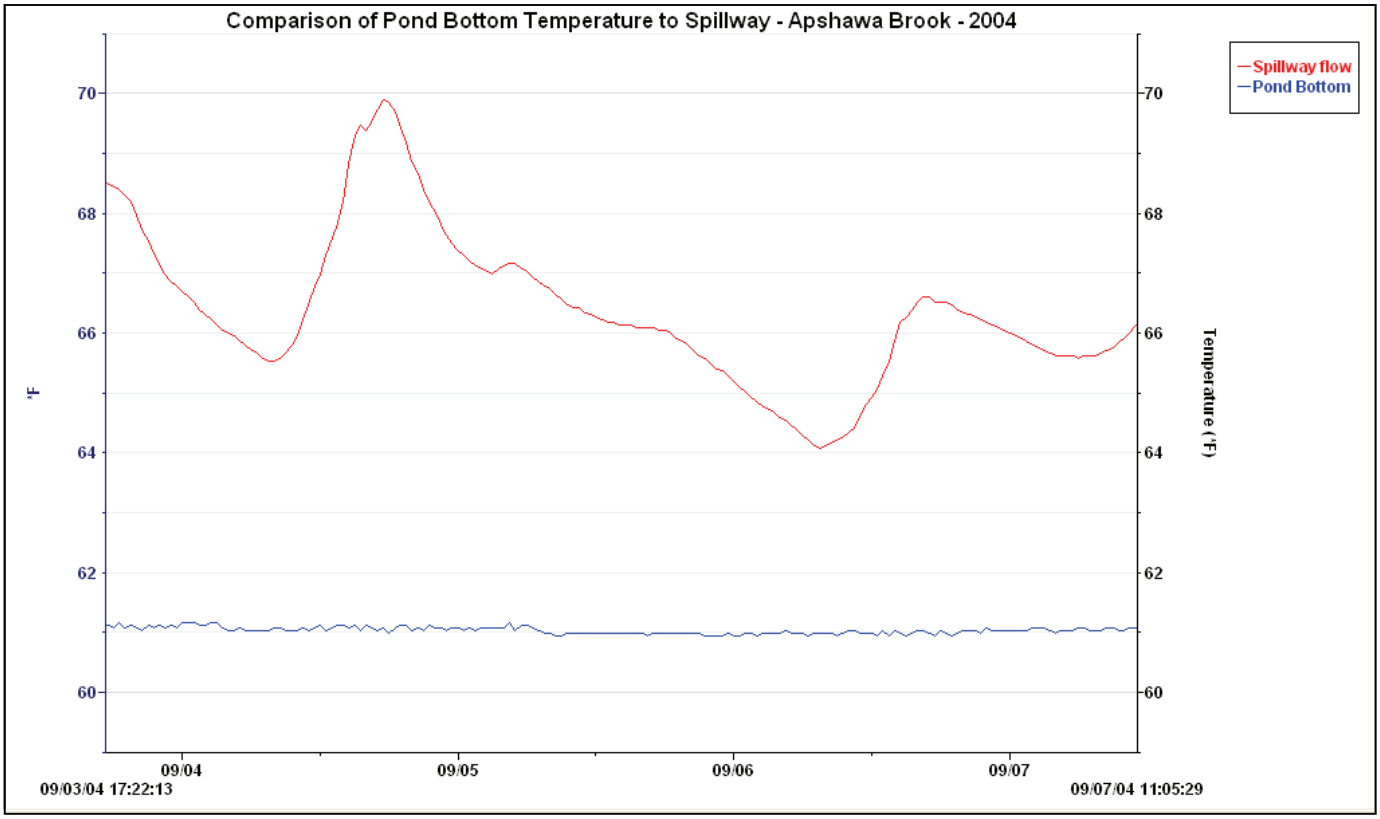


Figure 2C-1: Temperature recordings for a small pond (10 foot depth)

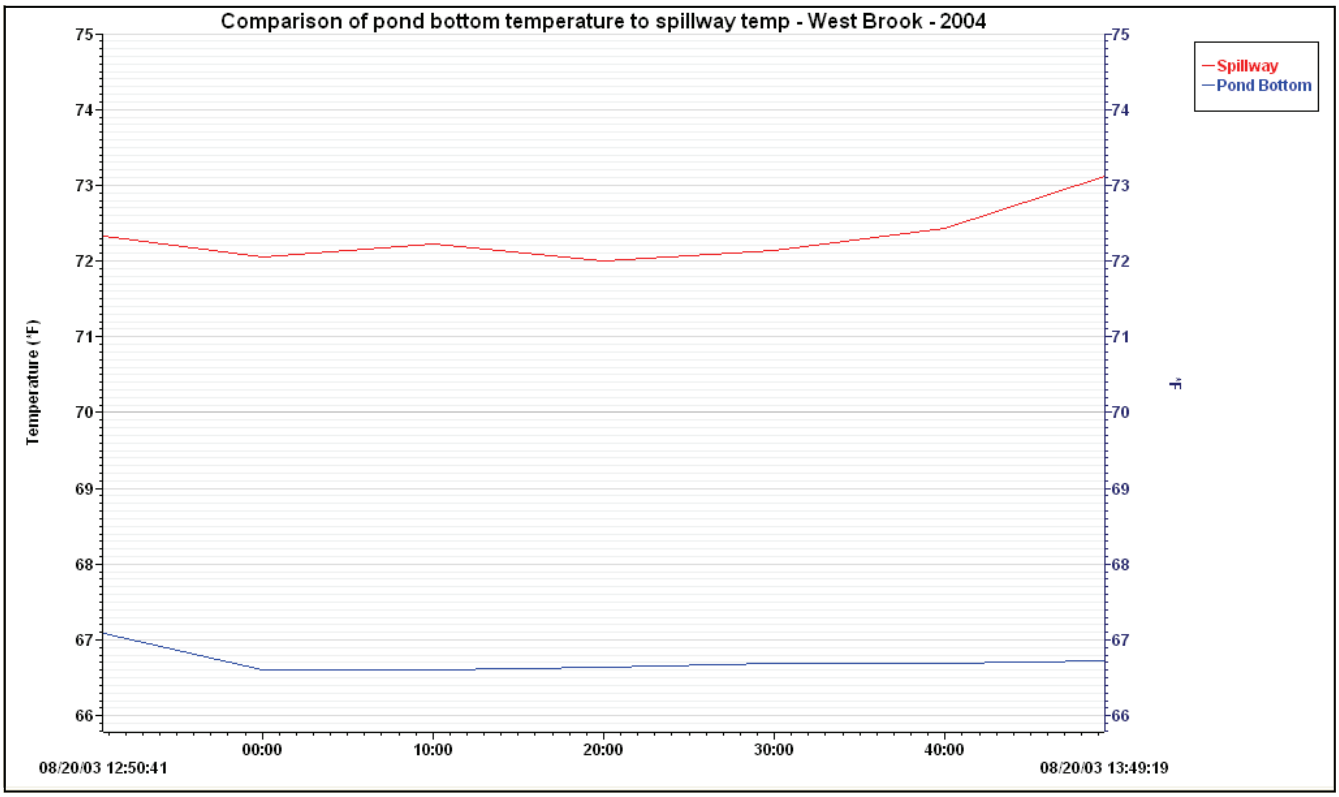


Figure 2C-2: Temperature recordings for a small pond (3 foot depth)

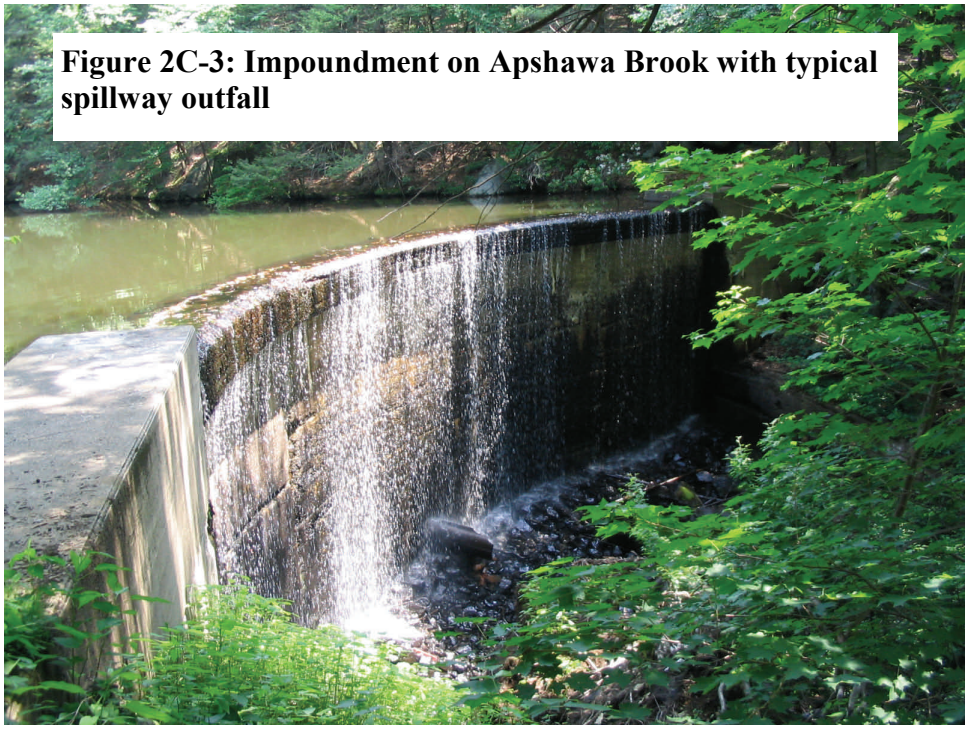


Figure 2C-3: Impoundment on Apshawa Brook with typical spillway outfall

These points are illustrated in Figures 2C-4, 2C-5 and 2C-6, showing temperatures recorded in the Pequannock River below the Oak Ridge Reservoir in 2003. This reservoir has bottom release valves in addition to a spillway outlet. Data in Figure 2C-4 includes periods of bottom release, periods of spillway flow and periods of mixed flow. Note the wide variation in temperatures recorded. Figure 2C-5 shows detail of temperatures recorded when a substantial bottom release was occurring. The reduction in temperatures is evident. Figure 2C-6 shows detail of temperatures during a period of high spillway flow resulting in elevated temperatures.

While any impoundment can elevate temperatures, the most significant to conditions in the Pequannock River are those that impound the mainstem river. These include the Macopin Reservoir, Charlottesburg Reservoir, Oak Ridge Reservoir, an unnamed reservoir in Vernon and two unnamed ponds in Hardyston (see Figure 2C-7). Second to these are impoundments on tributaries. Two tributaries are impounded in the Headwaters and Reservoir Sections – Clinton Brook(Clinton Reservoir) and Pacock Brook (Canistear Reservoir) as shown in Figure 2C-8. In the Lower Section of the Pequannock, ten tributaries also have impoundments along their courses (see Figure 2C-9).

Several reservoirs have bottom release valves (Charlottesburg, Macopin, Clinton and Canistear). Other impoundments have only spillway outfalls.

In 2004 the Pequannock River Coalition monitored water temperature within the Lower Section of the Pequannock in nine tributaries impacted by impoundments and at three sites on the

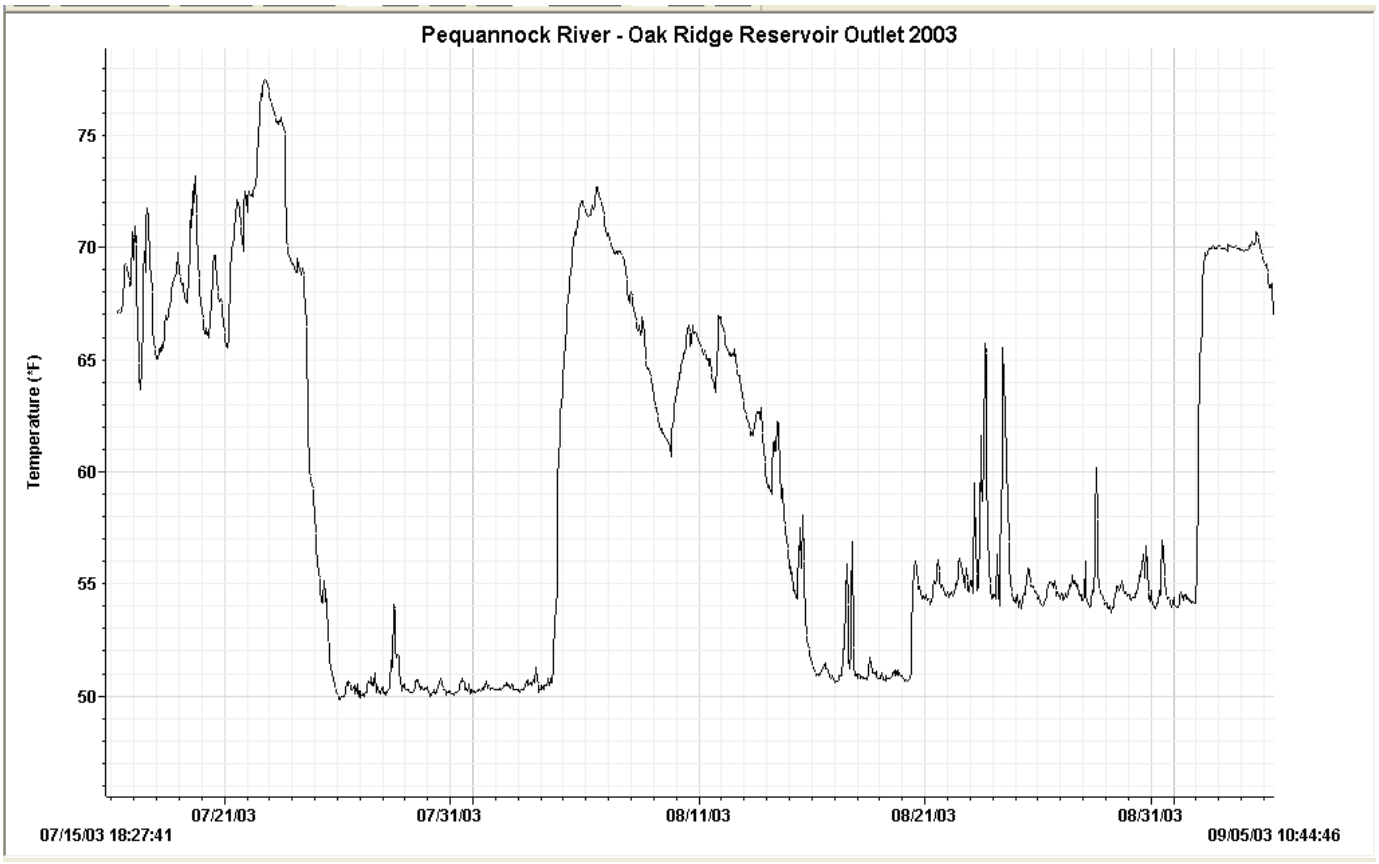


Figure 2C-4 – Oak Ridge outlet temperatures for entire season

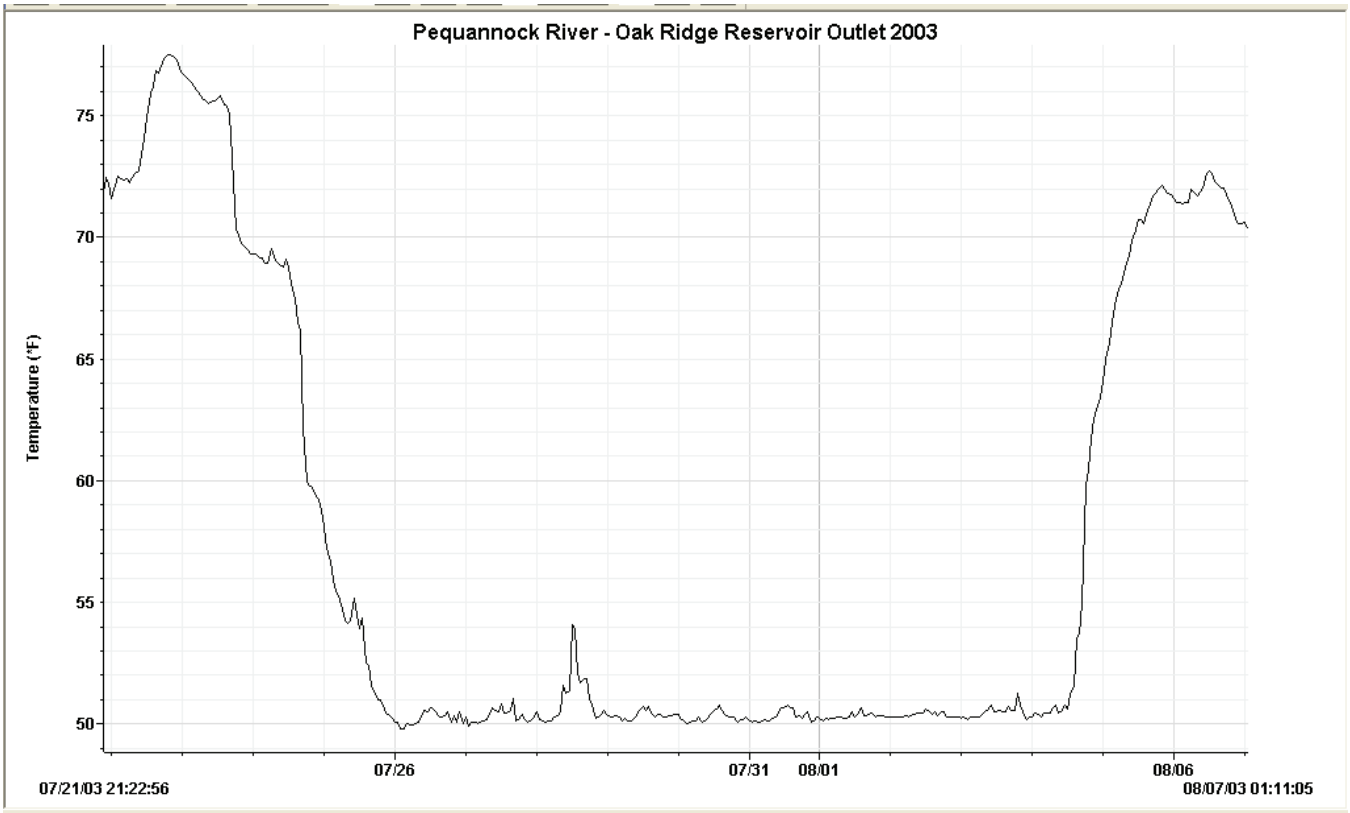


Figure 2C-5 - Oak Ridge outlet temperatures with bottom release

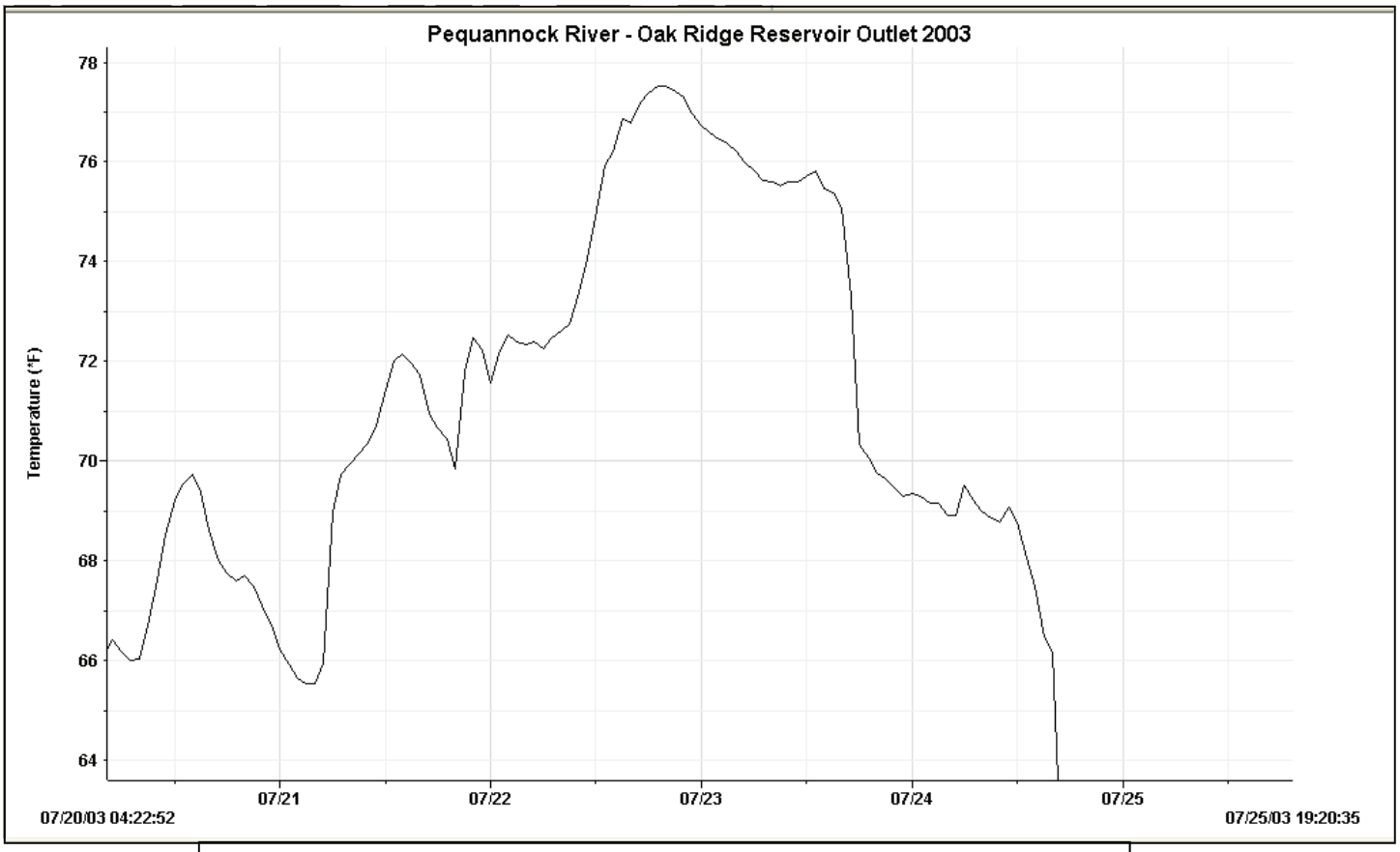


Figure 2C-6 – Oak Ridge outlet temperatures with high spillway flow

mainstem Pequannock (see Figures 2C-7 and 2C-8). Impoundments and their positions were found to be very important to tributary temperatures. Impoundments higher in the tributary subwatersheds had less influence. Examples are Apshawa Brook and the Maple Lake Tributary, where impoundments were 0.3 to 0.5 miles from the tributary confluence with the Pequannock River and the riparian canopy between the impoundment and the river was largely intact. The cooling affect of this shading canopy, as well as additional flow provided by groundwater and small springs is believed to have reduced the overall impact of impoundments on these tributaries.

At the opposite end of the spectrum were tributaries with impoundments low in their subwatersheds, such as the Cold Spring Lake Tributary or the Oakwood Lake Tributary. These conditions produced very high water temperatures. Table 2C-1 shows temperature data recorded in these four Pequannock River tributaries for 2004. This data is fully presented in the attached report “Pequannock River Tributary Flow and Temperature Monitoring” (Appendix A).

b) Applicable BMPs and Mitigation Approaches

Breaching of dams is the most effective method of eliminating the impacts of impoundments. However, this approach is rarely feasible. Also, where a waterway has multiple impoundments it may be necessary to remove all impoundments to completely negate thermal impacts.

As noted under "Current Conditions", on impoundments with bottom release valves, temperature problems can be reduced or eliminated by maintaining an adequate release of bottom water. These include Oak Ridge Reservoir, Clinton Reservoir, Charlottesburg Reservoir, Canistear Reservoir and Macopin Reservoir. The benefits of this approach have been amply documented. In the case of water supply impoundments these releases may be mandated through Water Allocation permit requirements.

At present little is known about operation of the unnamed reservoir in the Headwaters Section (see Figure 2C-7). If bottom release valves are incorporated in the dam structure these could be utilized to reduce downstream temperatures. Benefits might be significant since water temperatures recorded immediately below this reservoir by the Pequannock River Coalition in the summer of 2004 were extremely high. Water temperatures there reached a maximum of 84.7F and exceeded 68F on 92% of the days in the 3-month summer monitoring period.

For impoundments without bottom release valves, siphoning of bottom water through a supplemental piping system may offer the same benefits. As noted in this report, even small impoundments can hold substantially cooler water in their depths.

c) Applicable Model Ordinances

Model ordinances are not applicable as a remedy for these concerns.

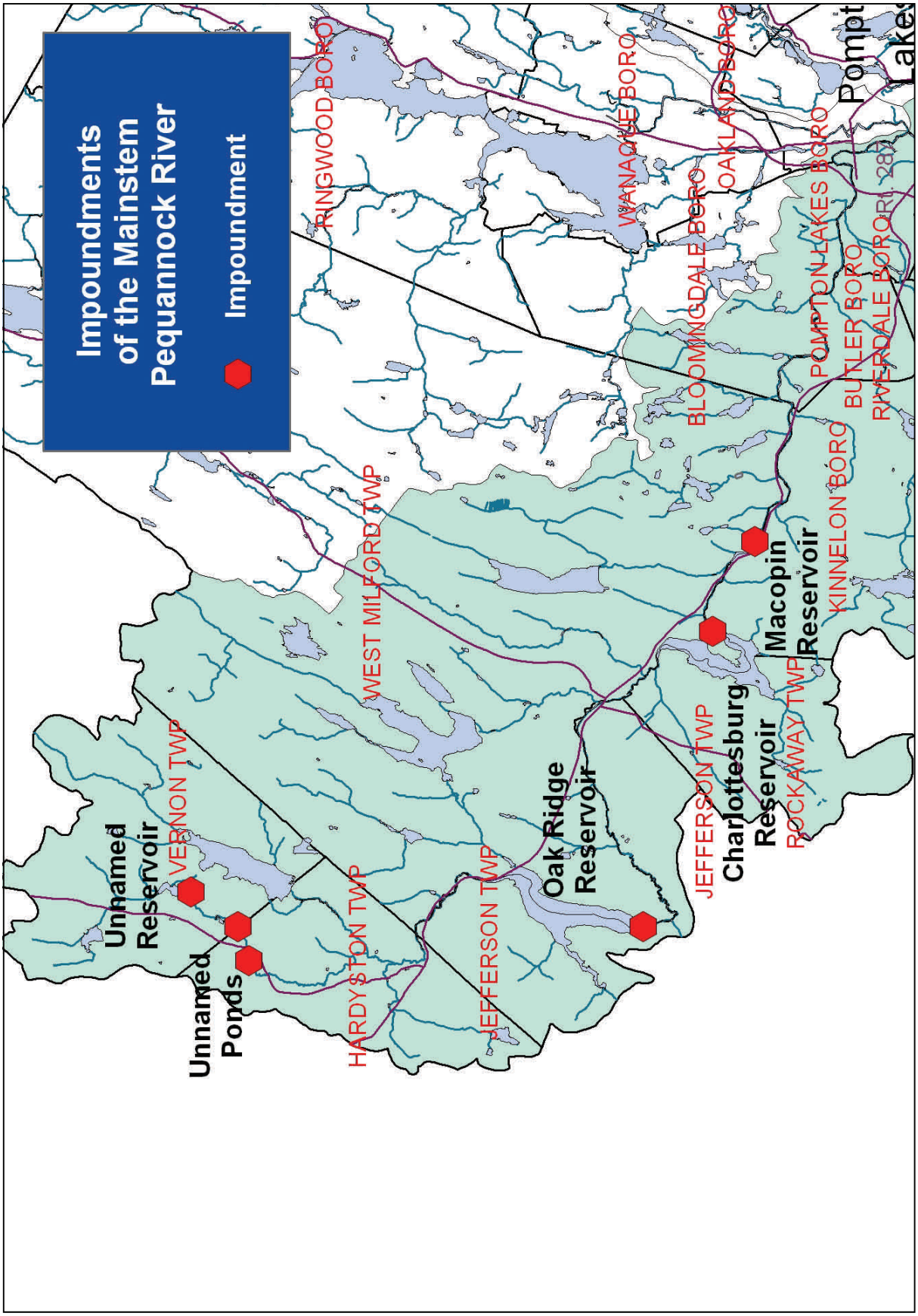


Figure 2C-7 – Impoundments of the Mainstem Pequannock River

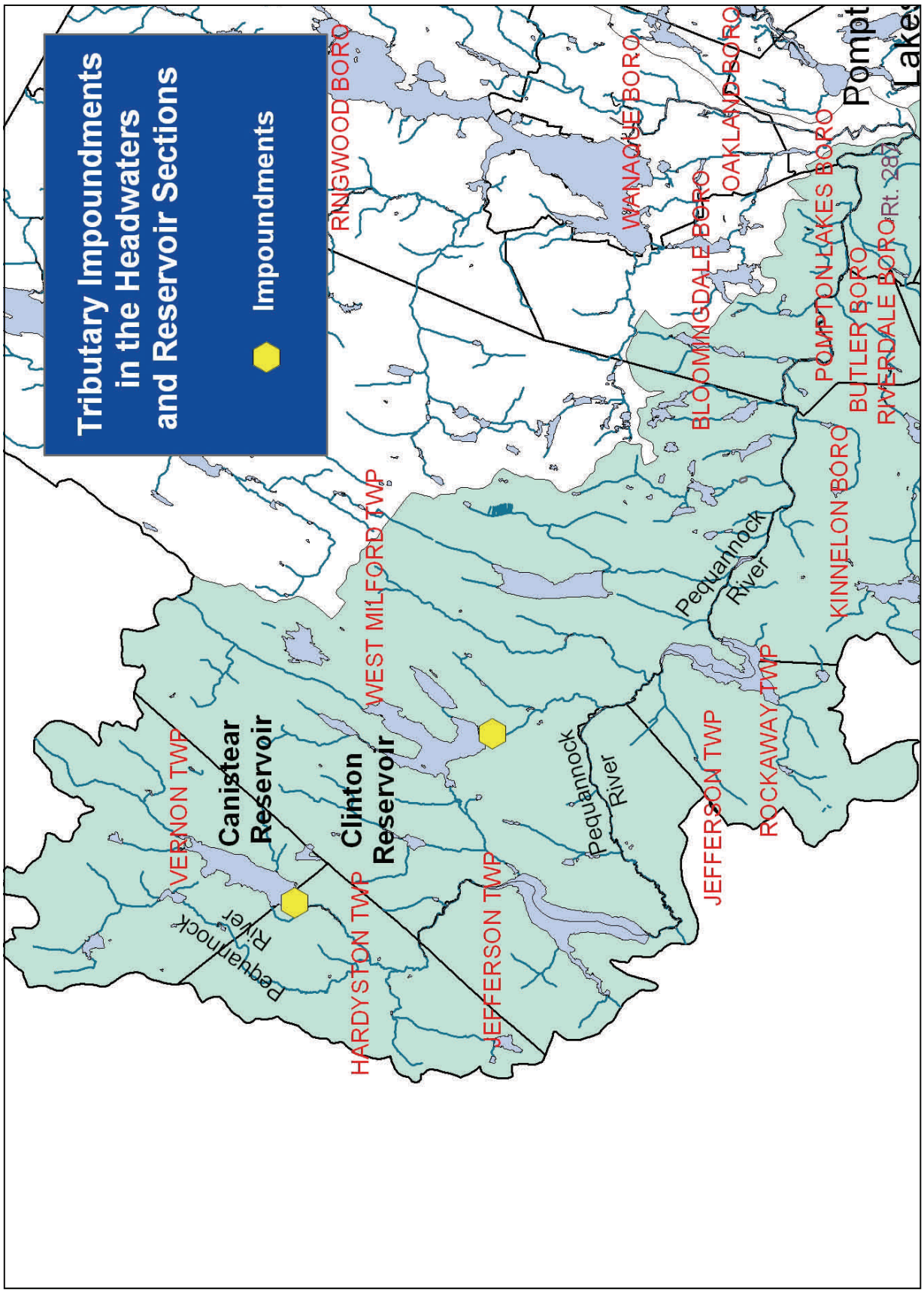


Figure 2C-8 – Tributary Impoundments in the Reservoir and Headwaters Sections of the Pequannock River

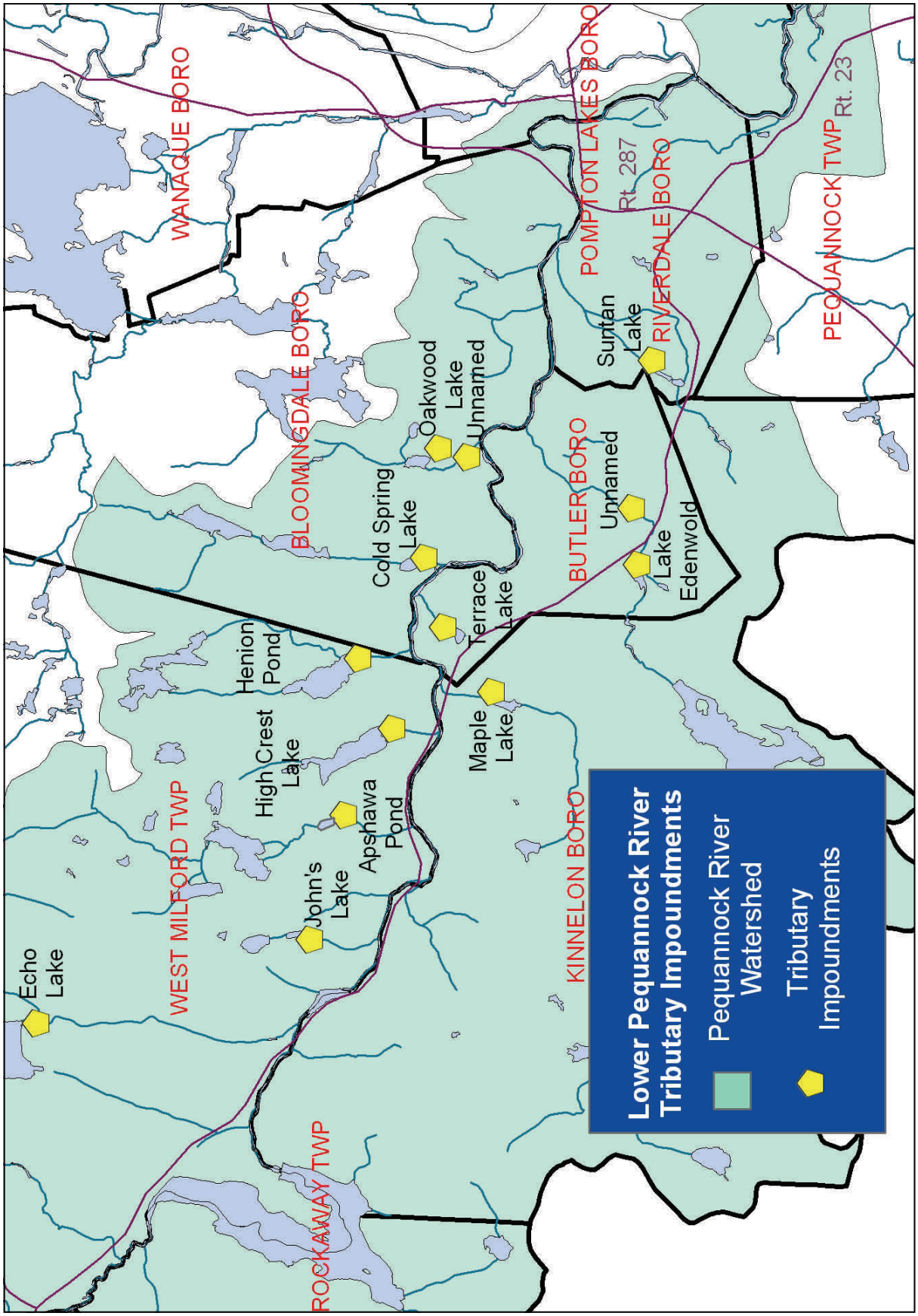


Figure 2C-9 – Tributary Impoundments – Lower Pequannock River Watershed

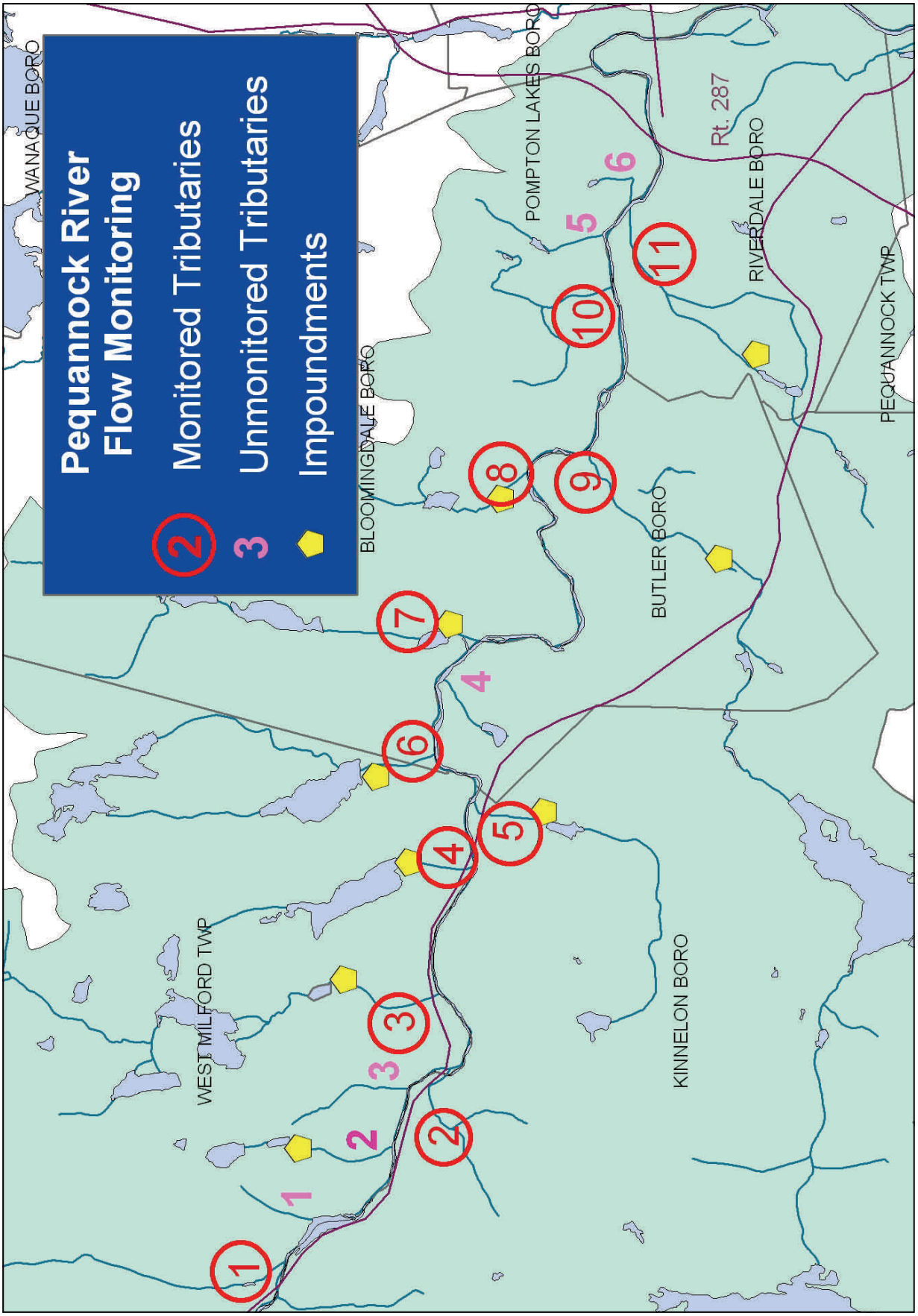


Figure 2C-10: Pequannock River – Tributaries monitored - 2004

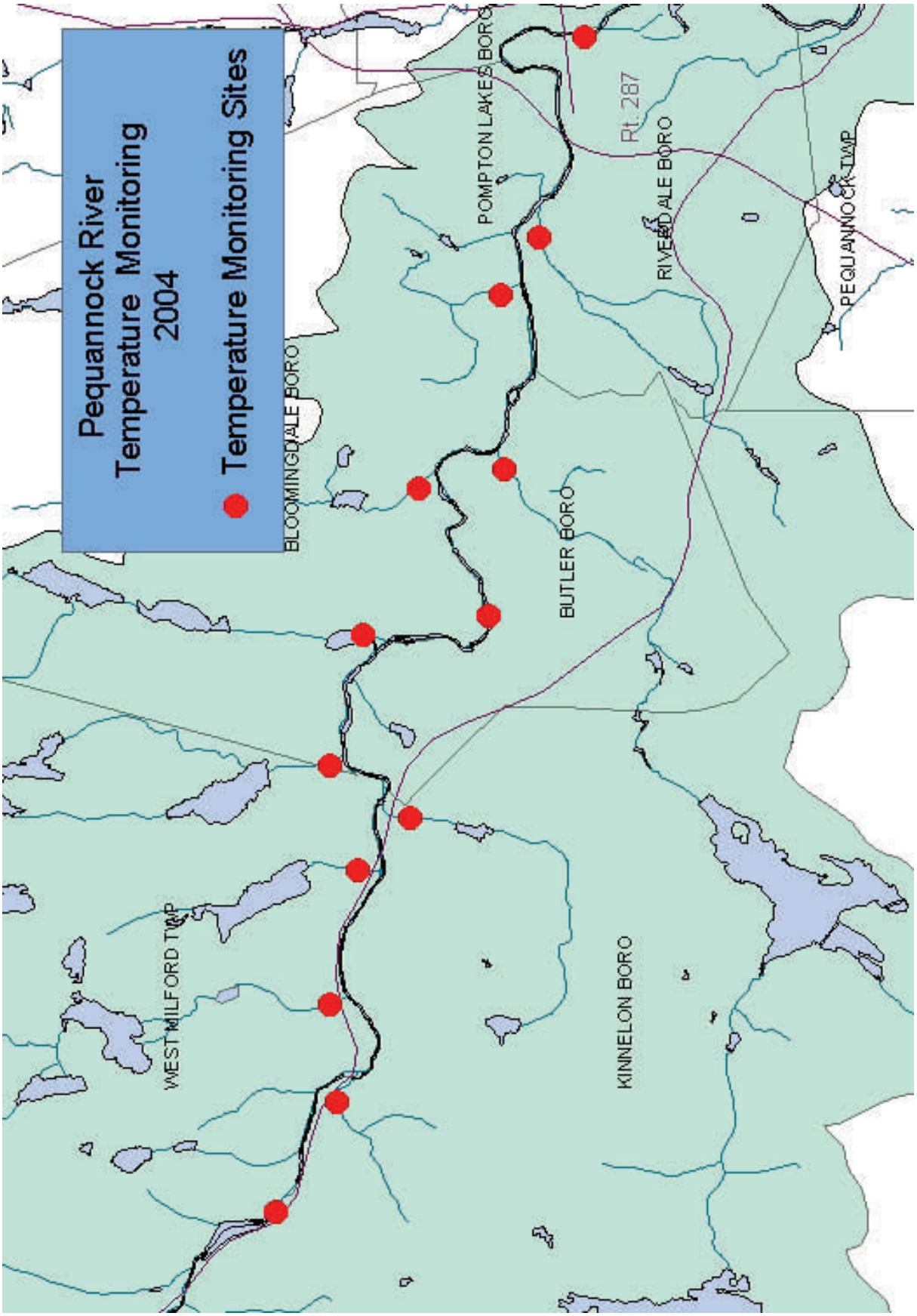


Figure 2C-11: Pequannock River – Flow/temperature monitoring sites - 2004

Site/Tributary	Average Water Temp	Maximum Water Temp	Number of Days Water Temp > 68	% of Days Water Temp > 68	Number of Days Water Temp > 75	% of Days Water Temp > 75
Apshawa Brook	65.98	72.48	47	45	0	0
Maple Lake Tributary	64.79	72.09	25	24	0	0
Cold Spring Lk Tributary	75.64	84.86	93	99	83	89
Oakwood Lk Tributary	70.28	81.16	89	94	27	29

Table 2C-1: Comparative temperatures in Pequannock River tributaries

D) Flow Rates

a) Current conditions

Flow rates in streams and rivers can influence water temperatures substantially. According to one study[2], where flows are greatly reduced "...water temperature becomes a limiting factor, especially in the lower reaches of streams in July and August." This has been confirmed through data collected by the Pequannock River Coalition at several sites.

Figure 2D-1 – Low flows on the Pequannock River below Oak Ridge Reservoir caused by inadequate water release

Low flow rates contribute to high water temperatures in summer months through thermal uptake; a consequence of reduced water depth in relation to surface area. The result of reduced flows is a larger percentage of the water column in contact with the air and the streambed and exposed to direct sunlight. Higher flows have a reverse effect as stated in another study[3] which found that "Increasing flows leads to a larger flow depth, and hence an increased heat capacity per unit surface area, thus attenuating atmospheric heating to a larger extent." This is particularly important where flows are unnaturally erratic, since abnormally high flows may carve an oversize river channel that will be covered only thinly with water during low flow periods, or typical high flows create a channel that has insufficient water during periods of abnormally low flows.

Low flows may be caused by natural conditions such as drought, but are aggravated by artificial manipulation as occurs in rivers and streams below water supply impoundments (see Figure 2D-1).

This can be further aggravated by any reduction in flows that may result from an increase in impervious coverage with a concurrent decrease in groundwater recharge and subsequent loss of base flow. Increased impervious coverage can also cause higher runoff volumes during storm events resulting in abnormal widening of stream and river channels.

While drought cannot be controlled, the artificial manipulation of flows and the extent of impervious cover can be altered. It is difficult to gauge the sole impact of drought on water temperatures since almost every segment of the Pequannock River and many river tributaries are influenced by controlled water releases from impoundments, making it impossible to segregate drought conditions from man-made low flows. However, it is significant to note that at the only site on the Pequannock River where historical flow[4] and temperature data are available (Pequannock River Below Macopin Reservoir) the highest water temperatures often occur on summer days with the lowest flows. A summary of this data is provided in Table 2D-1.

In contrast, the single tributary monitored without any upstream impoundments (Matthews Brook) had the lowest recorded temperatures of any site in the Pequannock Watershed for the year this tributary was monitored (2003). Graphs of recorded temperatures for these waterways are provided in Appendix x.

Date of lowest flow for year	Lowest flow rate for year	Highest temperature (F) on date of lowest flow	Highest temperature (F) for year
07/10/00	2.5 cfs	75.03	78.25
07/25/01	.75 cfs	80.84	80.84
08/18/02	.20 cfs	81.47	81.47

Table 2D-1: Summary of Flow/Temperature Data for Pequannock River Below Macopin Reservoir 2000-2002

b) Applicable BMPs and Mitigation Approaches

Regulation by the State is the most important mitigation approach since flow rates can be mandated through Water Allocation permits. Changes to existing permit conditions for the Priority Water segment of the Pequannock River have already been adopted, but have yet to be met. Similar permit requirements could be implemented on substantial river tributaries impacted by reservoirs, including Clinton Brook (releases from Clinton Reservoir), the Macopin River (releases from Echo Lake) and Kakeout Brook (releases from Butler Reservoir).

To some degree flow rates can also be protected by promoting stormwater management techniques that increase groundwater recharge and by reducing groundwater consumption. Stormwater management techniques are explored in detail in Section E of this report.

c) Applicable Model Ordinances

In areas where groundwater provides potable supplies to municipal or private users, water conservation efforts can aid in protecting these groundwater supplies with subsequent benefits for stream and river base flows. Two examples of model water conservation ordinances are included in Appendix G.

E) Stormwater Runoff and Impervious Coverage

a) Existing Conditions

Stormwater runoff from developed areas is widely recognized as a major water quality influence. This is of greatest concern in the Lower Section of the Pequannock River Watershed. The small amount of development in the Reservoir and Headwaters Section reduces these impacts.

Many recent development projects in the Lower Section of the Pequannock Watershed rely on dry extended detention basins or wet ponds for stormwater management. Although these basins can be effective at controlling peak runoff rates, their impact on water quality and quantity is negative and the generated runoff typically has a temperature much higher than spring-fed tributaries. A Montgomery County, Maryland study of extended detention basins[5] found basin discharge temperatures reaching 80F to 83F. The NJDEP BMP manual notes that "…stormwater falling on impervious surfaces or stored in detention/retention basins can become heated and raise the temperature of the receiving water body, which in turn can adversely affect cold water species such as trout."

Wet ponds, another commonly used BMP, offer an improved level of pollutant removal but according to one study[5], like dry extended detention basins, studies have shown they can elevate runoff temperatures by as much as 18F, and also reduce groundwater recharge. Older developments typically incorporated no stormwater treatment whatsoever. Runoff from roads, parking lots and rooftops was discharged directly to waterways or to existing stormwater piping.

While it is difficult to measure the amount of stormwater runoff in the Lower Section of the watershed, some indication can be gleaned from the large number of stormwater outfalls recently mapped by the Pequannock River Coalition in this area. These outfalls are shown on Figure 2E-1.

This can be compared with the minimal number of outfalls mapped in the Reservoir Section (see Figure 2E-2).

Although stormwater runoff is assumed to be a substantial cause of temperature elevation, this should be measurable by relating storm events to temperature spikes in the Pequannock River. For this report, rainfall data recorded at Caldwell, NJ by the National Oceanographic and Atmospheric Administration[6] for 2004 was compared to temperature data recorded by the Pequannock River Coalition at 3 sites on the mainstem Pequannock River. A close examination of this data in relation to temperature shows some correlation. At 2 sites where temperature data is available – "Pequannock River at Macopin Reservoir" and "Pequannock River at Riverdale" – there are no distinct spikes in relation to storm events. However, at the "Pequannock River at Butler" site there were definite spikes during moderate storm events of about .50 inches of rainfall in 24 hours. Larger storms and smaller storms did not have the same effect. Table 2E-1 shows a list of the storm events for 2004. Figure 2E-3 shows the result of 2 moderate storm events on 06/17/04 and 06/25/04. The elevated peaks are readily discernible, rising 1-2 degrees above typical temperatures. Figure 2E-4 shows the result of a larger storm event (1.62 inches of rain in 24 hours on 08/12/04) where river temperatures dropped slightly in response. These peaks during moderate storms may be expected since the highest temperatures from stormwater runoff could be seen in the "first flush" of runoff from impervious cover. Larger storms with resultant elevation in natural runoff, raising stream and river flows, may mask these impacts. In addition, heavy cloud

Date	Maximum Air Temperature (F)	Rainfall Amount (inches in 24 hours)
06/17/04	87	.62
06/25/04	82	.50
07/12/04	72	1.62
07/18/04	72	1.34
07/23/04	77	1.63
07/27/04	71	1.36
08/11/04	82	.89
08/12/04	81	.60
08/21/04	82	.93

Table 2E-1 – Storm Events (.50 inches or greater) for 2004

cover during large storms may reduce sunlight and air temperatures sufficiently to offset stormwater influences, while small storms may generate insufficient runoff to produce a measurable temperature spike.

One potential cause of these temperature spikes at the Butler site is the proximity of a large area of impervious cover in the adjacent Waterfall Village apartment complex. This complex is drained by 5 stormwater outfalls in close proximity to the river (see Figure 2E-1). A storm event releasing a sudden flush of heated stormwater through these outfalls might cause, and would certainly contribute to, a pronounced spike. This offers the potential for a mitigation project at this site to collect and treat the stormwater from this series of outfalls. This is explored in section 5-j of this report.

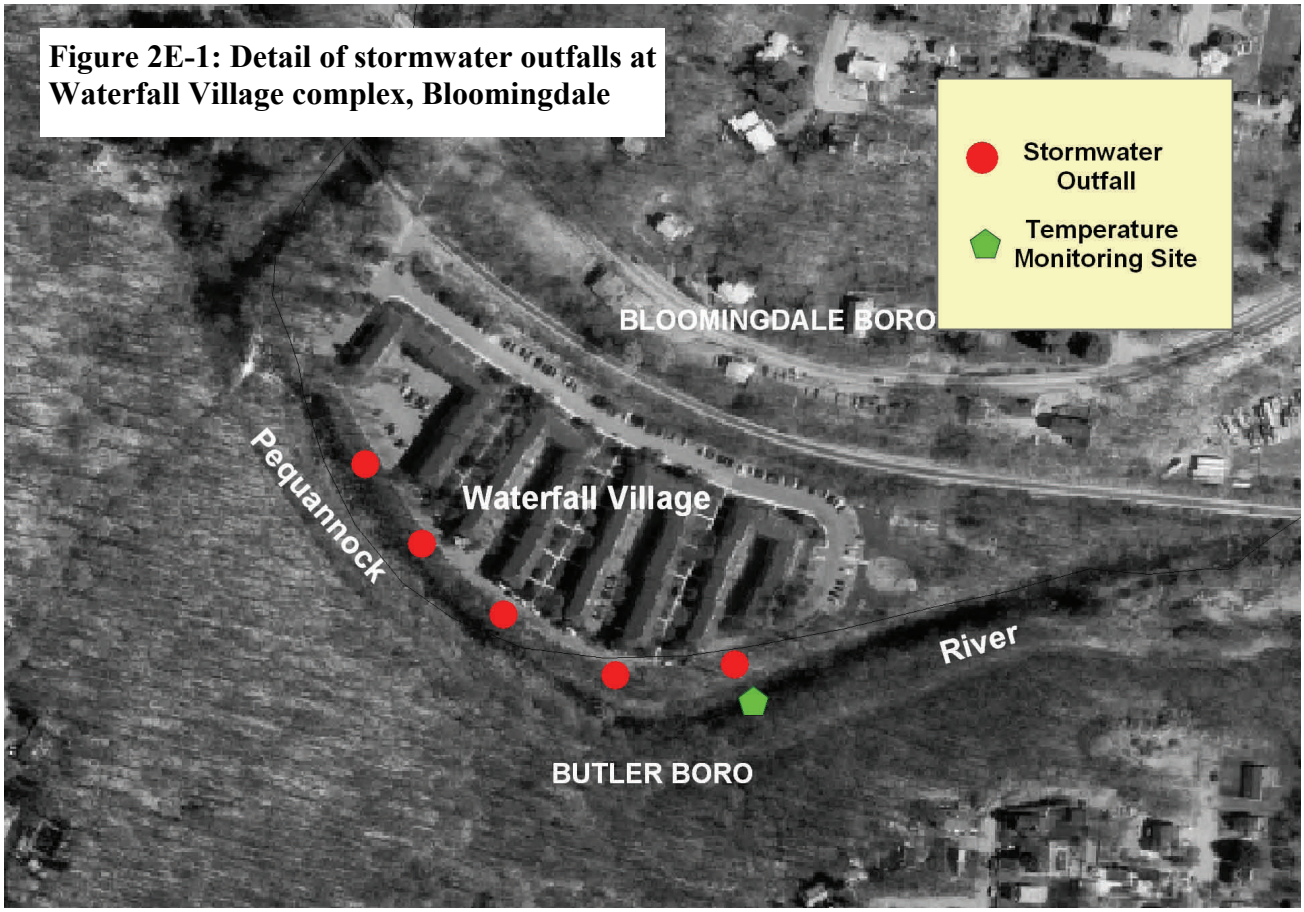


Figure 2E-1: Detail of stormwater outfalls at Waterfall Village complex, Bloomingdale

Although stormwater runoff is an influence only during storm events, there are also peripheral impacts. An increase in stormwater runoff is accompanied by a reduction in groundwater recharge, thereby reducing stream and river flows during non-rainfall periods. In addition, increases in impervious cover near waterways can mean the loss of shading riparian vegetation with resultant elevation in water temperatures.

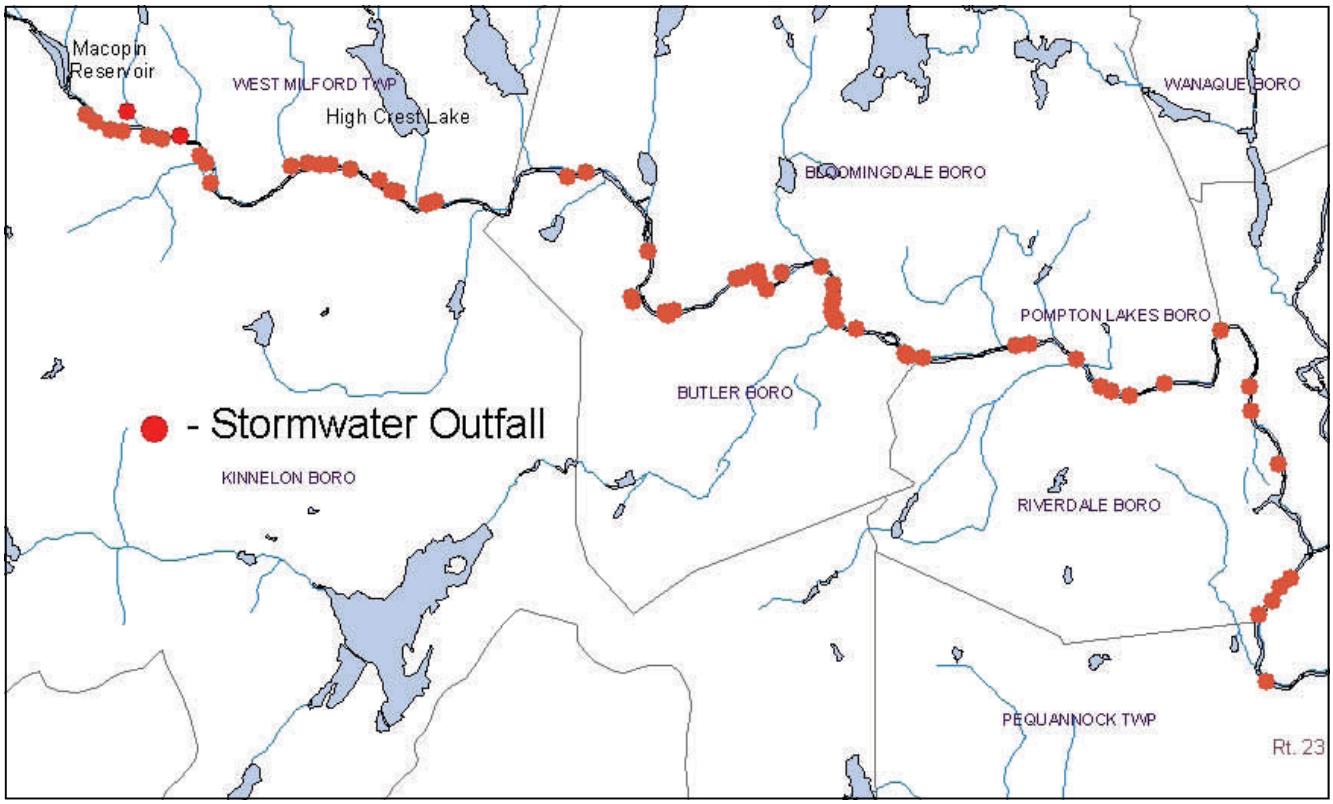


Figure 2E-2 – Stormwater Outfalls – Lower Section of the Pequannock Watershed

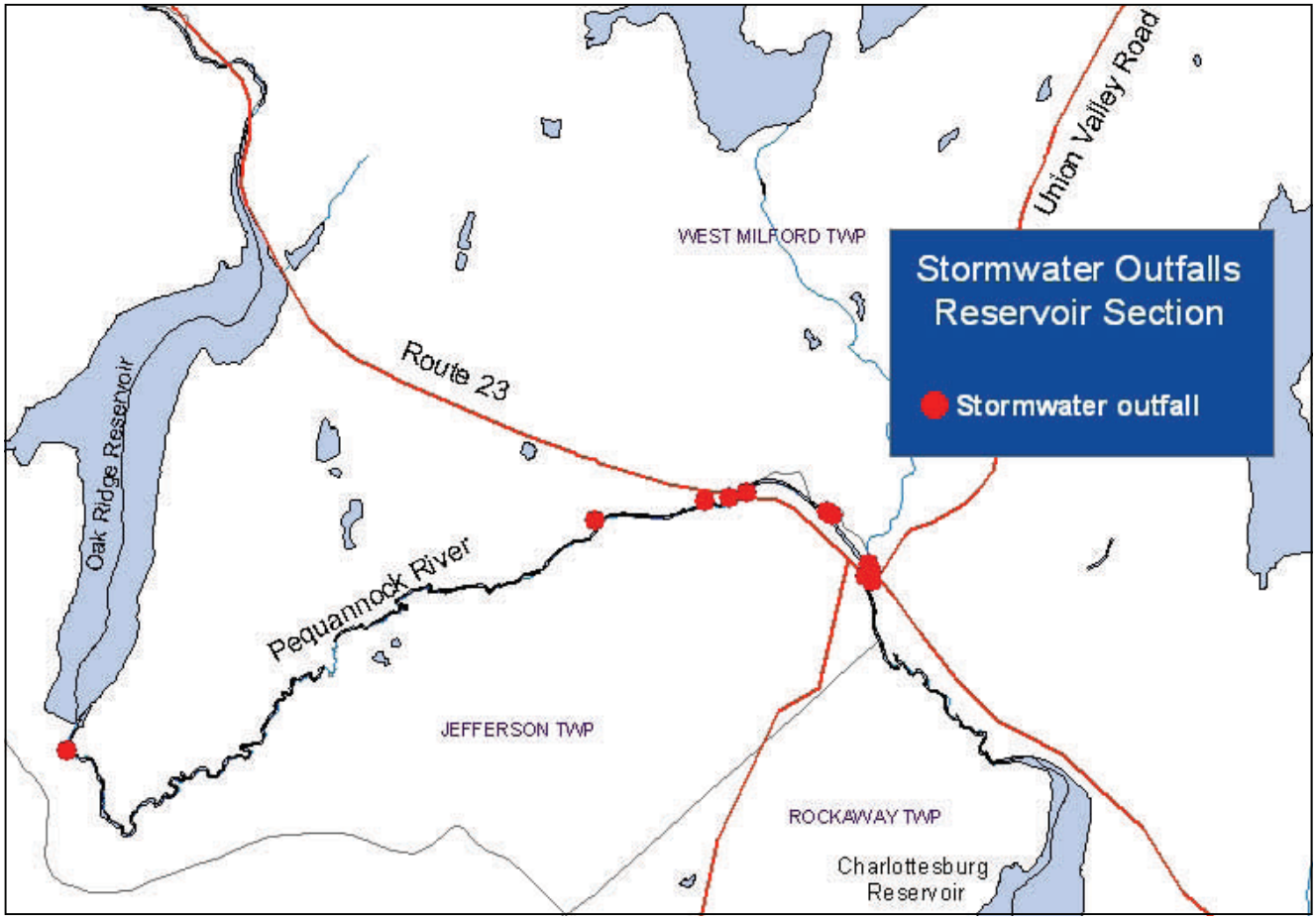


Figure 2E-3 – Stormwater Outfalls - Reservoir Section of the Pequannock Watershed

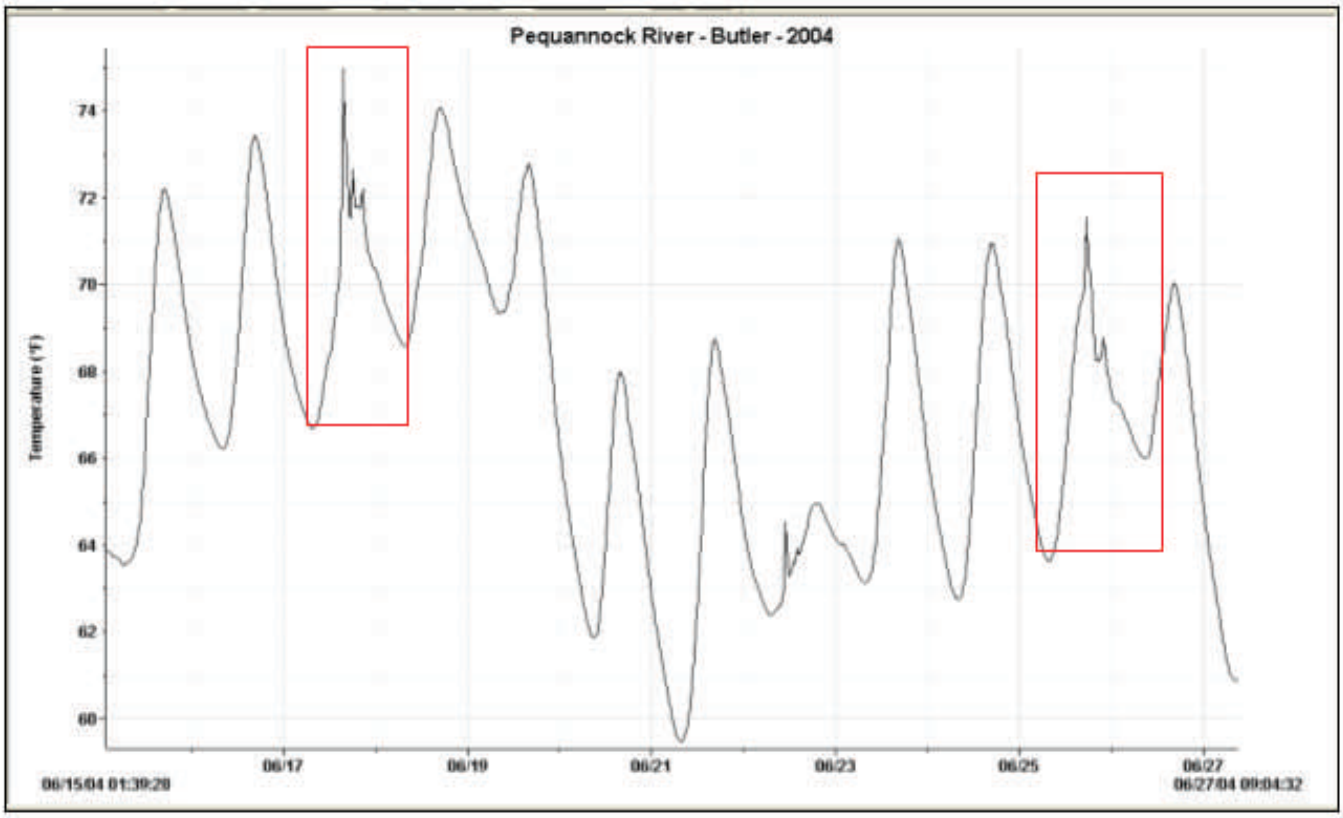


Figure 2E-4 – Pequannock River Temperature Spikes During Storm Events of 06/17/04 and 06/25/04

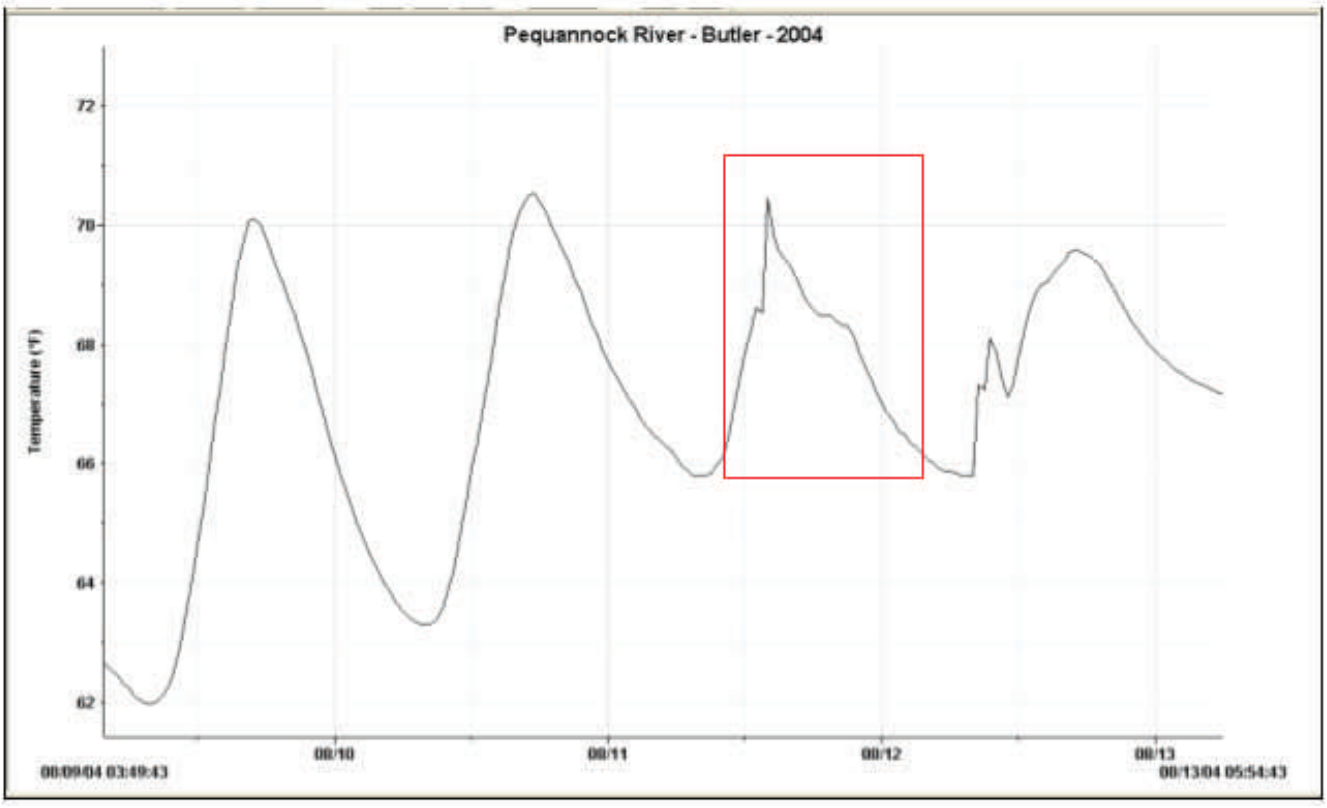


Figure 2E-5 – Pequannock River Temperatures During Storm Event Of 08/12/04

This combination of factors makes it difficult to segregate the influence of each. However, in general, the Pequannock River Coalition has found that streams with relatively undeveloped watersheds produce lower water temperatures than those with higher levels of development. As an example, Figure 2E-5 shows comparative temperatures for Apshawa Brook and Kakeout Brook. Accompanying maps (Figures 2E-6 and 2E-7) show the development patterns in these watersheds. Note the difference in the extent of development and the corresponding difference in recorded temperatures.

Also, pronounced temperature spikes during moderate storm events, similar to those recorded in the Pequannock River at the Butler site, can be seen in graphs for Kakeout Brook. These are minimal during the same storm events for Apshawa Brook (see Figure 2E-8). In addition, it is evident that all daily temperature swings from typical morning low to evening high were amplified in Kakeout Brook.

While it is difficult to draw firm conclusions from this data it would seem that at certain sites under certain conditions, stormwater runoff can cause temperature spikes in the Pequannock River Watershed. Clearly, further study is warranted.

b) Applicable BMPs and Mitigation Approaches

Reducing the impacts of stormwater runoff on stream and river temperatures relies on lowering the volume and temperature of the runoff generated. It should be noted that the new Stormwater Management Rules (N.J.A.C. 7:8) creat several new requirements for major development including minimization of site disturbance, use of non-structural controls and recharge of stormwater. Recharge is certainly a benefit in this regard. Several best management practices (BMPs) offer methods of increasing recharge of groundwater. This not only reduces the volume of runoff but also helps to maintain base flows during non-rainfall periods. These BMPs include infiltration basins, bioretention basins, pervious paving, vegetated swales and discharge as sheet flow.

In their Best Management Practices Manual[8] (BMP Manual) the NJDEP states "*Infiltration basins are used to remove pollutants and to infiltrate stormwater back into the ground. Such infiltration also helps to reduce increases in both the peak rate and total volume of runoff caused by land*

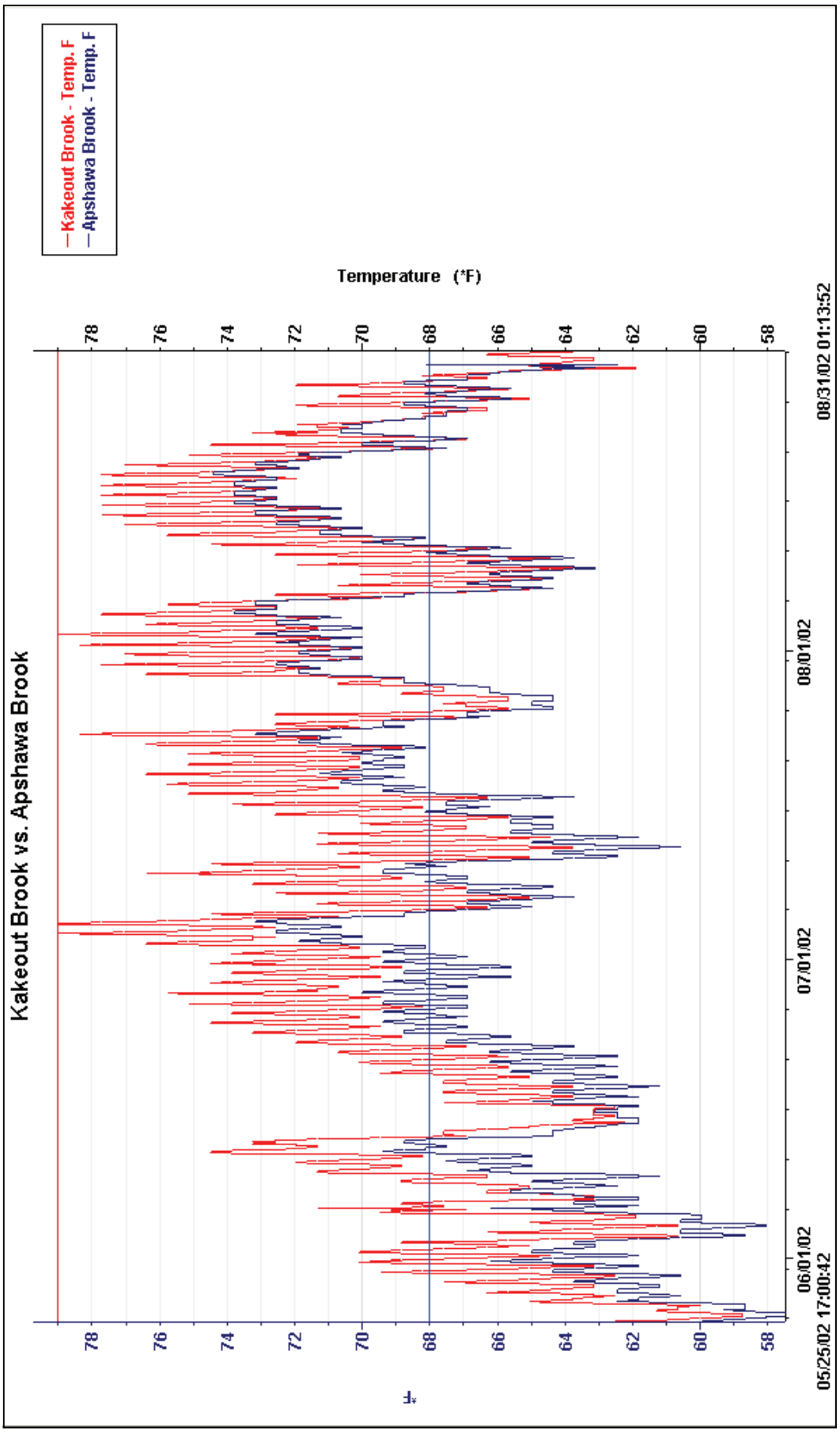


Figure 2E-6 – Comparison of temperatures – Apshawa Brook vs. Kakeout Brook

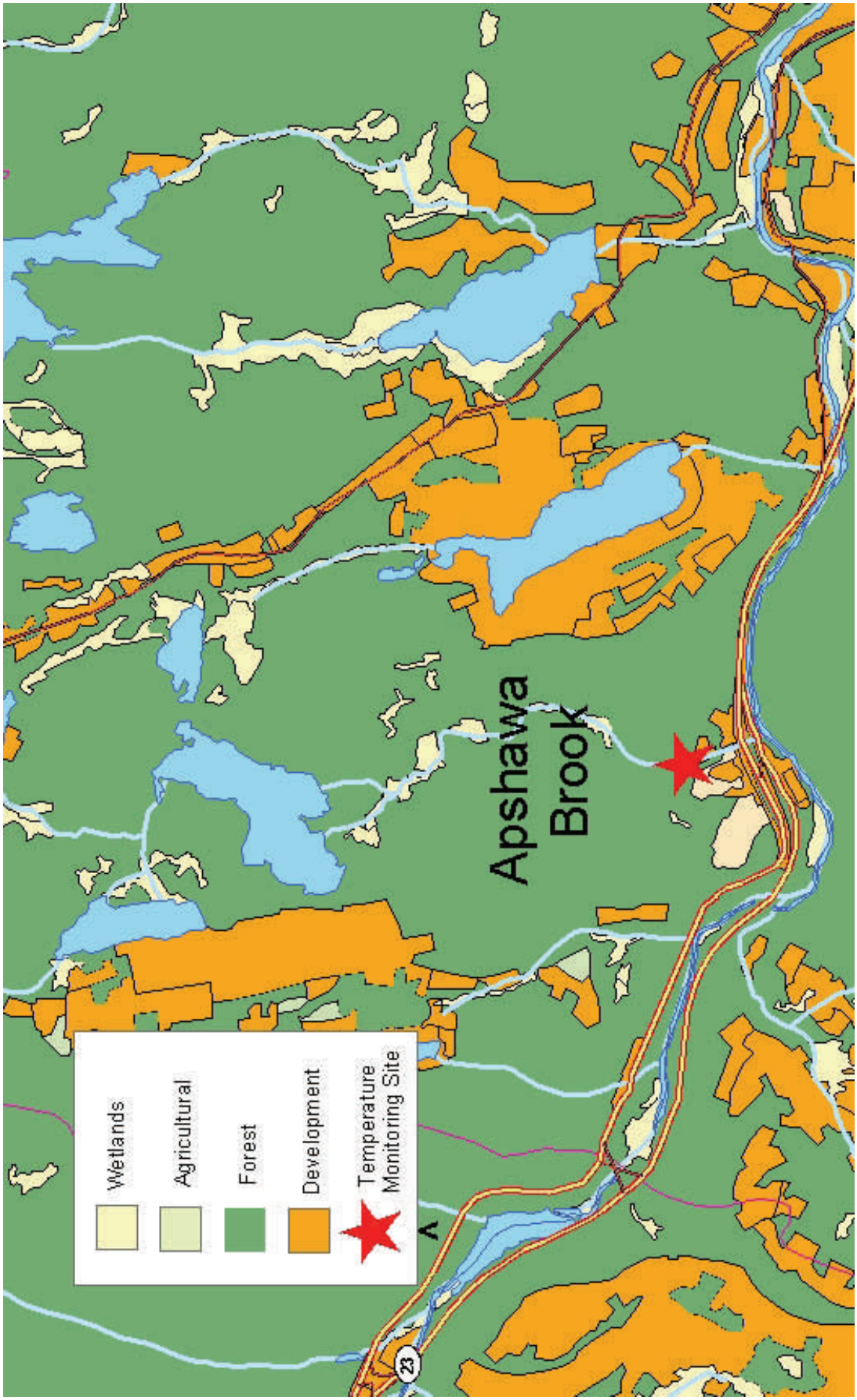


Figure 2E-7—Land Use in the Apshawa Brook Subwatershed

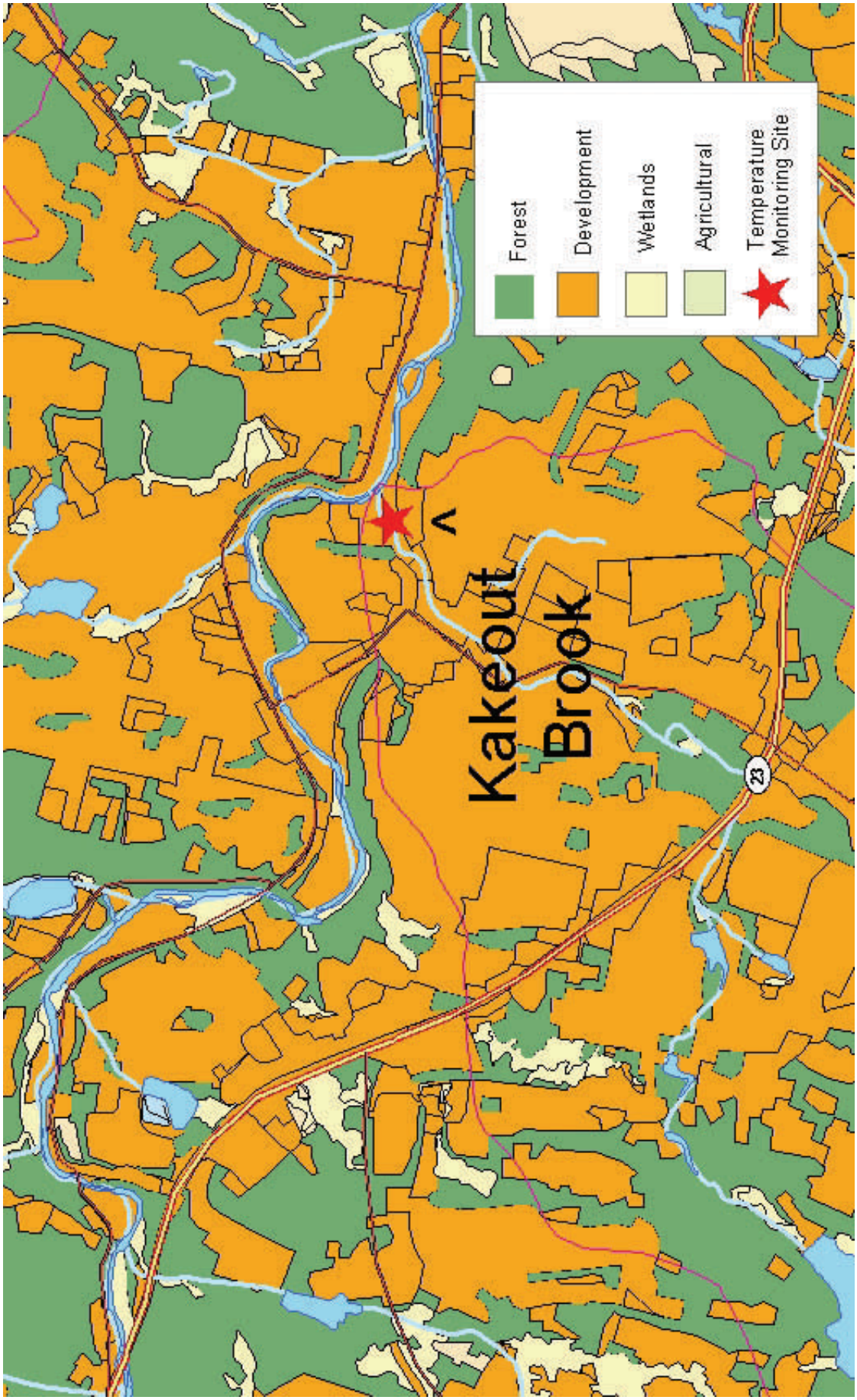


Figure 2E-8—Land Use in the Kakeout Brook Subwatershed

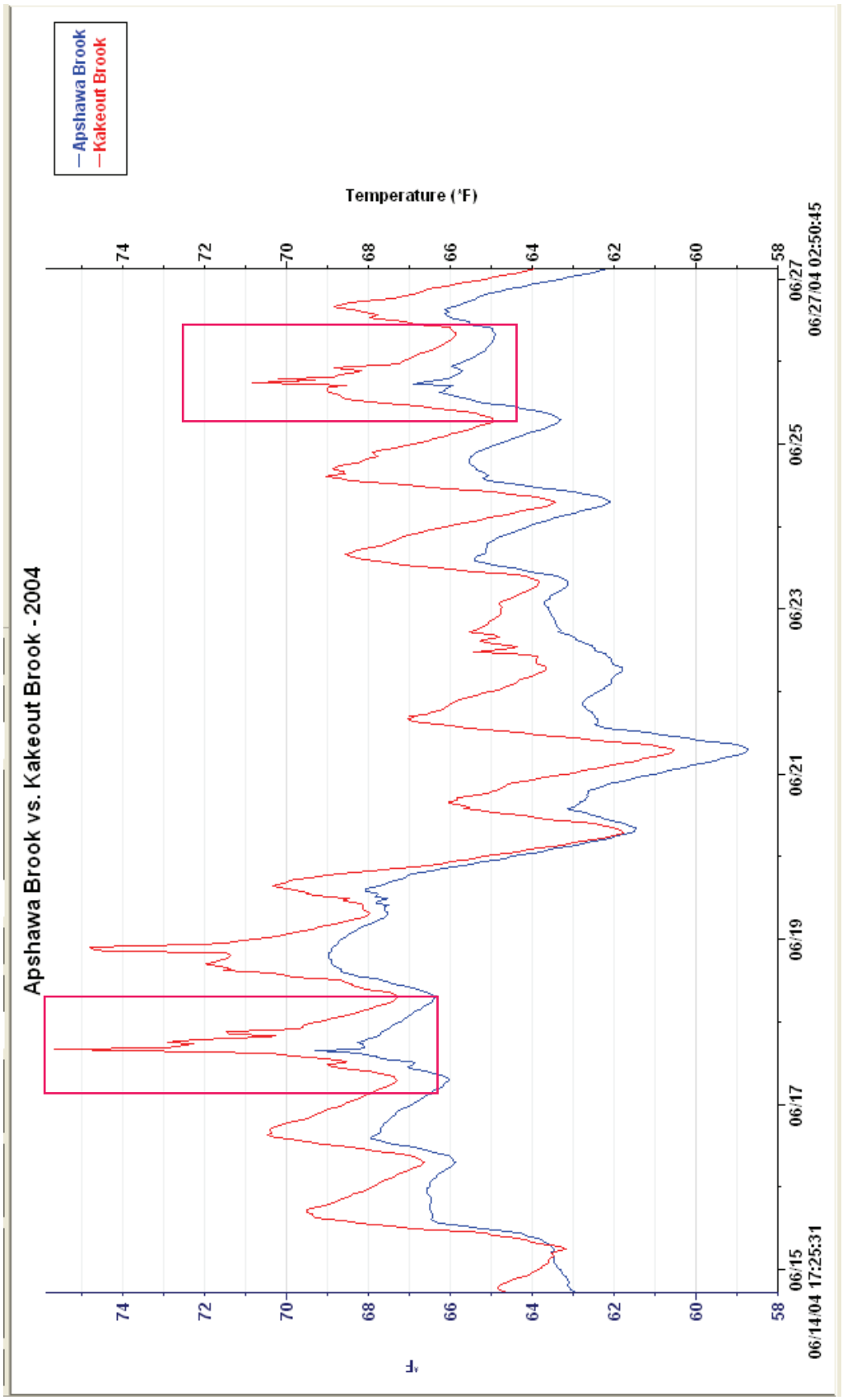


Figure 2E-9 – Kakeout Brook/Apshawa Brook Temperature Spikes During Storm Events of 06/17/04 and 06/25/04

development. Pollutant removal is achieved through filtration of the runoff through the soil as well as biological and chemical activity within the soil."

Of principal interest here is the recharge of runoff. These basins are limited to sites with suitable soil permeability, and according to the NJDEP "…*are not appropriate for areas where high pollutant or sediment loading is anticipated due to the potential for groundwater contamination."*

Bioretention systems, according to the NJDEP BMP Manual, "…*are used to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff. They can also be used to reduce peak runoff rates and improve stormwater infiltration when designed as a multi-stage, multi-function facility*." In addition, it is generally believed that the water discharging from such basins is cooled substantially by its subsurface drainage.

Pervious paving systems are another applicable BMP. According to the NJDEP "*pervious paving systems are used to reduce runoff rates and volumes from paved, on-grade surfaces such as patios, walkways, driveways, fire lanes, and parking spaces. Pervious paving systems with runoff storage beds below them achieve these reductions through the delivery and storage of runoff and eventual infiltration into the subgrade soils. Through this infiltration process, these types of pervious paving systems also achieve stormwater quality treatment. Porous paving and permeable paver with storage bed systems may also be used to meet the groundwater recharge requirements of the NJDEP Stormwater Management Rules. See the Recharge BMP Design Guidelines in Chapter 6: Groundwater Recharge for a complete discussion of these requirements and the use of pervious paving and other groundwater recharge facilities to meet them. Permeable pavers without storage bed systems also achieve reductions in runoff rates and volumes, primarily by generating less surface runoff than conventional paving. However, due to the lack of a runoff storage bed and significant runoff infiltration, these types of pervious paving systems achieve less runoff reductions than systems with storage beds.*"

Vegetative filters, swales and buffers and discharge as sheet flow are other useful means of promoting recharge. According to the NJDEP, these "…*can be created by preserving existing vegetated areas over which runoff will flow or by planting new vegetation. Vegetative filters located immediately downstream of impervious surfaces such as roadways and parking lots can achieve pollutant removal, groundwater recharge, and runoff volume reduction. Vegetated*

buffers adjacent to streams, creeks, and other waterways and water bodies can also help mitigate thermal runoff impacts, provide wildlife habitat, and increase site aesthetics." Generally these practices are limited to areas with gentle (<5%) slopes.

Beyond these documented BMPs, some studies[9] have shown that the temperature of stormwater exiting detention basins is closely linked to the temperature of the inflowing stormwater Therefore, cooling this stormwater before and during detention can offer benefits. This can be accomplished by planting trees around detention basins and within detention basins and by shading contributing impervious areas to the maximum extent practicable. An example of a site where planting of shade trees around a detention basin could be accomplished is the Terrace Lake development in Butler Borough. An illustration of this site is provided in Figure 2E-10.

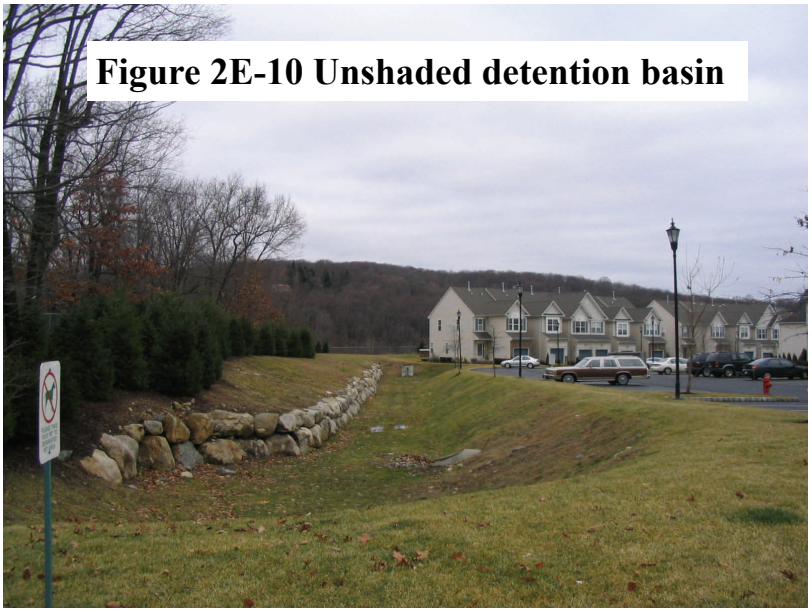


Figure 2E-10 Unshaded detention basin

c) Applicable Model Ordinances

One requirement of the Stormwater Management Rules is adoption by municipalities of stormwater management plans and stormwater control ordinances. A draft model stormwater ordinance has been provided by the NJDEP in Appendix D of the BMP Manual. This ordinance is attached in Appendix D. In describing the purpose of this ordinance the BMP Manual states: "Municipalities are encouraged to develop and adopt regional stormwater management plans and implement ordinances for specific drainage area performance standards that address local stormwater management and environmental characteristics." In this regard, the measures outlined in this report could be incorporated in the stormwater ordinances for municipalities in the Pequannock River Watershed. Language encouraging increased recharge, bio-retention, shading of impervious cover and shading of detention basins can be readily inserted. Further discussion on this topic is provided in Section 5-j of this report

F) Beaver Activity

Figure 2F-1: Beaver

a) Current conditions

Beavers are large aquatic rodents weighing up to 60 pounds (see Figure 2F-1). Beavers feed on aquatic plants and on the twigs and bark of selected trees, including birch, willow, aspen, maple, ash and apple (see Figure 2F-2). Beavers construct their dams on lower gradient sections of rivers and streams. These dams create impoundments that allow beavers to feed on trees in flooded forest and adjacent uplands while limiting their exposure to terrestrial predators (see Figure 2F-3).

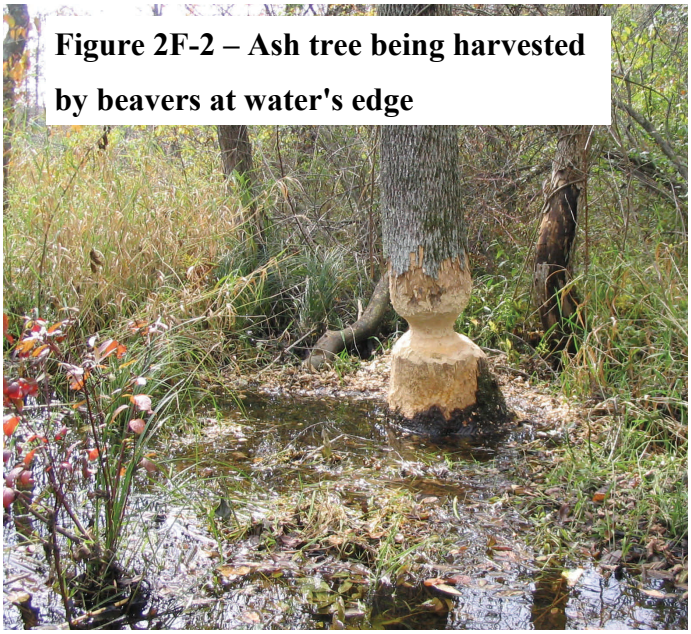


Figure 2F-2 – Ash tree being harvested by beavers at water's edge

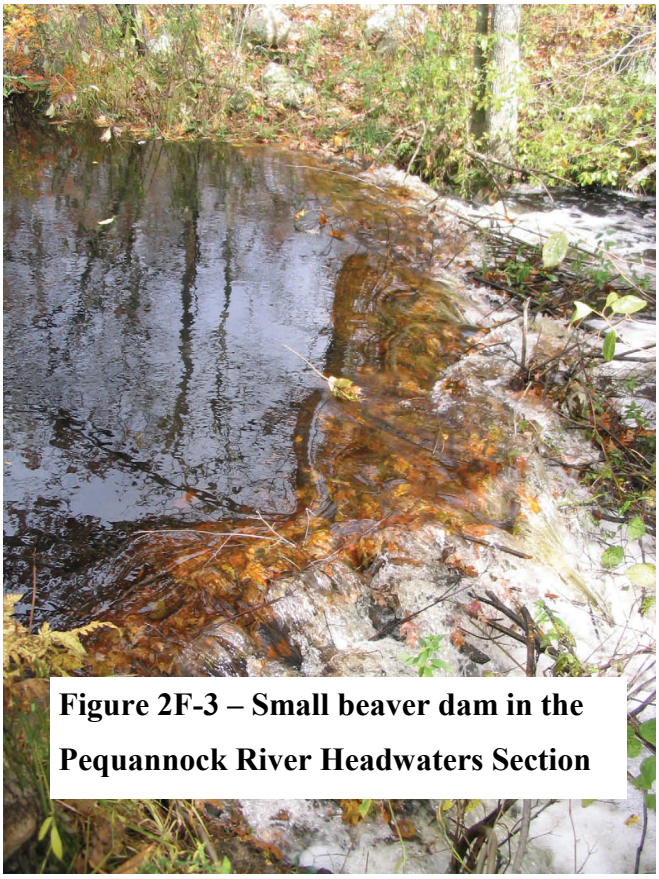


Figure 2F-3 – Small beaver dam in the Pequannock River Headwaters Section

Beavers do not inhabit the Lower Section of the Pequannock River Watershed and can be disregarded as an influence there. However, beaver activity is a major influence in the Headwaters Section and Reservoir Section of the Pequannock River Watershed.

Beavers elevate water temperature in a number of ways. Like any other impoundment a beaver pond slows and widens currents causing increased exposure to sunlight. These ponds range in size from less than ¼ acre to several acres. Flooding of adjacent land kills many trees,

while the harvest of other trees and shrubs by beavers for food and building material causes additional canopy loss.

Figure 2F-4—An abandoned beaver dam continues to impound water

Beaver ponds are often ephemeral in that beavers will generally exhaust the supply of desirable trees in and around a pond within several years. The pond is then abandoned and another site populated. A large number of beavers can de-forest miles of riverbank in a short period of time. Although abandoned dams will eventually disintegrate, some last for years or even decades and continue to impact flows and temperatures (see figure 2F-4).

In the Headwaters Section of the Pequannock River Watershed, the Pequannock River and Pacock Brook have extensive canopy loss due to beaver activity. This area was surveyed by the Pequannock River Coalition in the autumn of 2003 (Pequannock River Thermal Mitigation, Monitoring and Assessment Project, RP04-003.- see attached report "Pequannock River Headwaters Survey" in Appendix E). Within the Reservoir Section, Kanouse Brook and an unnamed tributary southwest of Kanouse Brook also have great canopy losses. To a lesser extent the Pequannock River and Clinton Brook in the Reservoir Section of the Pequannock Watershed have also been modified by beaver activity. Figure 2F-6 depicts active and abandoned beaver dams in these areas of the Pequannock River Watershed.

b) Applicable BMPs and Mitigation Approaches

The most certain method of reducing beaver impacts is to reduce beaver populations. Bobcat, coyote, otter and mink sometimes prey on beaver kits (young) and, occasionally on adults. These predators are all found in the Pequannock River Watershed, but beavers do not form a major part of their prey base and natural predation does little to reduce the overall population of beavers.

Although some beavers are also hit by vehicles or die due to natural accidents, injuries or disease, none of these sources of mortality are significant. Historically, the Eastern timber wolf was considered a major predator of beavers, and remains so in areas where wolves still survive[10] . However, wolves were extirpated in New Jersey long ago and are unlikely to return to the current highly-developed landscape. Today, humans remain the primary predator of beavers and, thus, the main factor controlling their populations. The annual removal of beavers by trapping is the best long-term solution to maintaining a balance between beaver populations, suitable beaver habitat, coldwater biota and human land uses.

This can be accomplished through recreational trapping or through targeted trapping by Fish and Wildlife staff. It should be noted that beaver ponds provide high-grade wetlands habitat for many wetlands-related species, and the beavers themselves are desirable native wildlife, so complete elimination of beavers in the Pequannock Watershed is not the intent. However, with current beaver numbers, large sections of the Pequannock River have been destroyed as wild trout habitat. This is especially important since the Pequannock headwaters and several impacted tributaries are a last stronghold of our native Brook trout; fish that are extremely sensitive to high water temperatures.

Figure 2F-5—Former beaver pond reverting to wet meadow

When a beaver dam is removed the pond area reverts to wet meadow and eventually, to forest cover (see Figure 2F-5.) Removal of active dams rarely offers long-term benefits since the dams are quickly rebuilt. However, hand removal of abandoned dams can reduce the impact of these dams and speed the conversion from pond to forest. In addition, replanting of former pond sites with trees and shrubs can also accelerate recovery. Sites that could benefit from replanting, as identified during the Pequannock River Coalition's recent survey, are depicted in Figure 2F-6.

Maintenance of adequate flows below manmade impoundments can help to reduce the number of

beaver dams in waterways. As noted, beavers build dams to provide protection from predators and to allow safe access to trees. When flows are greatly reduced in waterways inhabited by beavers they respond by building more and larger dams. This response is commonplace in the Reservoir Section of the Pequannock River.

c) Applicable Model Ordinances

Model ordinances are not applicable as a remedy for these concerns.

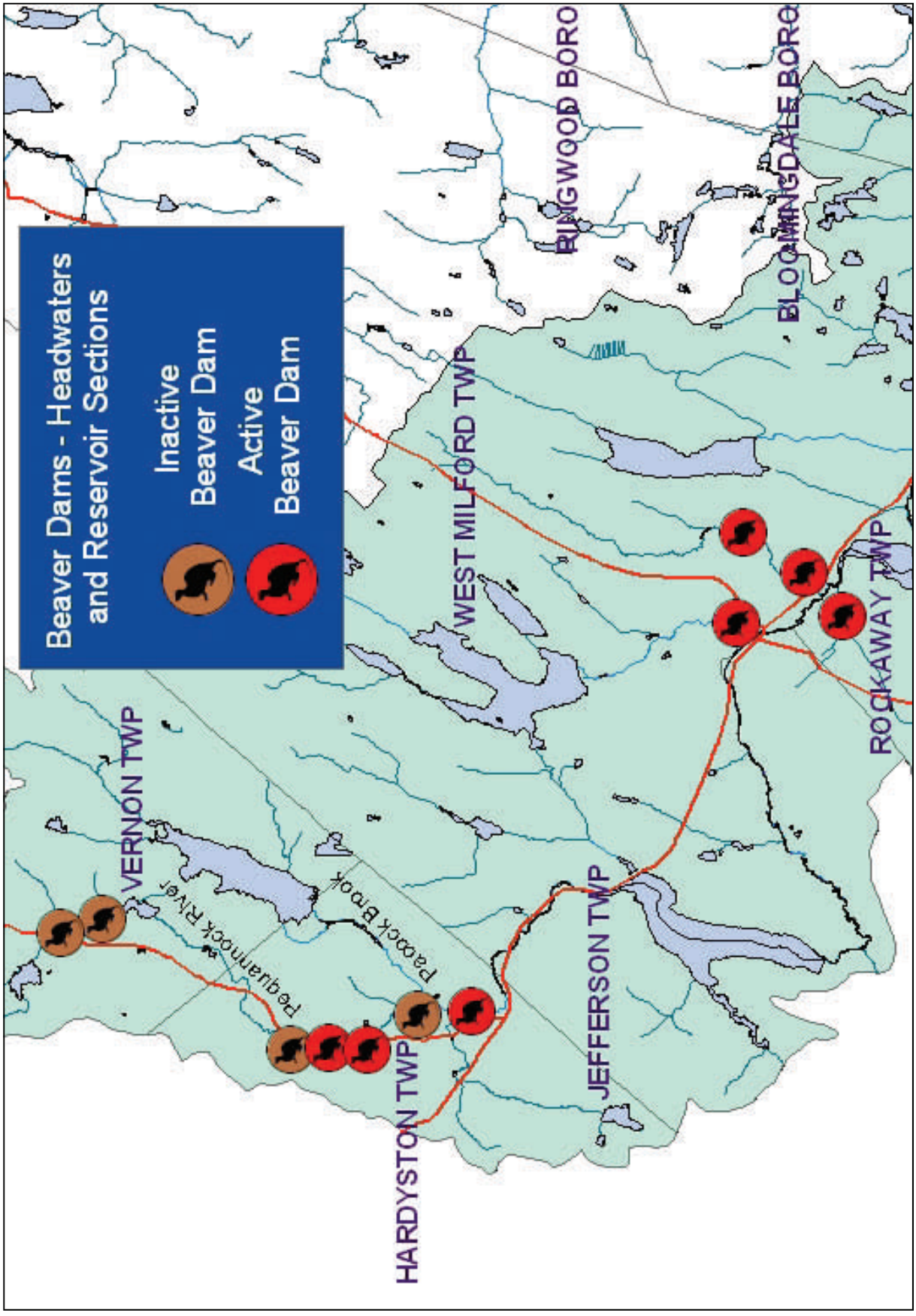


Figure 2F-6 – Beaver dams in Headwaters of Pequannock River

G) Air Temperature

Air temperature can influence stream and river temperatures whenever a difference exists between the temperatures of air and water. One study[11] found that "Air temperature will usually be the single most important factor in determining mean daily water temperature." The degree of influence is affected by the difference in temperature and air speed (wind). Often this influence is blended with other factors. For example, high air temperatures are often associated with cloudless summer days where solar radiation is also high. Nonetheless, as is illustrated in Figure 2G-1, temperatures in Matthews Brook did follow air temperatures to some degree, although the correspondence is not exact. Since air temperature cannot be controlled this influence is more informational than useful in addressing temperature problems.

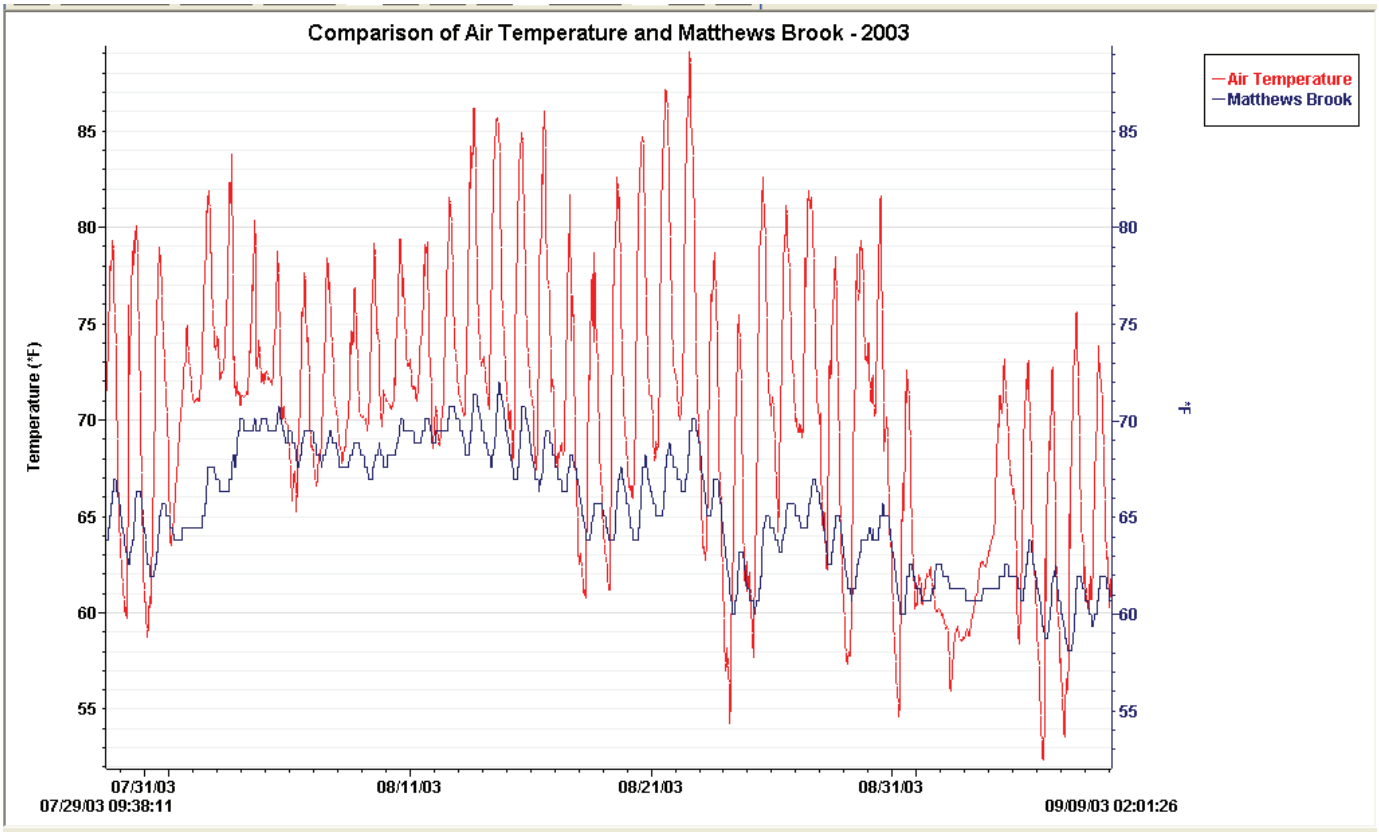


Figure 2G-1— Comparison of air temperature and water temperature in Matthews Brook – July/August/September 2003

H) NJPDES Discharges

While nonpoint sources of thermal degradation have been discussed here, some consideration should be given to point sources, particularly a NJPDES permit in the Lower Section of the Pequannock watershed that may have bearing on thermal properties. Permit # NJ00225712 issued to Vibration Mounting & Control for "thermal surface water discharge." The site of this discharge is shown in Figure 2H-1.

Although a recent analysis of the discharge for the re-issued permit showed that the proposed discharge would not result in a substantial (> 1F) elevation in river temperatures, monitoring above and below this discharge may be required to determine the actual influence.

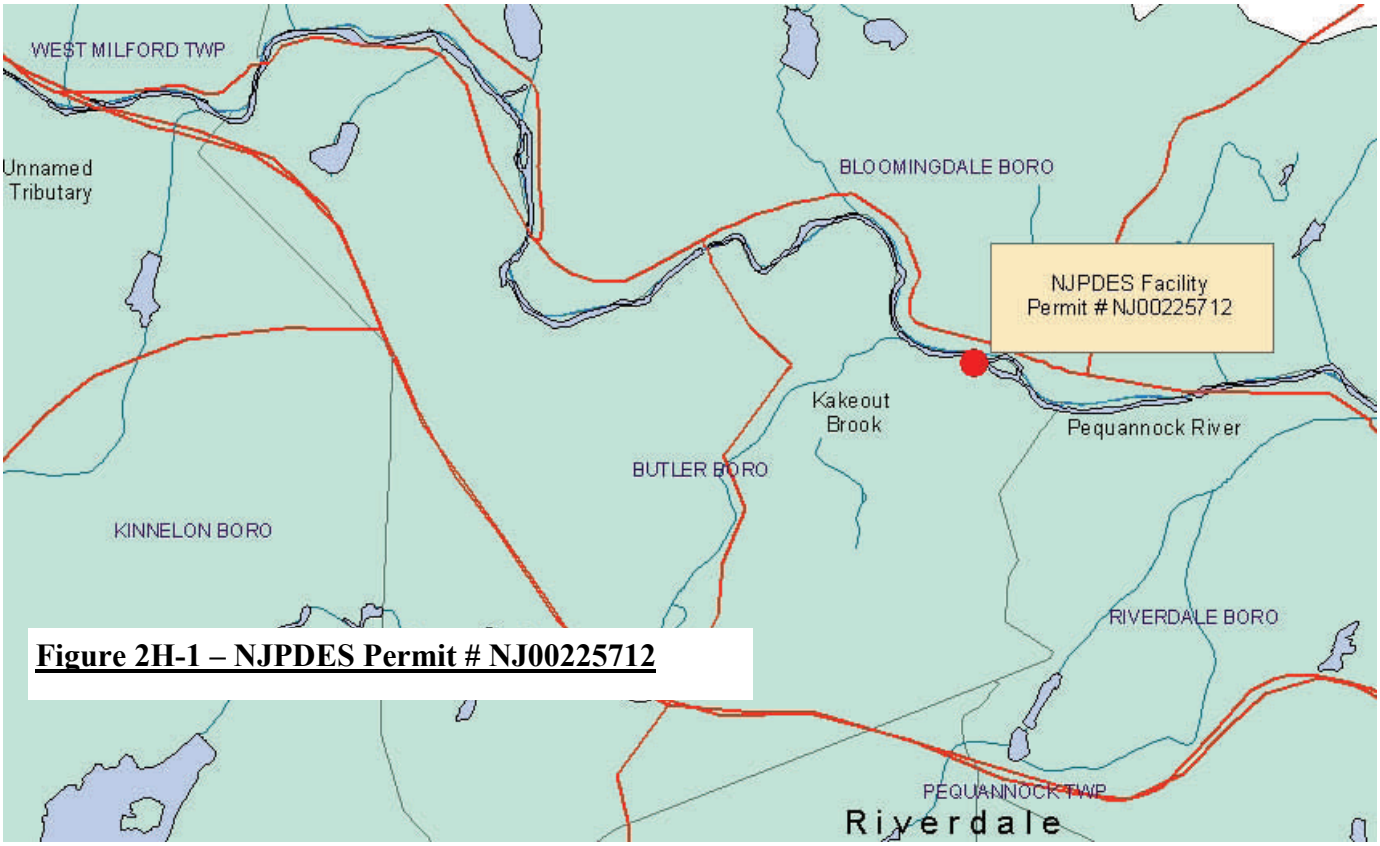


Figure 2H-1 – NJPDES Permit # NJ00225712

I) Low Dams

A series of five low dams in the Lower Section of the mainstem Pequannock are a likely source of temperature elevation (see Figure 2I-1). These dams widen the river channel substantially, thereby reducing the shaded portion of the channel and slowing flows, which results in this water being exposed to sunlight for longer periods of time. Presently these dams serve no purpose. Their removal is the best strategy of reducing these potential impacts. Additional monitoring is needed to assess the extent of temperature elevation caused by these dams and to prioritize the dams in order of importance.

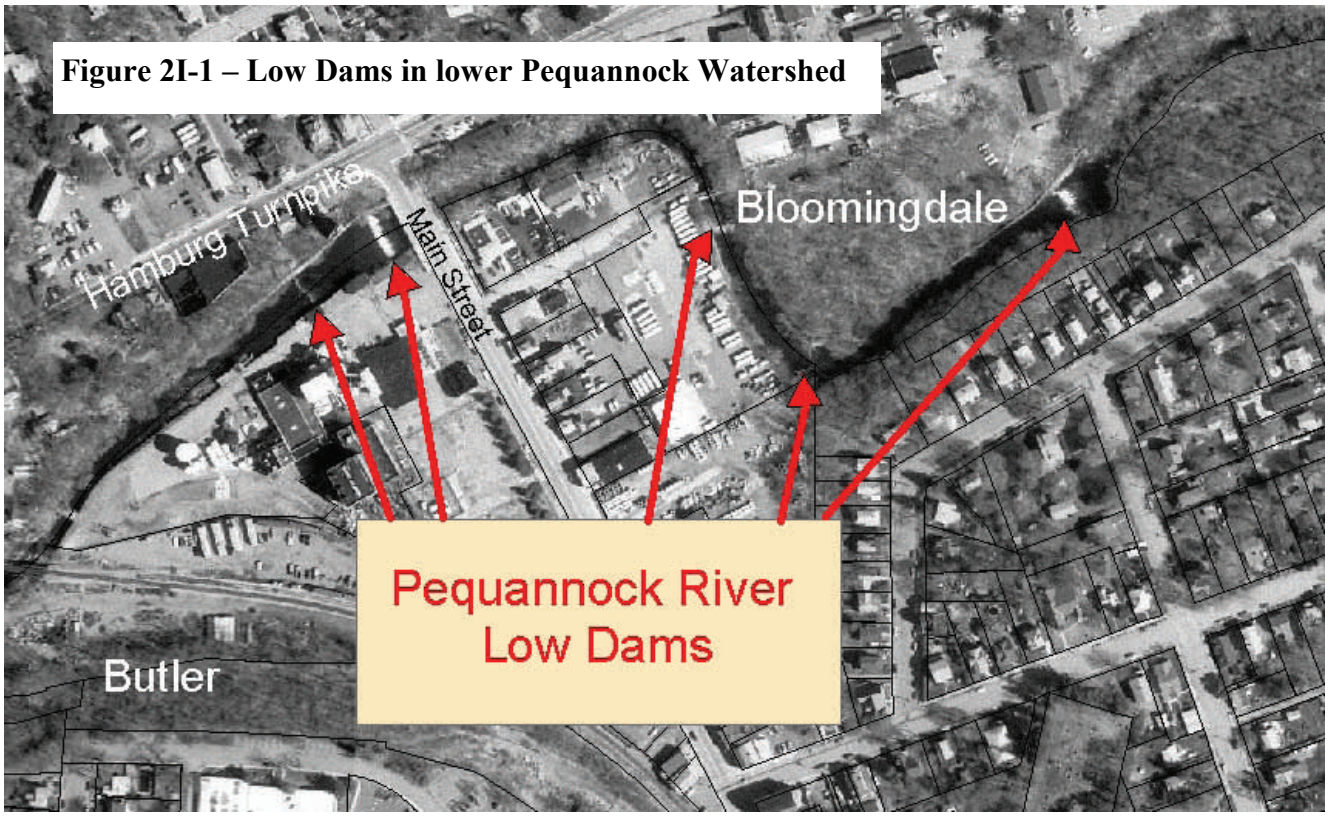


Figure 2I-1 – Low Dams in lower Pequannock Watershed

[1] Water On The Web. 2004. *Understanding Lake Ecology—Density Stratification*. http://www.waterontheweb.org/under/lakeecology/05_stratification.html

[2] Tennant, D.L. 1976. *Instream flow regimes for fish, wildlife, recreation, and related environmental resources.* In: Orsborn, J.F. and Allman, C.H. (Eds), Proceedings of the symposium and speciality conference on instream flow needs II. American Fisheries Society, Bethesda, Maryland, 359-373.

[3] Carron, John C. & Rajaram, Harihar. 2001. *Impact of variable reservoir releases on management of downstream temperatures.* Water Resources Research, Vol. 37, No. 6, pages 1733-1743

[4] Daily Streamflow for the Nation. 2004. U.S. Geological Survey, Washington, DC. http://nwis.waterdata.usgs.gov/usa/nwis/discharge/?site_no=01382500&agency_cd=USGS

[5] Galli, J., 1990. *Thermal impacts associated with urbanization and stormwater management best practices*. Metropolitan Washington Council of Governments. Maryland Department of Environment. Washington, D.C. 188 pp.

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[7] Liang, Weng & Meek, Sonya. 2000. *Pollution Removal Dynamics of Three Wet Ponds in Canada.* In: Scheuler, Thomas R. (Ed), Watershed Protection Techniques, Vol. 3, No. 3, pages 721-728. Center for Watershed Protection, Ellicott City, MD.

[8] 2004. *New Jersey Stormwater Best Management Practices Manual.* New Jersey Department of Environmental Protection. Trenton, NJ

[9] Sherwood, Donald A. 2001. *Effects of a Vegetated Stormwater-Detention Basin on Chemical Quality and Temperature of Runoff from a Small Residential Development in Monroe County, New York.*. U.S. Geological Survey, Ithaca, NY

[10] Shelton, P.C., Peterson, R.O. 1983. *Beaver, wolf and moose interactions in Isle Royale National Park, USA.* Acta Zoologica Fennica 174: pages 265-266.

[11]Bartholow, John. 2002. Stream Segment Temperature Model (SSTEMP) Version 2.0 Revised August 2002. U.S. Geological Survey, Fort Collins, CO

3 – Land Acquisition Plan

As noted in other sections of this report, the most effective method of preserving existing riparian canopy, preventing stormwater runoff increases and maintaining groundwater recharge is the preservation of undeveloped riparian lands through easements or purchase.

To this end, an evaluation was conducted of vacant lands in the Lower Section of the Pequannock River Watershed. All lands bordering the river and river tributaries were included in this survey. Parcels already preserved through purchase, or through purchase of development rights, were excluded.

A major exception was the Borough of Bloomingdale. At this time digitized tax maps are not available for Bloomingdale and the Borough's printed tax maps do not show tributaries of the Pequannock River. For these reasons it was impossible to identify and map all vacant riparian lands in this municipality. Only those on the mainstem Pequannock River were included.

Within the Reservoir Section of the Pequannock Watershed, some riparian parcels were identified. However, this list is not complete. For this study, no analysis was conducted of riparian lands in the Headwaters Section of the watershed. It should be noted that the overwhelming majority of riparian lands in the Headwaters and Reservoir sections are owned by the City of Newark and receive some level of protection. However, significant privately-owned riparian properties may exist in this area, and future review is recommended.

Each land parcel was ranked according to their likely impact on river temperature. In this respect, lands with greater waterway frontage were deemed as having greater importance. Also, lands on tributary streams were ranked lower than lands on the mainstem river. In addition, lands on tributary streams above impoundments were ranked lower than those below any impoundments, since impoundments serve to elevate tributary temperatures. Therefore, maintaining low water temperatures above impoundments is not as beneficial to river temperatures.

With these factors in mind each parcel was given an initial rank of "2" in each of two categories - water frontage and waterway influence - for a potential combined rank of "4". In the "water frontage" category, parcels with more than 500 feet of frontage on a river or tributary received a full

rank in this category of “2”. Those with at least 100 feet of frontage but less than 500 feet received a rank of “1”. Parcels with less than 100 feet of frontage received a frontage rank of “0”. For “waterway influence”, parcels on the mainstem river received the highest rank of “2”. Those on tributary streams below any impoundments received a rank of “1”. Those above impoundments received a rank of “0”.

These rankings for parcels were combined for a maximum potential rank of “4” (most important) to a minimum of “0” (least important). It should be noted that no parcel received a rank of “0”. It should also be noted that every parcel of land adjoining the Pequannock River or a river tributary has some importance in terms of water quality protection.

With this understanding, the following maps represent the parcels and their rankings. A full list of these properties is provided in Appendix F.

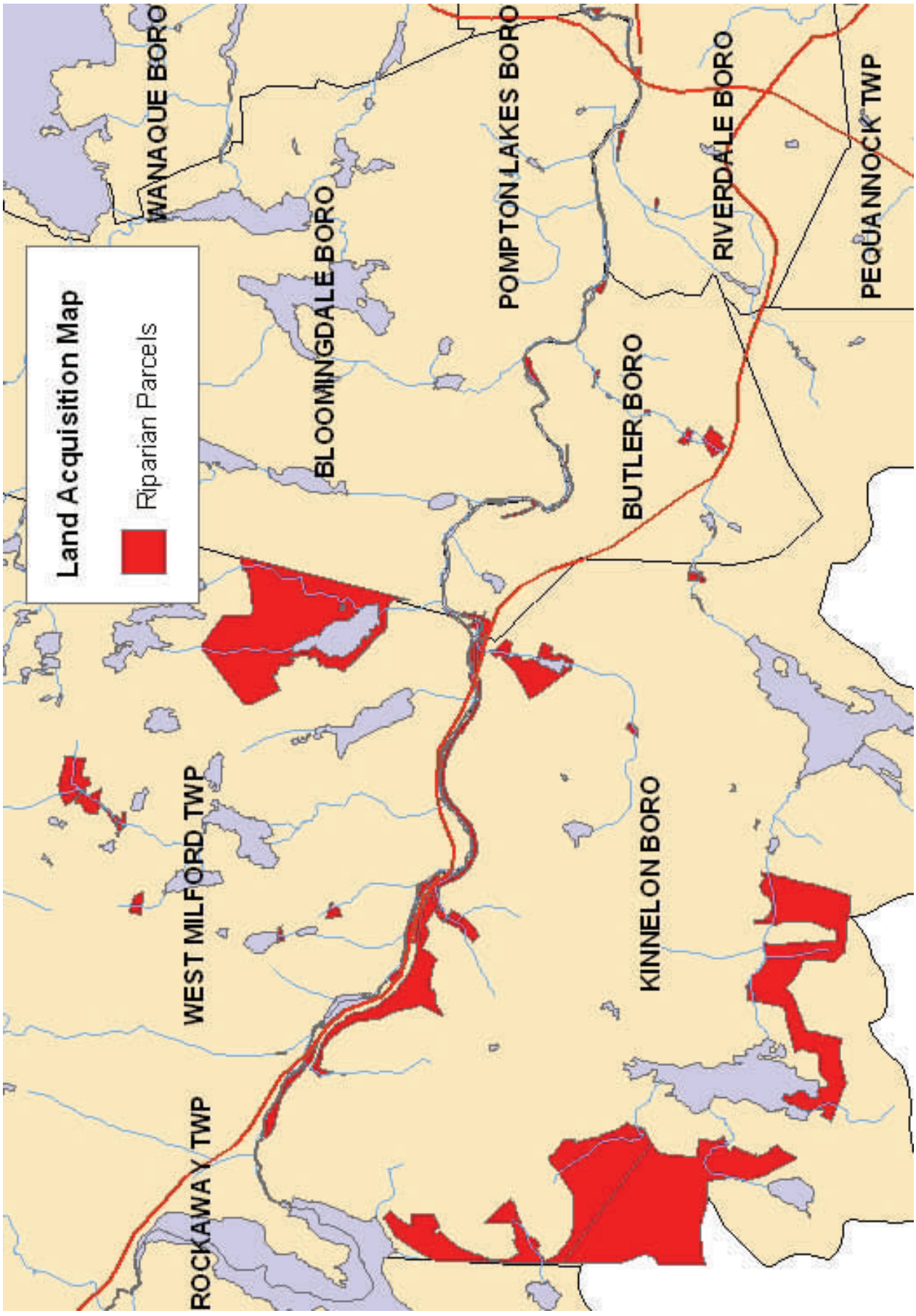


Figure 3-1—Riparian Parcel Map—Lower Section, Pequannock Watershed

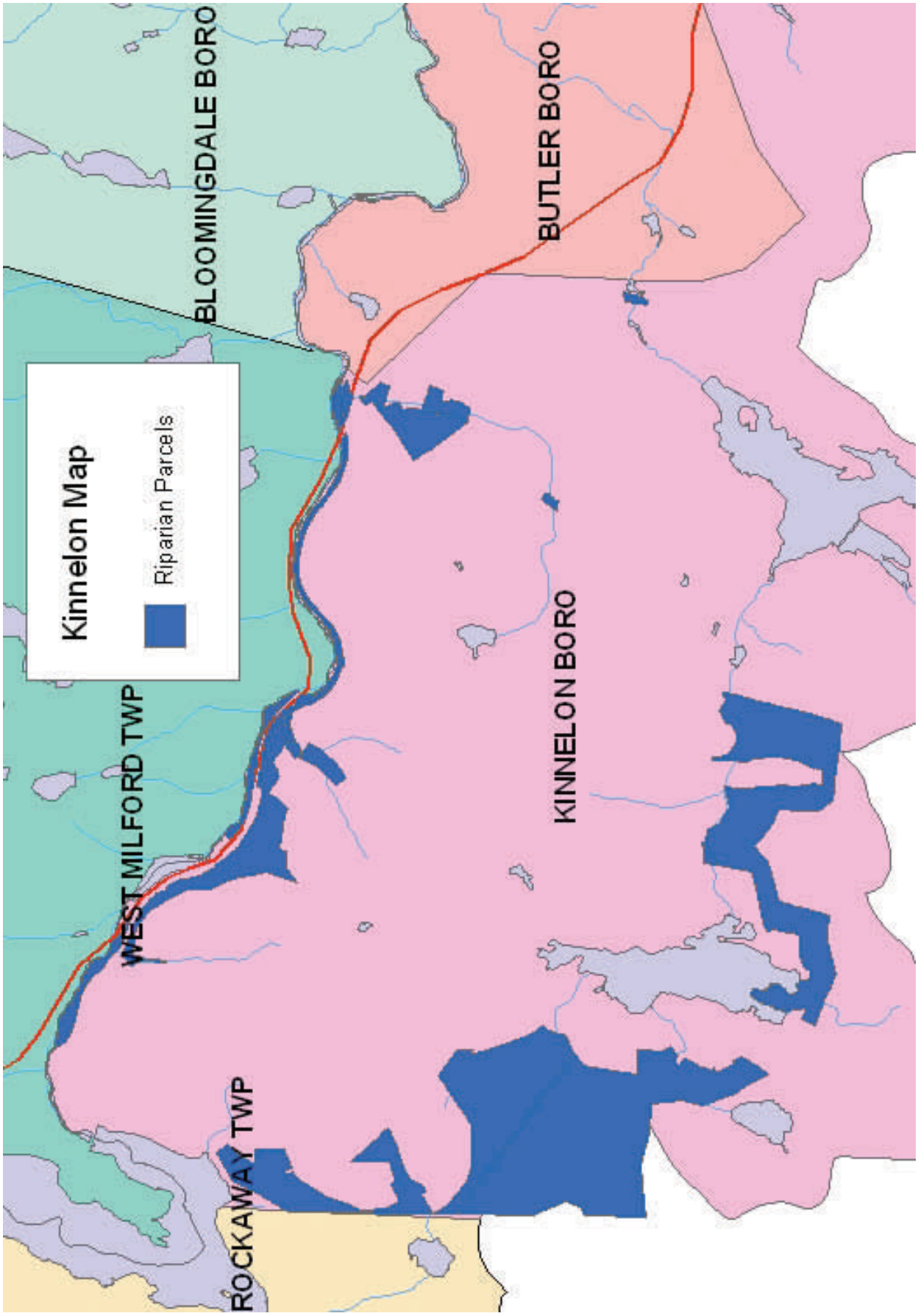


Figure 3-2—Riparian Parcel Map—Kinnelon Borough

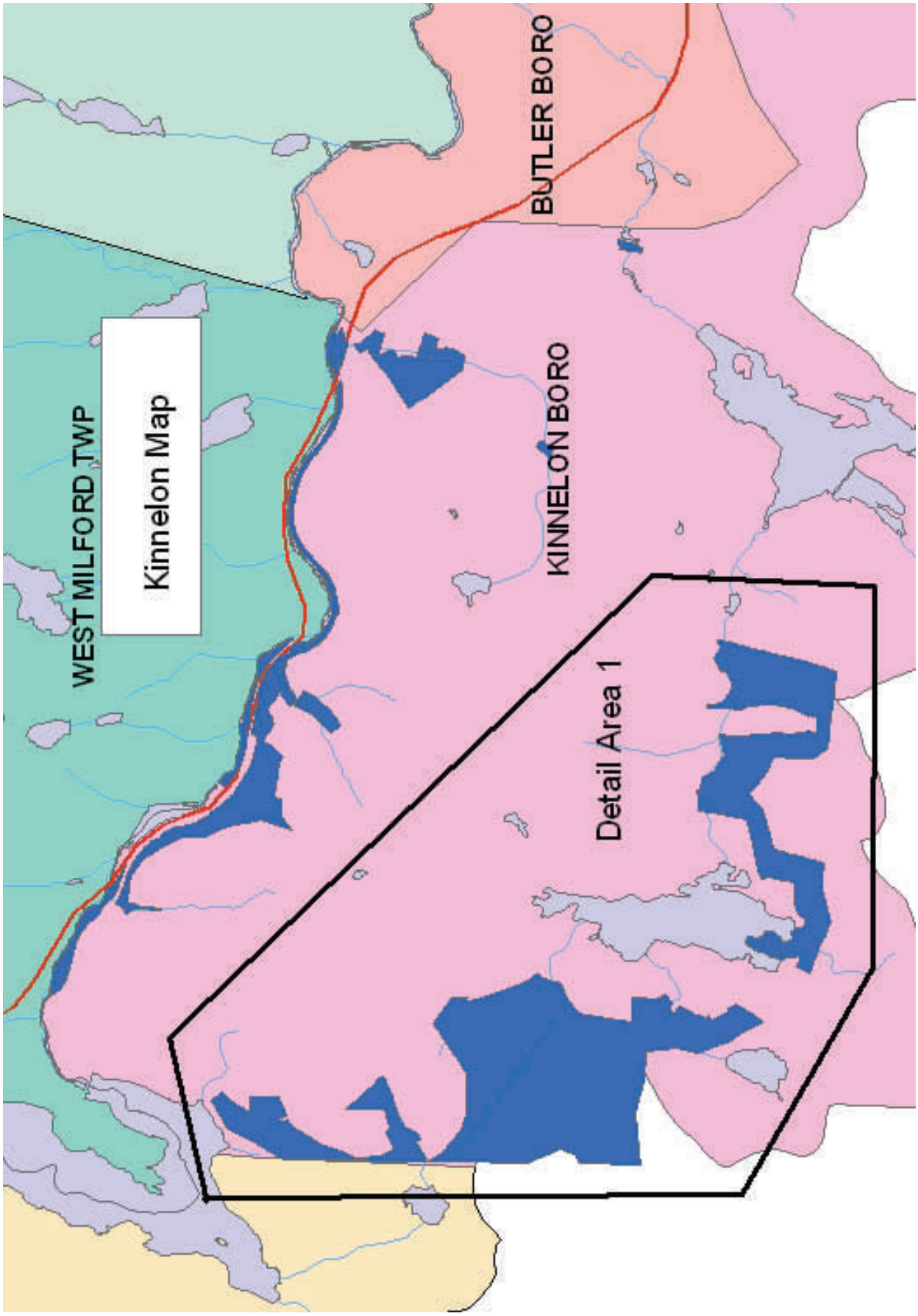


Figure 3-3—Riparian Parcel Map—Kinnelon Borough—Detail Area 1

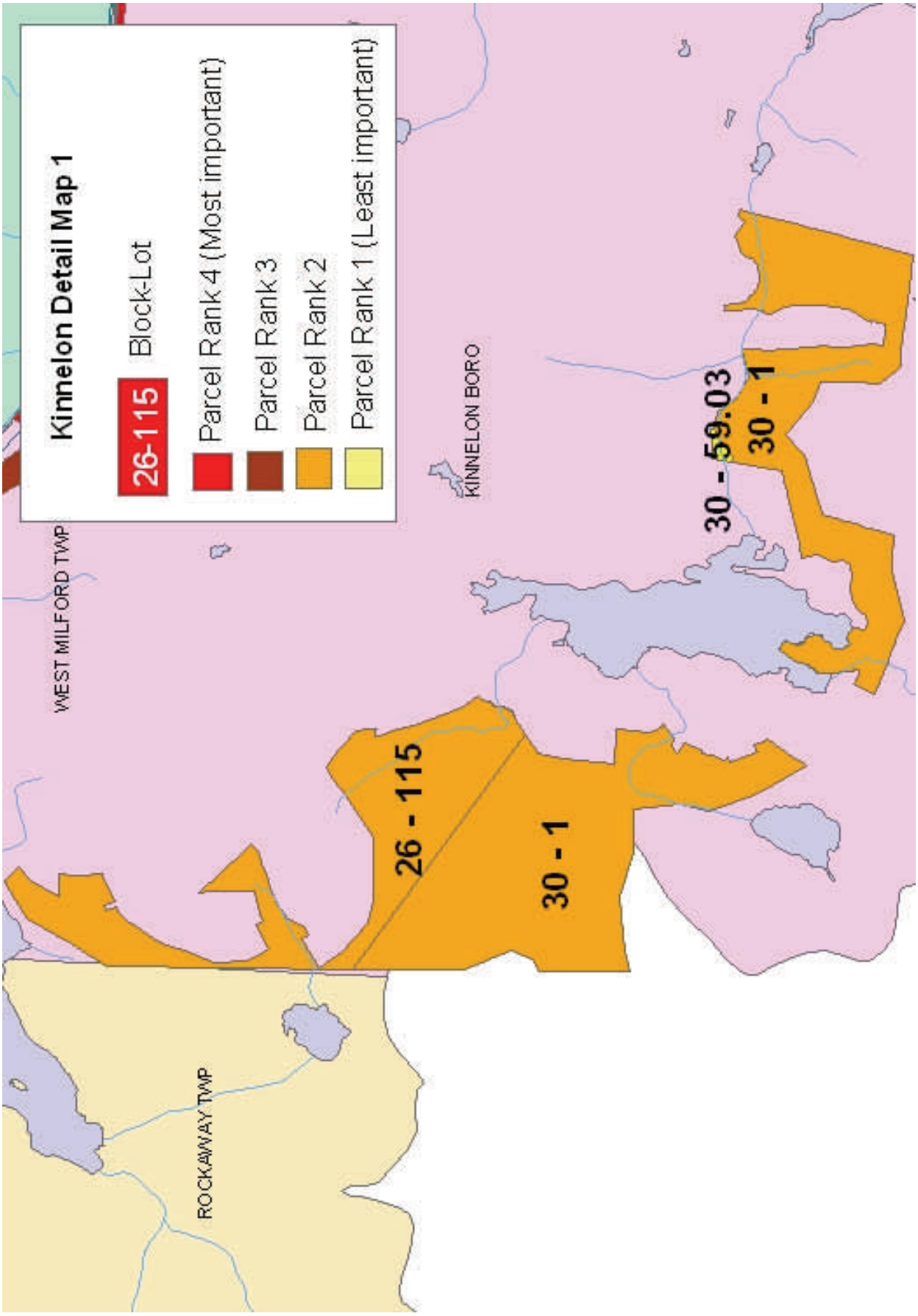


Figure 3-4—Riparian Parcel Map—Kinnelon Borough– Detail 1

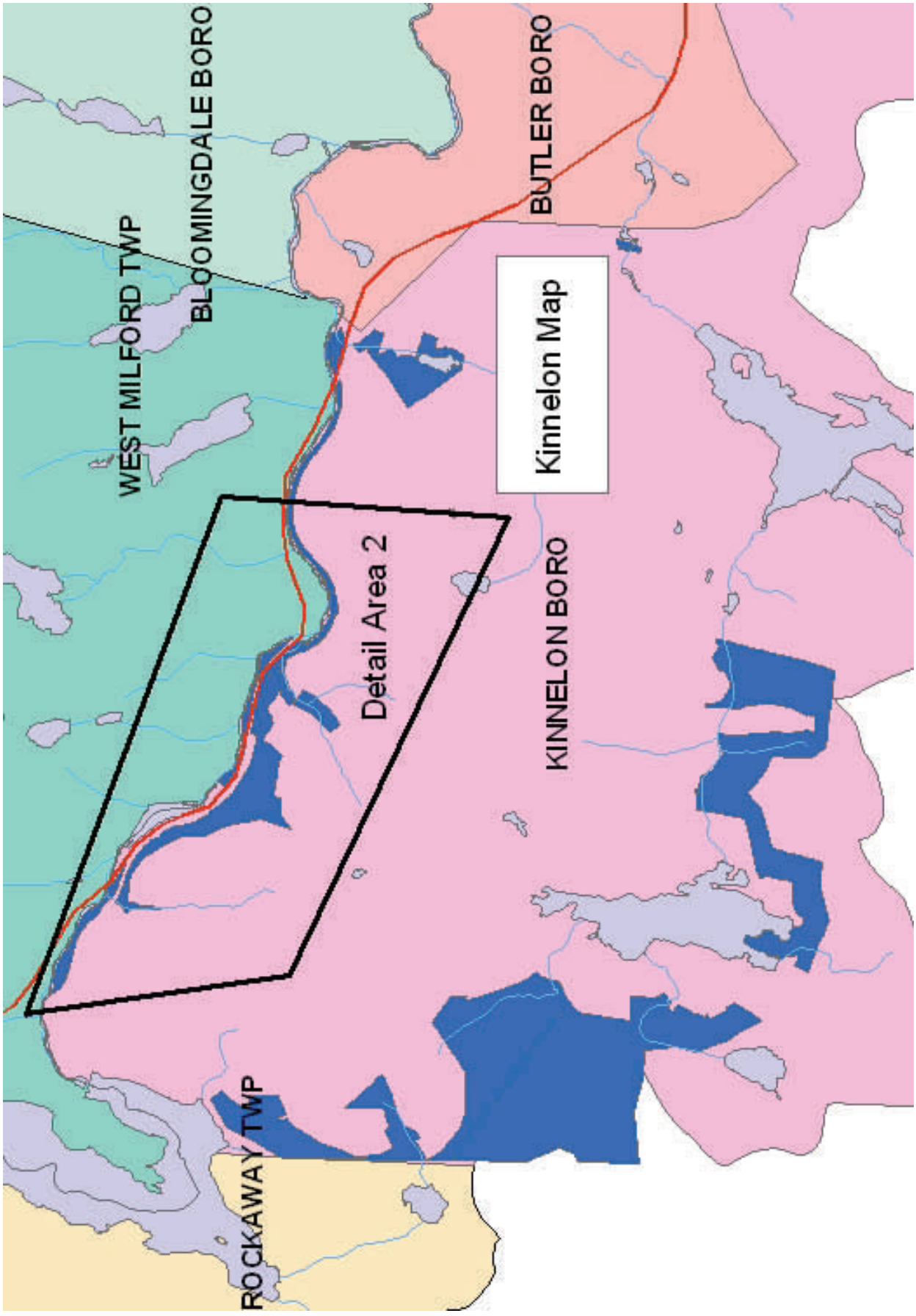


Figure 3-5—Riparian Parcel Map—Kinnelon Borough– Detail Area 2

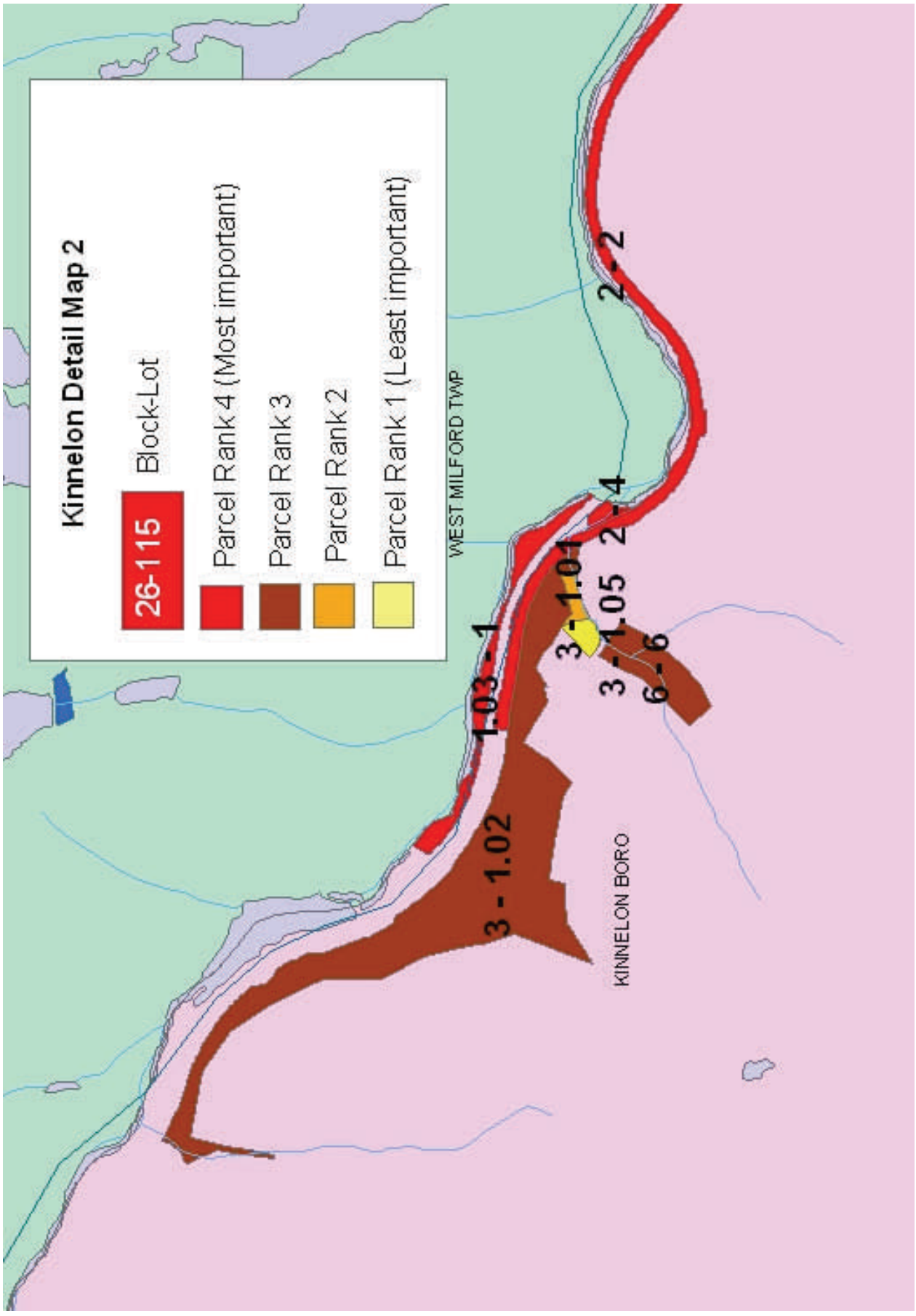


Figure 3-6—Riparian Parcel Map—Kinnelon Borough– Detail 2

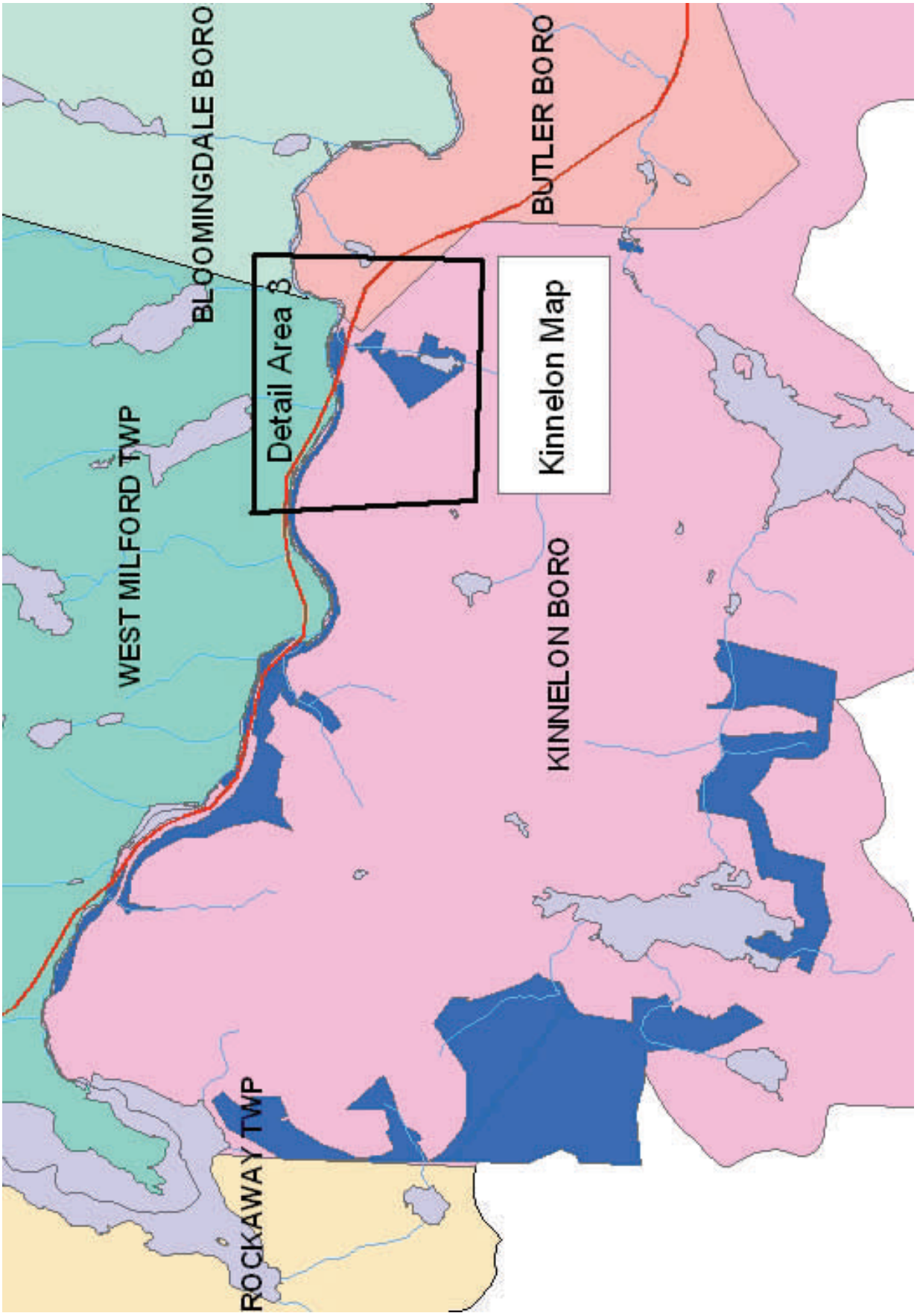


Figure 3-7—Riparian Parcel Map—Kinnelon Borough– Detail Area 3

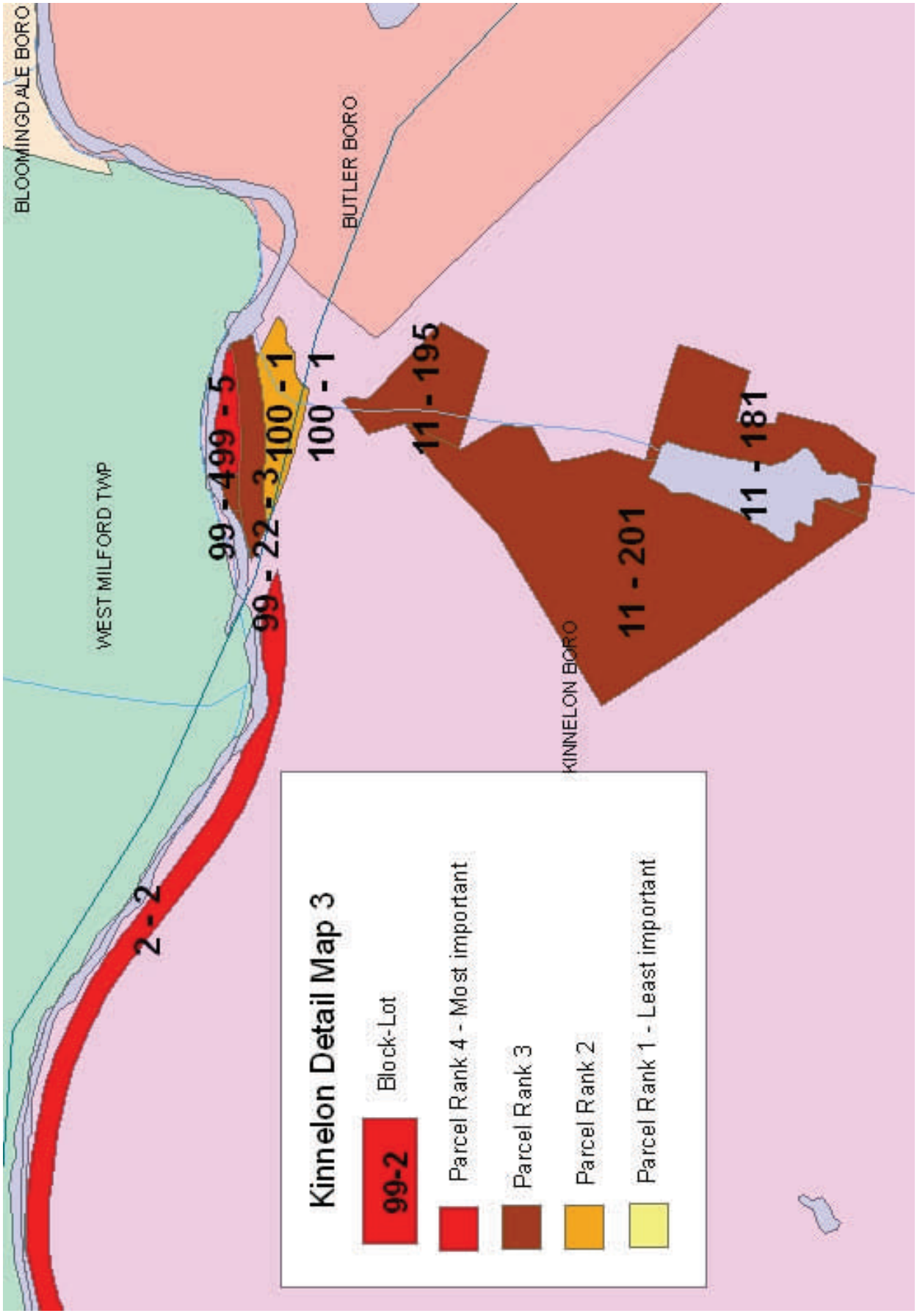
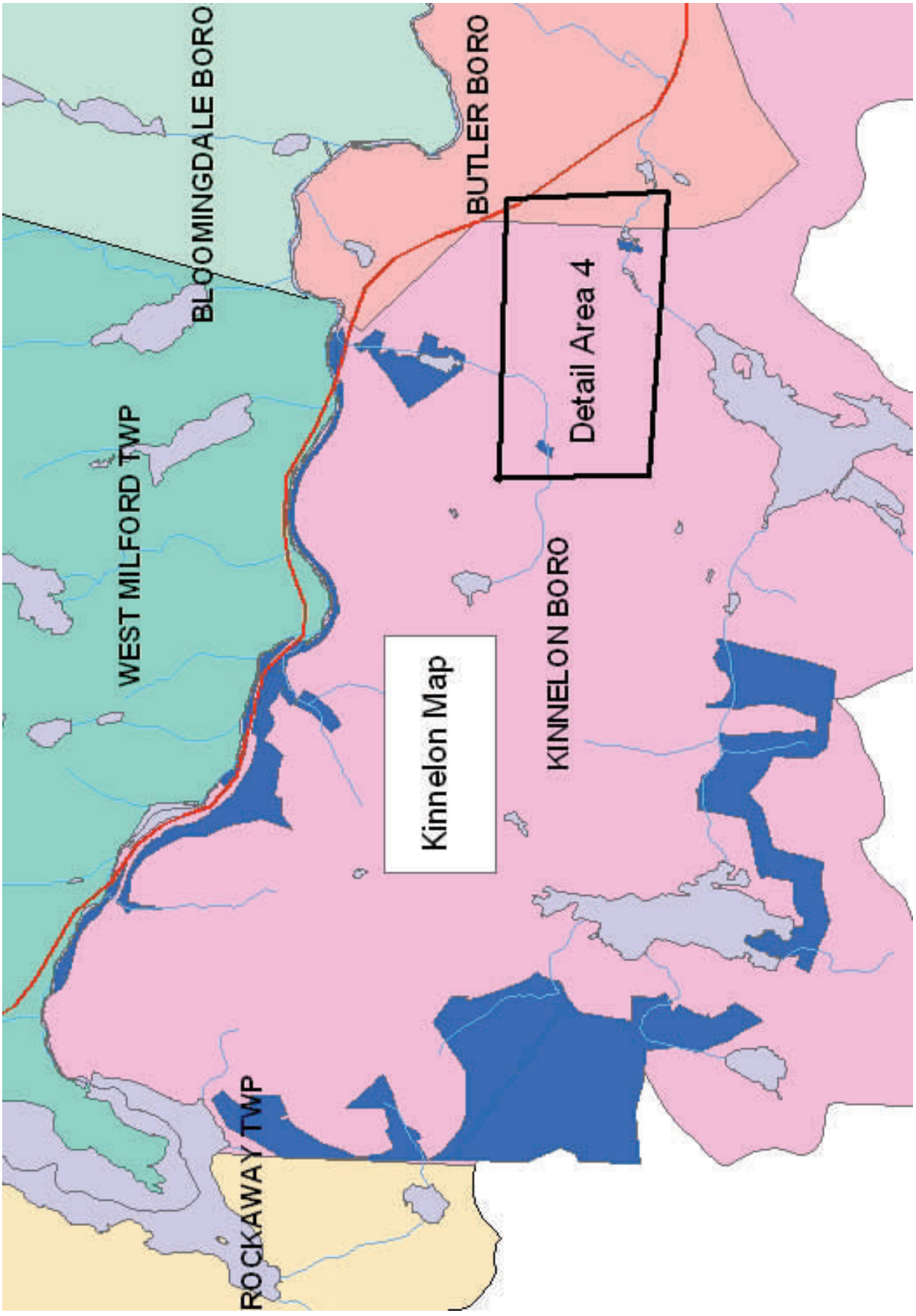


Figure 3-8—Riparian Parcel Map—Kinnelon Borough– Detail 3



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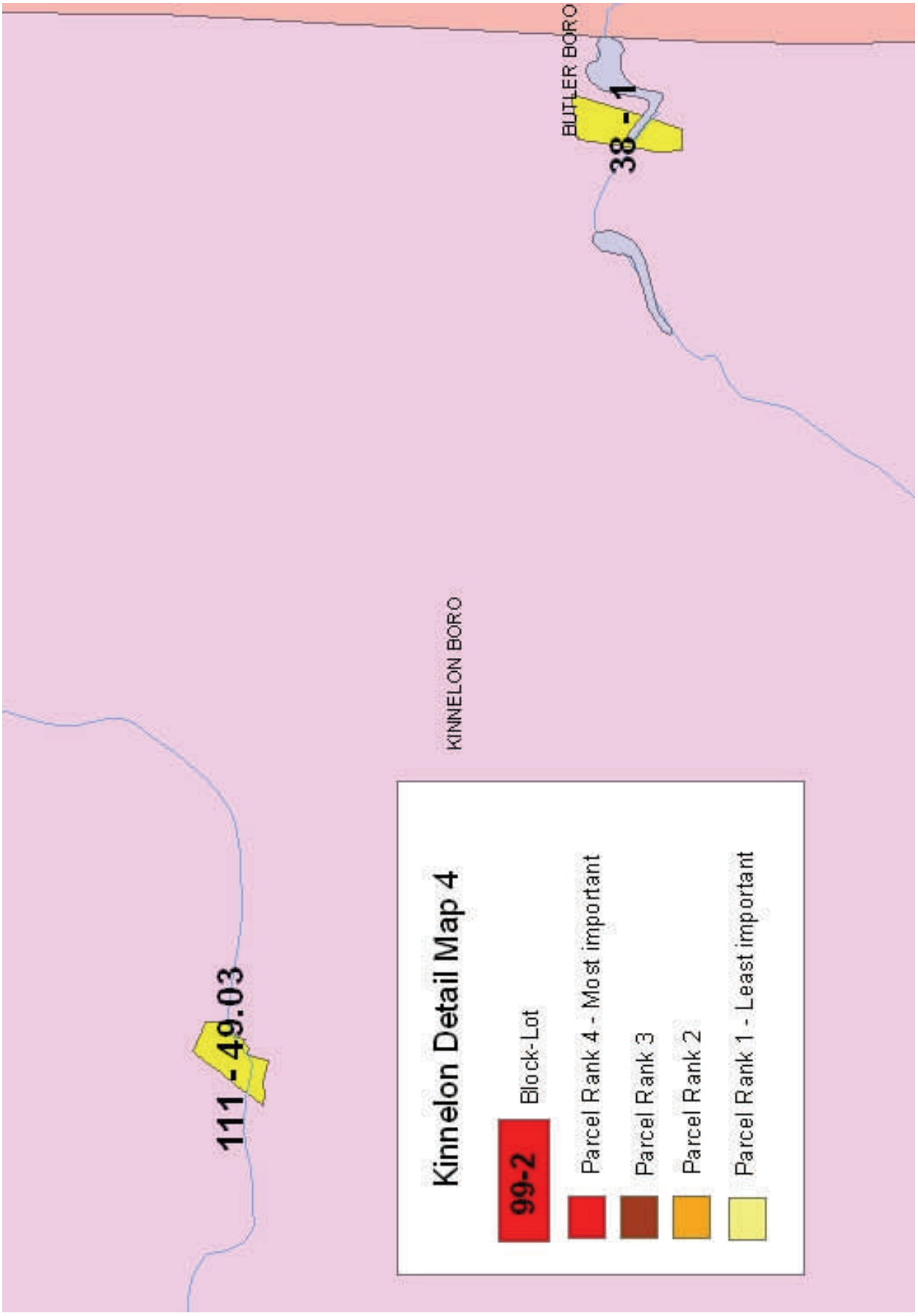


Figure 3-10—Riparian Parcel Map—Kinnelon Borough– Detail 4

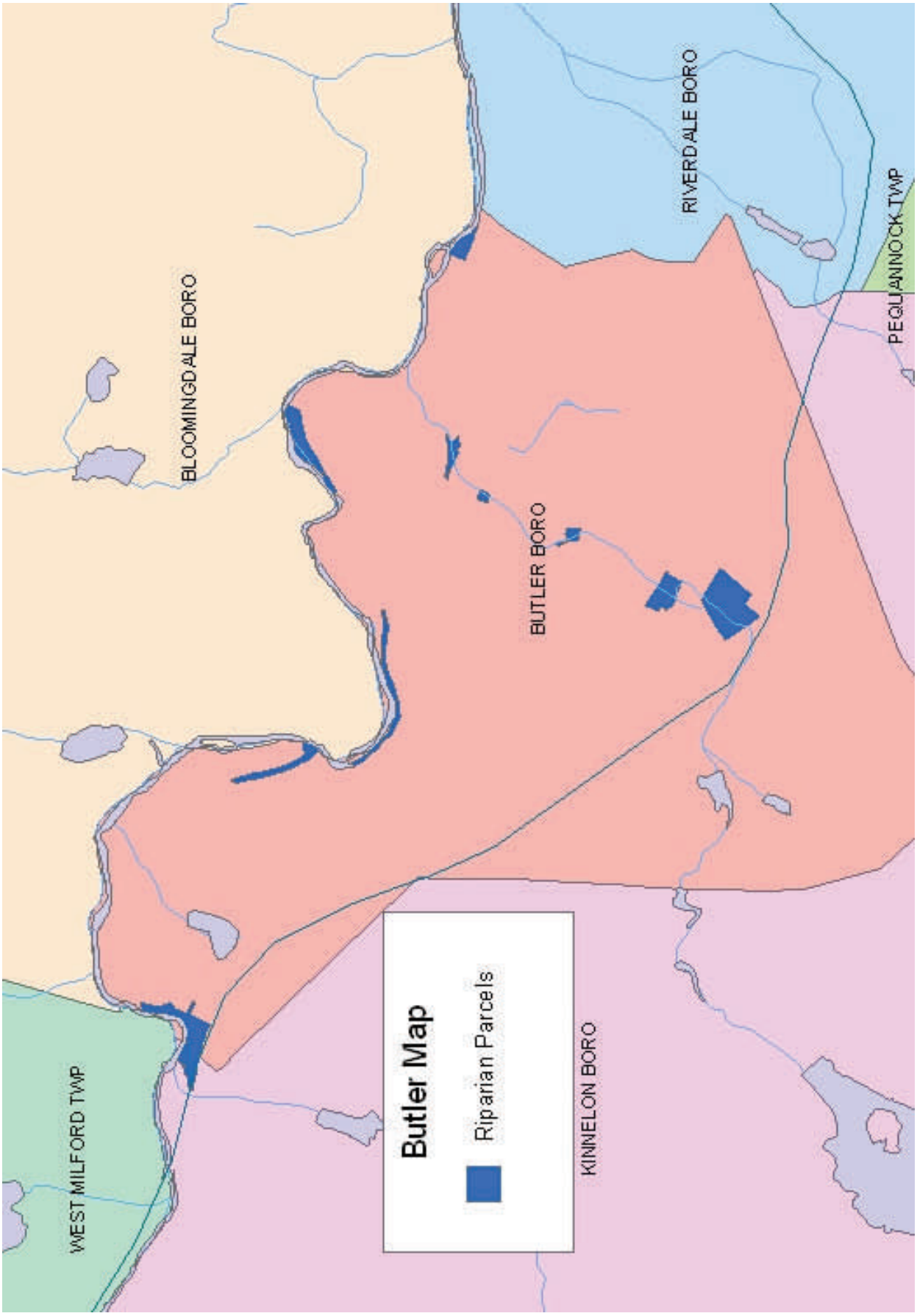


Figure 3-11—Riparian Parcel Map—Butler Borough

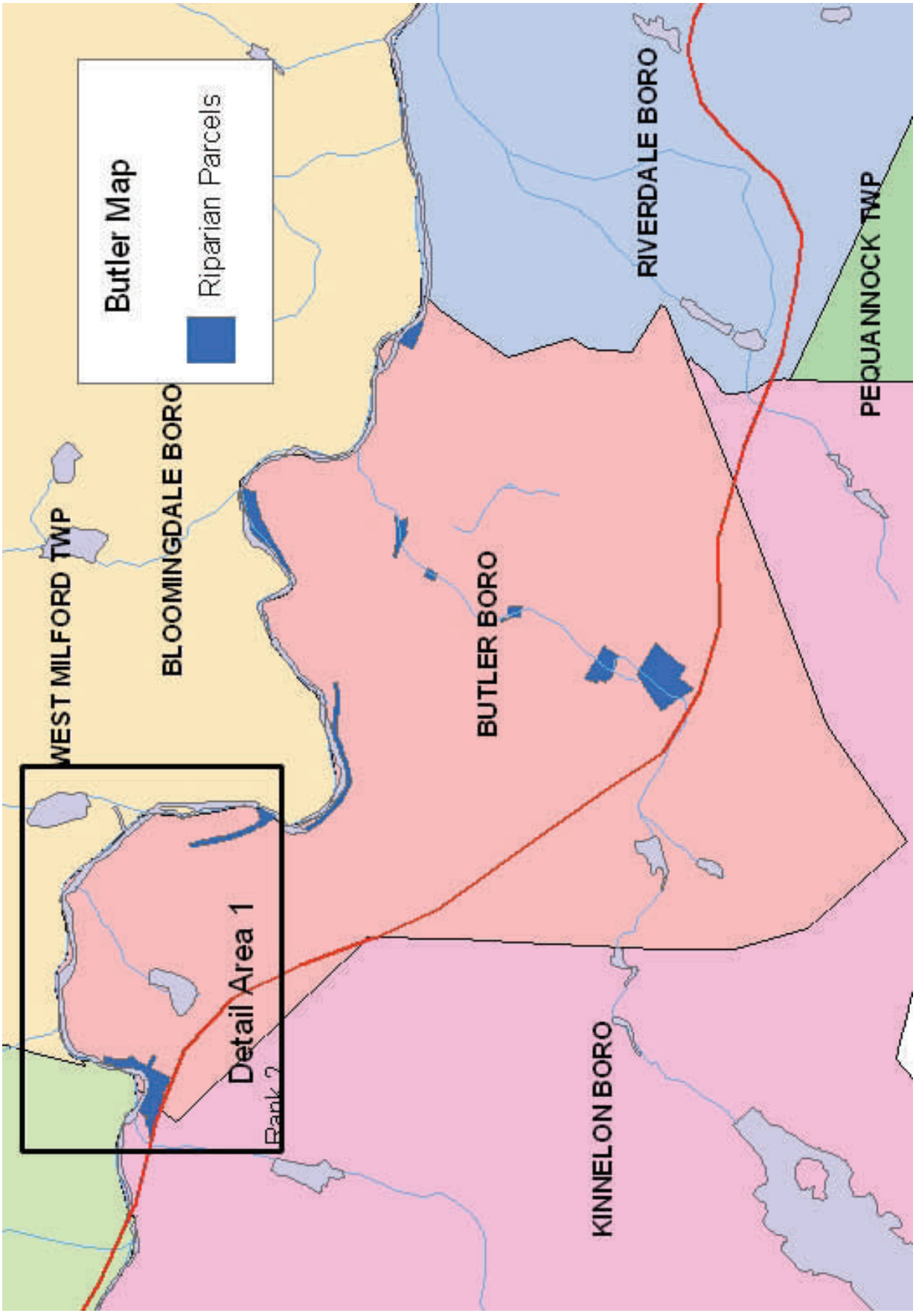


Figure 3-12—Riparian Parcel Map—Butler Borough—Detail Area 1

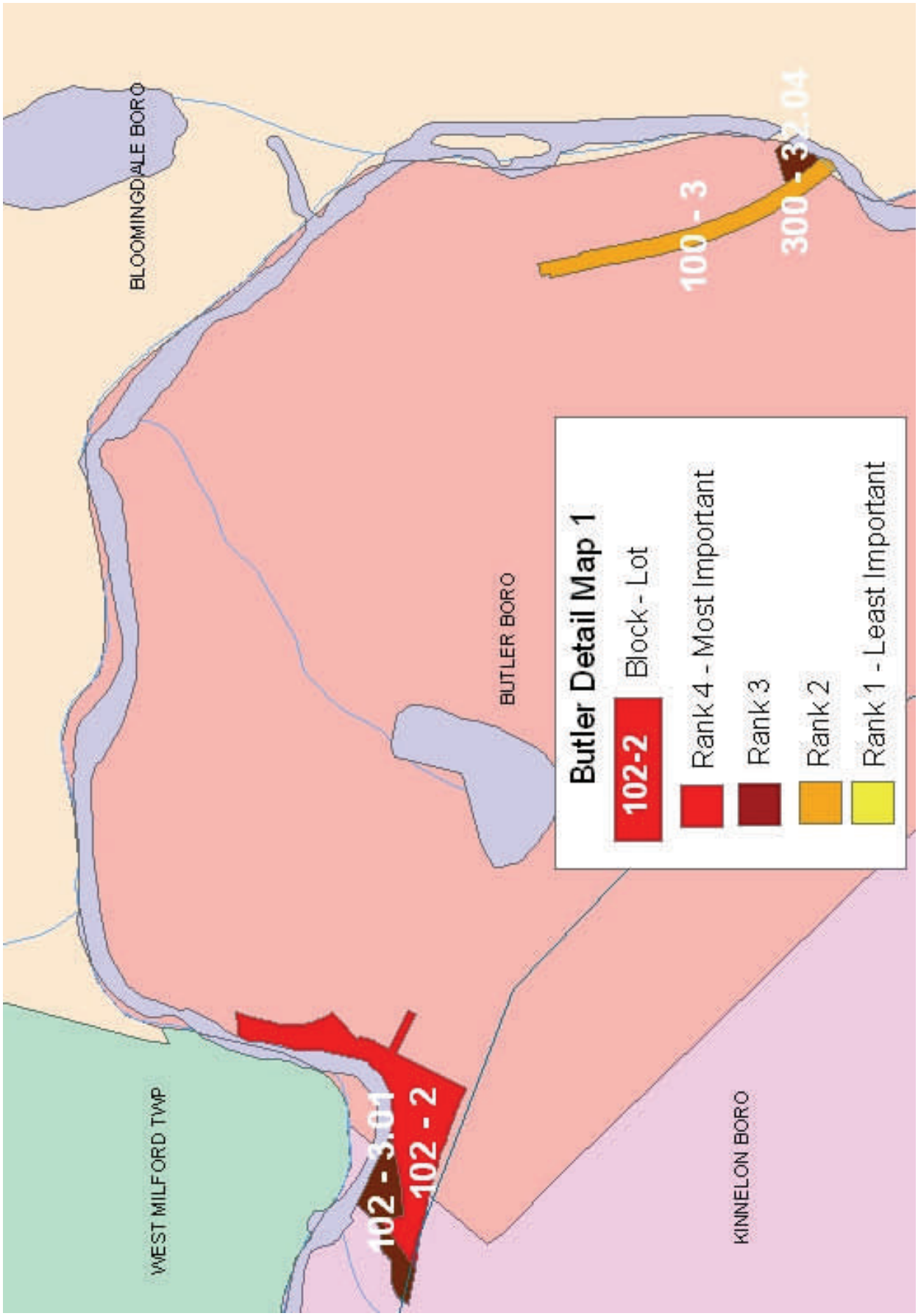
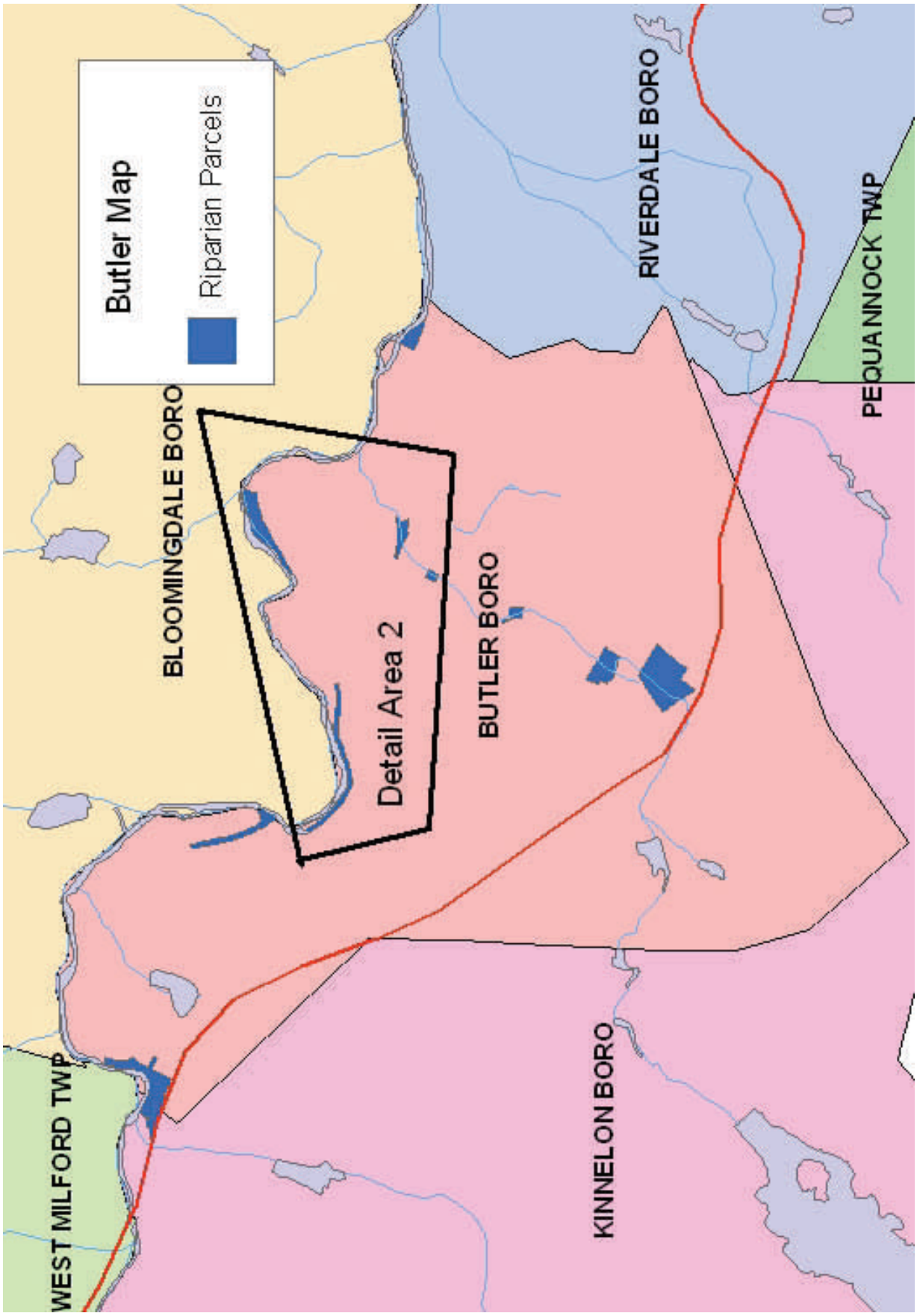


Figure 3-13—Riparian Parcel Map—Butler Borough– Detail 1



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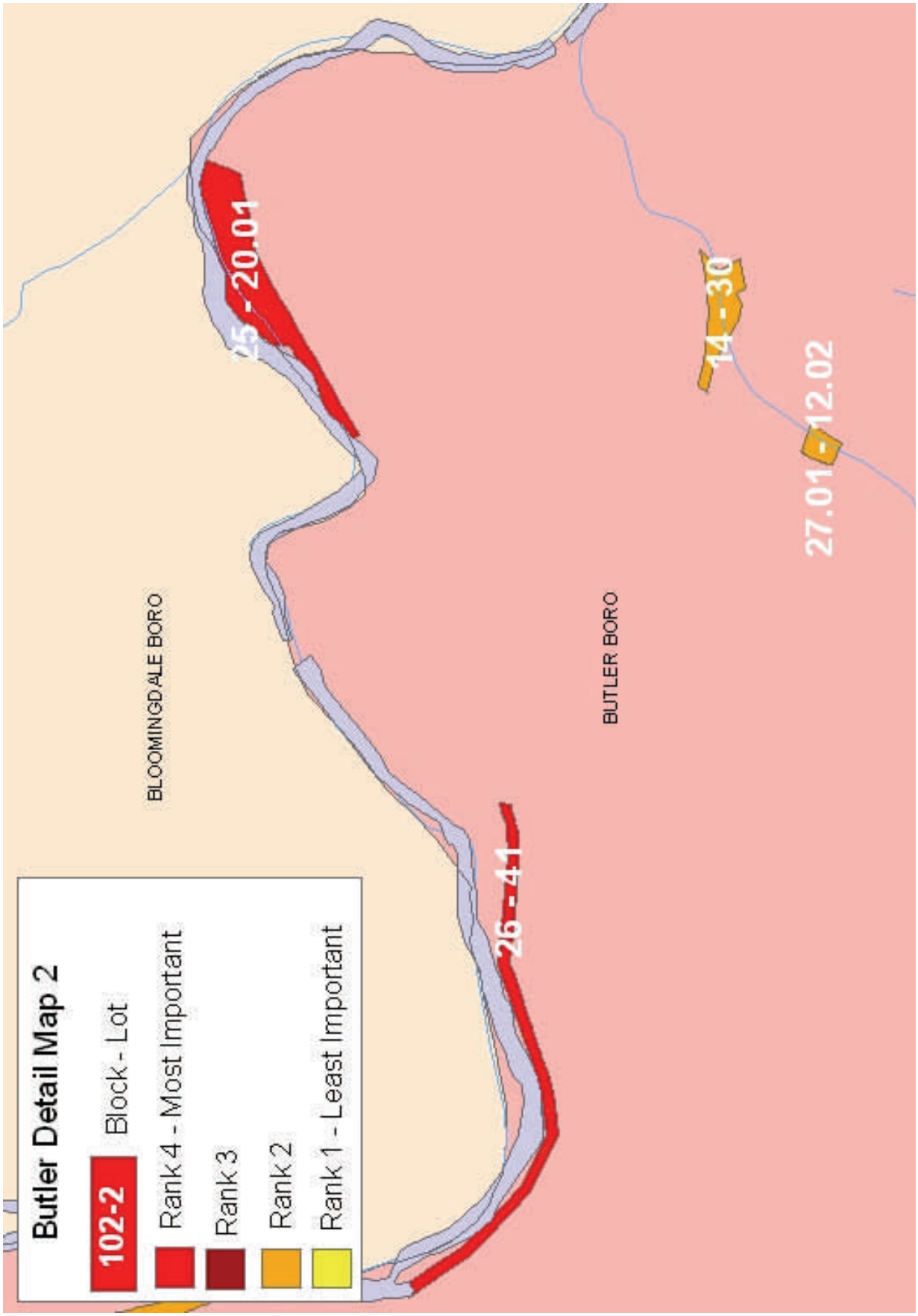

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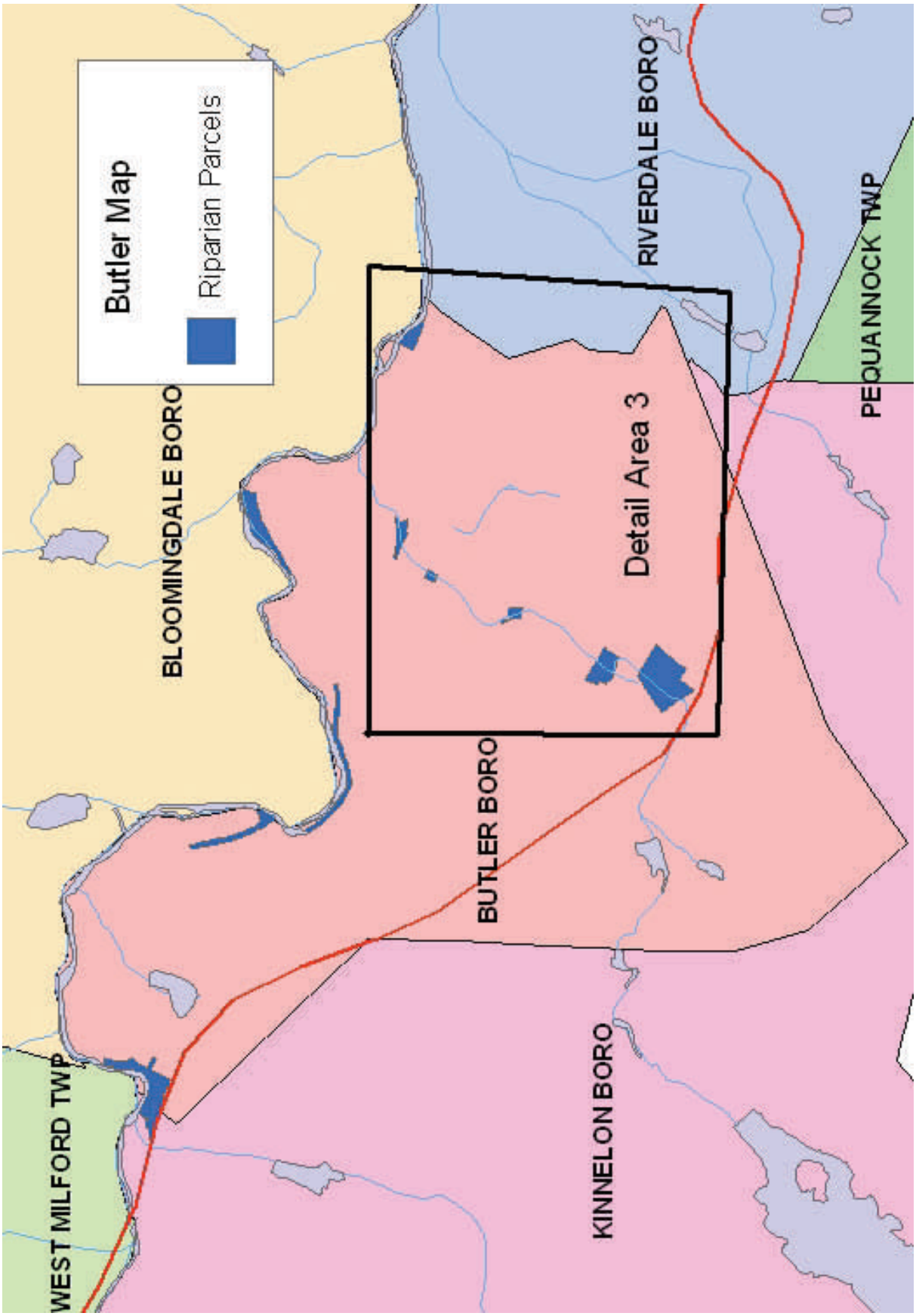

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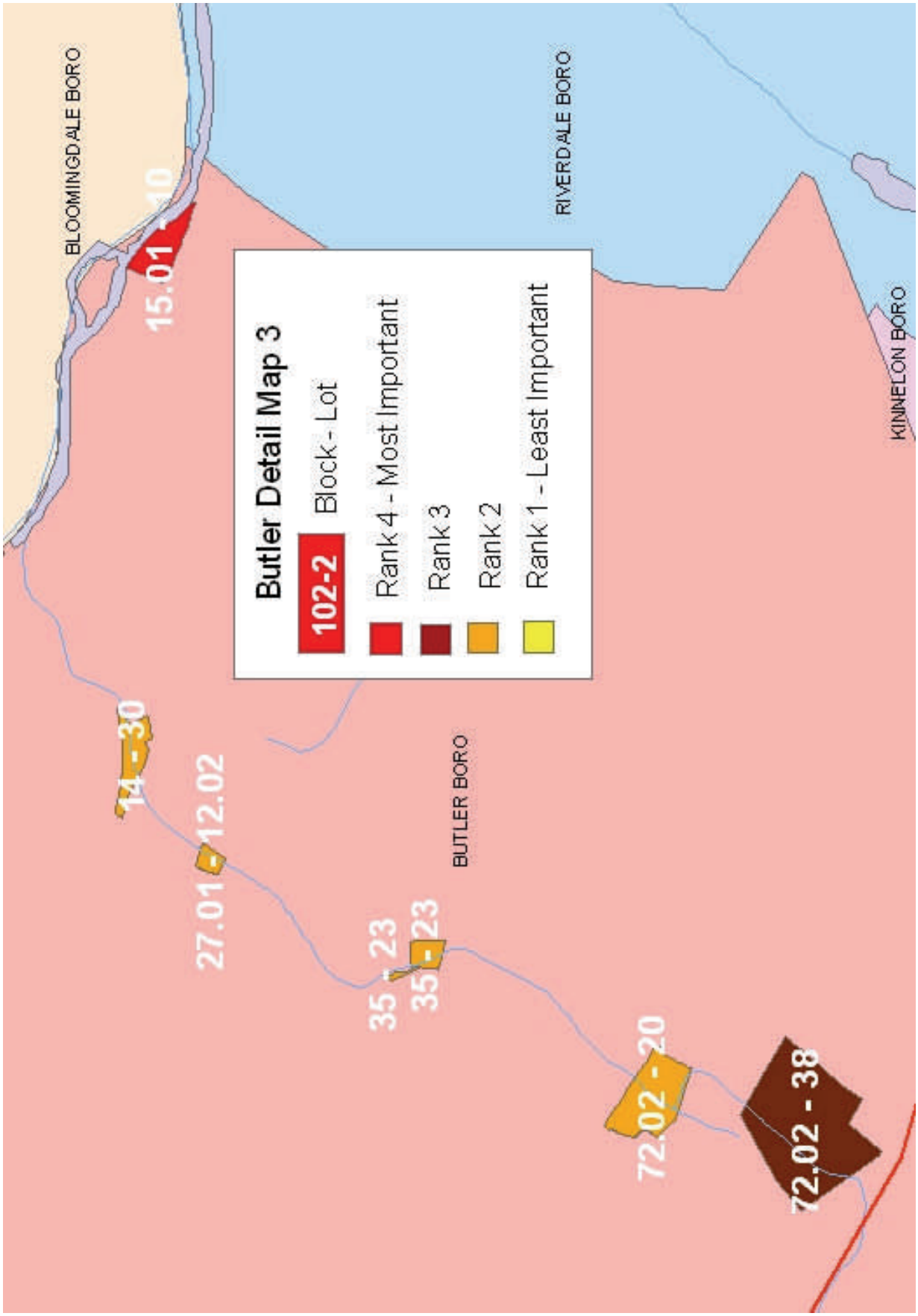

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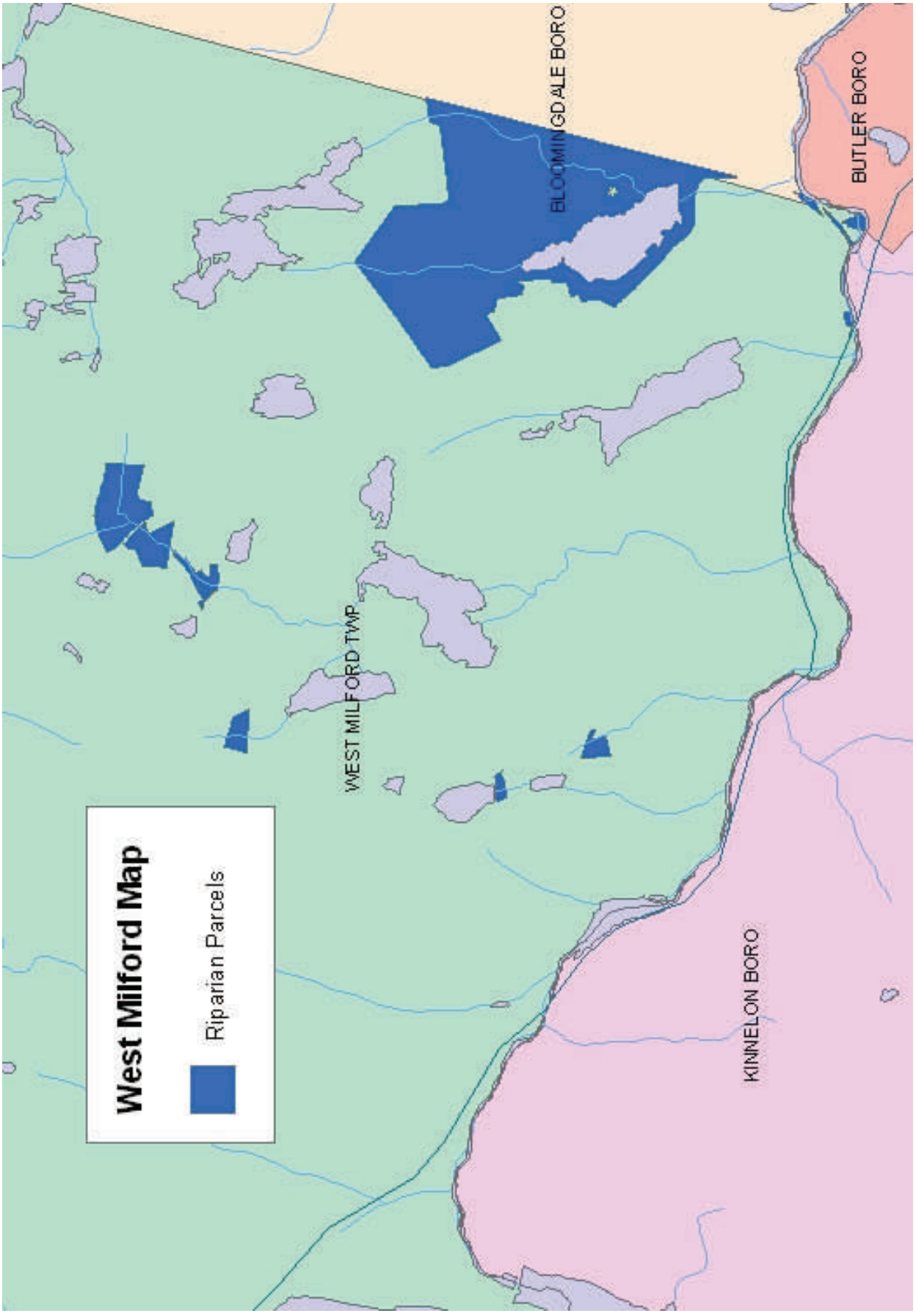


Figure 3-18—Riparian Parcel Map—West Milford Township

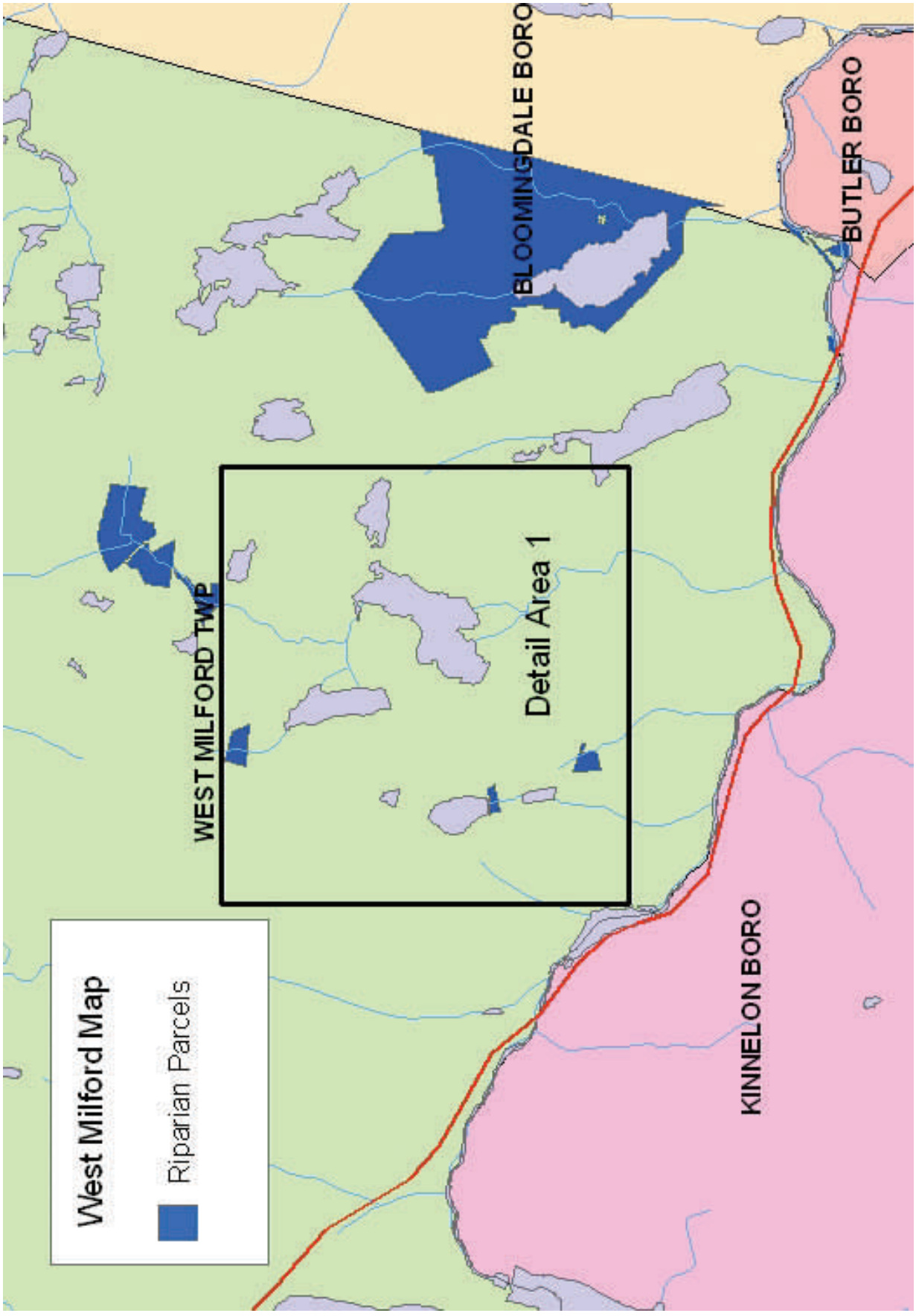
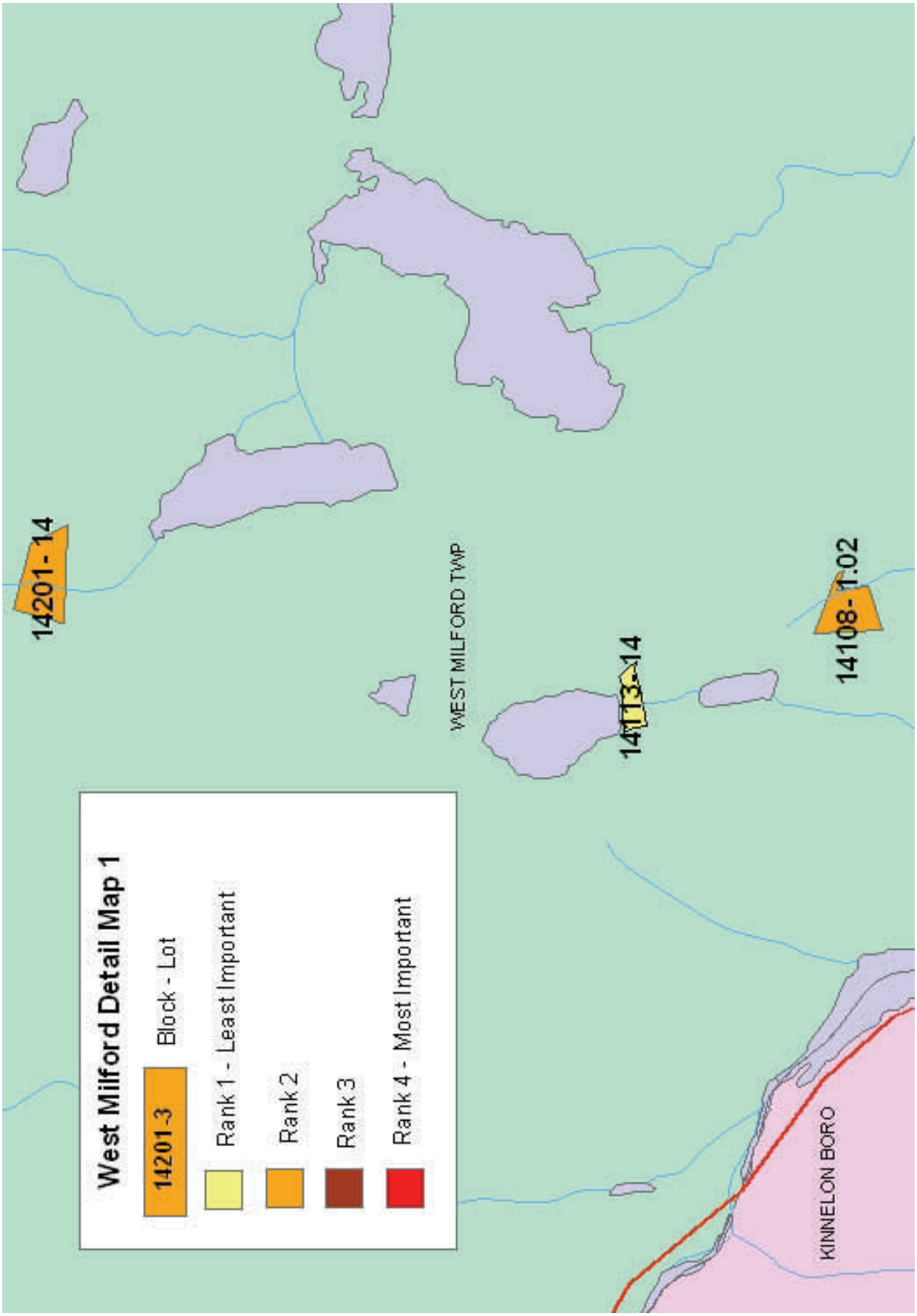


Figure 3-19—Riparian Parcel Map—West Milford Township—Detail Area 1



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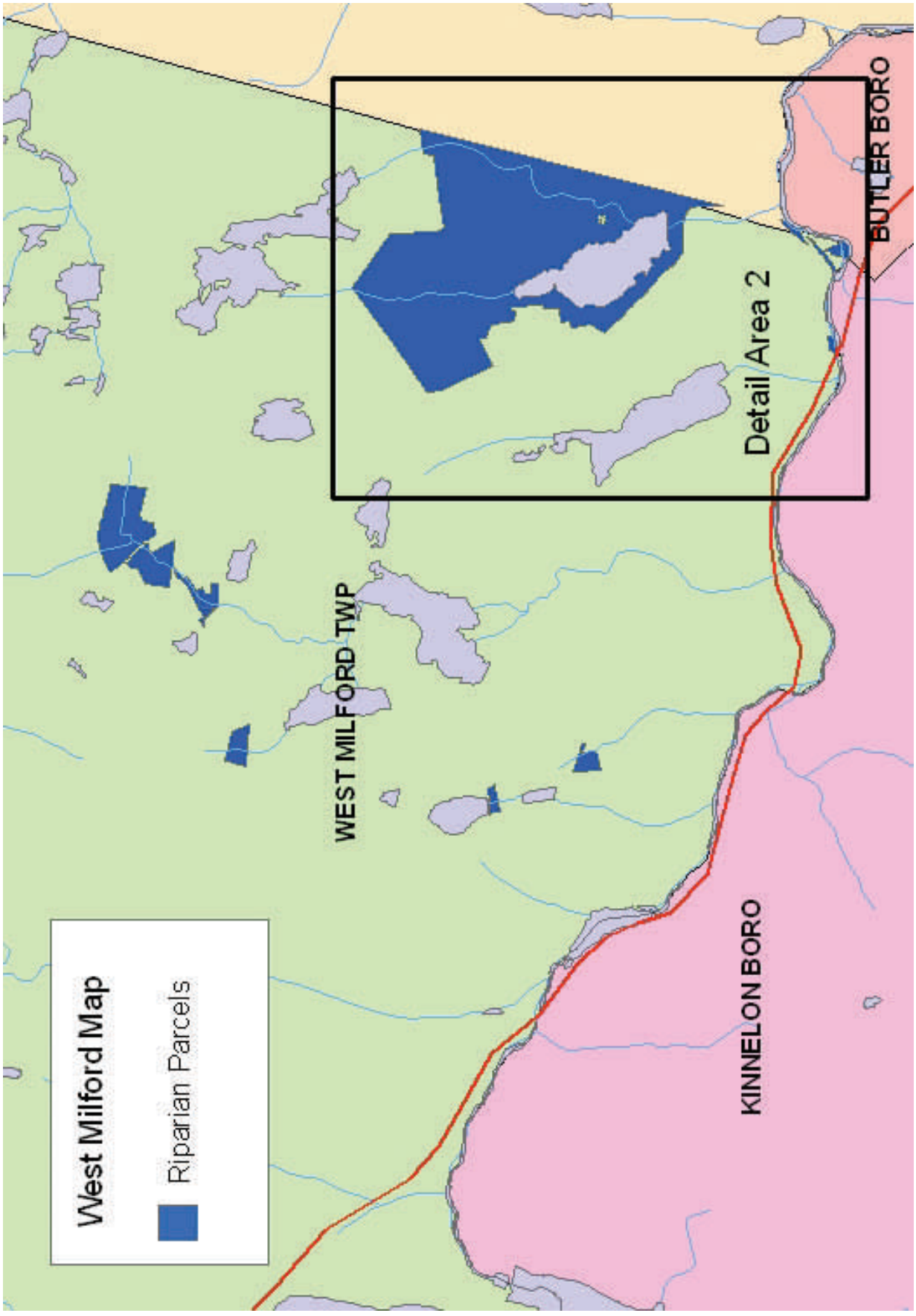

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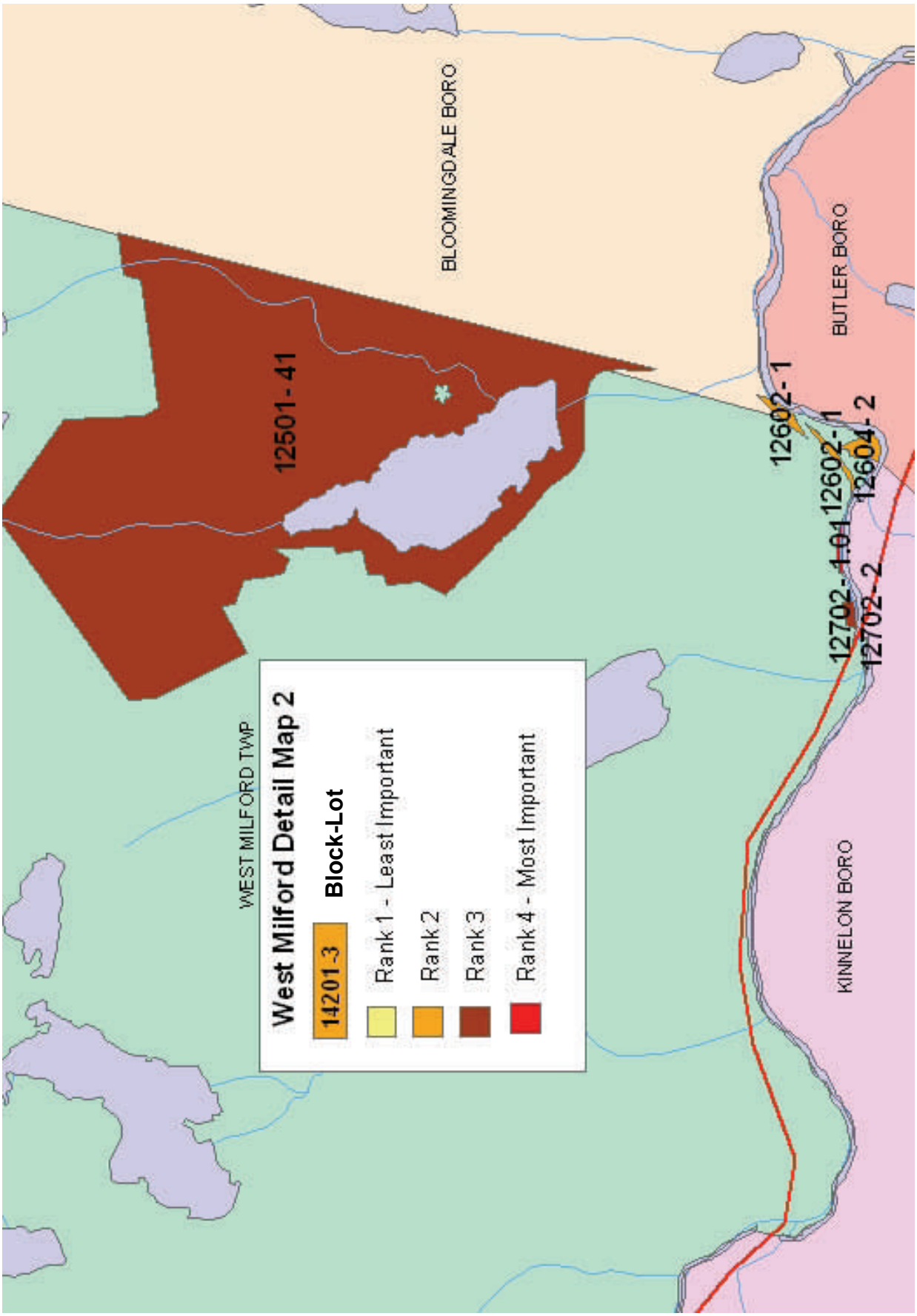

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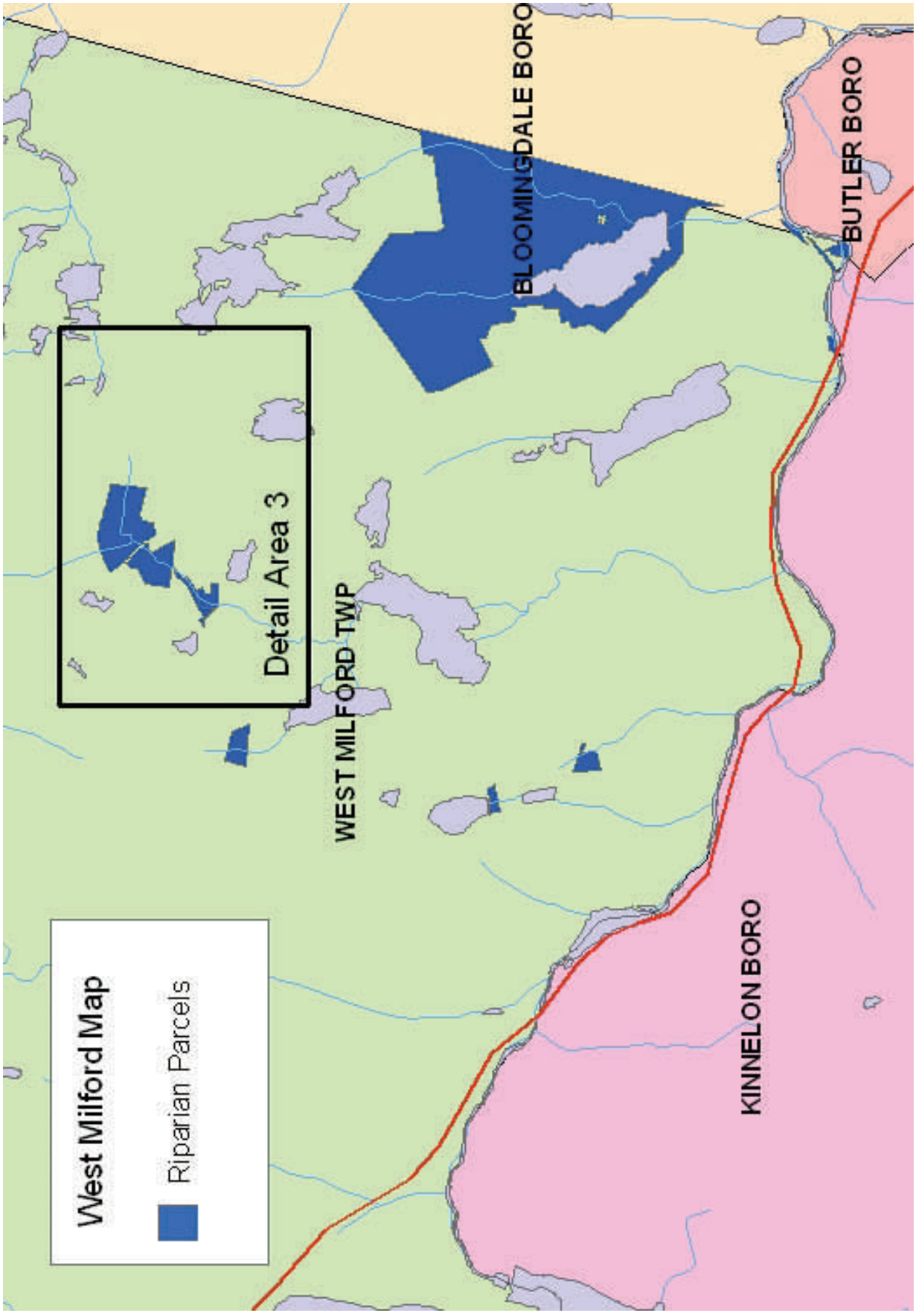

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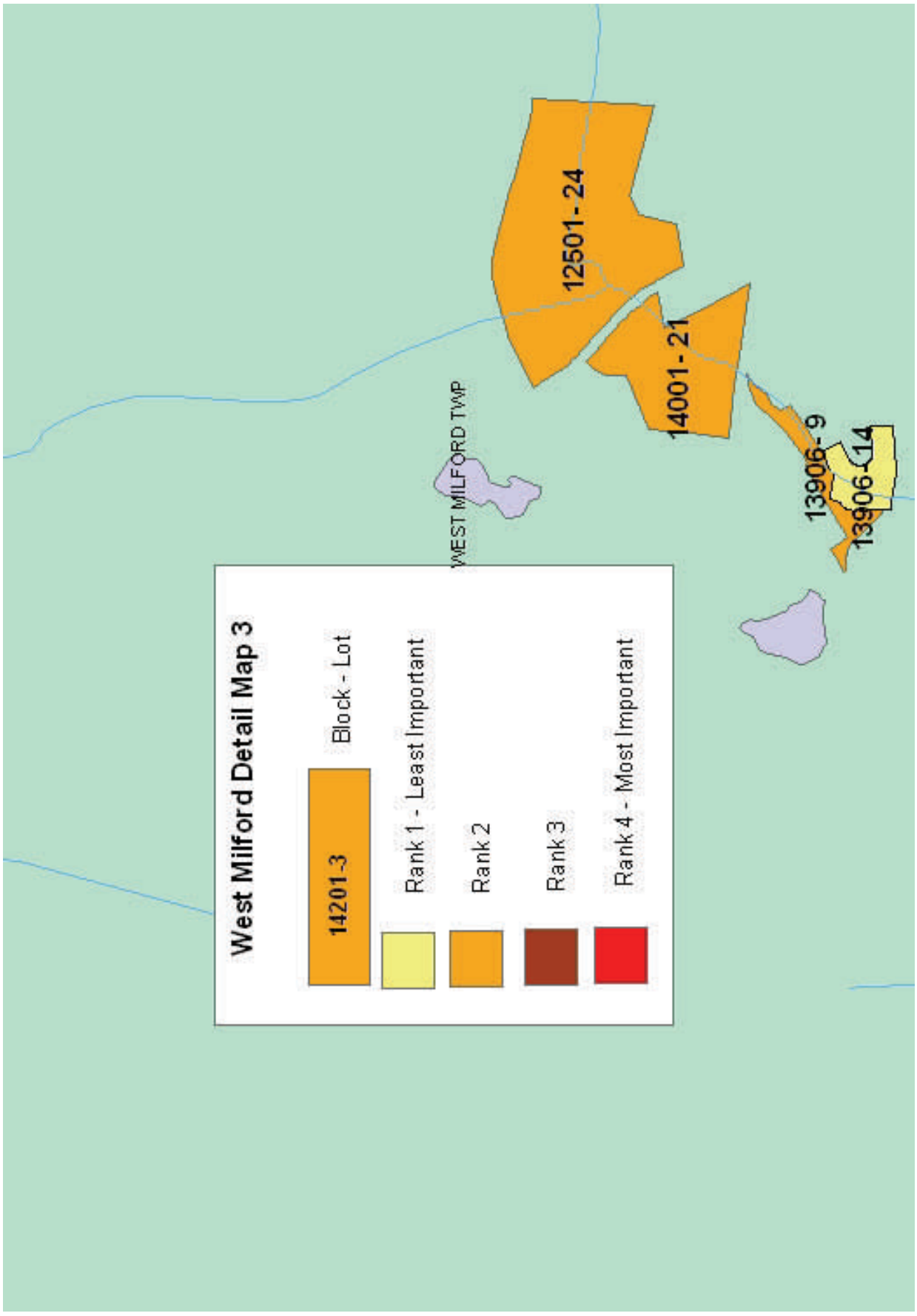

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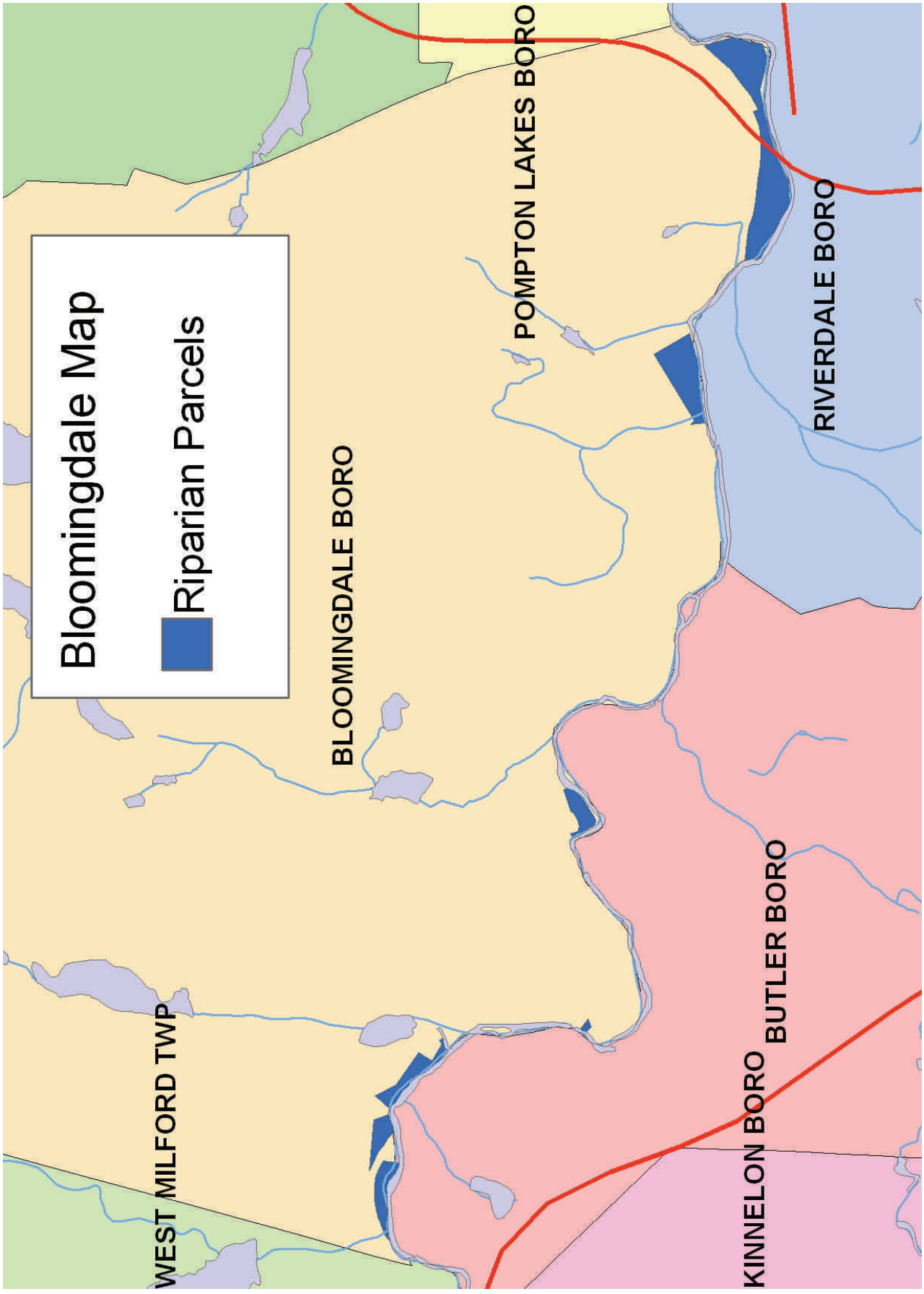


Figure 3-25—Riparian Parcel Map—Bloomingdale Borough

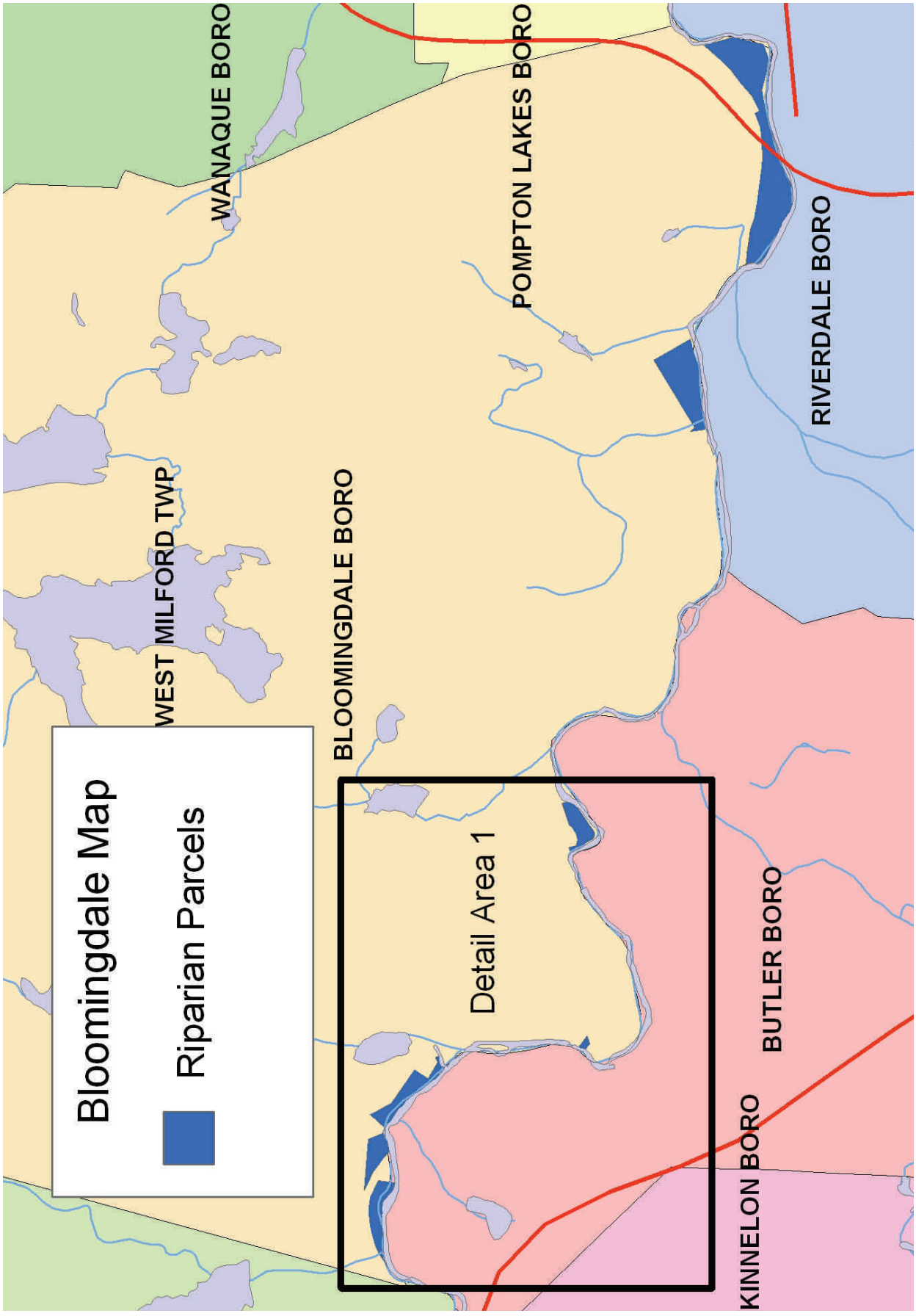


Figure 3-26—Riparian Parcel Map—Bloomingdale Borough, Detail Area 1

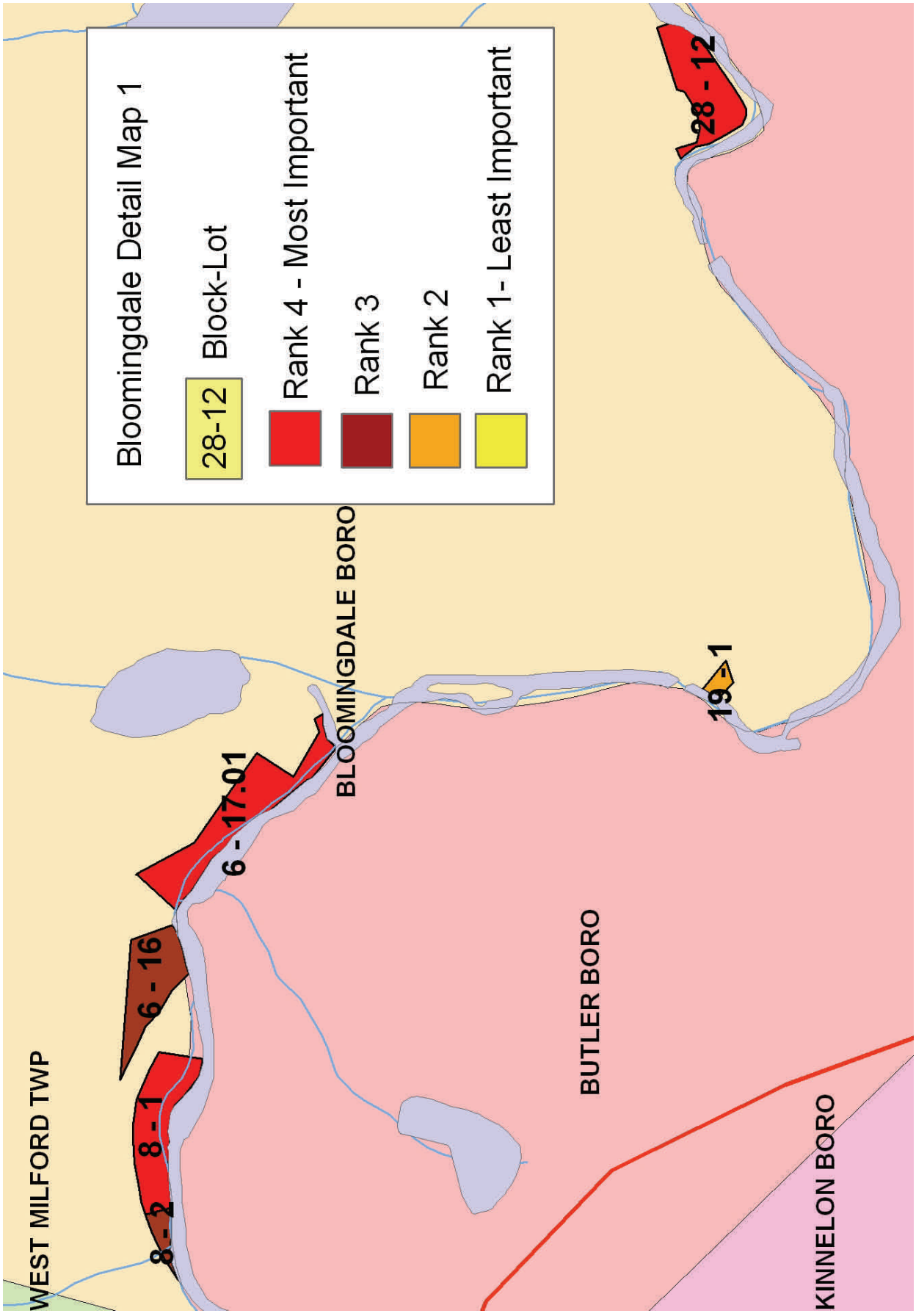
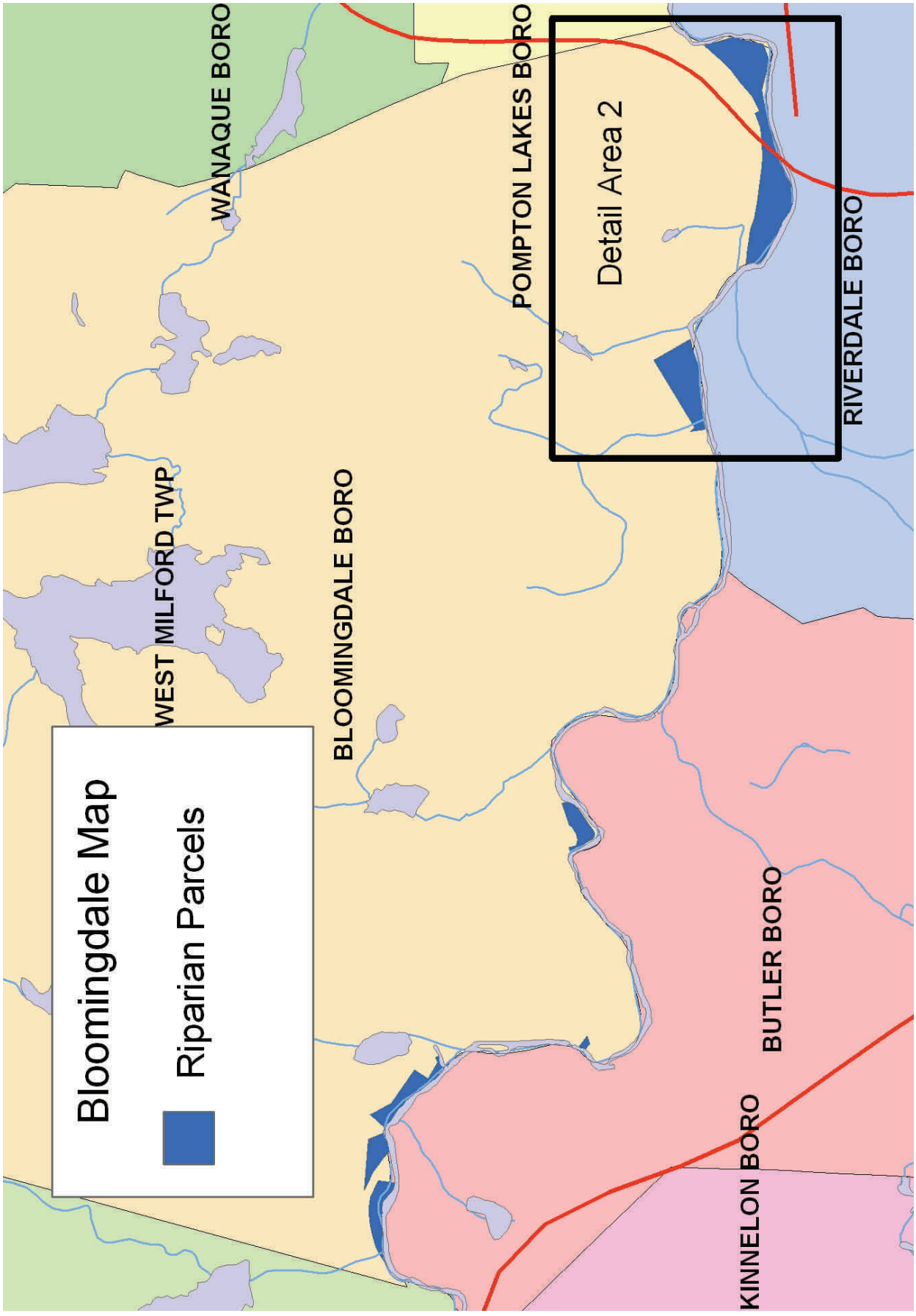


Figure 3-27—Riparian Parcel Map—Bloomingdale Borough, Detail Map 1



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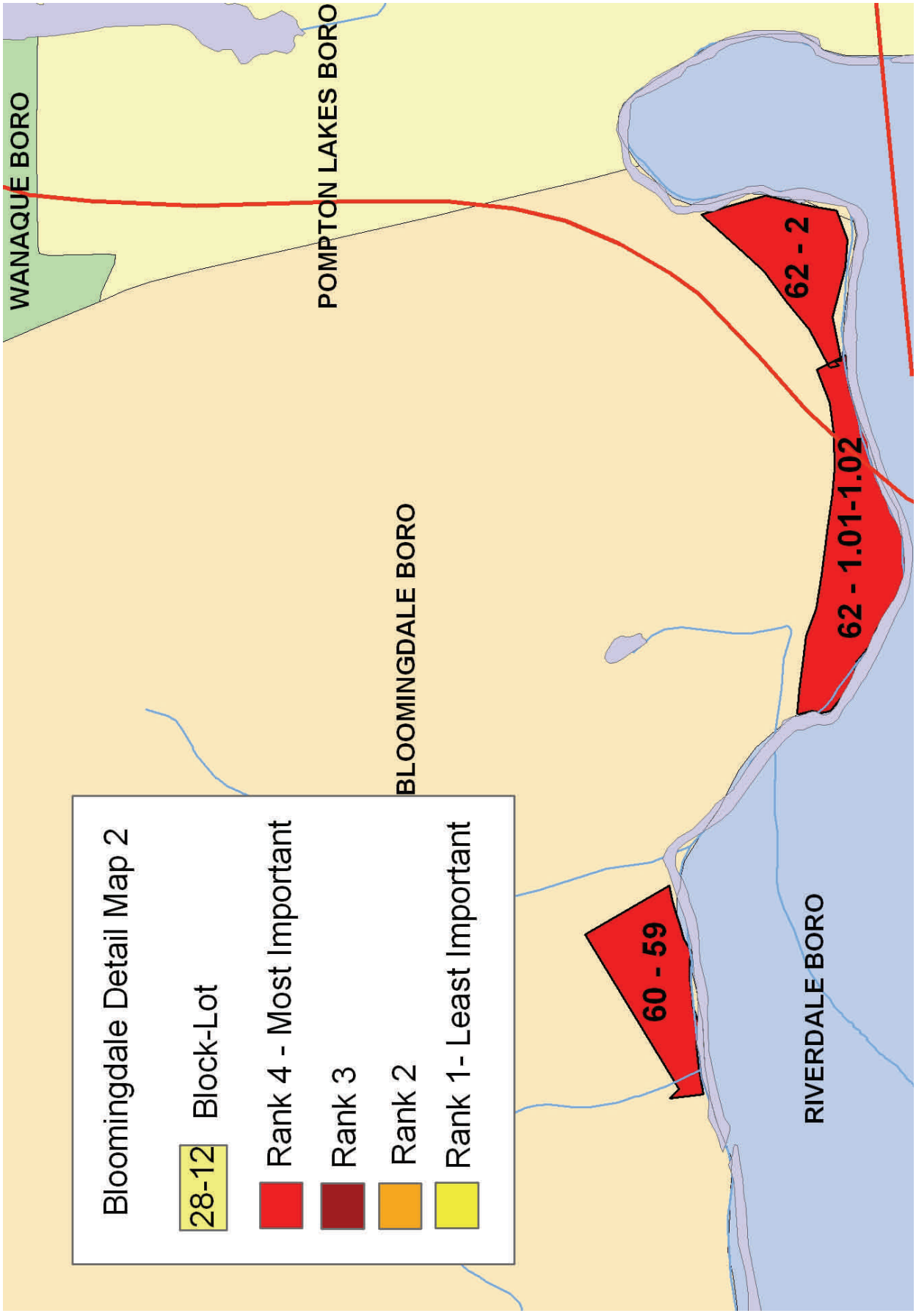

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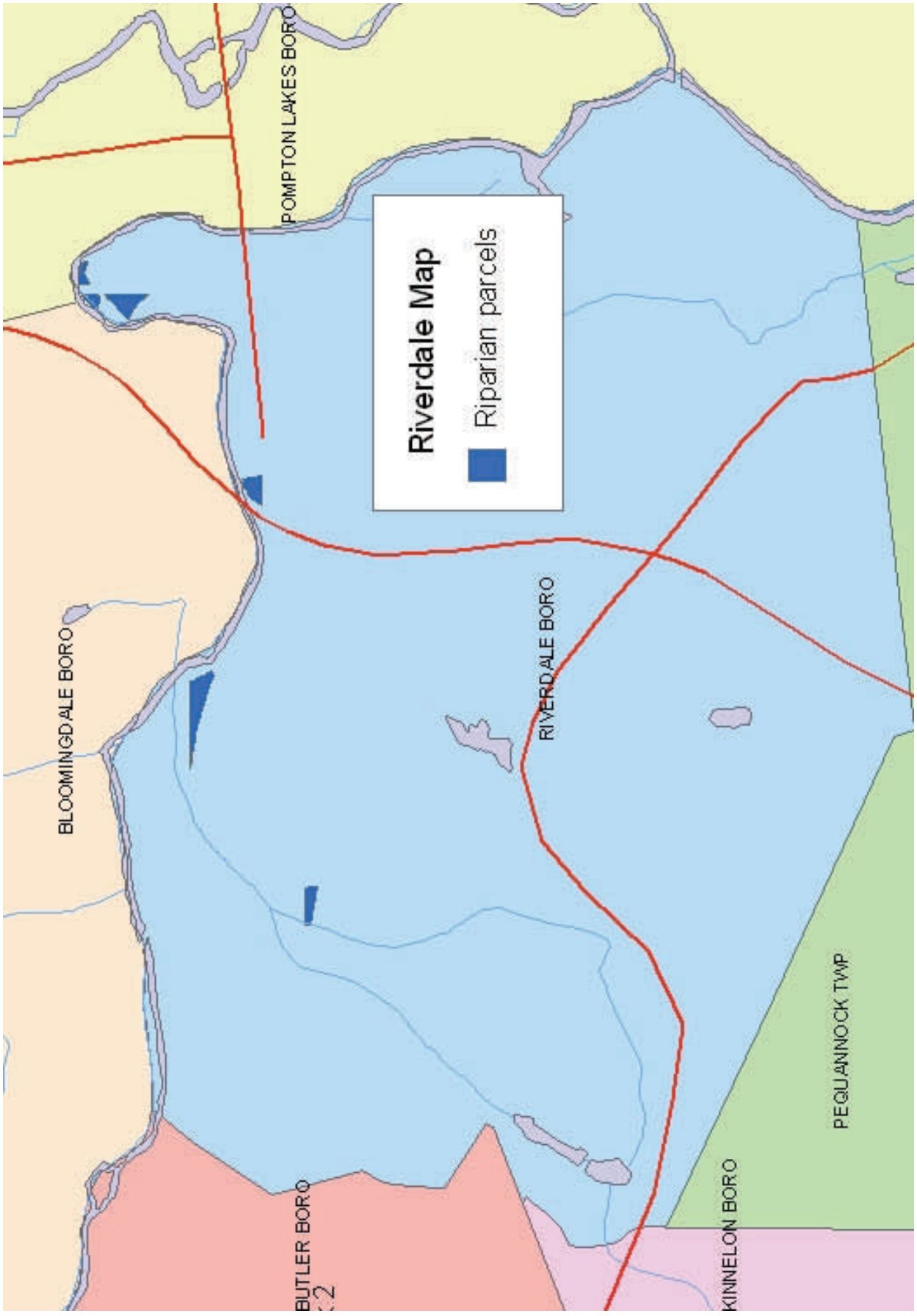


Figure 3-30—Riparian Parcel Map—Riverdale Borough

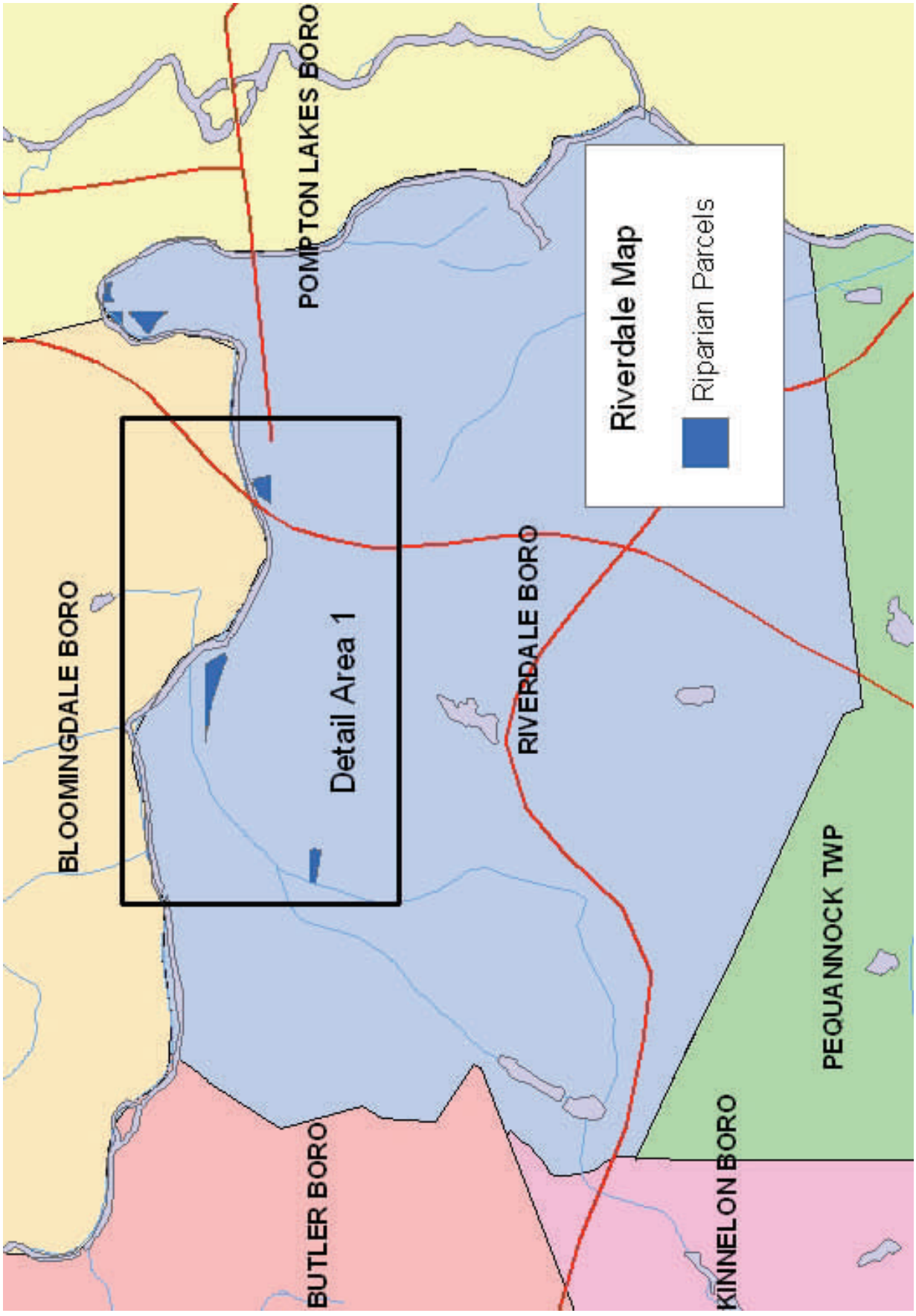
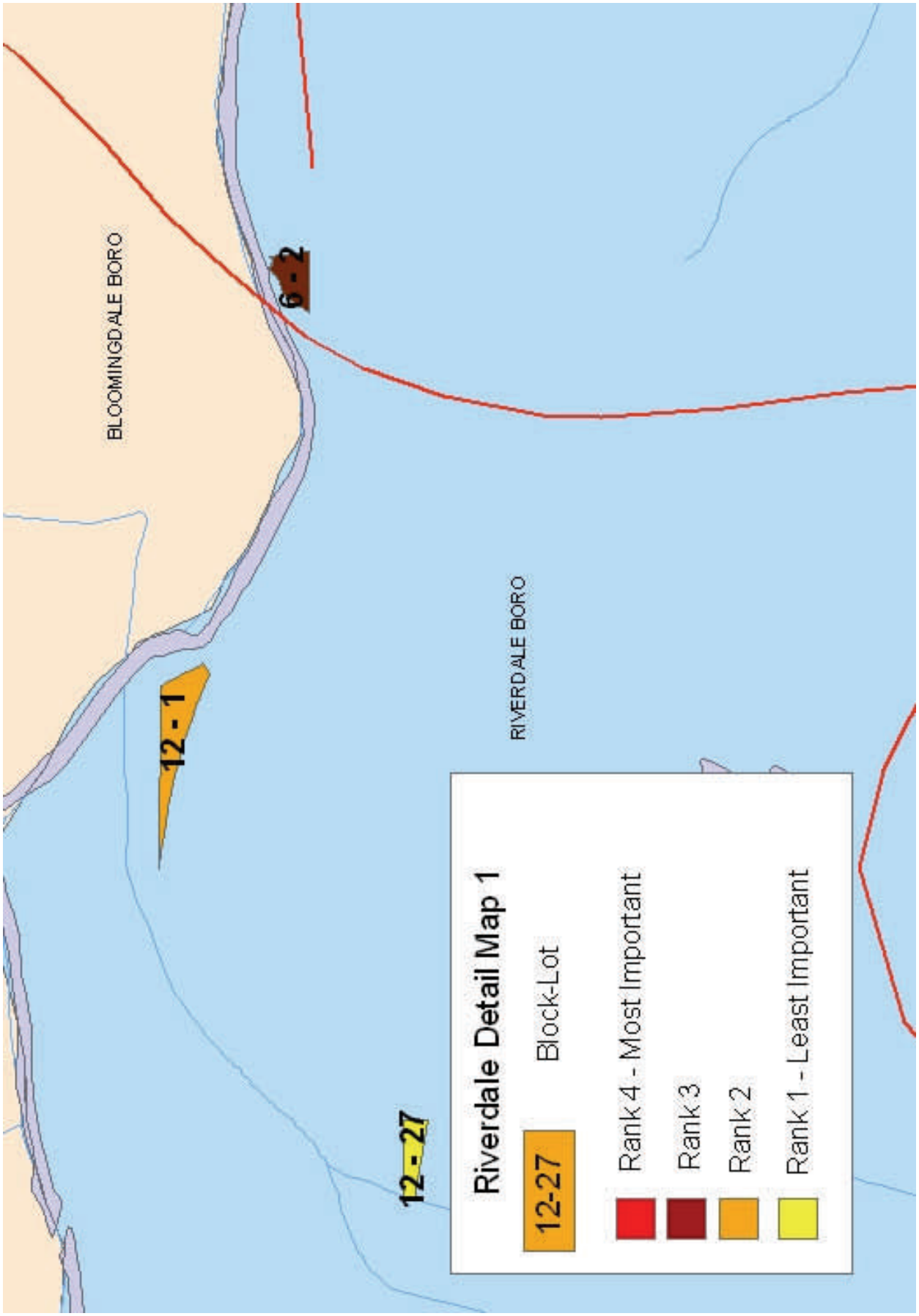


Figure 3-31—Riparian Parcel Map—Riverdale Borough—Detail Area 1



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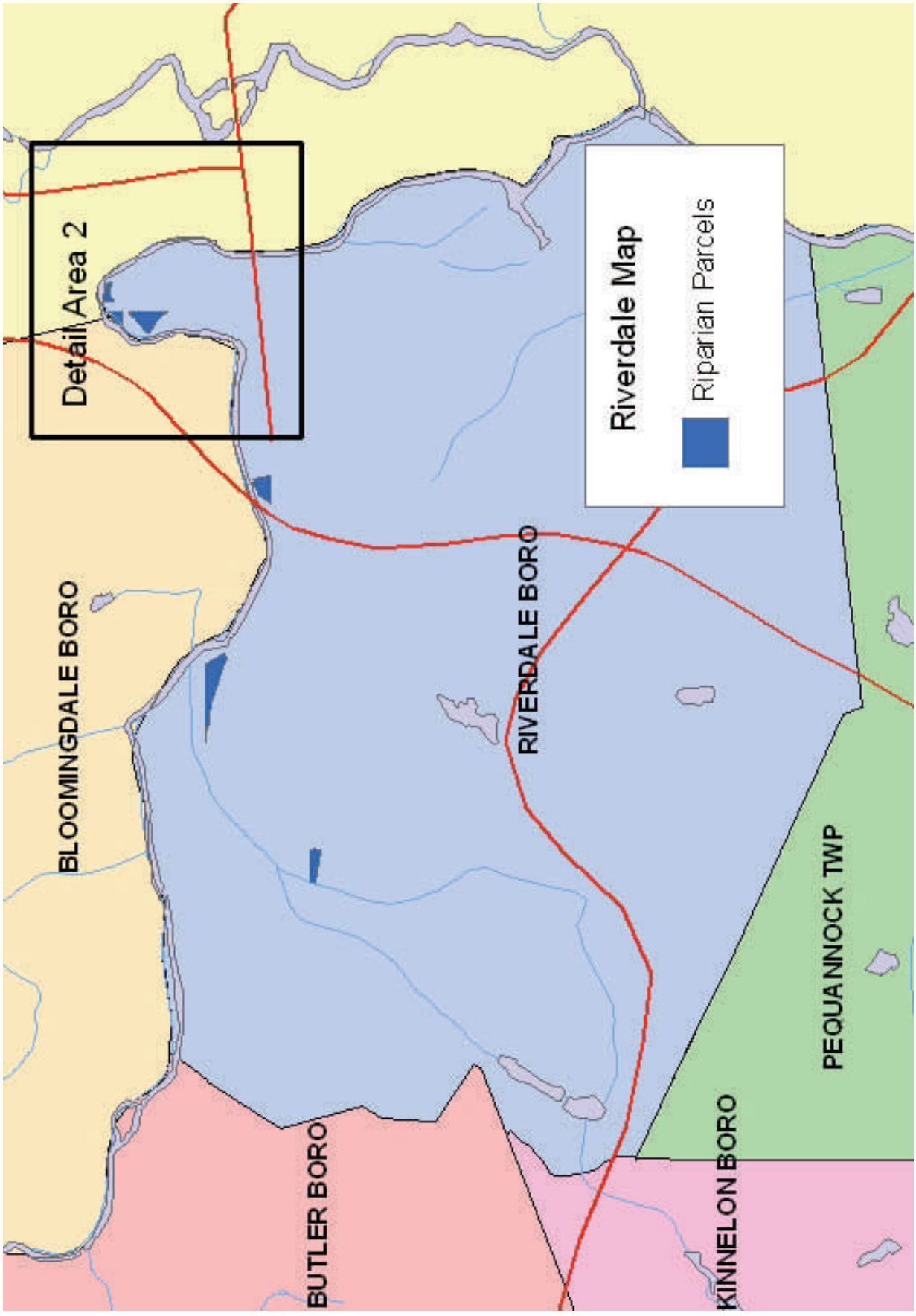

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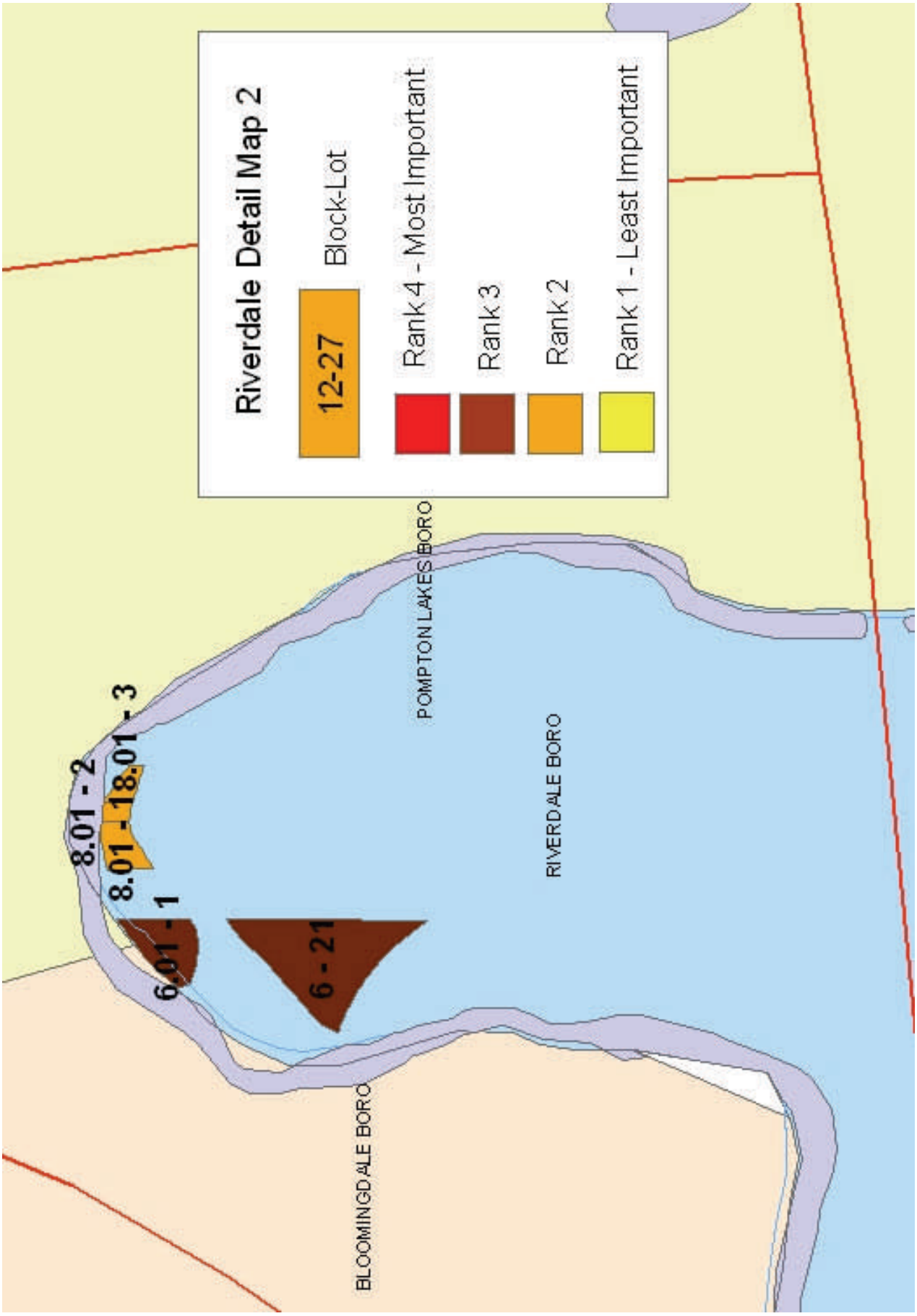

Figure 3-34—Riparian Parcel Map—Riverdale Borough– Detail 2

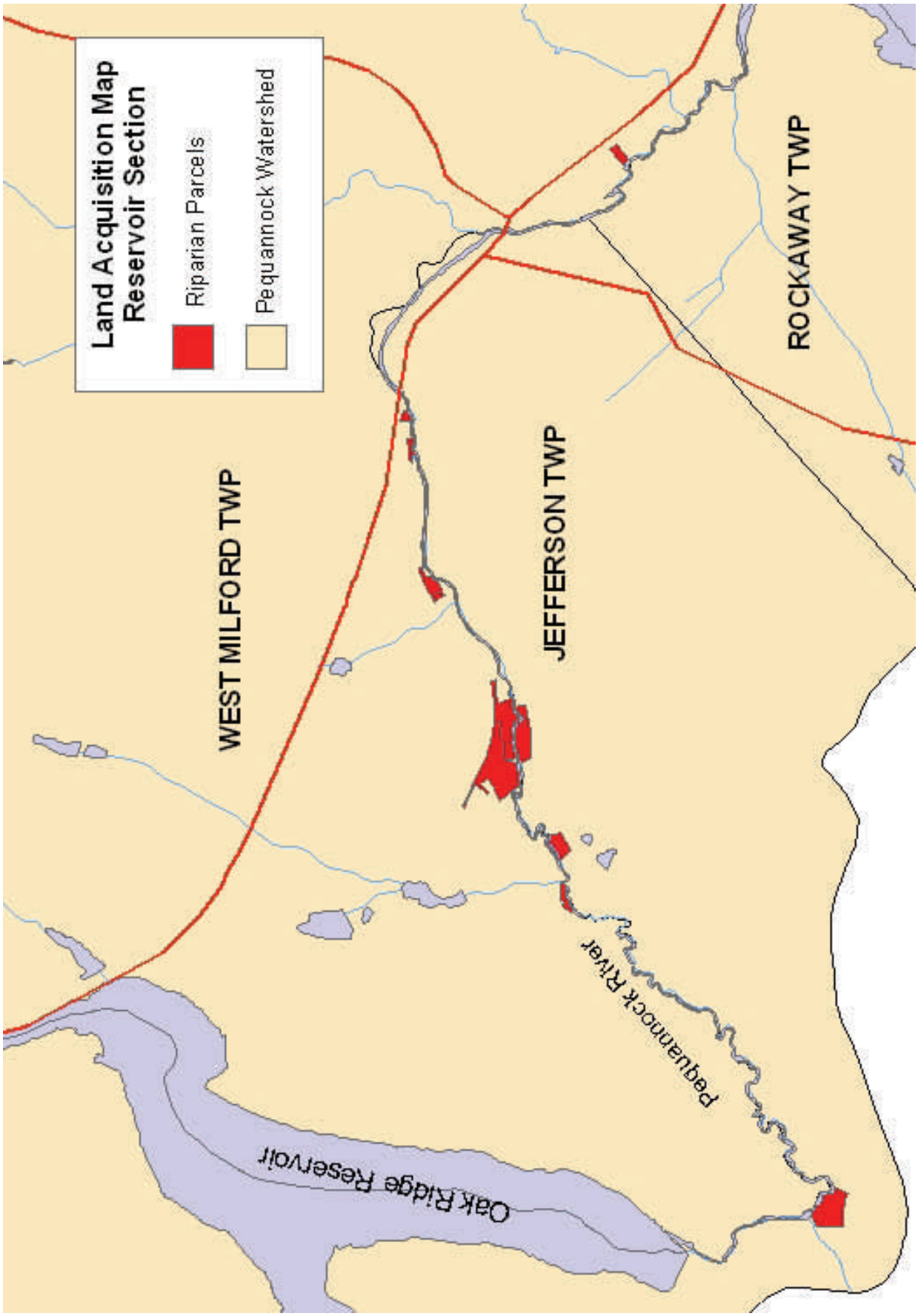

Figure 3-35—Riparian Parcel Map—Reservoir Section, Pequannock Watershed

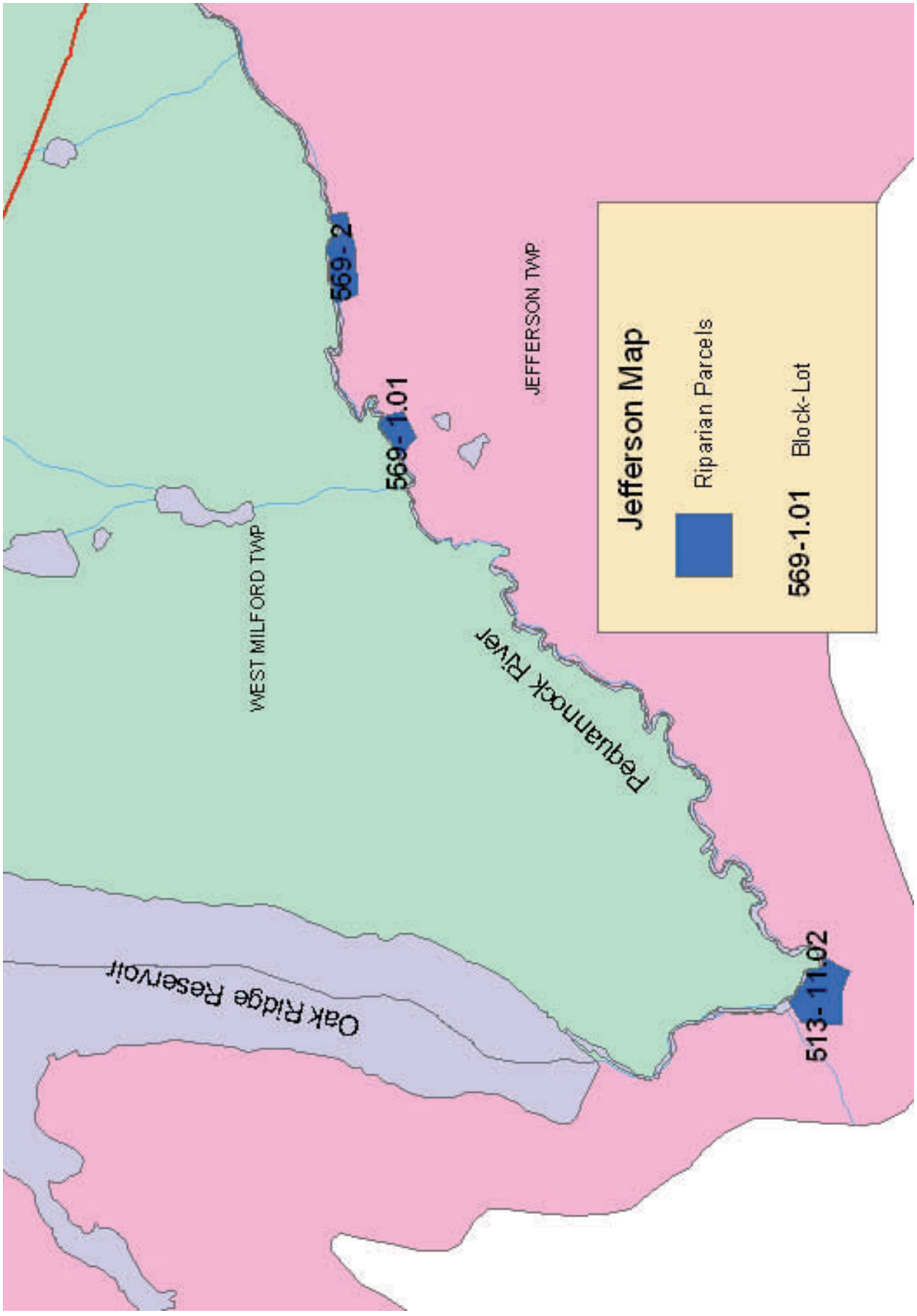

Figure 3-36—Riparian Parcel Map—Jefferson Township

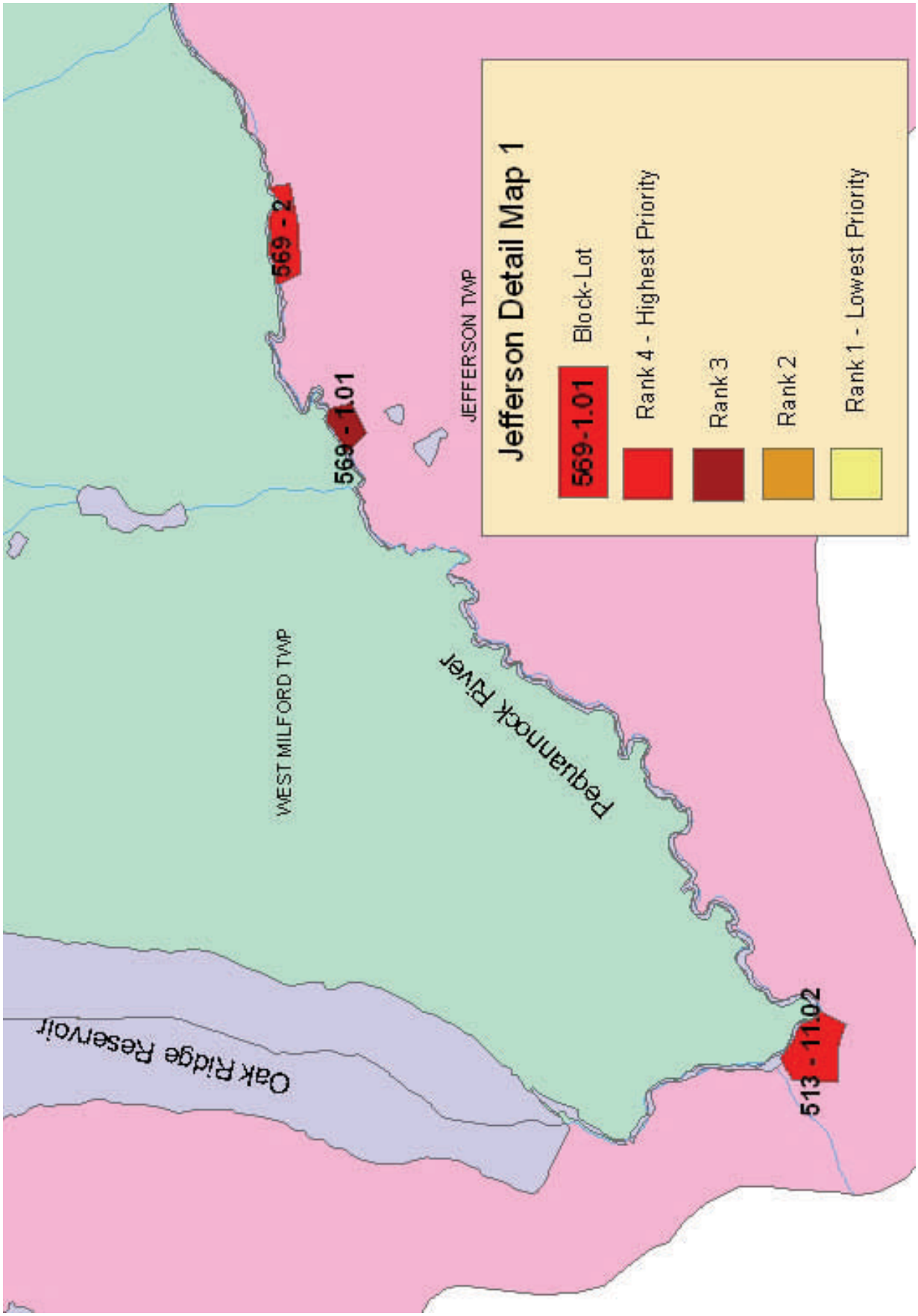

Figure 3-37—Riparian Parcel Map—Jefferson Township, Reservoir Section– Detail 1

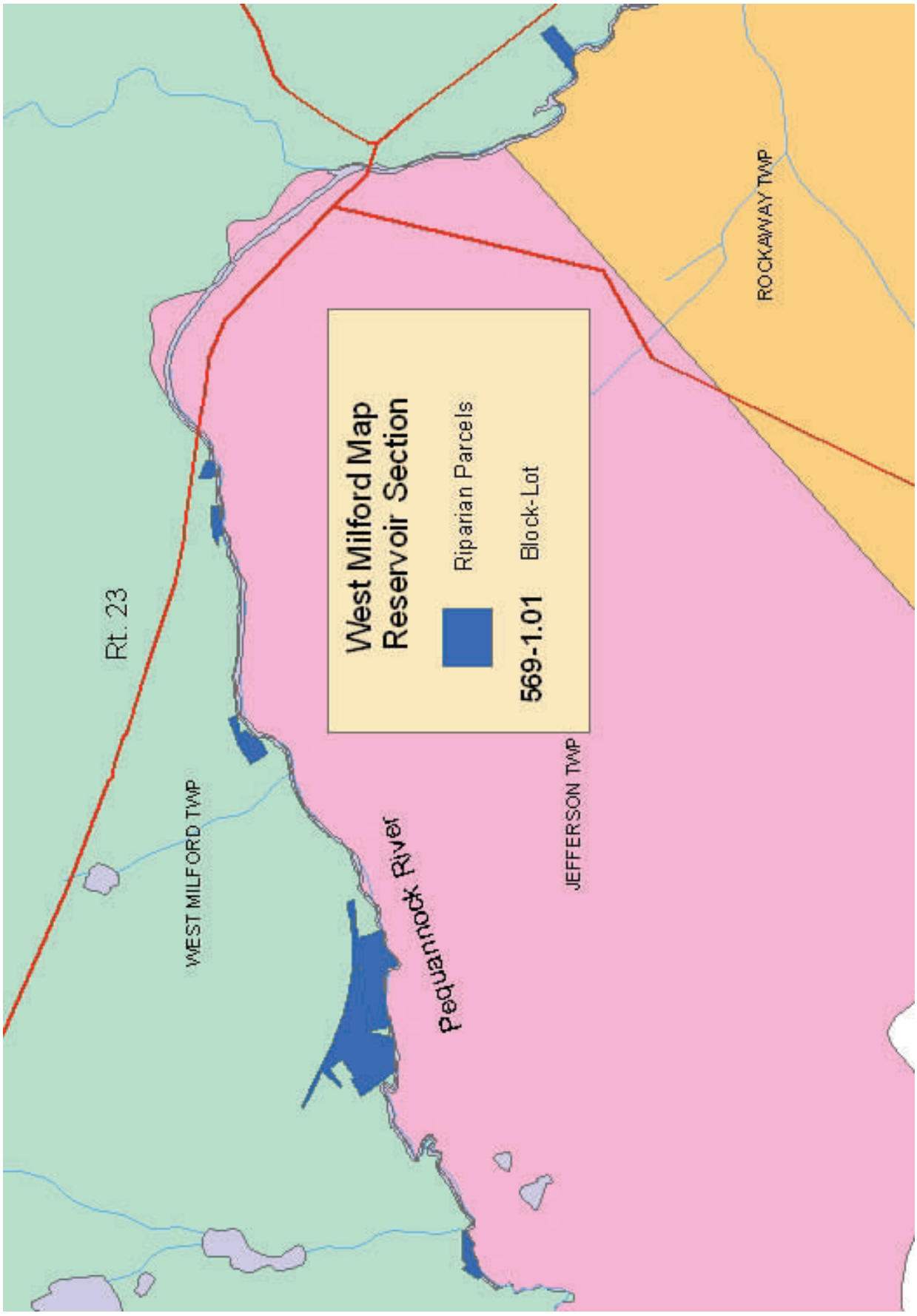

Figure 3-38—Riparian Parcel Map—West Milford Township—Reservoir Section

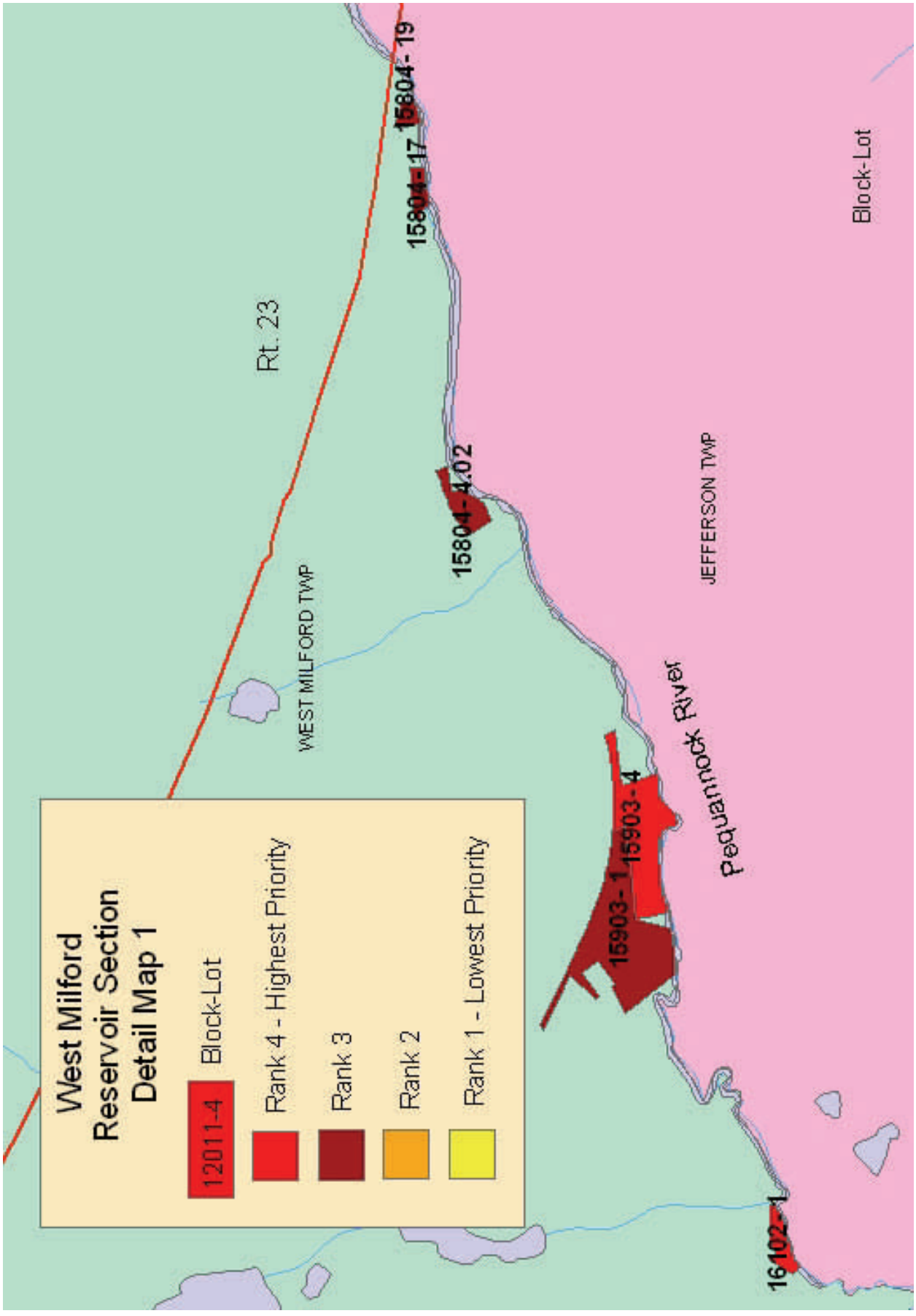

Figure 3-39—Riparian Parcel Map—West Milford Township, Reservoir Section– Detail 1

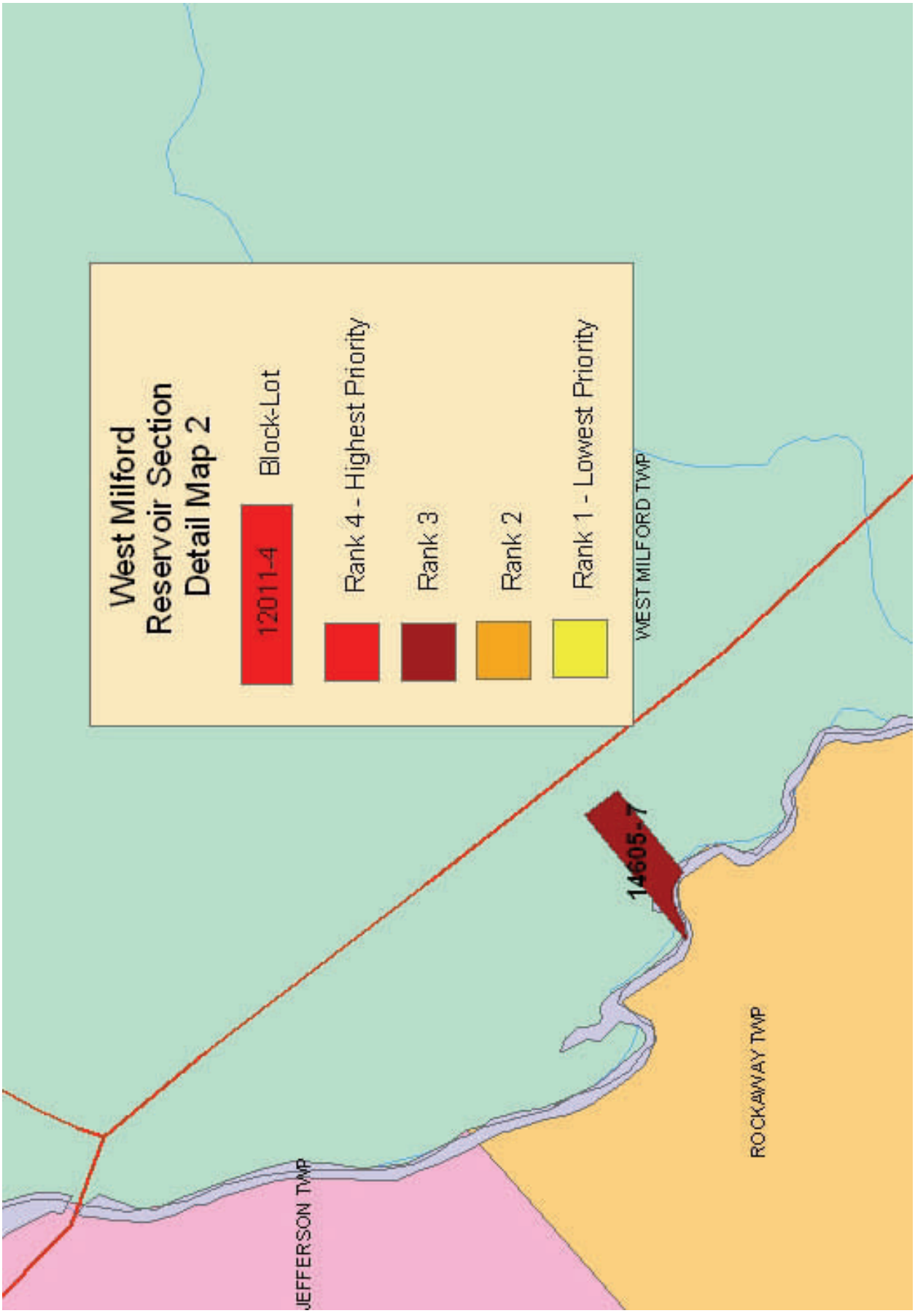

Figure 3-40—Riparian Parcel Map—West Milford Township, Reservoir Section– Detail 2

4 - Summary of Remaining Data Gaps

Additional temperature monitoring sites are recommended on the mainstem Pequannock River to measure the influence of low dams. A series of 5 temperature monitors placed above and between these low dams (see Figure 4-1) would show the temperature influence of each dam.

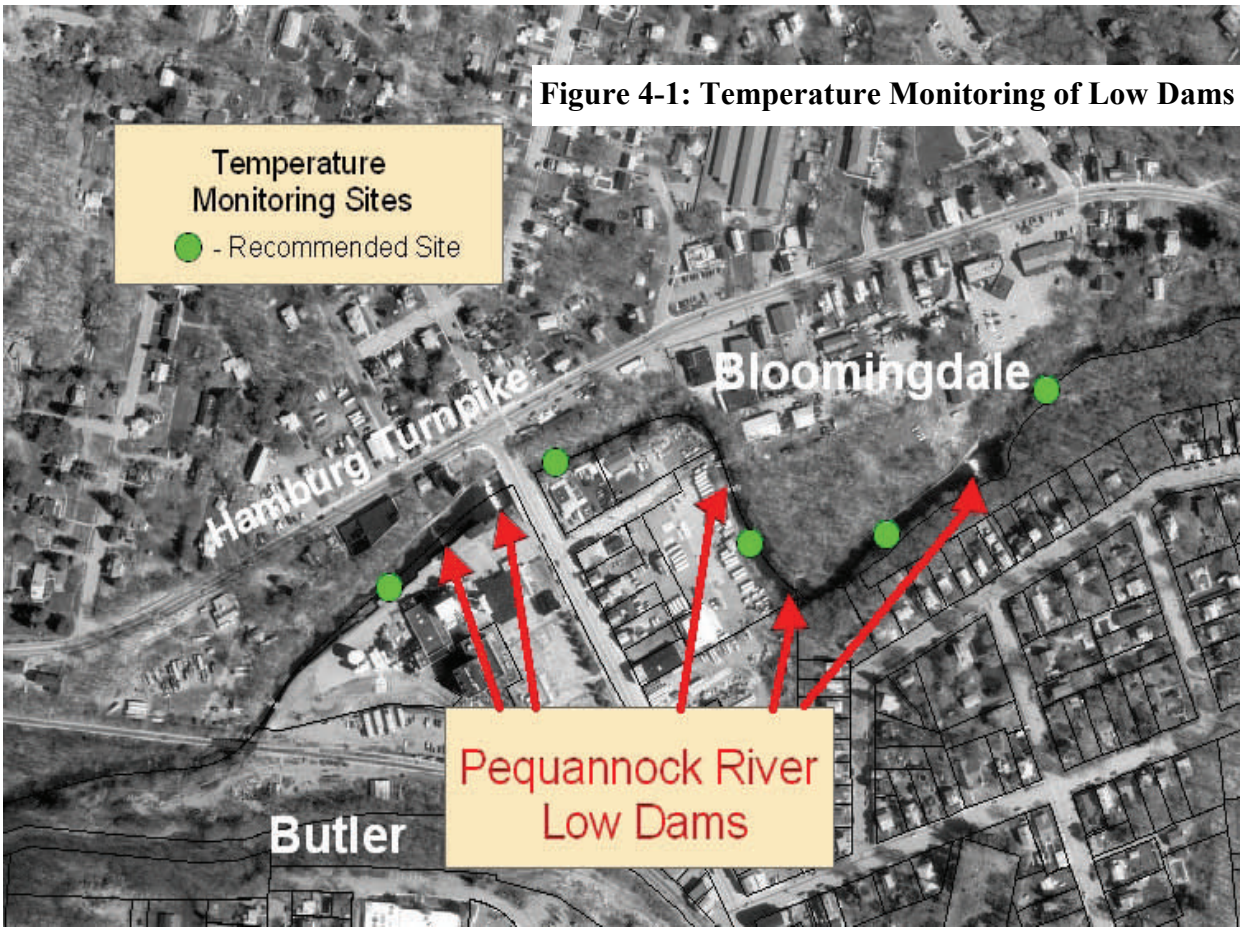

Figure 4-1: Temperature Monitoring of Low Dams

Temperature monitoring of significant tributaries is recommended in the Headwaters Section and Reservoir Section of the Pequannock River. Three additional monitoring sites are needed (see Figure 4-2), including sites on an unnamed tributary in Hardyston, Kanouse Brook in West Milford, and an unnamed tributary in Rockaway,

Temperature monitoring of the single NJPDES discharge listed in section 2-H of this report would alleviate any concern on the impacts of that discharge.

A comprehensive survey of beaver activity on river tributaries is recommended in the Headwaters

Section and Reservoir Section of the Pequannock River. Of particular importance are Pacock Brook, Kanouse Brook and Clinton Brook

All vacant riparian land parcels should be identified and mapped on the Pequannock river and river tributaries in Bloomingdale, Hardyston, Vernon, and on Pequannock River tributaries in the Reservoir Section of the watershed.

Kakeout Brook, draining portions of the Borough of Butler and the Borough of Kinnelon, has a relatively large and complex subwatershed and contributes substantial volumes of water to the Lower Section of the Pequannock River. The water contributed is neutral in terms of temperature. Generally tributaries should serve as positive influences discharging cooler water. As such, Kakeout Brook deserves a comprehensive analysis to determine sources of temperature elevation and practical methods of temperature reduction.

The Division of Fish and Wildlife has conducted periodic sampling of fish populations in the Pequannock River Watershed. In the future, as temperature reductions are achieved, it is essential

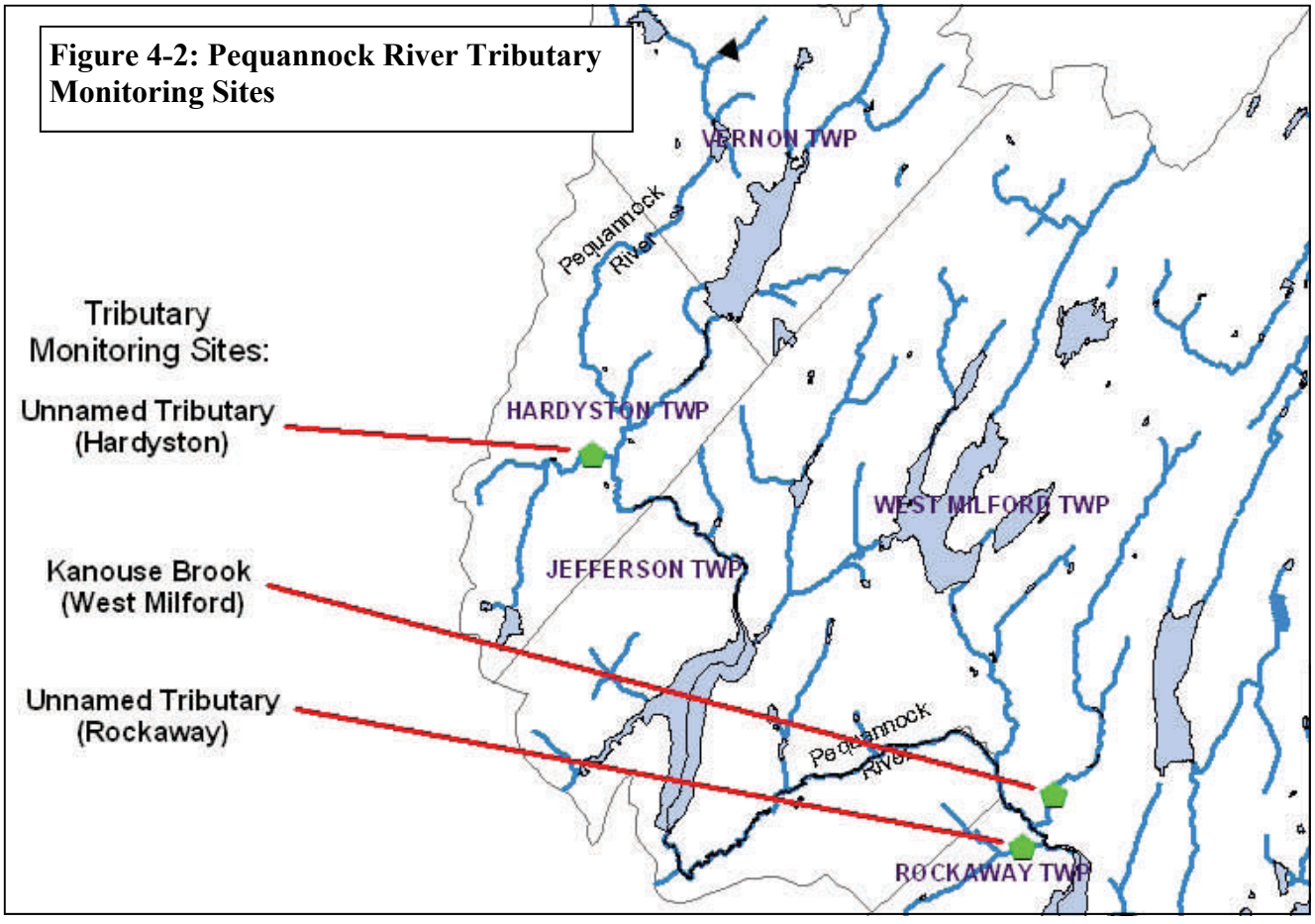

Figure 4-2: Pequannock River Tributary Monitoring Sites

that this sampling be continued to determine any changes in fish (particularly trout) populations. Since there are limits to the Division's ability to conduct such sampling it may be necessary to supplement the Division's work with sampling by other entities. Local colleges or independent consultants with additional volunteer effort, are possible alternatives.

5 –Prioritization and Action Plan

This section of the report is intended to prioritize potential strategies for achieving temperature reduction, provide site-by-site detail, funding suggestions and general cost estimates.

Table 5-1 Prioritization of Applicable Strategies

Issue	Priority	Applicable Strategies	Cost	Return	Anticipated reduction in % of temperature ex-	Time frame	Funding Sources
Flow rates	High	• Water Allocation permit modification	n/a	High	77%*	1-4 years	n/a
		• Promote increased groundwater recharge through municipal stormwater ordinance	$5,000	Low	unknown	1-2 years	
		• Promote protection of groundwater through municipal water conservation ordinance	$5,000	Low	unknown	1-2 years	
Impoundments	High	• Breaching of impoundments (1 site)	n/a	Moderate	unknown		319(h)
		• Supplementary piping of bottom water (3 sites)	$45,000	Moderate	14% **	6-8 years	319(h)
Beaver Activity	High	• Reduction of beaver populations	n/a	High	unknown	2-4 years	n/a
		• Removal of inactive dams	$3,000	High		1-2 years	319(h)
		• Replanting of former pond sites	$10,000	High		2-4 years	319(h)
Riparian Canopy Loss	Moderate	• Municipal riparian protection ordinance	$5,000	Moderate		1-2 years	
		• Municipal redevelopment ordinance	$5,000	Moderate		1-2 years	
		• Replanting of riparian buffers	$15,000	Moderate		1-2 years	319(h)
		• Promote riparian land acquisition	$5,000	Moderate		2-4 years	
		• Educational effort – riparian canopy protection	$5,000	Moderate		1-2 years	
Stormwater Runoff	Moderate	• Municipal stormwater ordinance	$5,000	Moderate		1-2 years	
		• Improvement of existing stormwater systems	$5,000	Low		2-4 years	319(h)
		• Promote riparian land acquisition	n/a	Moderate		2-4 years	
Low Dams	Low	• Breach dams	unknown	unknown		10 years	319(h)

* - This reduction is based on a 12.3 cfs flow at the Macopin Outlet as stated in the proposed TMDL for the Pequannock River
** - This reduction is based on the average percentage of tributary flow measured for these sites combined with a conservative estimated 2 degree Fahrenheit reduction in outflow temperature through siphon piping.

a) Flow Rates

Low river flows are the most important factor contributing to elevated temperatures in the Priority Water segment of the Pequannock River. The primary method of addressing these concerns is through proposed new Water Allocation permit conditions. As noted, these permit modifications are beyond the scope of this plan. However, as we have also noted, the imposition of similar permit conditions for Clinton Brook, the Macopin River and Kakeout Brook could yield significant benefits.

Some additional flow improvement and protection may be achieved through adoption of municipal ordinances promoting stormwater recharge and water conservation. Stormwater recharge is most important in more heavily developed areas of the watershed including Kinnelon, Butler, Bloomingdale, and Riverdale. Groundwater protection through water conservation is a significant issue in West Milford, Jefferson and Kinnelon since these communities rely primarily on groundwater for potable supply. A concerted effort to achieve adoption of such ordinances should be promoted in these municipalities. Model ordinances are attached in Appendix G.

b) Riparian Canopy

Aside from areas de-forested by beaver activity in the Headwaters and Reservoir sections, canopy losses that can be addressed through traditional re-planting projects are not extensive in the Pequannock River Watershed. One exception is the largest potential restoration site in that area (see Figure 2B-12) on lands owned by the City of Newark . However, as previously noted, the City has proven extremely uncooperative in authorizing restoration work.

A more pressing concern is preventing additional canopy loss, either through new development or through landowner actions on previously developed properties, and addressing losses on sites that have already been developed. To this end an educational effort aimed at private landowners is the best remedy. In previous discussions with the Division of Watershed Management, the Division had committed to developing the materials needed for such a program. Additional work would be necessary to develop a mailing list of riparian landowners, to conduct mailings and make site visits in response to landowner requests for assistance.

Costs for education and restoration are outlined in Table 5-3.

Site	Waterway	Ownership	Applicable Strategy	Cost	Benefit
Pqclbl010	Oakwood Lake tributary	Private	Replanting /Education	$1,000	Low (downstream impoundment)
Pqclbl020	Cold Spring Lake tributary	Private	Replanting / Education	$3,000	High
Pqclbl030	Van Dam Brook	Public	Replanting	n/a*	High
Pqclbt010	Kakeout Brook	Public/private	Redevelopment	n/a**	High
Pqclbt020	Kakeout Brook	?	Redevelopment	n/a**	High
Pqclbt030	Pequannock River	Public/private	Redevelopment	n/a***	High
Pqclkn010	Maple Lake tributary	Private	Replanting / Education	$1,000	Low (downstream impoundment)
Pqclkn020	Pequannock River	Private	Replanting	$5,000	High
Pqclrv010	Valley Spring Lake tributary	Private	Replanting	$5,000	High
Pqclrv020	Pequannock River	Public	Replanting	n/a*	High

Table 5-3 – Riparian Canopy Loss Sites

* - Site addressed through existing 319(h) grant

** - Site can only be addressed through future redevelopment

*** - Site will be addressed through existing redevelopment proposal

c) Impoundments

Based on recently collected data, impoundment of river tributaries is the second most significant problem. The high number of impoundments on Pequannock River tributaries and their documented elevation of river temperatures combine to raise the priority of this issue.

Each impoundment must be handled as a unique situation. Removal of dams is the most effective measure but is rarely feasible and, as noted, where multiple impoundments exist on a single tributary all must be removed to completely eliminate thermal problems. Siphon piping may offer a viable alternative. A suitable site for a demonstration siphon project should be identified and the project implemented and monitored. Results will determine whether such an approach can be utilized at other sites. Table x shows a list of impoundments and the recommended strategy for each.

Controlled release of cold bottom water is the appropriate strategy at all impoundments where bottom release is possible. These sites include Oak Ridge Reservoir, Charlottesburg Reservoir, Clinton Reservoir and may include Canistear Reservoir and the unnamed reservoir in the Pequannock Headwaters Section (see Figures 2C-7 and 2C-8). These releases should be mandated through changes to water allocation permit conditions

Table 5-2 Addressing Impoundments

Impoundment	Public or Private	Temperature of tributary	Flow Rate	Priority	Recommended strategy	Estimated Cost
Cold Spring Lake	Private	High	Low	High	Bypass piping	$15,000
Unnamed (Oakwood Lake Tributary)	Private	High	Low	High	Bypass piping	$15,000
Apshawa Pond	Public	Low	Moderate	Low	Breach	None*
Maple Lake	Private	Low	Low - Moderate	Low	None	None
High Crest Lake	Private	Low	Low	Low	None	None
Henion Pond	Private	Low	Low	Low	None	None
Lower Suntan Lake	Private	Low	Low-Moderate	Low	None	None
Suntan Lake	Private	Low	Low-Moderate	Low	None	None
Lake Edenwold	Private	Moderate	High	n/a (downstream impoundment)	n/a	n/a
Unnamed pond (below Lake Edenwold)	Public	Moderate	High	Moderate	Bypass piping	$15,000
Oakwood Lake	Public	High	Low	n/a (downstream impoundment)	n/a	n/a
Johns Lake	Private	n/a	n/a	n/a	Monitor	$800
Terrace Lake	Private	n/a	n/a	n/a	Monitor	$800

d) Beaver Activity

Although restricted to the Headwaters and Reservoir sections of the watershed, beaver activity has enormous importance in these areas. Of primary concern is the need for reduction of overall beaver populations in these areas. To this end the Pequannock River Coalition can continue to report areas of high beaver activity to the Division of Fish and Wildlife so that trapping can be targeted to the these areas.

In addition, hand removal of derelict beaver dams is an extremely cost-effective method of achieving considerable improvement at minimal cost. During recent surveys of the Pequannock River Headwaters Section a number of sites were identified where this can be accomplished (see Figure 5-1). It is estimated that removal of these dams could be accomplished at a cost of $2,000-$3,000 utilizing a largely volunteer work force.

Re-planting of former pond sites can accelerate the conversion from pond to forest and speed shading of these river sections. Cost of re-planting is dependent on the size of the area targeted. Past replanting projects conducted by the Pequannock River Coalition had costs of $5-$6 per linear foot of stream/river bank. A rough estimate for the 2 sites identified in the Headwaters Section is $5,000 to $10,000. Again, this assumes a largely volunteer effort, and the utilization of cuttings from willows and dogwoods.

Unfortunately these sites are on lands owned by the City of Newark and the City has rejected proposals for such projects in the past. Without this cooperation it is unlikely these projects can proceed.

Going forward, areas impacted by beaver activity should be re-surveyed at least every 2 years since, as noted in this report, beaver dams can be abandoned at any time while other dams may be quickly built. This is far from a static situation.

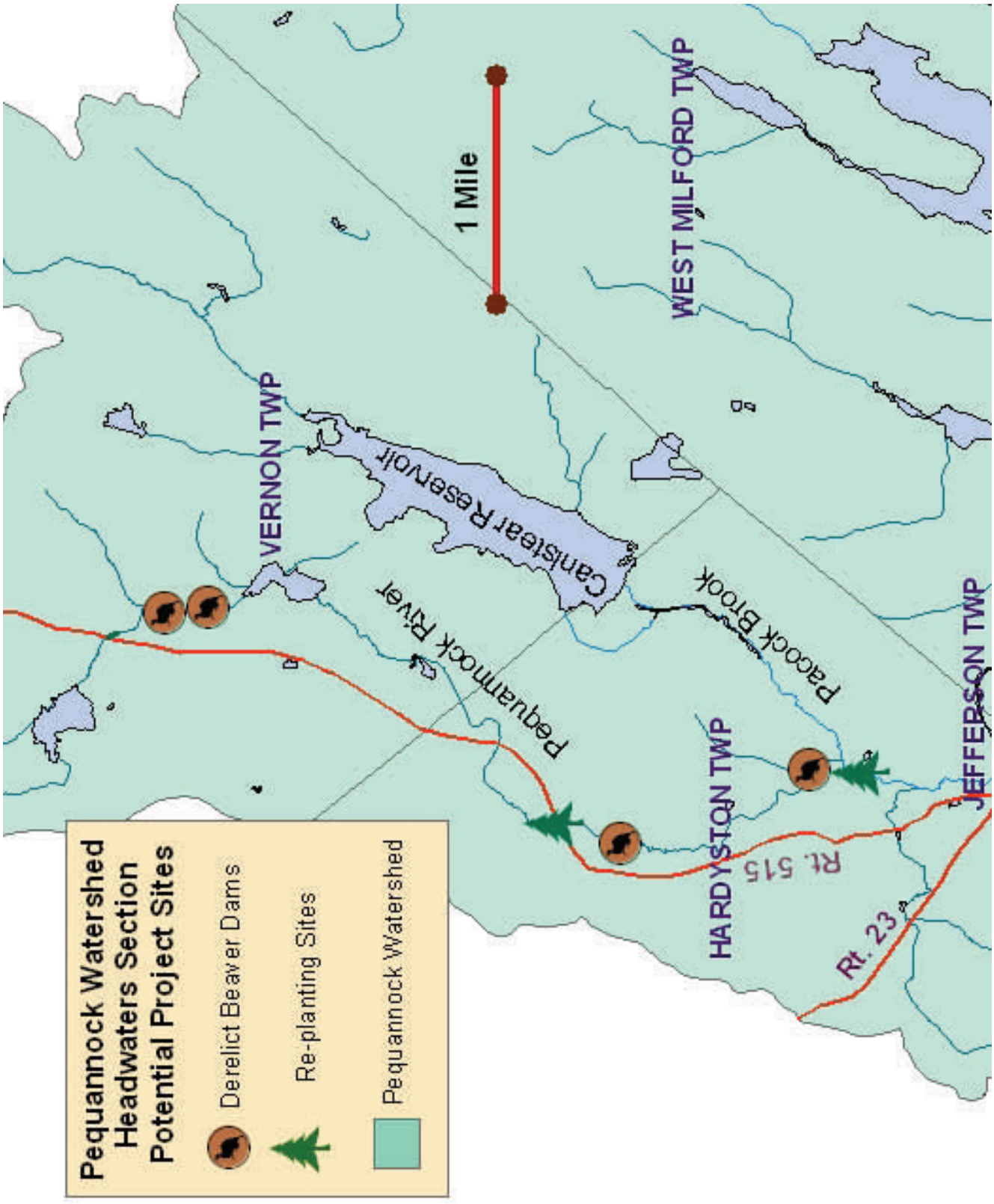

Figure 5-1: Project Sites to address beaver activity

e) Stormwater Runoff

As noted, new development is typically accompanied by increased stormwater runoff. Specific temperature reduction measures outlined in this report should be required for stormwater management in all new development proposals within the impaired sections of the Pequannock River Watershed.

In addition, the shading of existing detention basins and impervious cover should be considered as a method of reducing existing runoff temperatures. A good example of a suitable location is the Terrace Lake development in the Borough of Butler (see Figure X) where stormwater discharging from unshaded detention basins is routed directly to the Pequannock River. An additional site is the Cedar Crest Village complex in Pequannock Township (see Figure x). Such improvements are particularly important in the Lower Section of the Pequannock Watershed as data suggests this is where stormwater plays the greatest role in temperature elevation.

Extending the protection of the existing riparian canopy beyond the 50-foot buffer now regulated for small developments should be promoted through municipal ordinances, as noted.

Preservation of riparian lands through acquisition is an extremely effective strategy in preventing increases in stormwater runoff and is addressed here in section f.

f) Low Dams

Until additional data is collected on the extent of temperature elevation caused by low dams in the mainstem Pequannock, these dams may be considered a low priority. However, if opportunities arise to eliminate these dams, their removal would almost certainly be beneficial.

g) NJPDES discharges

See section 4 for identified data gaps.

h) Land Acquisition

There are multiple entities involved in land preservation in the Pequannock River Watershed and several sources for acquisition funding. These include municipalities, counties and private land trusts such as the Passaic River Coalition. At the time of this report all municipalities in the Pequannock River Watershed, with the exception of Butler and Hardyston, had dedicated municipal

open space tax funds. Morris, Sussex and Passaic counties also have such funding. Other funding sources include State Green Acres, and federal funding (i.e. Forest Legacy Program).

A detailed package of appropriate parcels should be developed for each entity and provided to them. These packages should include lists of parcels, maps and GIS layers. In addition, other significant resource values on these parcels could be identified and promoted (linkage to existing open space, recreational value, threatened/endangered species habitat, wetlands, etc.). This material can be presented to local Open Space committees, and to the other entities listed above.

i) Integration with the Highlands Water Protection and Planning Act

Several components of this legislation offer opportunities for addressing temperature impairment in the Pequannock River Watershed. This is significant as much of the Pequannock River Watershed is within the Preservation Area as defined by the Act (see Figure 5-2). As an example, one primary goal of this Act within the Preservation Area is to "protect, restore, and enhance the quality and quantity of surface and ground waters therein;" (Section 10-b-1). Included in the responsibilities of the Highlands Council are:

"To prepare and transmit to the Commissioner of Environmental Protection such recommendations for water quality and water supply standards for surface and ground waters in the Highlands Region, or in tributaries and watersheds thereof, and for other environmental protection standards pertaining to the lands and natural resources of the Highlands Region, as the council deems appropriate;" (Section 6-m).

"To identify and designate in the regional master plan special areas in the preservation area within which development shall not occur in order to protect water resources and environmentally sensitive lands while recognizing the need to provide just compensation to the owners of those lands when appropriate, whether through acquisition, transfer of development rights programs, or other means or strategies;" (Section 6-n).

"To develop model land use ordinances and other development regulations, for consideration and possible adoption by municipalities in the planning area, that would help protect the environment, including, but not limited to, ordinances and other development regulations pertaining to steep

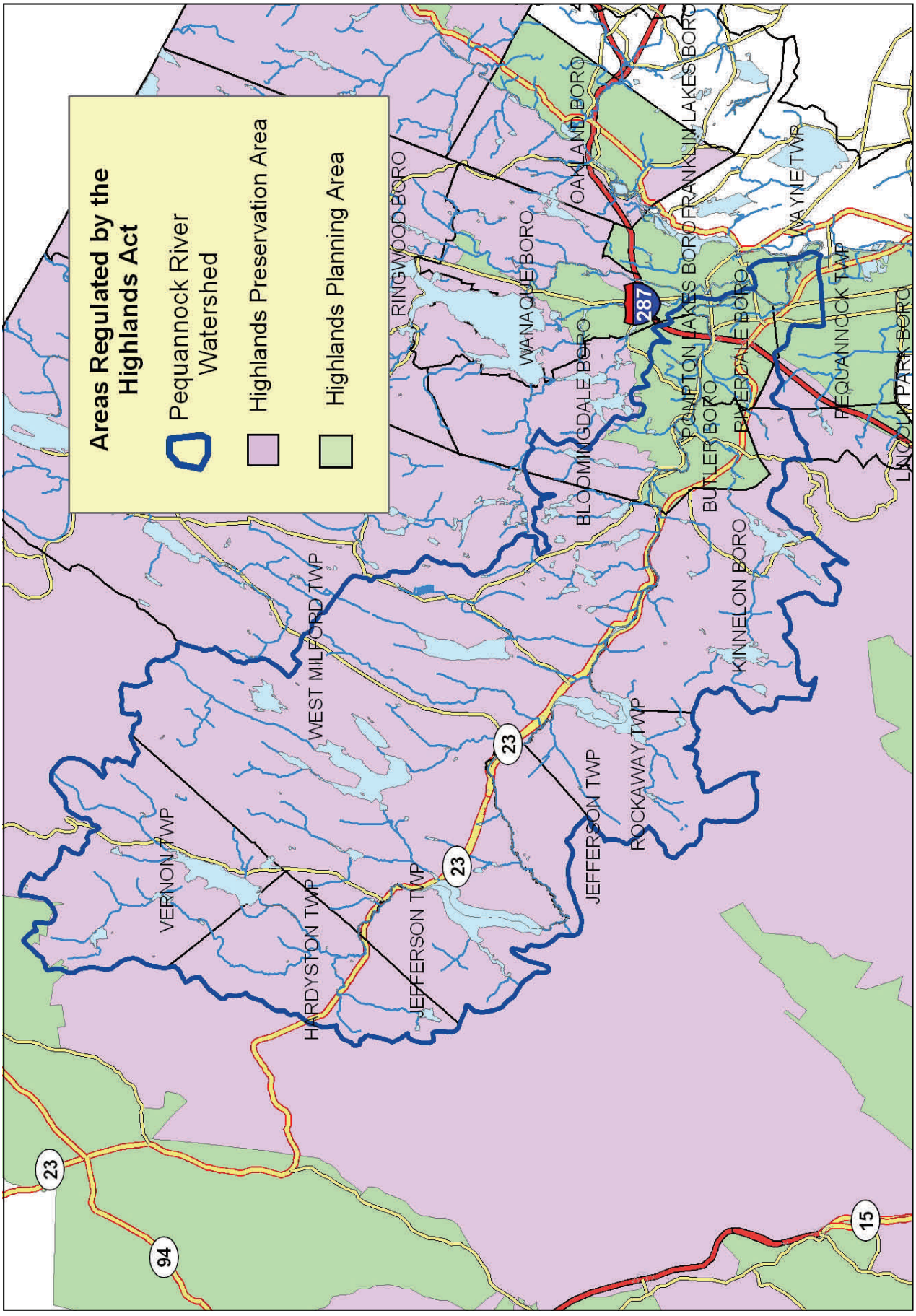

Figure 5-2: Areas regulated under the Highlands Water Protection and Planning Act

slopes, forest cover, wellhead and water supply protection, water conservation, impervious surface, and clustering; and to provide guidance and technical assistance in connection therewith to those municipalities;" (Section 6-p).

Early integration of this Management Plan, particularly promotion of model ordinances and key land acquisitions, and the provision of municipal guidance and specific water quality standards, could yield great benefits.

j) Integration with implementation of the Stormwater Management Rules

The Stormwater Management Rules at N.J.A.C. 7:8 require all municipalties to develop storm-water management plans. Section 2.2(a) of these rules provides 9 specific goals for all stormwater management plans. The goals include:

5. Maintain groundwater recharge;

6. Prevent to the greatest extent feasible, an increase in nonpoint pollution;

7. Maintain the integrity of stream channels for their biological functions, as well as for drainage;

Section 2.4 of the rules provides 6 requirements for Stormwater management plans. These in-clude:

a) A stormwater management plan shall include structural and nonstructural stormwater management strategies necessary to meet the stormwater management goals of this chapter.

b) In developing a stormwater management plan and identifying appropriate stormwater management measures thereunder, each stormwater management planning agency shall consider the physical characteristics and ecological resources of the stormwater management planning area.

It should be noted that these plans are not restricted to new development alone. Section 7:8-4.2(a) of the Rules state that plans "*... may also address stormwater-related water quality, water quantity and groundwater recharge impacts of existing land uses.* " This is meaningful in terms of redevelopment, restoration work and improvement of existing stormwater systems.

Clearly these goals and requirements can have special application in addressing temperature impairment in the Pequannock River Watershed and offer a chance to institute mitigation measures. Section 4.2 of the Rules provides specifics on the granting of variances and exemptions from the Rules. The Rules state:

11. In order to grant a variance or exemption from the design and performance standards in N.J.A.C. 7:8-5, include a mitigation plan that identifies what measures are necessary to offset the deficit created by granting the variance or exemption. The mitigation plan shall ensure that mitigation is completed within the drainage area and for the performance standard for which the variance or exemption was granted;

These mitigation plans offer an opportunity to address known water quality issues, such as the site in Bloomingdale discussed in Section 2-E of this report. It should be noted that the extensive buffers the Stormwater Rules provide around the Pequannock River and river tributaries are likely to generate frequent requests for exemptions.

Appendix A

Pequannock River Tributary Flow and Temperature Monitoring

Appendix B

NJDEP Stream Buffer Conservation Zone Model Ordinance

Appendix C

Design and Construction Standards for Sanitary Sewer and Surface Water Management

(Model Redevelopment Ordinance)

Appendix D

NJDEP Model Stormwater Ordinance

Appendix E

Pequannock River Headwaters Survey

Appendix F—Riparian Property List

Appendix G—Model Water Conservation Ordinances

Appendix A

Pequannock River Tributary Flow and Temperature Monitoring

Pequannock River Tributary Flow and Temperature Monitoring

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Pequannock River Thermal Mitigation, Monitoring and Assessment Project

This project was funded under NJDEP Grant Identifier RP04-003

Date: 01/24/05

Table of Contents:

Figures

1) Introduction

Several segments of the Pequannock River have been listed as impaired for water temperatures in excess of the New Jersey Surface Water Quality Standards criteria. Water temperature is a critical element throughout much of the Pequannock River since this waterway supports spawning trout populations. The resident wild Brown trout can be extirpated by water temperatures exceeding 78F and trout populations suffer degradation at temperatures above 68F. Although the principal cause of this impairment is believed to be inadequate flow rates and the NJDEP is currently developing an improved flow management plan to correct these impairments, other sources may contribute to high water temperatures. In the lower Pequannock River drainage, defined as that portion of the river below Macopin Reservoir, these sources include higher levels of impervious surface, impoundment of tributaries, loss of riparian canopy, stormwater discharges and NJPDES discharges.

Currently the Pequannock River Coalition maintains 3 temperature monitoring stations on this segment of the river – one immediately below the Macopin Reservoir, one approximately 4 miles downriver at Butler and one 3 miles lower at Riverdale. Preliminary monitoring of several Pequannock River tributaries in this same area has revealed that some tributaries have a positive influence, some have a negative influence and others are neutral in terms of temperature. Due to the large number and substantial size of the tributaries in this river reach we believe a full understanding of these tributaries is necessary to assessing their impact.

To better understand their influence this study was conducted in 2004 of temperatures and flow rates in 11 significant tributaries (see Map 1). Temperature data was collected from June to September on these 11 tributaries. Flow rates were measured three times on each tributary from July to August. Flow rates were also measured in the mainstem Pequannock at the lower limit of that portion of the Pequannock designated as Category 1. The comparison of tributary flow to mainstem flow and tributary temperatures to mainstem temperatures was intended to show the relative influence and importance of each tributary.

One tributary, the Macopin River, was included in this study because it is an important tributary and its characteristics should be understood. However, its position, above Macopin Reservoir, means that it does not have a direct influence on the river temperatures examined in this study. In addition, its flow is combined into the total river flow measured at the Macopin gauging station. Since this report looks at the difference in flow between the Macopin gauging station and points downstream, the inflow of the Macopin River must be ignored as it cannot be segregated. Therefore this report concentrates primarily on only 10 tributaries.

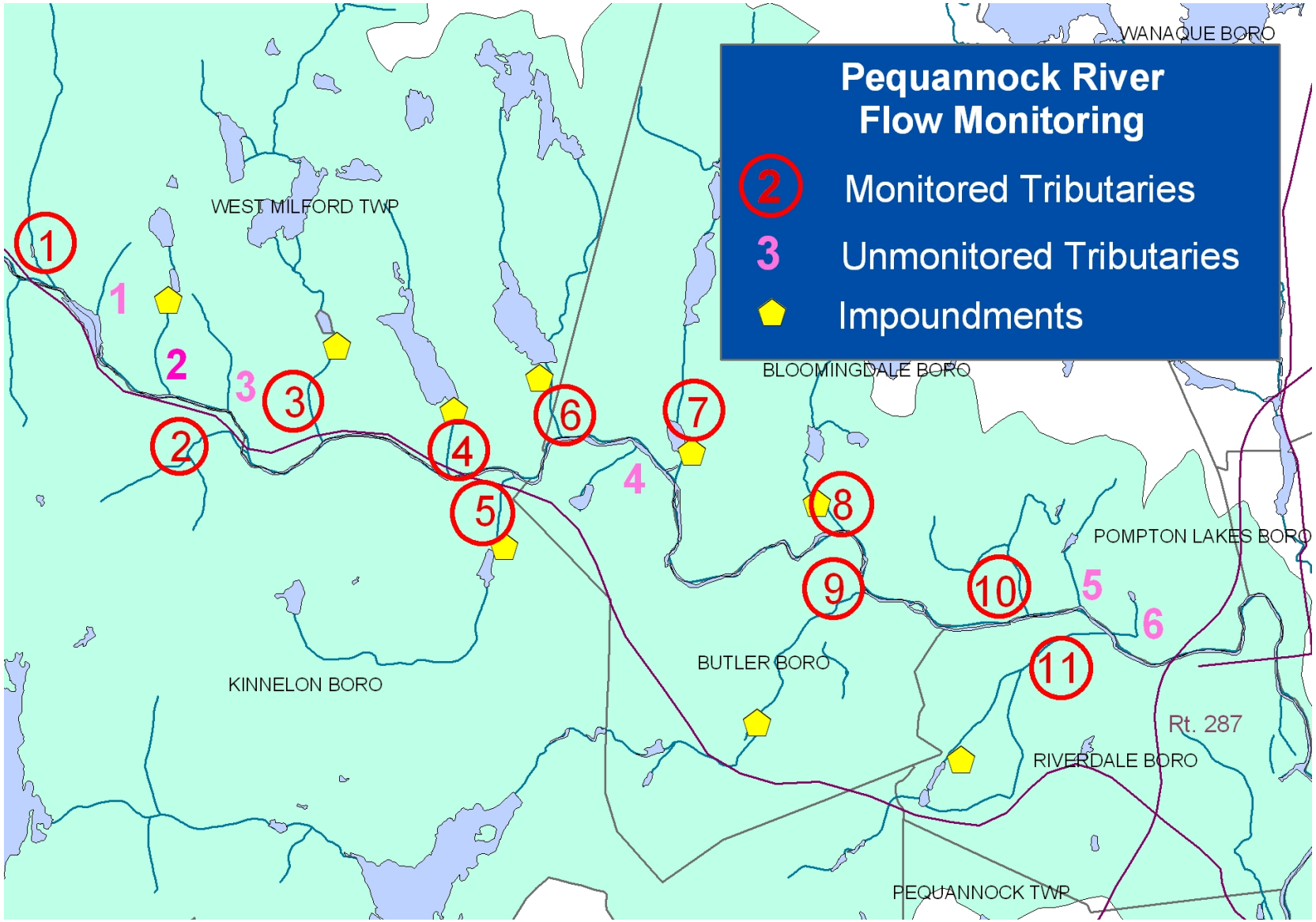


Figure 1 – Map of Pequannock River Tributaries

Monitored Tributaries: 1 – Macopin River, 2 – Smoke Rise Tributary (unnamed), 3 – Apshawa Brook, 4 – High Crest Lake Tributary (unnamed), 5 – Maple Lake Outlet (unnamed), 6 – Henion Pond Tributary (unnamed), 7 – Cold Spring Lake Tributary (unnamed), 8 – Oakwood Lake Tributary (unnamed), 9 – Kakeout Brook , 10 – Van Dam Brook, 11 – Valley Spring Lake Tributary (unnamed)

2) Study Methodology

a) Temperature Monitoring

Temperature data from the Pequannock River and Pequannock River tributaries was collected to determine the relative influence of tributaries on river temperatures.

Typically the highest water temperatures are encountered in the months of June, July, August and September. Temperature data was collected from June to September of 2004. Submersible electronic devices were deployed at selected sites during these months to record water temperatures at half-hour intervals. To insure the integrity of the data, all electronic units were calibration tested before, during and after deployment.

The electronic temperature recording units used were "Optic StowAway Temp" and "Hobo Water Temp Pro" models manufactured by the Onset Computer Corporation. These units are submersible, capable of recording temperatures at pre-set intervals and are guaranteed to be accurate within .5°C at temperatures of 30°-100°F. Data was downloaded from the electronic monitors via Onset's Boxcar software. This data was then printed in graph form, and exported to Microsoft EXCEL and ACCESS format.

Sampling methods are fully described in the attached QA/QC document. It should be noted that these monitoring units were set to record temperature at half-hour intervals rather than the hourly intervals originally projected. This was done to ensure a closer match on field calibration checks and to improve the accuracy and validity of the data recorded.

b) Flow Monitoring

The purpose of this project was to record flow rates in the Pequannock River and Pequannock River tributaries. This information was used in combination with water temperature data to determine the relative influence and importance of measured river tributaries on river temperatures. Since this information was combined with water temperature data and the highest water temperatures are encountered in the months of July and August, flow monitoring was also conducted in these months. Flow rates were measured with the GLOBAL "Flow Probe", a water velocity instrument with an accuracy of .5 feet-per-second. Sampling methods are fully described in the attached QA/QC document.

It should be noted that there were some minor departures from the QA/QC methodology. In some cases the narrow width of the stream channel precluded the taking of 10 measurements across the channel. These variations were recorded in the field data collection forms and in the Microsoft ACCESS tables produced from this data. In addition, although we had originally intended to measure Pequannock River flows at 2 sites (Butler and Riverdale) it became apparent that a measurement at the Riverdale site alone would be sufficient and more useful. In addition, it was not always possible to find a tributary section that was "…relatively straight and free flowing for 200-300 ft both upstream and downstream of the measurement site." The small size and winding course of some tributaries made locating such sites impossible. We do not believe these variations in any way reduce the validity of the data produced. Additional flow data

utilized in this study was taken from recordings by the U.S. Geological Survey at their gauging station below the Macopin Reservoir. See Map 2 for an illustration of all flow measurement sites.

Flow monitoring was avoided when rainfall elevated stream and river flows. In most cases monitoring was restricted to periods when flow rates at the Macopin gauging station were near normal levels, although due to frequent heavy rains during the study period the flows at the Macopin site were consistently above average. Particularly notable were the recordings taken in late August (08/26/04-08/27/04) when a high rate of discharge from Charlottesburg Reservoir increased Pequannock River flow rates substantially. However, since this discharge was isolated to the Charlottesburg outlet this was not an indication of abnormally high stream flows throughout the watershed.

Flow rates measured in the Pequannock River at the Riverdale site (the lowest point in the study area) during the monitoring period ranged from a low of 11.75 cfs on 07/08/04 to a high of 66.88 cfs on 08/26/04 with an average flow of 28.7 cfs. The Pequannock River flow at the Riverdale site is assumed to represent the combined flow from several sources. These are:

1) Flow from the Pequannock River above Macopin Reservoir (measured at Macopin gauging station)

2) Tributaries monitored in this study (except Macopin River) - see Map 1

3) Tributaries not monitored in this study - see Map 1

4) Small groundwater seeps and springs

Flow rates in the Pequannock River at the Macopin gauging station in July and August are typically in the range of 0.5 – 1 cfs. Flow rates at this site during the monitoring period ranged from a low of .5 cfs on 08/11/04 to a high of 40 cfs on 08/26/04 with an average flow of 8.2 cfs. On average this flow represented 29% of the combined river flow at the Riverdale site.

Total tributary flow rates were assumed to be the increase in flow rate between flows recorded at the Macopin gauging station and flow rates recorded at the Riverdale site. As noted, this flow would include tributaries monitored in this study, those that were not monitored, and groundwater springs.

Tributaries monitored in this study contributed, on average, 12.5 cfs to the total flow at the Riverdale site. This figure represents, on average, 44% of the total river flow at the Riverdale site.

The remaining 27% of the average total river flow at the Riverdale site is assumed to be derived from unmonitored tributaries, groundwater seeps and springs.

An important element in this study was the proportion of total flow at the Riverdale site derived from all tributaries within the study area. As noted, these tributary flows comprised, on average, 71% of the total river flow at the Riverdale site (44% from monitored tributaries and 27% from unmonitored tributaries and/or groundwater springs). The 71% figure is probably conservative. If abnormal flows recorded on 08/26/04 and 08/27/04 are eliminated from the equation (see notes above) the percentage of total flow at the Riverdale site provided by tributaries ranged from a low of 75% to a high of 97% with most calculated daily percentages well above the 71% average. These figures underline the enormous importance of tributaries to flows and temperatures within this segment of the Pequannock River.

Flow derived from the Pequannock River above the Macopin gauging station, as a component of the combined flow in Riverdale, varied from a low of 3% to a high of 25%. Considering that the watershed area above Macopin is much larger than the area below Macopin (see Figure 2), this figure is unusually low. However, diversion of water from upstream reservoirs and manipulation of flows by the City of Newark are the causes of these low flow rates. This is the reason for the disproportionately high influence of tributaries in the study area.

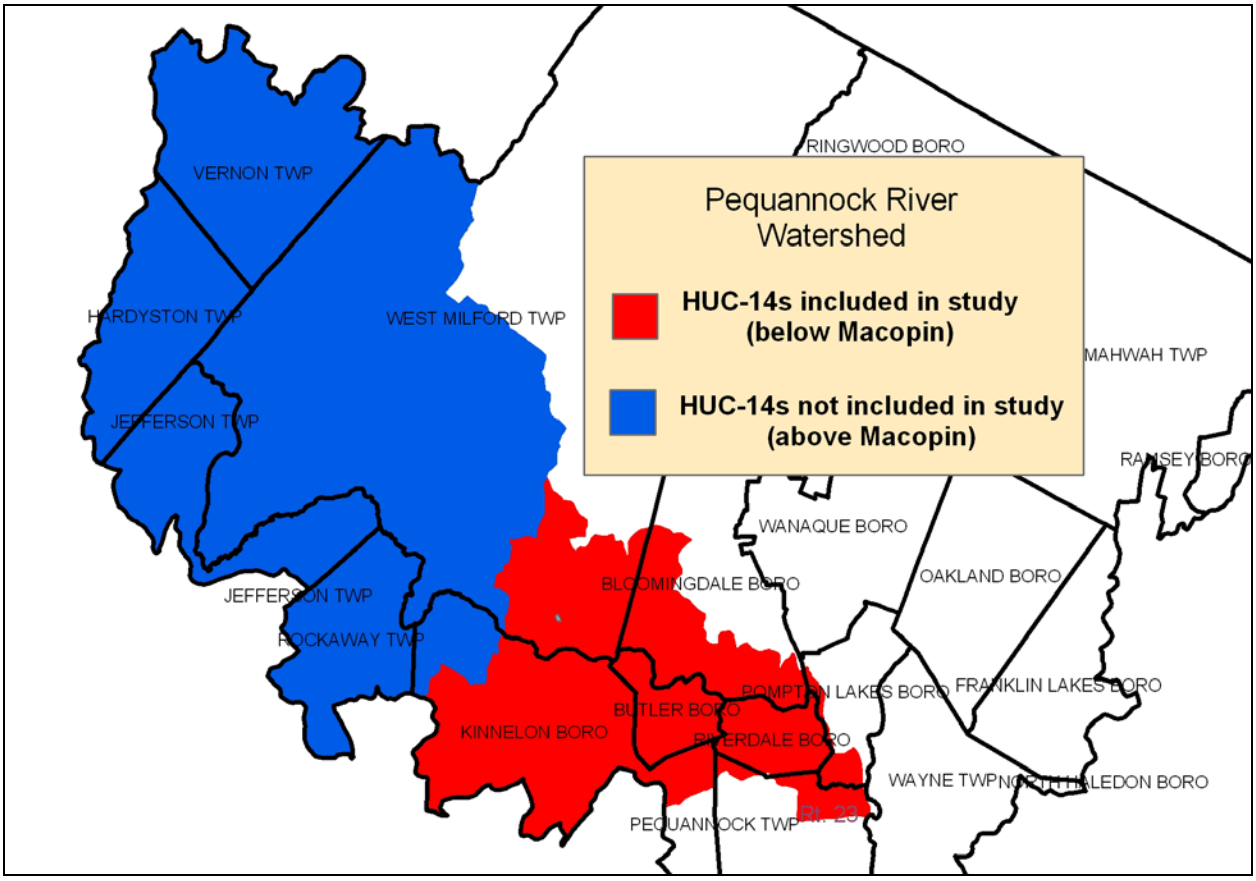


Figure 2 – Pequannock River Watershed above/below Macopin

Table 1 – River and Tributary Flow Rates

Stream/site	Lowest Flow(cfs)	Highest Flow (cfs)	Avg. Flow (cfs)
Pequannock River @ Macopin	0.5	40	7.9
Smoke Rise Tributary	0.2	0.5	.3
Apshawa Brook	0.8	1.0	0.9
High Crest Lake Tributary	0.5	0.8	.6
Maple Lake Tributary	0.8	1.2	.9
Henion Pond Tributary	0.4	0.5	.5
Cold Spring Lake Tributary	0.9	1.6	1.2
Oakwood Lake Tributary	0.3	0.7	.4
Kakeout Brook	4.0	5.7	5.2
Van Dam Brook	0.6	1.0	.8
Valley Spring Lake Tributary	1.4	2.2	1.7
Pequannock River @ Riverdale	11.8	66.9	28.3

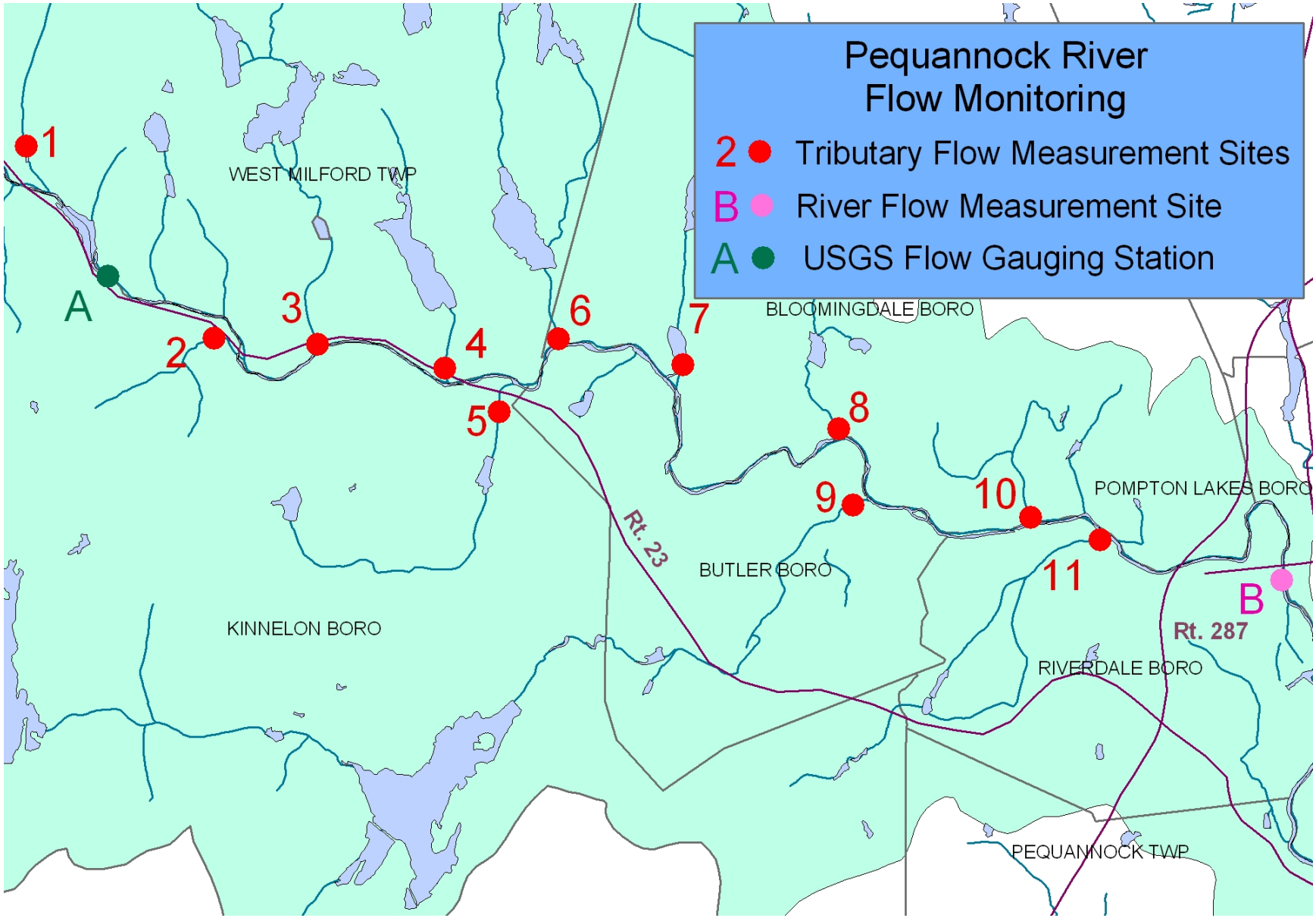


Figure 3 – Map of Flow Monitoring Sites

3) Tributary Descriptions

In addition to physical descriptions, and a summary of temperature and flow data, each tributary is ranked here for temperature as “High”, “Moderate” or “Low”. These rankings are based on 4 criteria – the number of days water temperatures exceeded 68F, number of days water temperatures exceeded 75F, average temperature, and maximum temperature (see Table 1). For each category the full range of readings was divided into three tiers with tributary rankings assigned based on their total “score”. Each of the 4 criteria chosen to evaluate temperature has significance.

The 68F threshold is the limit for trout production waterways in the NJ Surface Water Quality Standards (SWQS). It should be noted that most of these tributaries, with the exception of Kakeout Brook, Apshawa Brook and the Smoke Rise Tributary, are unlisted tributaries of that segment of the Pequannock River designated as “trout production” (FW2-TP(C1)) and are therefore regulated as “trout production” under the SWQS. Apshawa Brook and the Smoke Rise Tributary are also listed in the SWQS as “trout production.” Kakeout Brook, although listed as “non-trout” in the SWQS, was recently documented as hosting reproducing Brown trout, and will soon be upgraded to FW2-TP(C1).

The 75F limit is the thermal limit for Brook trout and near the lethal limit for Brown trout and provides an additional and useful threshold.. Average temperature is a good overall indicator of waterway condition. The maximum temperature is the final deciding factor in a waterway’s suitability for coldwater species such as trout.

A similar approach was taken with tributary flows. The relative importance of each tributary depends on the amount of tributary flow, the amount of flow in relation to river flow at its discharge point and the amount of tributary flow in relation to total tributary flow measured at the lowest river point in Riverdale (see Table 2).

It is essential to weigh each of these factors. For example, a tributary may provide a small percentage of the combined total of all tributary flows. However, a modest tributary flow discharged higher in the watershed can represent a large percentage of total river volume at its mouth. In regard to temperature, the relative temperature of the tributary flow is also significant. A low tributary flow at a very high temperature can have greater influence than a much larger flow volume at a temperature that is similar to the receiving river segment. Since tributary flows often constitute as much as 80% of total river flow(measured at Riverdale), these smaller streams can still be important.

Please note that the subwatershed boundaries depicted on figures in this report are an approximation based on topography, and are provided for general reference only.

Summary depictions of relative tributary flows and temperatures are provided in Figures 4 and 5.

Table 2 – River and Tributary Temperatures

Site/Tributary	Rank	Avg Temp	Avg Temp Rank	Max Temp	Max Temp Rank	Days > 68	% > 68	% > 68 Rank	Days > 75	% > 75	% > 75 Rank	Total of all rankings
Apshawa Brook	**1**	65.98	**2**	72.48	**1**	47	45	**2**	0	0	**1**	**6**
Cold Spring Lk	**3**	75.64	**4**	84.86	**4**	93	99	**4**	83	89	**4**	**12**
Henion Pond Trib	**1**	66.17	**2**	73.87	**2**	33	34	**2**	0	0	**1**	**7**
High Crest Trib	**1**	61.34	**1**	73.86	**2**	14	13	**1**	0	0	**1**	**5**
Kakeout Brook	**2**	67.02	**2**	75.68	**2**	74	71	**3**	1	1	**1**	**8**
Macopin River	**2**	66.59	**2**	75.14	**2**	56	52	**3**	1	1	**1**	**8**
Maple Lake Trib	**1**	64.79	**1**	72.09	**1**	25	24	**1**	0	0	**1**	**4**
Oakwood Lk Trib	**3**	70.28	**3**	81.16	**4**	89	94	**4**	27	29	**2**	**13**
Smoke Rise Trib	**1**	62.20	**1**	69.47	**1**	3	3	**1**	0	0	**1**	**4**
Valley Spring Lk Tributary	**1**	64.16	**1**	72.57	**1**	42	40	**2**	0	0	**1**	**5**
Van Dam	**1**	64.41	**1**	75.68	**2**	52	50	**2**	1	1	**1**	**6**
Peq Riverdale	**2**	67.81	**2**	76.20	**2**	82	79	**4**	3	2	**1**	**9**
Peq Butler	**2**	67.36	**2**	75.377	**2**	78	76	**4**	2	2	**1**	**9**
Peq Macopin	**3**	69.47	**3**	77.20	**3**	81	91	**4**	11	12	**1**	**11**

Rank – 1 = Low temperatures, 2 = Moderate temperatures, 3 = High temperatures
Avg Temp = total of all temperature recordings / number of temperature recordings
Max Temp = highest temperature recorded
Days > 68 = number of days in monitoring period when temperatures exceeded 68F
Days > 75 = number of days in monitoring period when temperatures exceeded 75F
% > 68 = number of days in monitoring period when temperatures exceeded 68F / number of days in monitoring period
% > 75 = number of days in monitoring period when temperatures exceeded 75F / number of days in monitoring period

Avg Temp Rank	**Max Temp Rank**	**% > 68 Rank**	**% > 75 Rank**	**Rank based on Total**
Rank 1 – 61.34-64.91	Rank 1 – 69.47-73.32	Rank 1 – 3-27	Rank 1 – 0-22	Rank 1 – 4-7
Rank 2 – 64.92-68.49	Rank 2 – 73.33 – 77.17	Rank 2 – 27-51	Rank 2 – 22-44	Rank 2 – 8-10
Rank 3 – 68.5 – 72.07	Rank 3 – 77.18 – 81.01	Rank 3 – 51-75	Rank 3 – 44-66	Rank 3 – 11-13
Rank 4 – 72.08 – 75.64	Rank 4 – 81.02 – 84.86	Rank 4 – 75-99	Rank 4 – 66-89	

Stream	River Miles Below Macopin Reservoir	River Miles Below Upstream Tributary	Avg. Flow	Avg. % of Total Tributary Flow	Cumulative Tributary Flow (%)	% of Cumulative %	Cumulative Flow Rank	Total Tributary Flow Rank
Macopin River	n/a	n/a	4.8	n/a	n/a	n/a	n/a	n/a
Smoke Rise Tributary	0.9	n/a	.3	2	2	100	1	3
Apshawa Brook	1.3	0.4	.9	5	7	71	1	3
High Crest Lake Tributary	2.0	0.7	.6	2	9	22	3	3
Maple Lake Tributary	2.3	0.3	.9	6	15	40	2	3
Henion Pond Tributary	2.6	0.3	.5	2	17	12	3	3
Cold Spring Lake Tributary	3.2	0.6	1.2	6	23	26	3	3
Oakwood Lake Tributary	4.6	1.4	.4	2	25	8	3	3
Kakeout Brook	5.0	0.4	5.2	26	51	51	2	1
Van Dam Brook	5.8	0.8	.8	4	55	7	3	3
Valley Spring Lake Tributary	6.2	0.4	1.7	10	65	15	3	2

Table 3 – Tributary Rank Based on Measured Stream/River Flows

Rank – 1 = High flow, 2 = Moderate flow, 3 = Low flow

Table 2 – Description

"Avg. Flow" was the average flow rate recorded for this tributary or at this river site.

"Avg. % of Total Tributary Flow" was the average percentage of all tributary flows provided by this tributary.

"Cumulative Tributary Flow (%)" was the average percentage of tributary flows provided by this tributary, added to the percentages provided by upstream tributaries in the study area.
"% of Cumulative Flow %" is the percentage of the "Cumulative Tributary Flow (%)" provided by this particular tributary.

"Cumulative Flow Rank" and "Total Tributary Flow Rank" are rankings assigned to each tributary based on the proportion of cumulative or total tributary flow they represent. 1 is "High", 2 is "Moderate", 3 is "Low."

Calculations, Terms and Definitions
AF = average tributary flow = (F1 + F2 + F3) / 3
Fx (F1, F2, etc) = tributary flow measurement
APT= average percentage of total tributary flow = (PT1 + PT2 + PT3) / 3
PTx (PT1, PT2, etc.) = percentage of total tributary flow = 100 / (TTFx / Fx)
TTFx (TTF1, TTF2, etc.) = total tributary flow = FRx - FMx
FRx (FR1, FR2, etc.) = Pequannock River flow measured at Riverdale site
FMx (FM1, FM2, etc.) = Pequannock River flow recorded at USGS Macopin station
CTF = sum of APT for all upstream tributaries at tributary discharge point
PCTF = percentage of cumulative tributary flow percentage = 100 / (CTF / APT)

Example: Apshawa Brook
Average Flow (AF)
F1 = .936 F2 = .8288 F3 = .953
AF = (.936 + .8288 + .953) / 3 = .9 (rounded to 1/10 cfs)

Average % of Total Tributary Flow (APT)
F1 = .8288
FR1 = 15.928
FM1 = 2
TTF1 = 15.928 – 2 = 13.928
PT1 = 100 / (13.928 / .936) = 7 (rounded to whole number)

F2 = .936
FR2 = 24.275
FM2 = 3.9
TTF2 = 24.275 – 3.9 = 20.375
PT2 = 100 / (20.375 / .8288) = 4 (rounded to whole number)

F3 = .953
FR3 = 29.575
FM3 = 7
TTF3 = 29.575 – 7 = 22.575
PT3 = 100 / (22.575 / .953) = 4 (rounded to whole number)

APT = (7 + 4 + 4) / 3 = 5

Cumulative Tributary Flow % (CTF)
CTF = APT for Smoke Rise Tributary + APT for Apshawa Brook = 2 + 5 = 7

% of Cumulative % (PCTF)

PCTF = 100 / (7 / 5) = 71

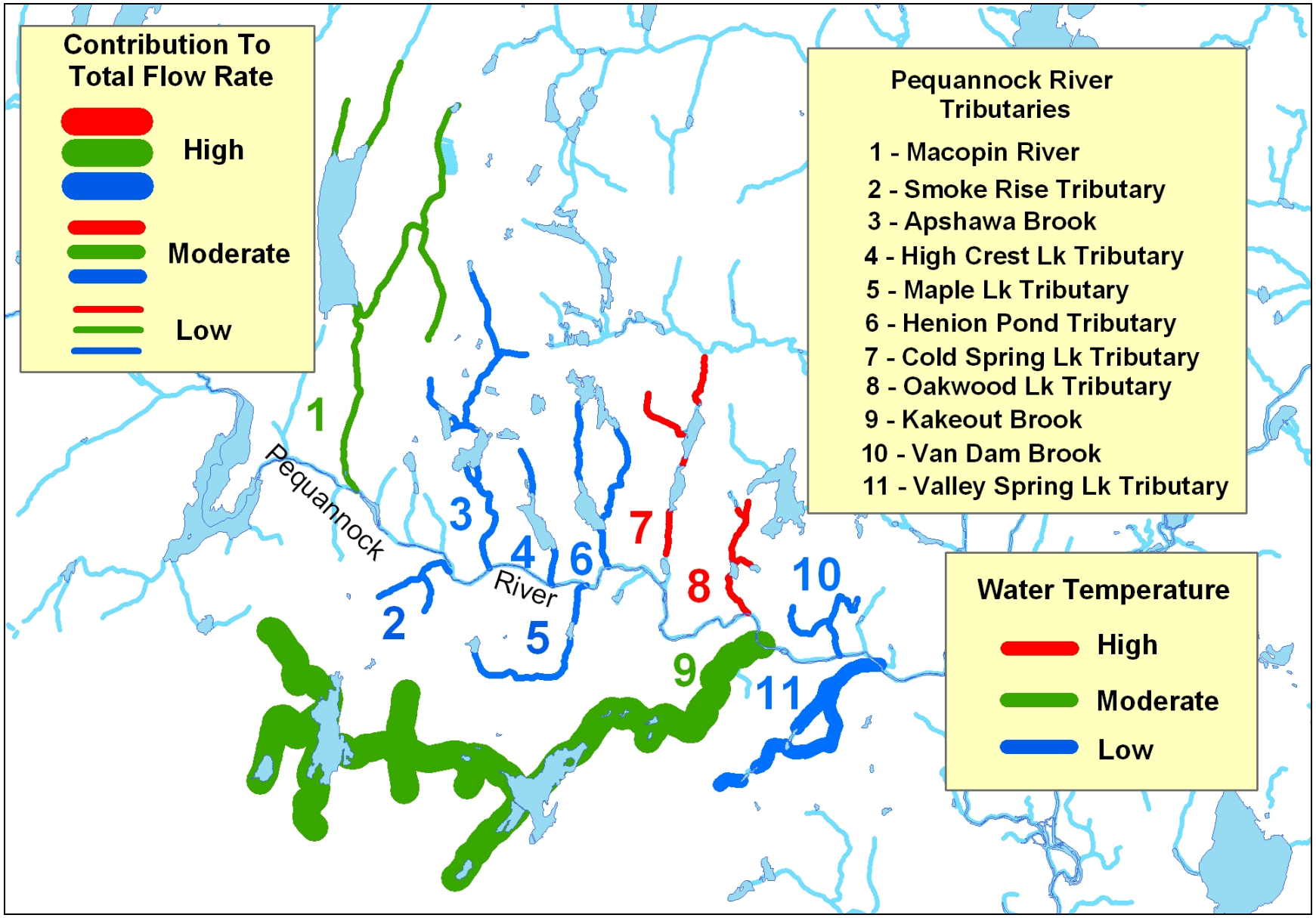


Figure 4 – Map of Tributary Flows and Temperatures – Total Influence

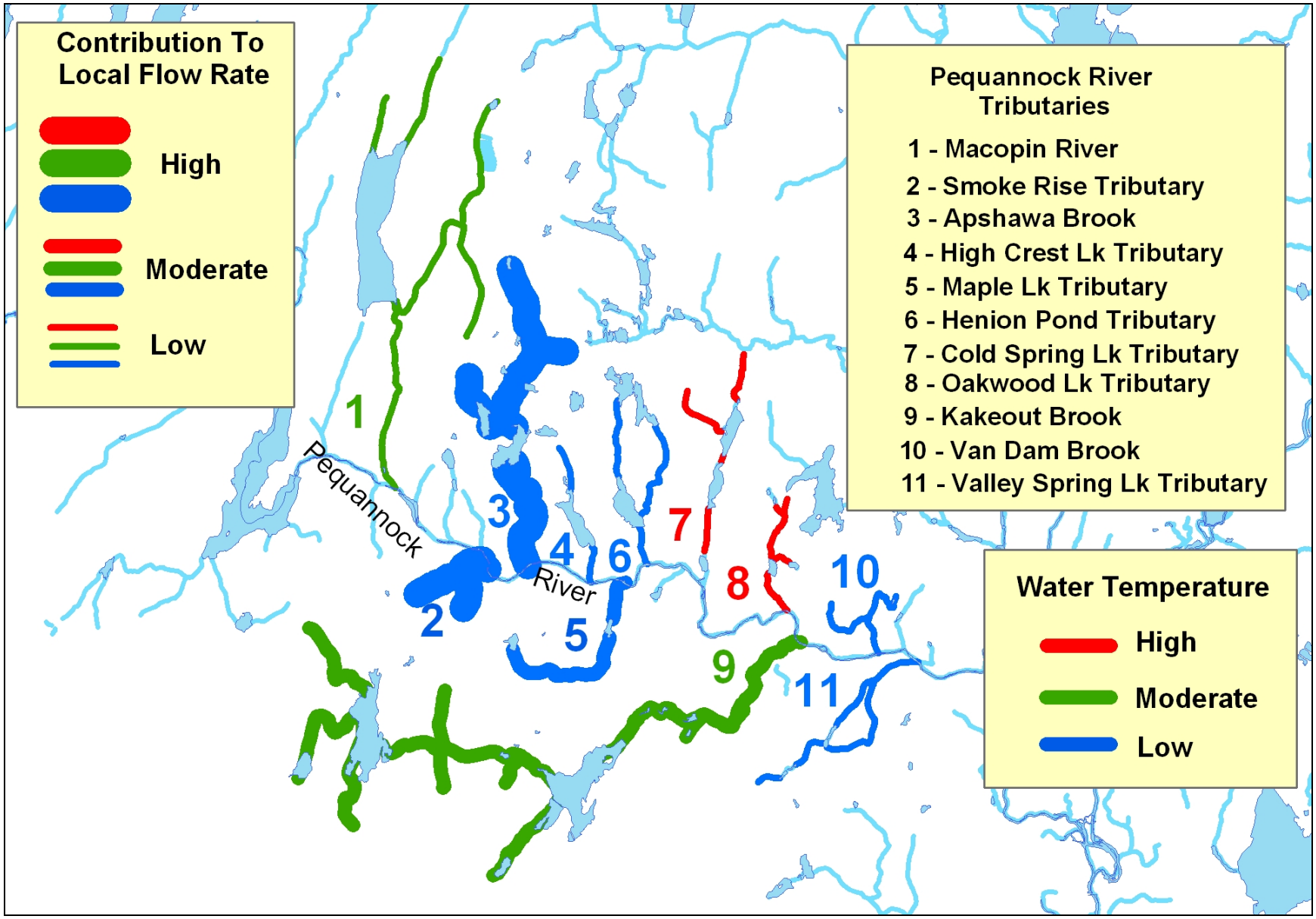


Figure 5 – Map of Tributary Flows and Temperatures – Local Influence

a) Macopin River

The Macopin River drains southern West Milford Township, running northeast to southwest and the entering the Pequannock River just above Macopin Reservoir (see Figure 7). Much of the Macopin River subwatershed is owned by the City of Newark. The Macopin subwatershed covers about 6 square miles. Development of the Macopin subwatershed is relatively light. A major manmade impoundment (Echo Lake) is utilized by the City of Newark to divert potable water from the Macopin drainage into Charlottesburg Reservoir. The Macopin River is classified as FW2-TP(C1) from Echo Lake to the Pequannock River and as FW2-NT above Echo Lake.

The Macopin River was the only tributary monitored in this study that enters the Pequannock above Macopin Reservoir. Therefore it was not considered as contributing to total tributary flows in the studied segment of the river. It was included due to its size and its influence on flows in the Pequannock River below Macopin Reservoir.

Flow rates on the Macopin River averaged 4.8 cubic feet per second during the study period. Water temperatures were ranked as “Moderate.” During the monitoring period, temperatures exceeded 68F on 52% of the days monitored and exceeded 75F on 1% of days monitored. The highest temperature recorded was 75.14F with an average temperature of 66.59F.

Figure 6 - Macopin River

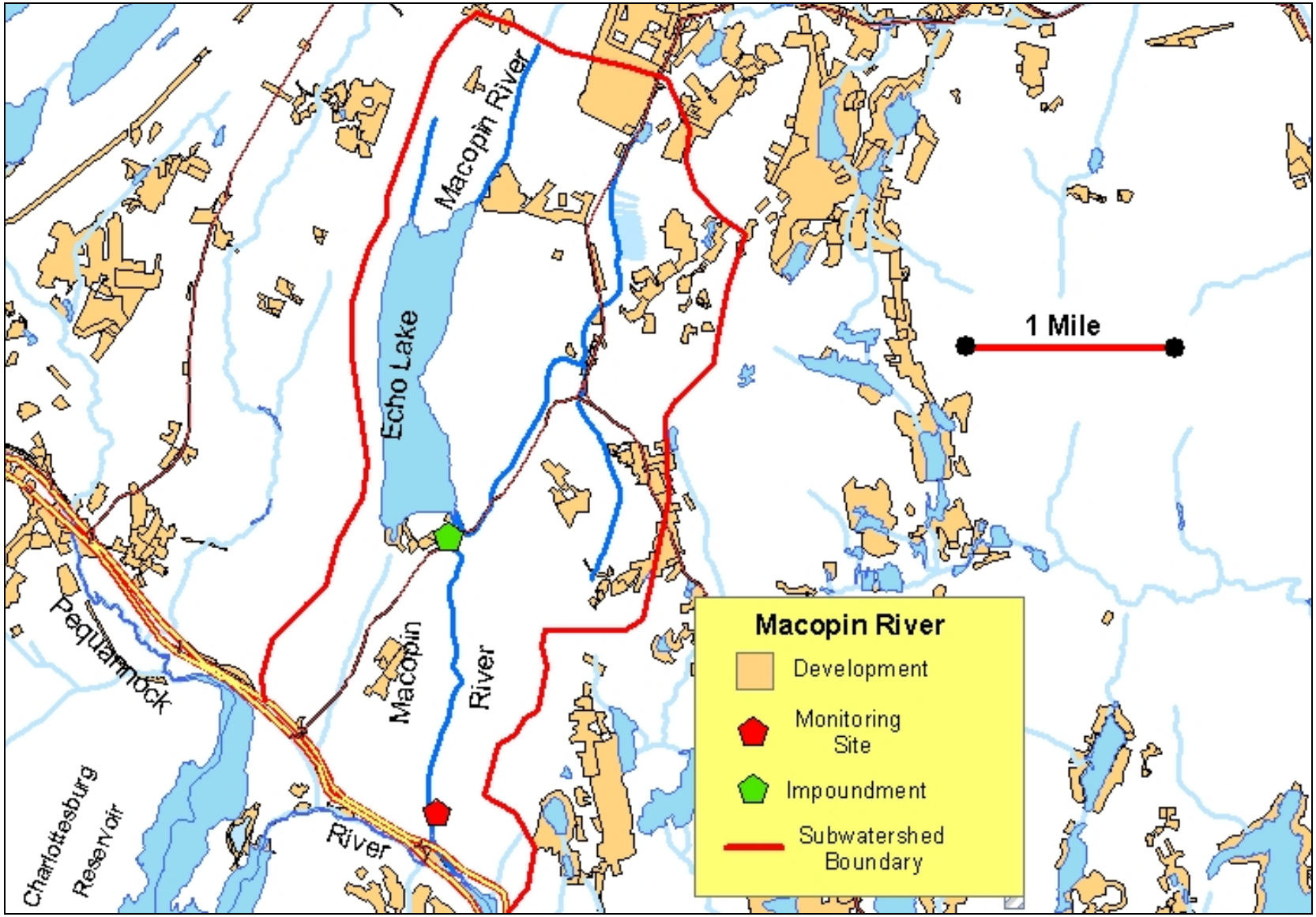


Figure 7 – Map of Macopin River

b) Smoke Rise Tributary

The Smoke Rise Tributary is an unnamed tributary draining eastern Kinnelon Borough, running northeast to southwest and the entering the Pequannock River approximately .9 miles below Macopin Reservoir (see Figure 9), with a drainage area of about 1 square mile. Development of the Smoke Rise Tributary subwatershed is moderate. This tributary is classified as FW2-TP(C1).

Flow rates on the Smoke Rise Tributary were measured as .2244 cfs, .468 cfs and .266 cfs for an average of .3 cfs during the study period. Flows were ranked as "Low" in total tributary flows but as "High" in local (cumulative) flow contribution. Water temperatures were ranked as "Low." During the monitoring period temperatures exceeded 68F on only 3% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 69.47F with an average temperature of 62.2F.

Although the Smoke Rise Tributary produces minor flows, the position of this stream high in the watershed means that its local influence is increased. The extremely cold water contributed by this waterway has a significant impact on water temperatures in this segment of the Pequannock River, particularly under typical low flow summer conditions.

Figure 8 - Smoke Rise Tributary

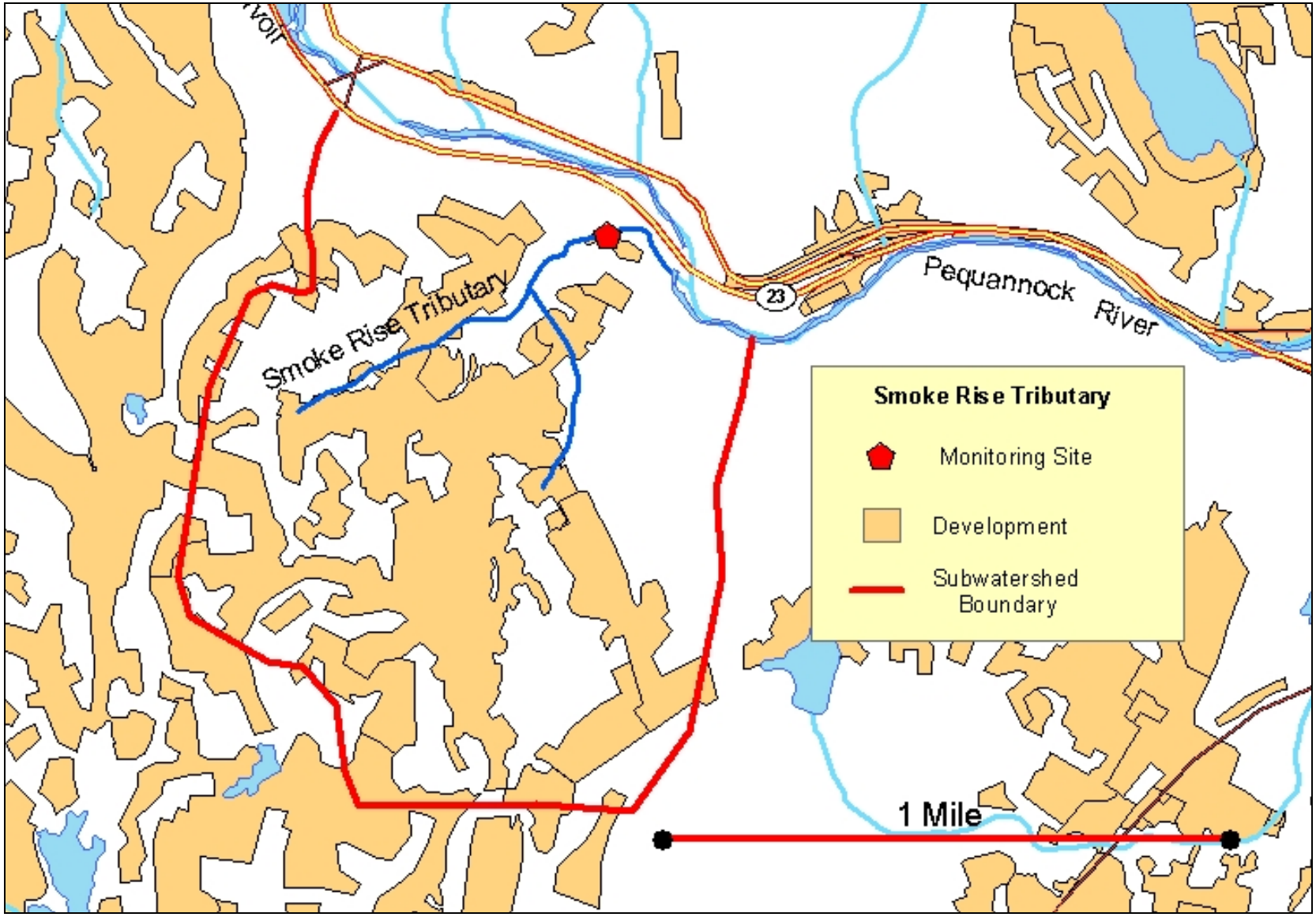


Figure 9 – Map of Smoke Rise Tributary

c) Apshawa Brook

Apshawa Brook drains southern West Milford Township, running northeast to southwest and entering the Pequannock River approximately 1.3 miles below Macopin Reservoir (see Figure 11). The Apshawa Brook subwatershed covers about 2 square miles. Development of the Apshawa Brook subwatershed is light, with much of the watershed held as open space under the Green Acres program. A large manmade impoundment (Butler Reservoir) and a small unnamed manmade pond are located on this waterway. This tributary is classified as FW2-TP(C1).

Flow rates on Apshawa Brook were measured as .936 cfs, .8288 cfs and .953 cfs for an average of .9 cfs during the study period. Flows were ranked as "Low" in total tributary flows but as "High" in local (cumulative) flow contribution. Water temperatures were ranked as "Low." During the monitoring period temperatures exceeded 68F on 45% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 72.48F with an average temperature of 65.98F.

A position high in the watershed and locally significant flow rates (71% of cumulative tributary flow) make Apshawa Brook an important influence in this segment of the Pequannock River. Despite its largely undeveloped subwatershed, temperatures in Apshawa Brook are not as low as other nearby tributaries such as the Smoke Rise Tributary. This is probably due to upstream impoundments with spillway outfalls that release heated surface water from the impoundments downstream. Nonetheless, Apshawa Brook has a strong and beneficial affect on Pequannock River temperatures at its discharge point.

Figure 10 - Apshawa Brook

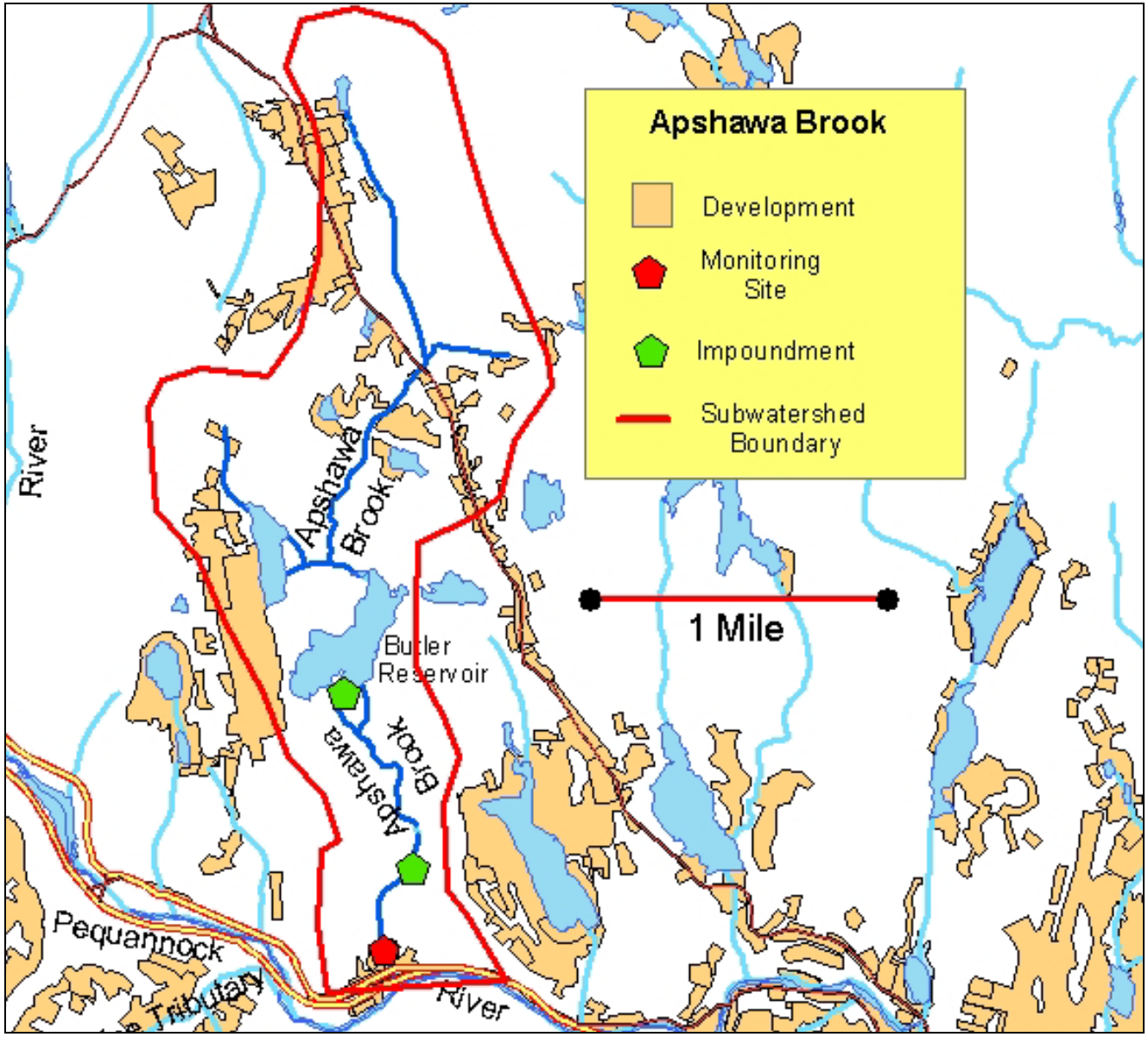


Figure 11 – Map of Apshawa Brook

d) High Crest Lake Tributary

The High Crest Lake tributary is an unnamed stream draining southern West Milford Township, running north to south and the entering the Pequannock River approximately 2 miles below Macopin Reservoir (see Figure 13) with a subwatershed of about 1 square mile. Development of the High Crest subwatershed is moderate to high. Much of this development is concentrated around High Crest Lake, a manmade impoundment in the tributary headwaters. This tributary is currently not classified.

Flow rates on the High Crest Lake Tributary were measured as .5083 cfs, .4921 cfs and .7735 cfs for an average of .6 cfs during the study period. Flows were ranked as "Low" in total tributary flows. In local (cumulative) tributary flow it is also ranked "Low" although this tributary constitutes 22% of combined tributary flow at its discharge point. Water temperatures were ranked as "Low." During the monitoring period temperatures exceeded 68F on 13% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 73.86F with an average temperature of 61.34F.

Low temperatures and locally significant flows make this tributary a considerable positive influence on the mainstem Pequannock River at its discharge point in summer months.

Figure 12 - High Crest Lake Tributary

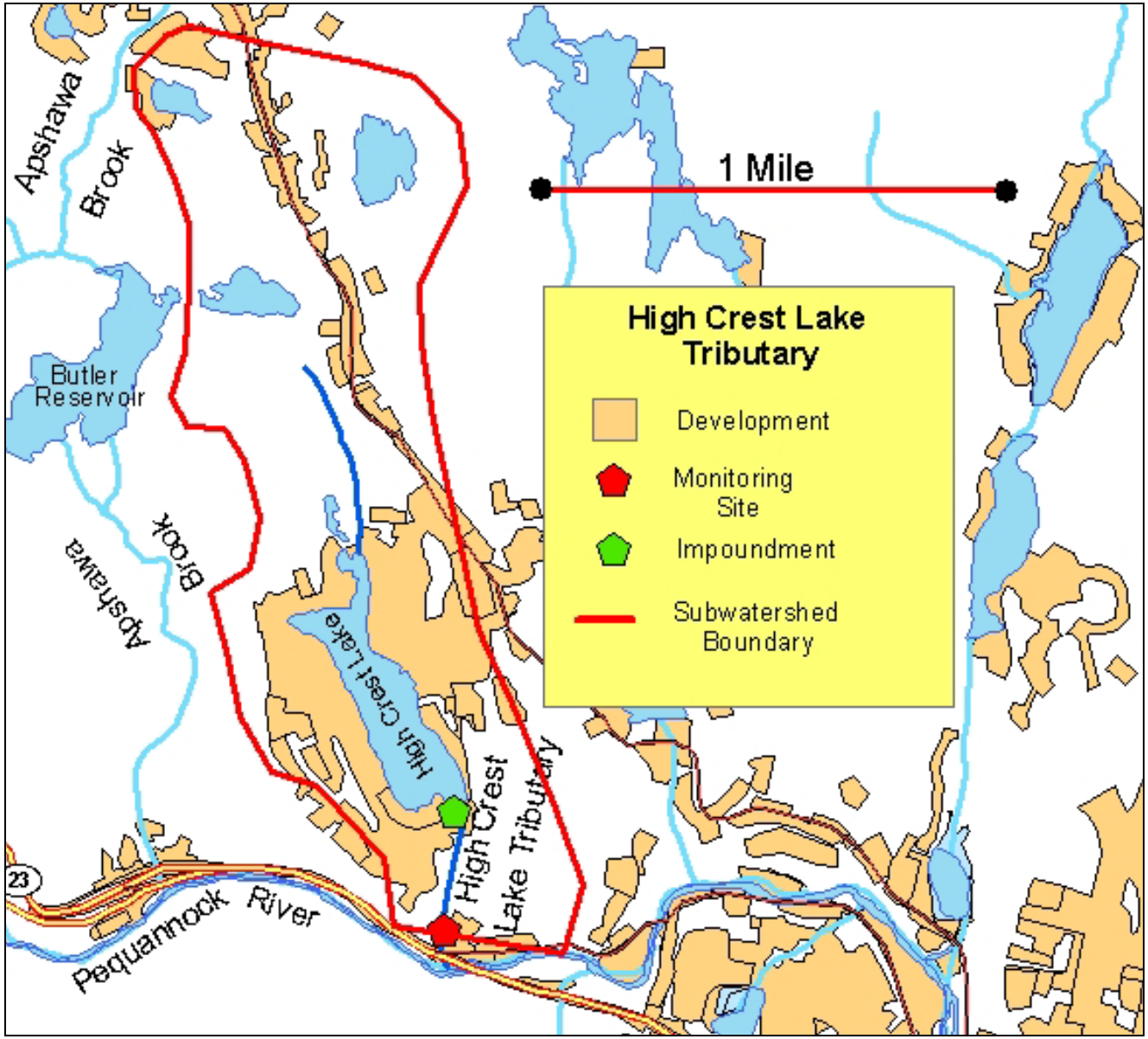


Figure 13 - Map of High Crest Lake Tributary

e) Maple Lake Tributary

The Maple Lake Tributary is an unnamed stream draining eastern Kinnelon Borough and northern Butler Borough, running northwest to southeast and entering the Pequannock River approximately 2.3 miles below Macopin Reservoir (see Figure 15), with a drainage area of about 2 square miles. Development of this subwatershed is moderate. Two manmade impoundments, including Maple Lake, are located on this waterway. This tributary is currently unclassified.

Flow rates on the Maple Lake Tributary were measured as .866 cfs, 1.159 cfs and .8101 cfs for an average of .9 cfs during the study period. Flows were ranked as "Low" in total tributary flows but as "Moderate" in local (cumulative) flow contribution. Water temperatures were ranked as "Low." During the monitoring period temperatures exceeded 68F on 24% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 72.09F with an average temperature of 64.79F.

As noted, this tributary had low water temperatures. However, like Apshawa Brook, it has an upstream impoundment that may cause some elevation in temperature. Although flow rates on this tributary are not high, due to its upriver discharge point, the stream contributes 40% of the cumulative tributary flow at its mouth. For this reason it is a locally significant tributary with a strong and positive influence on Pequannock River temperatures when river flows are at low summer levels.

Figure 14 - Maple Lake Tributary

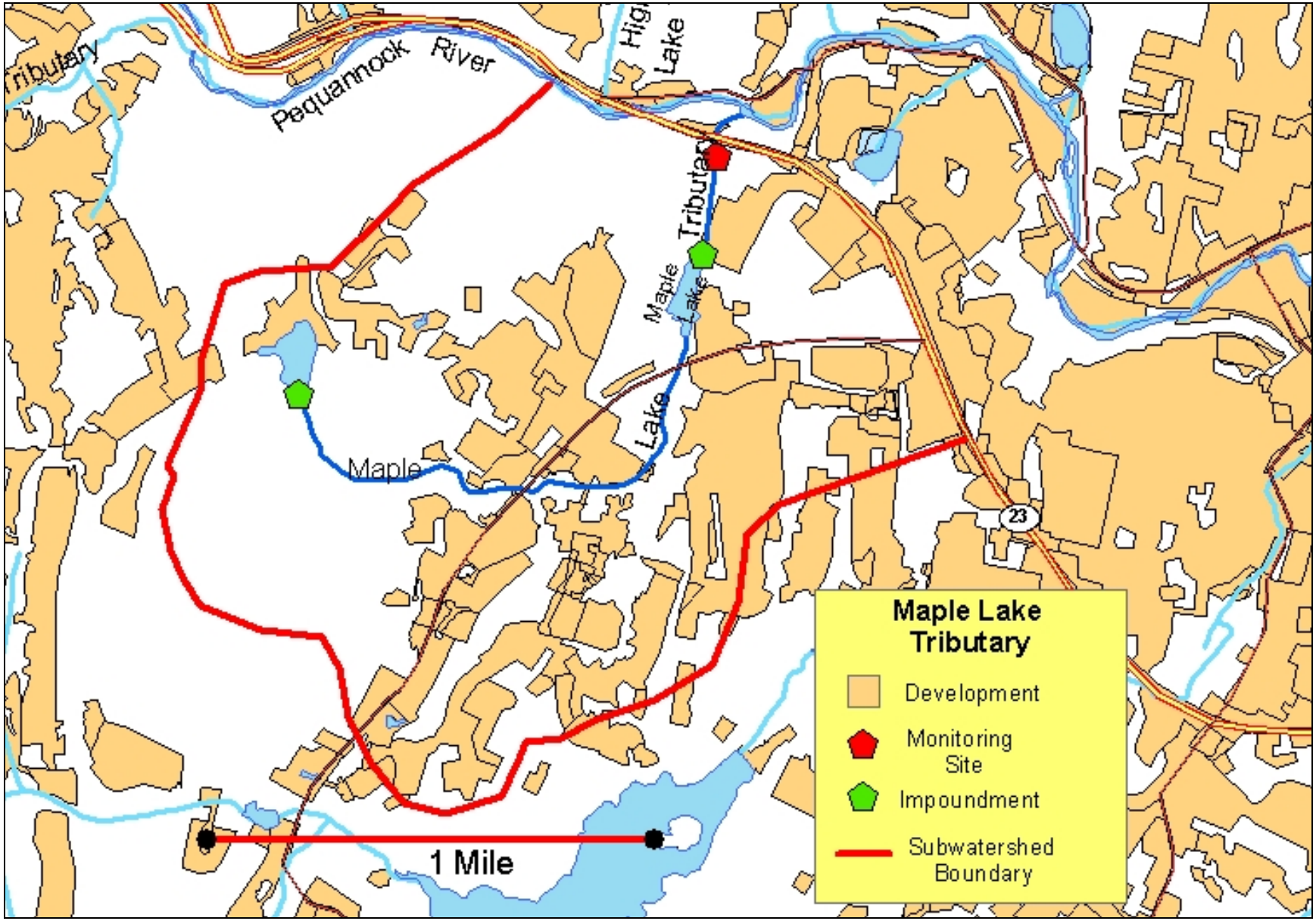


Figure 15 – Map of Maple Lake Tributary

f) Henion Pond Tributary

The Henion Pond Tributary is an unnamed stream draining southern West Milford Township, running north to south and the entering the Pequannock River approximately 2.6 miles below Macopin Reservoir (see Figure 17). This subwatershed has an area of about 1.5 square miles. Development of this subwatershed is relatively light. Several manmade impoundments, including Henion Pond, are located on this waterway. This tributary is currently unclassified.

Flow rates on the Henion Pond Tributary were measured as .417 cfs, .4606 cfs and .5082 cfs for an average of .5 cfs during the study period. Flows were ranked as "Low" in total tributary flows and as "Low" in local (cumulative) flow contribution. Water temperatures were ranked as "Low." During the monitoring period, temperatures exceeded 68F on 34% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 73.87F with an average temperature of 66.17F.

Despite an upstream impoundment, temperatures recorded in this tributary were lower than the receiving segment of the mainstem Pequannock River. It should be noted that this impoundment is a considerable distance from the stream mouth which may explain the lack of temperature elevation caused by it. With modest flow rates, this tributary has a slight but beneficial influence on Pequannock River temperatures at its discharge point, contributing 12% of cumulative tributary flow.

Figure 16 - Henion Pond Tributary

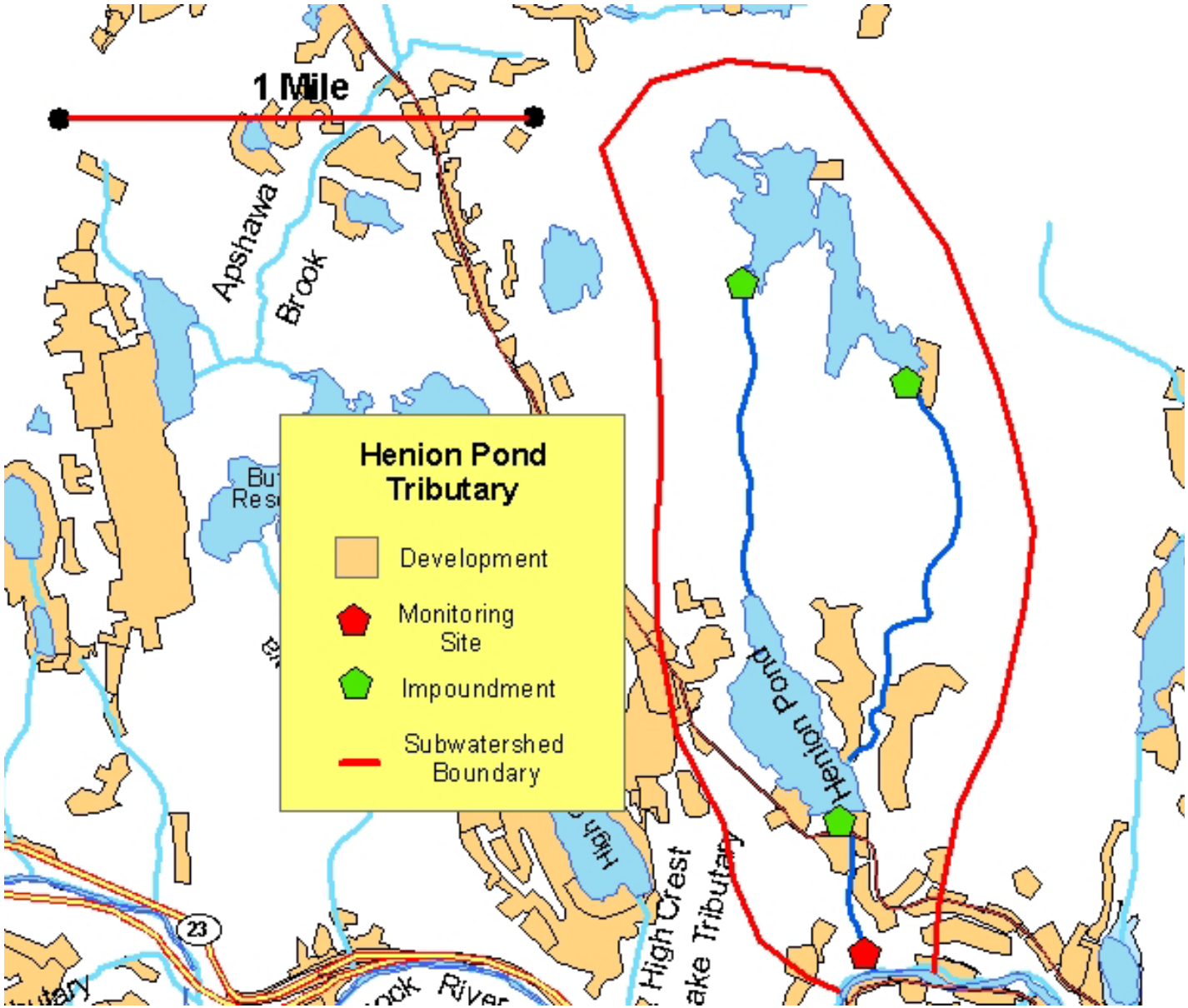


Figure 17 - Map of Henion Pond Tributary

g) Cold Spring Lake Tributary

The Cold Spring Lake Tributary is an unnamed stream draining northern Bloomingdale Borough, running north to south and the entering the Pequannock River approximately 3.2 miles below Macopin Reservoir (see Figure 19) with a subwatershed area of about 1.5 square miles. Development of this subwatershed is relatively light. Several manmade impoundments, including Cold Spring Lake (also known as “Star Lake”), are located on this waterway. This tributary is currently unclassified.

Flow rates on the Cold Spring Lake Tributary were measured as 1.5708 cfs, 1.26 cfs and .9016 cfs for an average of 1.2 cfs during the study period. Flows were ranked as “Low” in total tributary flows and as “Low” in local (cumulative) flow contribution. Water temperatures were ranked as “High” and were, in fact, the highest temperatures recorded on any tributary. Temperatures during the monitoring period exceeded 68F on 99% of the days monitored and exceeded 75F on 89% of days monitored. The highest temperature recorded was 84.86F with an average temperature of 75.64F.

Despite relatively minor flows, this waterway still provides 26% of the total tributary flow at its discharge point. Combined with a very high temperature, this makes it a significant detriment to the mainstem Pequannock River. It is likely that the large impoundments on this tributary and their close proximity to the Pequannock River (and the monitoring site) are the cause of this temperature elevation.

Figure 18 - Cold Spring Lake Tributary

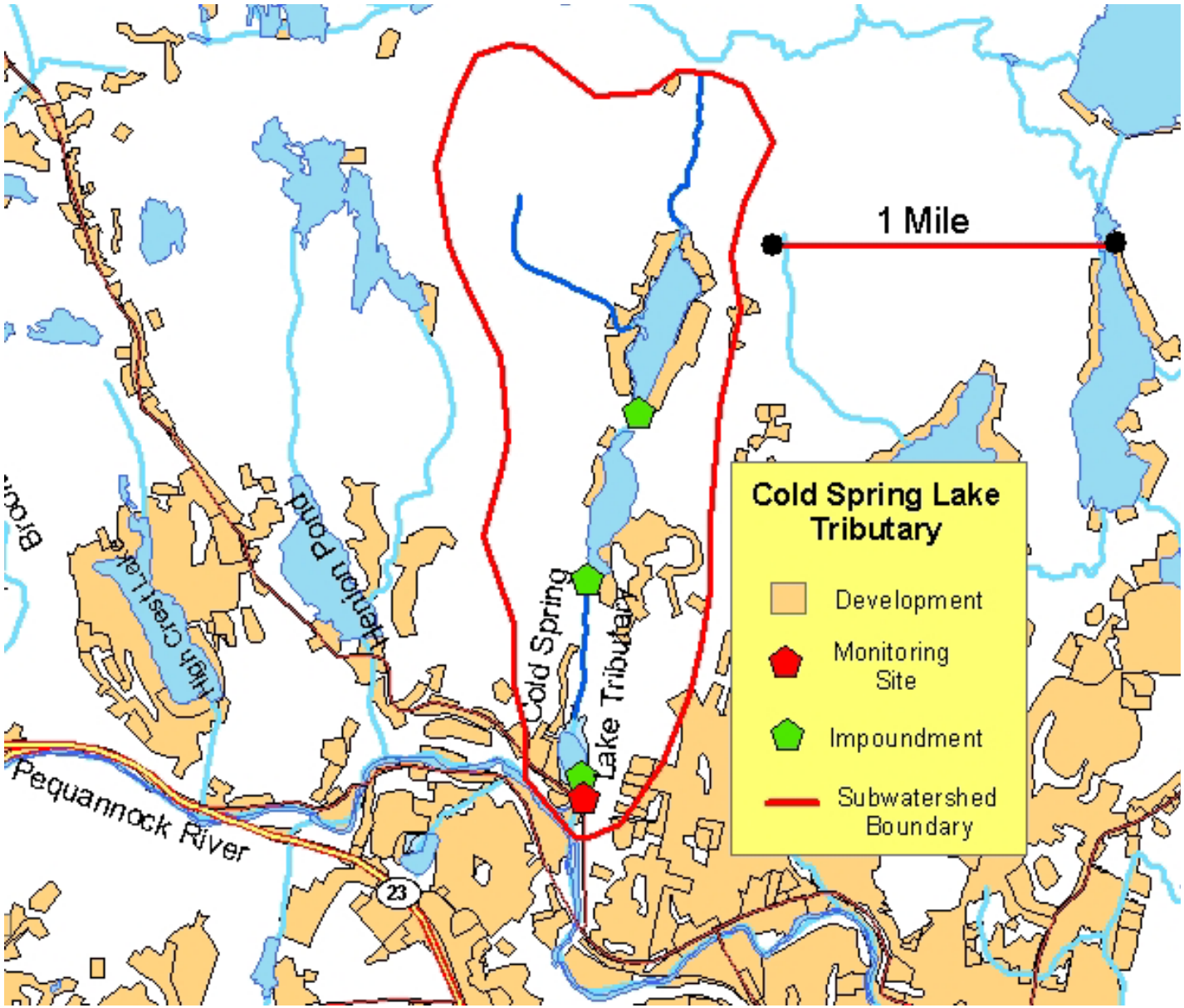


Figure 19 – Map of Cold Spring Lake Tributary

h) Oakwood Lake Tributary

The Oakwood Lake Tributary is an unnamed stream draining central Bloomingdale Borough, running north to south and the entering the Pequannock River approximately 4.6 miles below Macopin Reservoir (see Figure 21). This subwatershed has an area of about 1 square mile. Development of this subwatershed is high. Several manmade impoundments, including Oakwood Lake, are located on this waterway. This tributary is currently unclassified.

Flow rates on the Oakwood Lake Tributary were measured at .7375 cfs, .2943 cfs and .2624 cfs for an average of .4 cfs during the study period. Both total and cumulative tributary flow rates were ranked as "Low." Water temperatures were ranked as "High." During the monitoring period temperatures exceeded 68F on 94% of the days monitored and exceeded 75F on 29% of days monitored. The highest temperature recorded was 81.16F with an average temperature of 70.28F. These very high temperatures have a detrimental impact on the Pequannock River, although that impact is lessened by the low rate of flow. The causes of high temperatures on this waterway are probably the series of upstream impoundments and the high level of development in this subwatershed.

Figure 20 - Oakwood Lake Tributary

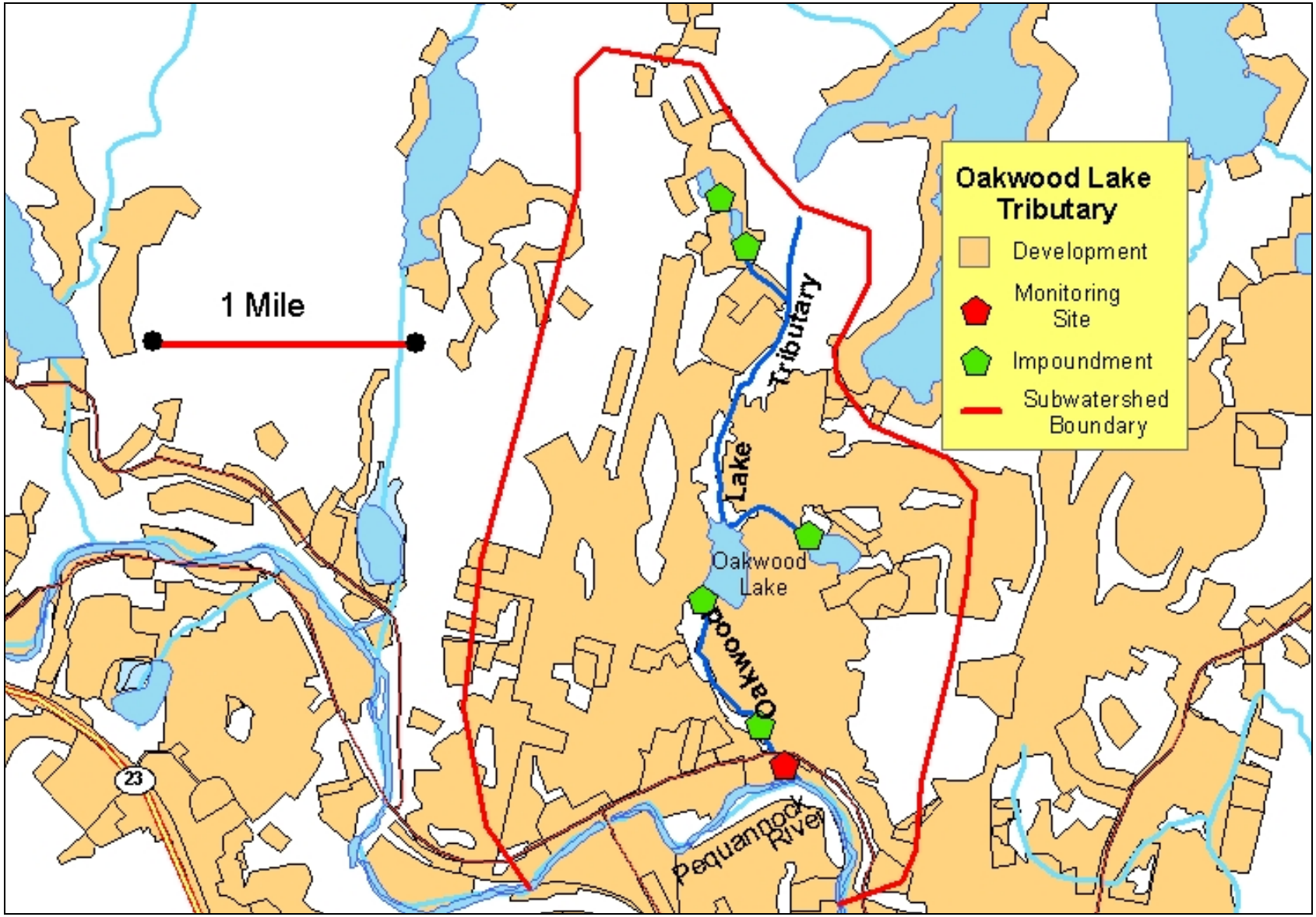


Figure 21 - Map of Oakwood Lake Tributary

i) Kakeout Brook (Stonehouse Brook)

Kakeout Brook (also known as Stonehouse Brook) drains western Kinnelon and eastern Butler boroughs, running northwest to southeast and the entering the Pequannock River approximately 5 miles below Macopin Reservoir (see Figure 23). The waterway has a large and complex drainage system of about 6 square miles, with a wide range of riparian conditions. Development of this subwatershed is low to moderate in the upper reaches of the Kinnelon area and high in the lower watershed through Butler. A substantial number of manmade impoundments, including Butler Reservoir, are located on this waterway. This tributary is currently classified as FW2-NT but has been recommended for upgrade to FW2-TP(C1) due to the presence of a spawning population of Brown trout.

Flow rates on Kakeout Brook were measured at 4.088 cfs, 5.738 cfs and 5.658 cfs, averaging 5.2 cfs during the study period. Water temperatures were ranked as "Moderate." During this period temperatures exceeded 68F on 71% of the days monitored and exceeded 75F on 1% of days monitored. The highest temperature recorded was 75.68F with an average temperature of 67.02F.

In terms of flow, Kakeout Brook is the most important river tributary in the study area. Flow rates in Kakeout Brook were the highest of any tributary monitored, providing nearly 1/3 of all tributary flows. At present the influence of Kakeout Brook is neutral in terms of temperature. Both high rates of development and upstream impoundments may elevate these tributary temperatures.

Figure 22 - Kakeout Brook (Stonehouse Brook)

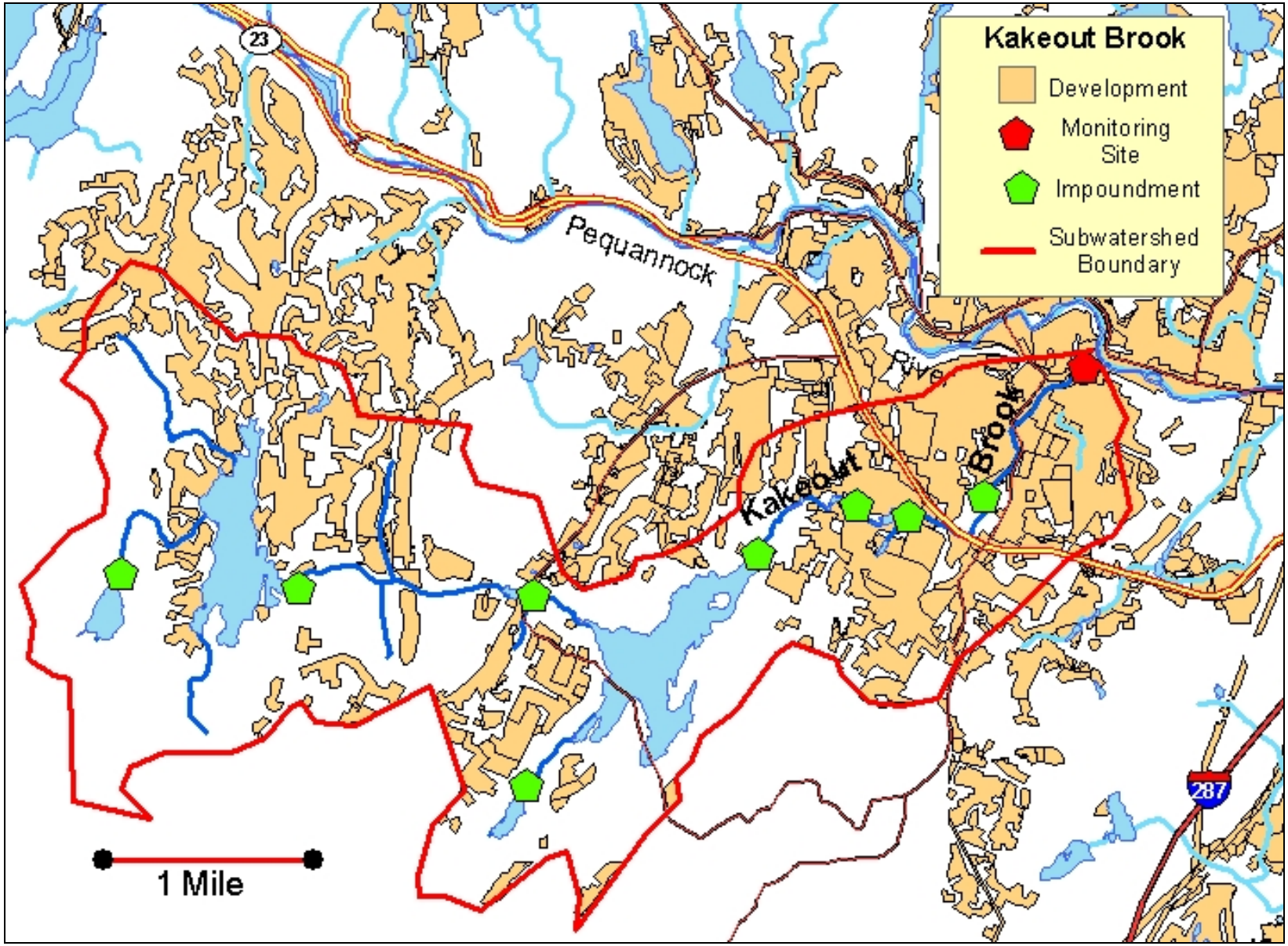


Figure 23 - Map of Kakeout Brook

j) Van Dam Brook

Van Dam Brook drains southern Bloomingdale Borough, running north to south and entering the Pequannock River approximately 5.8 miles below Macopin Reservoir (see Figure 25). This subwatershed has an area of about 1 square mile. Development of this subwatershed is high in the western portion and low to moderate in the eastern portion. One small manmade impoundment is located in the headwaters of this waterway. This tributary is currently unclassified.

Flow rates on Van Dam Brook were measured at .616 cfs, 1.0222 cfs and .7215 cfs, averaging .8 cfs during the study period. Water temperatures were ranked as "Low." During the monitoring period, with temperatures exceeding 68F on 50% of the days monitored and exceeding 75F on 1% of days monitored. The highest temperature recorded was 75.68F with an average temperature of 64.41F. Although Van Dam Brook has a mild positive influence on the mainstem Pequannock River, that influence is limited by the relatively low flows in this waterway and its lower position in the Pequannock drainage.

Figure 24 - Van Dam Brook

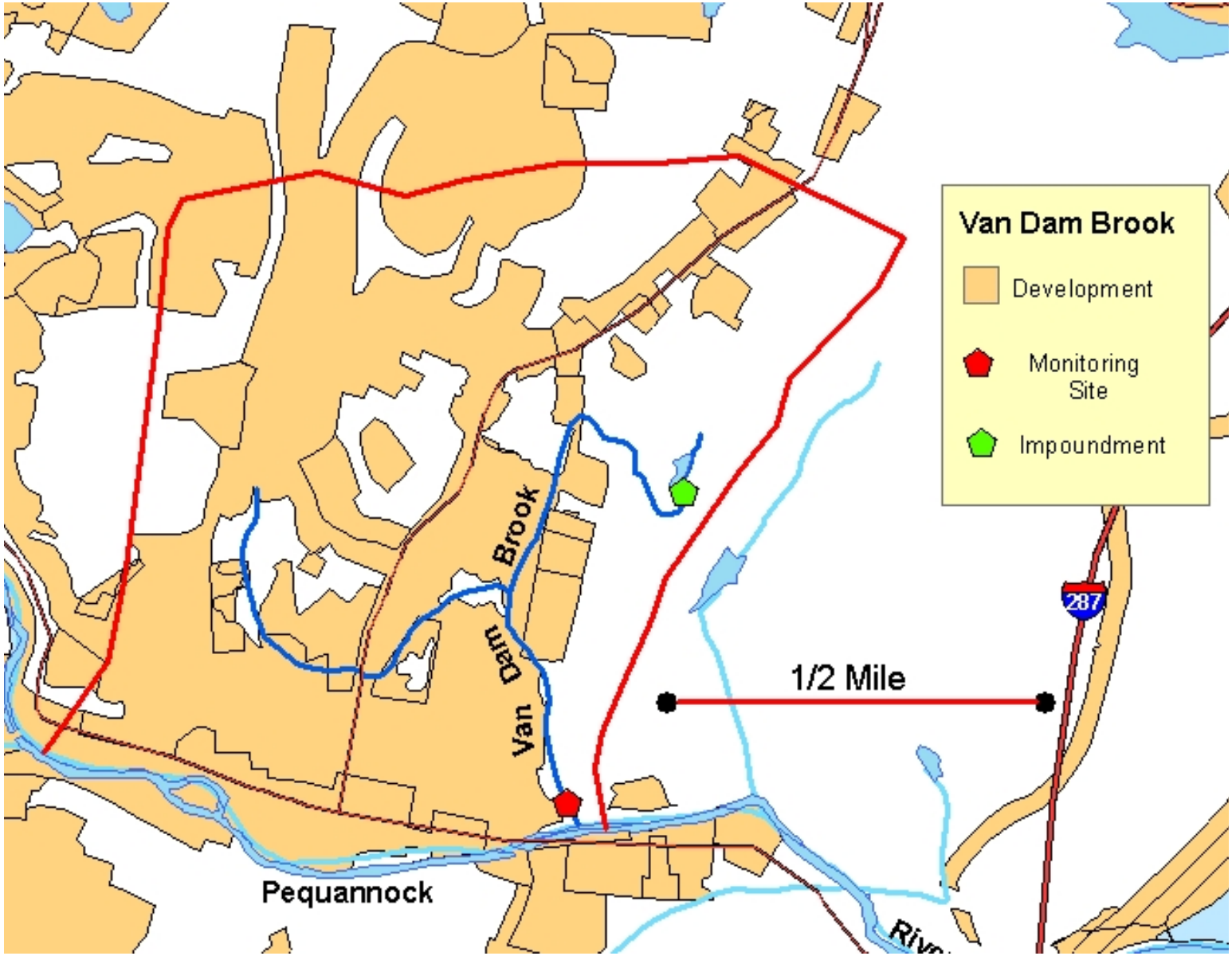


Figure 25 – Map of Van Dam Brook

k) Valley Spring Lake Tributary

The Valley Spring Lake Tributary drains southeastern Kinnelon and western Riverdale, running northwest to southeast and entering the Pequannock River approximately 6.2 miles below Macopin Reservoir (see Figure 27) with a subwatershed area of about 2 square miles. Development of this subwatershed is high, as shown in the mapped 1995 land use coverage, with a great deal of more recent development indicated on the same map. Two small manmade impoundments are located on this waterway. It should be noted that Valley Spring Lake, although shown on this map, has been breached and drained. This tributary is currently unclassified.

Flow rates on the Valley Spring Lake Tributary were measured at 2.205 cfs, 1.611 cfs and 1.3794 cfs, averaging 1.7 cubic feet per second during the study period. These flows were the second highest of any tributary monitored in the study area. Water temperatures were ranked as "Low." During the monitoring period, temperatures exceeded 68F on 40% of the days monitored and exceeded 75F on 0% of days monitored. The highest temperature recorded was 72.57F with an average temperature of 64.16F.

Substantial flows and low temperatures make this tributary an important and positive influence on the mainstem Pequannock River. That importance is lessened somewhat by the lower position of this tributary in the river drainage.

Figure 26 - Valley Spring Lake Tributary

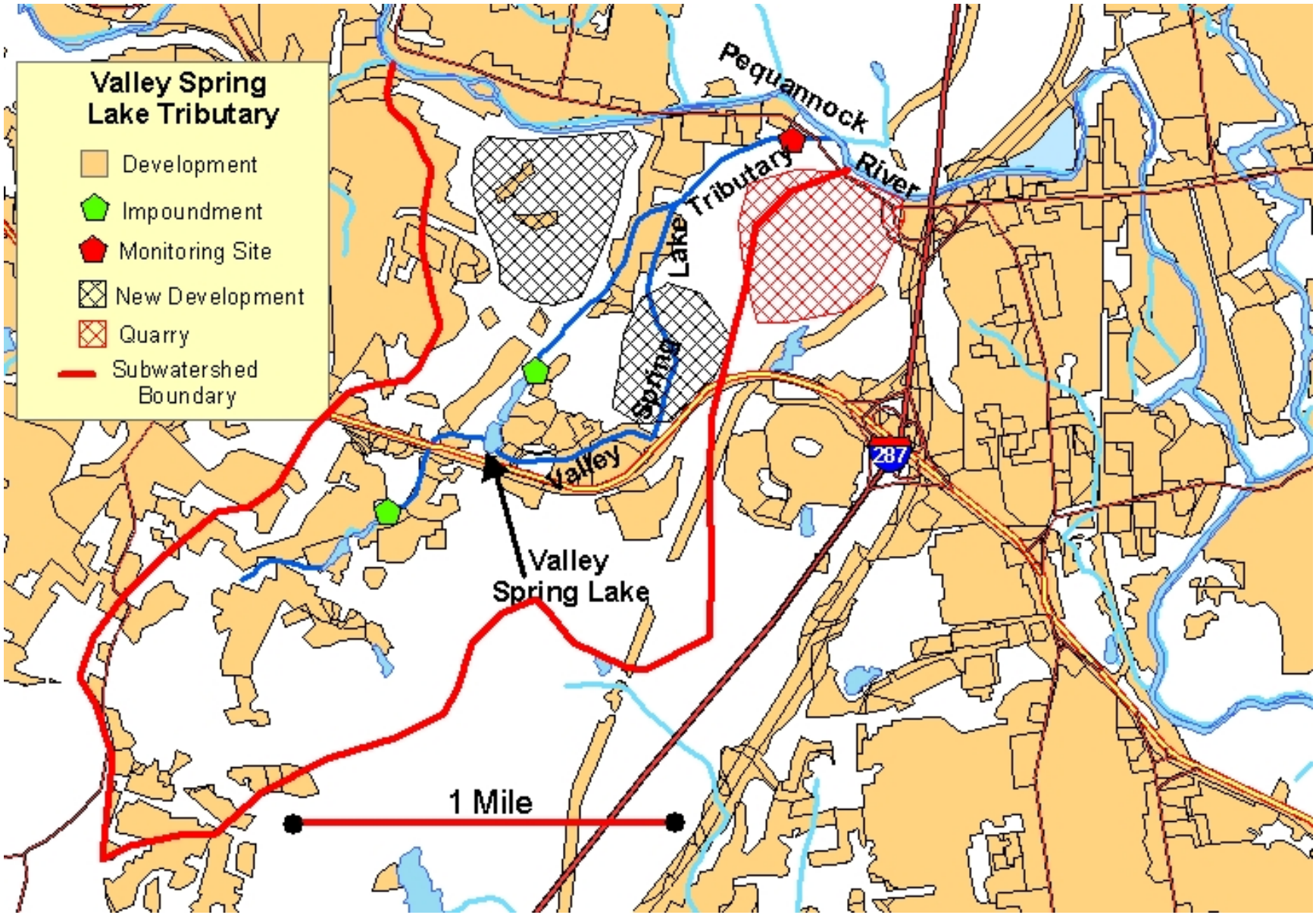


Figure 27 – Map of Valley Spring Lake Tributary

4) Summary

In general, the water temperatures of rivers and streams have a tendency to elevate as flows progress downstream. The extent of this temperature elevation is influenced by such factors as gradient, the state of the riparian canopy and channel characteristics. The fact that the Pequannock River fails to follow this trend shows the marked influence of tributary flows.

At the Butler and Riverdale monitoring sites on the mainstem Pequannock River, all major temperature criteria were lower than at the Macopin site upriver. This is hardly surprising when we consider that 82% of average river flow at the Riverdale site was comprised of tributary flow, and 9 of the 11 tributaries monitored had lower overall temperatures than those recorded at the Macopin site.

Pequannock River tributaries showed a wide range in temperatures. While each of these tributaries is unique, there are some generalizations that apply. Those with low levels of development, healthy riparian canopies and without impoundments had the lowest temperatures. However, only one stream, the “Smoke Rise Tributary”, met all these conditions. All other tributaries had either higher levels of development, impoundments, or both.

Impoundments and their position were very important factors in elevation of tributary temperatures. Impoundments higher in the tributary subwatersheds had less influence. Examples are Apshawa Brook and the Maple Lake Tributary, where impoundments were 1/3 to 1/2 mile from the tributary mouths and the riparian canopy from impoundment to river was largely intact. The cooling affect of this shading canopy, as well as additional flow provided by small groundwater seeps and springs, reduced the overall impact of impoundments on these tributaries.

At the opposite end of the spectrum were tributaries with impoundments low in their subwatersheds, such as the Cold Spring Lake Tributary, or those with impoundments low in their subwatersheds and higher levels of development such as the Oakwood Lake Tributary. These conditions produced very high water temperatures.

Appendix B

NJDEP Stream Buffer Conservation Zone Model Ordinance

6/26/03

STREAM BUFFER CONSERVATION ZONE
MODEL ORDINANCE

I. INTENT AND PURPOSE

In recognition of the fact that values afforded by functional stream buffers contribute to the welfare of residents, the following regulations have been enacted to provide reasonable controls governing the conservation, disturbance, restoration and management of existing stream buffers for all perennial and intermittent streams, and all lakes, ponds and reservoirs in the municipality by establishing a Stream Buffer Conservation Zone (SBCZ). The specific purposes and intent of this article are to:

A. Regulate the land use, siting, and engineering of all development in the SBCZ to be consistent with the intent and objectives of this ordinance and accepted conservation practices.

B. Prevent excessive nutrients, sediment, and organic matter, as well as biocides and other pollutants, from reaching surface waters by optimizing opportunities for filtration, deposition, absorption, adsorption, plant uptake, biodegradation, and denitrification, which occur when stormwater runoff is conveyed through vegetated buffers as stable, distributed sheet flow prior to reaching receiving waters.

C. Provide for shading of the aquatic environment so as to moderate temperatures, retain more dissolved oxygen, and support a healthy assemblage of aquatic flora and fauna.

D. Provide for natural organic matter (fallen leaves and twigs) and large woody debris (fallen trees and limbs) that provide food and habitat for small bottom dwelling organisms (insects, amphibians, crustaceans, and small fish), which are essential to maintain the food chain.

E. Increase stream bank stability and maintain natural fluvial geomorphology of the stream system, thereby reducing streambank erosion and sedimentation and protecting habitat for aquatic organisms.

F. Conserve the natural features important to land and water resources, e.g., headwater areas, groundwater recharge zones, floodway, floodplain, springs, streams, wetlands, woodlands, and prime wildlife habitats.

G. Work with state laws and other ordinances that regulate environmentally sensitive areas to minimize hazards to life, property, and stream features and assist in the implementation of pertinent state laws concerning erosion and sediment control

practices.

II. DEFINITIONS

For the purposes of this ordinance the following definitions shall apply:

“Category one waters" or “C1”means those waters designated in the tables in N.J.A.C. 7:9B-1.15

“Category two waters” or “C2” means those waters not designated as Outstanding National Resource Waters or Category One at N.J.A.C. 7:9B-1.15.

“Intermittent stream” means surface water drainage channels with definite bed and banks in which there is not a permanent flow of water. Most intermittent streams are shown on Soil Conservation Service county soil surveys. These are portrayed as a dashed line on a USDA Soil Survey Map of the most recent edition, or as state open water identified in a letter of interpretation issued by the NJDEP Land Use Regulation Program, whichever is more inclusive.

"Lake, pond, or reservoir" means any impoundment, whether naturally occurring or created in whole or in part by the building of structures for the retention of surface water, excluding sedimentation control and stormwater retention/detention basins and ponds designed for treatment of wastewater.

“Perennial stream” means a stream that appears as a blue line on USGS topographic quadrangle maps and flows continuously throughout the year in most years.

III. ESTABLISHMENT OF THE STREAM BUFFER CONSERVATION ZONE

A. The SBCZ is defined as the designated area adjacent to surface water, including lakes, ponds and reservoirs, and intermittent or perennial streams. The SBCZ may or may not contain trees and other vegetation at the time of ordinance enactment. The SBCZ shall be measured from each defined edge of an intermittent or perennial stream, or lake, pond or reservoir at bank-full flow or level. The SBCZ will consist of two distinct classifications. These classifications determine the width of the SBCZ, except where steep slopes (in excess of 10 percent) are located within the designated widths, in which case the SBCZ shall be extended to include the entire distance of this sloped area. The two classes are designated as:

1. **Class 1 Stream Buffer Conservation Zones** are adjacent to C1 waters and extend 150 feet from the top of each bank at bank-full flow or level or from the centerline of intermittent streams.

2. **Class 2 Stream Buffer Conservation Zones** are adjacent to C2 waters and extend 75 feet from the top of each bank at bank-full flow or level or from the centerline of intermittent streams.

B. The SBCZ is an overlay to the existing zoning districts. The provisions of the underlying district shall remain in full force, except where the provisions of the SBCZ differ from the provisions of the underlying district, in which case the provision which is more restrictive, and less permissive, to a landowner or applicant shall apply.

These provisions are intended to modify the type of land use, siting of structures, and engineering of all proposed development on parcels located within the SBCZ. These provisions apply to land disturbances resulting from or related to any activity or use requiring application for any of the following permits or approvals:

- Building permit
- Zoning variance
- Special exception
- Conditional use
- Subdivision/land development approval

IV. STREAM BUFFER CONSERVATION ZONE USES

Stream Buffer Conservation Zones shall remain in a natural condition or, if in a disturbed condition, including agricultural activities, at the time of adoption of this ordinance, may be restored to a natural condition. There shall be no clearing or cutting of trees and brush, except for removal of dead vegetation and pruning for reasons of public safety or for the replacement of invasive species with indigenous species, altering of watercourses, dumping of trash, soil, dirt, fill, vegetative or other debris, regrading or construction.

A. Open space uses that are primarily passive in character shall be permitted to extend into the SBCZ, provided near stream vegetation is preserved, including:

1. Wildlife sanctuaries, nature preserves, forest preserves, fishing areas, game farms, fish hatcheries and fishing reserves, operated for the protection and propagation of wildlife, but excluding structures.

2. Passive areas of public and private parklands including unpaved hiking, bicycle and bridle trails, provided that said trails have been stabilized with pervious materials.

B. Streambank stabilization or riparian reforestation, which conform to the guidelines of the Stream Buffer Management Plan described in Section X, or

wetlands mitigation projects that have been approved by the Department of Environmental Protection, are permitted to extend into the SBCZ.

C. SBCZ crossings by recreational trails, roads, railroads, sewer and/or water lines, and public utility transmission lines, are permitted, provided that any disturbance is offset by buffer improvements in compliance with the Stream Buffer Management Plan mitigation plan, and any applicable State permits are acquired.

V. PERFORMANCE STANDARDS FOR STREAM BUFFER CONSERVATION ZONES

A. All new major and minor subdivisions and site plans shall be designed to provide sufficient areas outside of the SBCZ to accommodate primary structures, any normal accessory uses appurtenant thereto, as well as all planned lawn areas. Portions of lots within the SBCZ must be permanently restricted by deed or conservation easement held by [*insert name of municipality*] to prevent clearing of vegetation within the SBCZ. Any lands proposed for development which include all or a portion of a SBCZ, shall as a condition of any major subdivision or major site plan approval, provide for the vegetation or re-vegetation of any portions of the SBCZ which are not vegetated at the time of the application or which were disturbed by prior land uses, including for agricultural use. Said vegetation plan shall utilize native tree and plant species in accordance with the Stream Buffer Management Plan described in Section X.

B. Minimum required front, side, and rear setbacks required for building lots which exist as of the date of adoption of this ordinance, but have not obtained a building permit, may extend into the SBCZ, provided that a deed restriction and/or conservation easement is applied which prohibits clearing or construction in the SBCZ.

VI. NONCONFORMING STRUCTURES AND USES IN THE STREAM BUFFER CONSERVATION ZONE

Nonconforming structures and uses of land within the SBCZ are subject to the following requirements:

A. Existing nonconforming structures or uses may be continued but shall not have the existing building footprint or uses expanded or enlarged.

B. Discontinued nonconforming uses may be resumed any time within one year from such discontinuance but not thereafter when showing clear indications of abandonment. No change or resumption shall be permitted that is more detrimental to the SBCZ, as measured against the intent and purpose under Section I, than the existing or former nonconforming use. This one-year time

frame shall not apply to agricultural uses that are following prescribed Best Management Practices for crop rotation. However, resumption of agricultural uses must be strictly confined to the extent of disturbance existing at the time of adoption of this ordinance.

VII. USES SPECIFICALLY PROHIBITED IN THE STREAM BUFFER CONSERVATION ZONE

Any use or activity not specifically authorized within Sections IV or VI shall be prohibited within the SBCZ.

VIII. ACTIVITIES PERMITTED IN STREAM BUFFER CONSERVATION ZONES IN THE CASE OF NO REASONABLE OR PRUDENT ALTERNATIVE OR EXTREME HARDSHIP

A. Hardship variances may be granted by the Zoning Board in cases of a pre-existing lot (existing at the time of adoption of this ordinance) for a one-family or two-family dwelling, when there is insufficient room outside the SBCZ for uses permitted by the underlying zoning and there is no other reasonable or prudent alternative to placement in the SBCZ, including obtaining variances from setback or other requirements that would allow conformance with the SBCZ requirements, and provided the following demonstrations are made:

1. An applicant shall be deemed to have established the existence of an extreme economic hardship, as distinguished from mere inconvenience, if the subject property is not capable of yielding a reasonable economic return if its present use is continued or if it is developed in accordance with provisions of this ordinance and that this inability to yield a reasonable economic returns results from unique circumstances peculiar to the subject property which:

    a. do not apply to or affect other property in the immediate vicinity;
    b. relate to or arise out of the characteristics of the subject property because of the particular physical surroundings, shape or topographical conditions of the property involved, rather than the personal situations of the applicant; and
    c. are not the result of any action or inaction by the applicant or the owner or his predecessors in title. The necessity of acquiring additional land to locate development outside the SBCZ shall not be considered an economic hardship unless the applicant can demonstrate that there is no adjacent land that is reasonably available.

2. An applicant shall be deemed to have established compelling public need if the applicant demonstrates, based on specific facts, that:

   a. the proposed project will serve an essential public health or safety need;
   b. the proposed use is required to serve an existing public health or safety need; or
   c. there is no alternative available to meet the established public health or safety need.

3. A variance can only be granted if it shown that the activity will not be materially detrimental or injurious to other property or improvements in the area in which the subject property is located and will not endanger public safety; and the exception granted is the minimum relief necessary to relieve the hardship.

B. If the above demonstrations are made, then the following encroachments into the SBCZ may be permitted:

1. Encroachment of impervious surfaces (structures or pavement) otherwise permitted by the underlying zoning is permitted to the extent of 750 square feet total. Said encroachment is not permitted closer than 100 feet from the top of the bank at bank-full flow or level of C1 waters or closer than 50 feet from the top of the bank at bank-full flow or level of C2 waters.

2. Encroachment of lawn areas, but no closer than 100 feet from the edge of a C1 water or 50 feet from the edge of a C2 water.

C. If such an exception is granted, the applicant shall rehabilitate an environmentally degraded stream corridor within or adjacent to the same site at least equivalent in size to the SBCZ reduction permitted or, if not possible, rehabilitate or expand a SBCZ at least equivalent in size within a nearby site and, if available, within the same watershed. Rehabilitation shall include reforestation, stream bank stabilization and removal of debris, in accordance with a Stream Buffer Management Plan.

IX. BOUNDARY INTERPRETATION, APPEALS PROCEDURES, INSPECTIONS, CONFLICTS, SEVERABILITY

(Option: municipality may prepare map of municipality depicting extent of the SBCZ, which would then need to be updated to keep up with changes made by the NJDEP in water classifications.)

A. When a landowner or applicant disputes the boundaries of the Stream Buffer

Conservation Zone or the defined bank-full flow or level, the landowner or applicant shall submit evidence to (*insert name of appropriate municipal contact*) that describes the SBCZ, presents the landowner or applicant's proposed SBCZ, and presents all justification for the proposed boundary change.

B. Within 45 days of a complete submission of Section IX A above, the Township Engineer, or appointed representative, shall evaluate all material submitted and shall make a written determination, a copy of which shall be submitted to (*insert name of appropriate municipal contact*) and the landowner or applicant. Failure to act within the 45-day period shall not be interpreted to be an approval of the proposed boundary change.

C. Any party aggrieved by any such determination or other decision or determination under this section may appeal to the (*insert name of appropriate municipal contact*) under the provisions of this ordinance. The party contesting the location of the SWCZ boundary shall have the burden of proof in case of any such appeal.

D. Inspections

1. Lands within or adjacent to an identified SBCZ will be inspected by the municipal representative when:

   a. a subdivision or land development plan is submitted.
   b. a building permit is requested.
   c. a change or resumption of nonconforming use is proposed.
   d. discontinued use for more than a year as described in Section VI. The party contesting the discontinued use shall have the burden of proof to demonstrate when use was discontinued.

2. The SBCZ may also be inspected periodically by the representatives from the Township if excessive or potentially problematic erosion is present, other problems are discovered, or at any time when the presence of an un-authorized activity or structure is brought to the attention of Township officials or when the downstream surface waters are indicating reduction in quality.

D. Conflicts

All other ordinances, parts of ordinances, or other local requirements that are inconsistent or in conflict with this ordinance are hereby repealed to the extent of any inconsistency or conflict and the provisions of this ordinance apply.
E. Severability

(Add standard severability clause)

X. STREAM BUFFER MANAGEMENT PLAN

A. Within any Stream Buffer Conservation Zone, no construction, development, use, activity, or encroachment shall be permitted unless the effects of such development are accompanied by preparation, approval, and implementation of a Stream Buffer Management Plan.

B. The landowner, applicant, or developer shall submit to (*insert name of appropriate municipal contact*), or its appointed representative, a Stream Buffer Management Plan prepared by an environmental professional, professional engineer or other qualified professional which fully evaluates the effects of any proposed uses on the SBCZ. The Stream Buffer Management Plan shall identify the existing conditions including:

1. Existing vegetation;
2. Field delineated streams, wetlands, and the 100-year floodplain;
3. Mapped soils;
4. Existing subdrainage areas of site;
5. Slopes in each subdrainage area segmented into sections of slopes less than or equal to ten (10) percent; eleven (11) to nineteen percent; and greater than or equal to twenty (20) percent;
6. All proposed activities; and
7. A mitigation plan that demonstrates how the loss of value afforded by the existing buffer will be compensated for.

C. The Plan shall be reviewed and must be approved by the Township Engineer, in consultation with the Environmental Commission, as part of the subdivision and land development process.

D. The Stream Buffer Management Plan should include management provisions in narrative and/or graphic form specifying:

1. The manner in which the SBCZ will be owned and by whom it will be managed and maintained.

2. The conservation and/or land management techniques and practices that will be used to conserve and protect the SBCZ, as applicable.

3. The professional and personnel resources that are expected to be necessary in order to maintain and manage the SBCZ.

4. A revegetation plan, if applicable, that includes: three (3) layers of vegetation, including herbaceous plants that serve as ground cover, understory shrubs, and trees that form an overhead canopy. Vegetation selected must be native and consistent with the soil, slope and moisture conditions of the site. The revegetation plan shall be prepared by a qualified

professional such as a landscape architect or engineer, and shall be subject to the approval of the Municipal Engineer, in consultation with the Environmental Commission.

E. A Stream Buffer Management Plan is not required where the SBCZ is not being disturbed and conservation easements/deed restrictions applied to ensure there will be no future clearing or disturbance of the SBCZ.

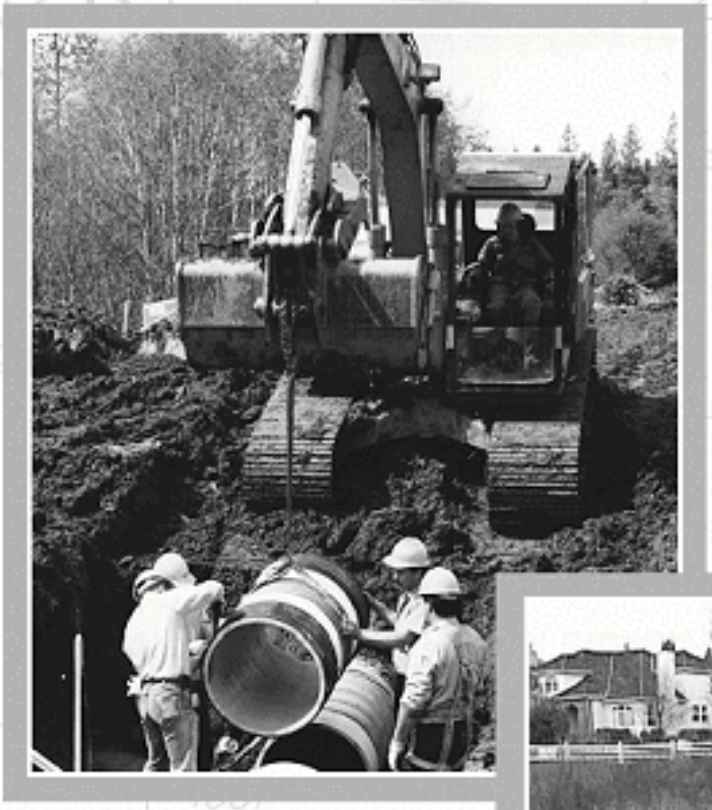
Appendix C

Design and Construction Standards for Sanitary Sewer and Surface Water Management

(Model Redevelopment Ordinance)

DESIGN AND CONSTRUCTION STANDARDS

for Sanitary Sewer and Surface Water Management



MARCH 2004

Clean Water Services
Our commitment is clear.

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Chapter 1

GENERAL CONSTRUCTION REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

Chapter 1

GENERAL CONSTRUCTION REQUIREMENTS AND ADMINISTRATIVE PROVISIONS

1.01 Application of These Regulations

1.01.1 Except as provided otherwise in a specific section of these rules, these standards and regulations shall apply to all territory within the District. A city within the District may adopt more restrictive standards within the scope of this Resolution and Order, but may not adopt less restrictive standards.

1.01.2 Application of Chapter

The requirements and administrative provisions of this Chapter shall apply to the construction of all components of the District and City sanitary sewer and storm and surface water systems. Additionally, all requirements and provisions of this Chapter except Sections 1.04, Plan Submittal and 1.05, Easements shall apply to the construction of any building sewer or side sewer within the District and City boundaries.

1.02 Definitions

As used in this Resolution and Order, the words or abbreviations set forth below shall have the indicated meanings unless the context requires otherwise. The definitions set forth in Ordinance 27, as amended, shall also apply.

1.02.1 AASHTO

American Association of State Highway and Transportation Officials.

1.02.2 ANSI

American National Standard Institute.

1.02.3 Approved by District or City

See Chapter 2. 01.1.

1.02.4 ASTM

American Society of Testing and Materials.

1.02.5 AWWA

American Water Works Association.

1.02.6 Break in Slope

The transition point where a valley or river bank slope flattens and represents an historic geologic terrace of a stream or river. The point at which the grade extending from a break in slope, away from the stream or river, is less than 25%. Break in slope is also commonly referred to as top of ravine in steeply sloped headwater environments. Break in slope does not include minor surface anomalies that result from localized landslide slumps or site grading.

1.02.7 Building Sewer

That portion of the private sanitary sewer extending from a point five feet outside the established line of the building or structure (including any structural projection except eaves) to the public right-of-way or easement line.

1.02.8 Capital Improvement Plan

The Capital Improvement Plan adopted by the Clean Water Services Board of Directors, and any updates of the plan.

1.02.9 Construction Permit Agreement

An agreement signed by the owner containing all assurances deemed necessary by the District that all public improvements will be constructed in accordance to these standards and the approved project plans.

1.02.10 Contractor

The person designated by the District, City, or owner to do the work in question.

1.02.11 Conveyance System

The surface water conveyance system includes all portions of the surface water system, either natural or man-made, that transport storm and surface water runoff. The purpose of the conveyance system is to drain surface water from properties so as to provide protection to property and the environment. The sanitary sewer conveyance system includes all interceptor and main sewer pipe lines, force mains, pumping or lift facilities, manholes, and related facilities.

1.02.12 Culvert

A surface water drainage pipe crossing a road, driveway, or pathway which has no attached structures.

1.02.13 Designee

The entity designated by the District to conduct alternatives analysis activities, per District/City Inter-Governmental Agreement (IGA) and/or co-permitee status on the National Pollution Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit issued by the Department of Environmental Quality.

1.02.14 Development

a. All human-induced changes to improved or unimproved real property, including:

1) Construction of structures requiring a building permit if such structures increase the impervious surface footprint on the real property;
2) Land division, including subdivisions, lot line adjustments, expedited land partitions and minor land partitions. “Land Division” does not include plats for the sole purpose of converting existing buildings to condominiums;
3) Drilling;
4) Site alterations resulting from surface mining or dredging;
5) Grading that would require an erosion control permit;
6) Construction of earthen berms;
7) Paving and roadway construction;
8) Excavating that would require an erosion control permit;
9) Clearing when it results in the removal of trees or native vegetation that would require a permit from the City/County or notification to the Oregon Department of Forestry;
10) Redevelopment; and
11) Construction of utility infrastructure.

b. The following activities are not included in the definition of development:

1) Farming activities when conducted in accordance with accepted farming practices as defined in ORS 30.930 or under the Tualatin River Subbasin Agricultural Water Quality Management Area Plan;
2) Construction on lots in subdivisions meeting the criteria of ORS 92.040(2);

3) Any development activity for which land use approvals have been issued pursuant to a land use application submitted to a land use authority on or before February 4, 2000 and deemed complete by the land use authority on or before March 15, 2000. Renewals or modifications of such land use approvals shall be required to conform to these regulations.

4) Measures to repair, maintain, or remove **existing** structures, facilities, roadways, driveways, accessory uses, or other development, provided such measures are consistent with District/City/County regulations, and do not encroach further into the Vegetated Corridor or Sensitive Area.

5) Interior modifications and vertical additions (additional stories) that do not modify the existing structure footprint or increase the building footprint impervious area of the site, provided such modifications or additions are consistent with District/City/County regulations and do not encroach further into the Vegetated Corridor or Sensitive Area.

6) Measures to replace within the existing footprint a structure(s) lost due to a catastrophic event such as fire, provided that such measures are consistent with District/ City/County regulations. Structures that are partly or wholly within a FEMA designated 100-year floodplain that are damaged beyond more than 50% of the value or proposed to be improved by more than 50% of their value, must be elevated or flood-proofed consistent with the National Flood Insurance Program participation requirements.

1.02.15 District or CWS

"District" or "CWS" means Clean Water Services and includes any representative or employee of the District authorized to act in its behalf.

1.02.16 District or City

When the term "District or City" is used in this Resolution and Order, either the District or a City, including its authorized representatives, may perform a task or duty specified within this Resolution and Order, provided that, a City may perform such task or duty only when:

a. There is an intergovernmental agreement in effect between the District and City assigning such authority to the City, and

b. The City action is within the boundary of that City, and

c. Said action is subject to the terms of such agreement and to the provisions of this Resolution and Order.

Where the term "District or City" is used, the District shall retain the ability to carry out a task or duty.

1.02.17 Drainage Ditch

a. Drainage ditches include:
   1) Roadside ditches that carry only storm water runoff from the adjacent road which may be mixed with unconcentrated flow from adjacent lots
   2) Constructed channels designed as part of the storm water infrastructure and drain directly from storm water facilities or storm pipe systems
   3) Agricultural or other manmade ditches that divert water away from the natural stream for the purpose of irrigation or livestock watering

b. Drainage ditches do not include historically altered streams or channels that convey surface water flows

1.02.18 Easement or Right-of-Way

A right of use on real property of another, entitling the District and City to construct, own and maintain a public sanitary sewer, pump station, storm system, and related facilities on, under and through the subject real property.

1.02.19 Edge of Sensitive Area

1. The top of the channel bank;
2. The two-yr 24 hour design storm elevation for the Tualatin River;
3. The delineated boundary of the wetland, per DSL / Corps procedures for wetland delineation;
4. The outside edge of spring emergence (measured as the area of saturation, hydric soil conditions, or channel formation, whichever is greatest);
5. The average high water mark for lakes, ponds, and in-stream impoundments;
6. For streams draining 10 to 50 acres where no defined channel exists, and where there are no other sensitive areas such as wetlands, the edge of the sensitive area shall be the centerline of the natural drainage swale.

1.02.20 Engineer

The person, firm, corporation, partnership, or association duly registered by the State of Oregon, which is providing engineering work on a project or construction covered by this Resolution and Order. If the person providing the engineering for the project is a District or City employee, then "engineer" expressly includes such employee.

1.02.21 Enhancement

Modification of a Sensitive Area or Vegetated Corridor to improve the resources ecological functions and values and improve its ability to protect the water resources.

1.02.22 Erosion

The movement of soil particles resulting from the flow or pressure from water, or wind, or from tracking by vehicles or foot traffic.

1.02.23 Floodplain

The land area identified and designated by the United States Army Corps of Engineers, the Oregon Division of State Lands, FEMA, or Washington County that has been or may be covered temporarily by water as a result of a storm event of identified frequency.

1.02.24 Floodway

The portion of a watercourse required for the passage or conveyance of a given storm event as identified and designated by the District pursuant to this Resolution and Order. The floodway shall include the channel of the watercourse and the adjacent floodplain that must be reserved in an unobstructed condition in order to discharge the base flood without increasing flood levels by more than one foot.

1.02.25 Floodway Fringe

The area of the flood plain, lying outside the floodway, which does not contribute appreciably to the passage of flood water, but serves as a retention area.

1.02.26 Frontage Length

A linear measure of the length of the development front, which is directly adjacent to the vegetated corridor.

1.02.27 General Processing Fee

A fee established in the District's Rates and Charges Resolution and Order.

1.02.28 Governmental Unit

Governmental unit includes:

a. The federal government and any of its departments, agencies, boards or commissions;

b. The government of the State of Oregon and any of its departments, agencies, boards or commissions;

c. Any city within the District's service district boundaries;

d. The cities of Portland and Lake Oswego;

e. Washington County;

f. Any school district;

g. Any municipal or public corporation or special district, as defined by ORS Chapter 198, which is created for the administration of public affairs, supported by public funds and governed by managers which derive their authority from a federal, state, or local governing body;

h. Any intergovernmental agency, department, council, or like entity created under ORS Chapter 190.

1.02.29 Hazardous Material(s)

"Hazardous material(s)" or "hazardous substance(s)" means any element or compound that, when it enters in or upon the water, presents an imminent and substantial danger to the public health or welfare or the environment, including but not limited to fish, animals, vegetation or any part of the natural habitat in which they are found. "Hazardous material or substance" includes but is not limited to a substance designated under 33 U.S.C. §1321 (b)(2)(A), any element, compound, mixture, solution or substance designated under 42 U.S.C. §9602, any hazardous waste having characteristics identified under or listed under 42 U.S.C. §6921, any toxic pollutant listed under 33 U.S.C. §1317 (a), any imminently hazardous chemical substance or mixture with respect to which the Administrator of the United States Environmental Protection Agency has taken action under 15 U.S.C. §2606, and any residue classified as a hazardous waste pursuant to ORS 466.020(3).

1.02.30 ICEA

Insulated Cable Engineers' Association.

1.02.31 Impervious Area

Pavement, maintained gravel areas, structures, public and private roadways, roofs, and other hard surfaces which are not specifically designed to allow water to infiltrate. Effective impervious area is not directly connected to the drainage system via piping.

1.02.32 Inspector/District Inspector

The person designated by the District or City to inspect the work.

1.02.33 Intermittent Flow

The flow in streams and springs that consistently do not have year-round water or saturated soil within their channel or swale in a year with wet to average precipitation patterns. Intermittent flow must occur with some degree of regularity and must be in a definite direction. Refer to Appendix C Table 1: Precipitation to determine wet, dry or average year precipitation levels. To be considered intermittent, the channel must meet one of the following criteria in a year with wet to average precipitation levels:

a) The channel must be dry without visible flow or standing water for a minimum of 30 consecutive days; or
b) The channel must not have saturated soil in the upper 12 inches.

1.02.34 Local Program

The portion of the sanitary sewerage system, or storm and surface water system, program of construction, operation, maintenance, and regulation within the District's service area which may be performed by the District, or by a City, County, or by intergovernmental agreement.

1.02.35 Mitigation

The reduction of adverse effects of a proposed project by considering, in the following order:

a. Avoiding the impact altogether by not taking a certain action or parts of an action;

b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

c. Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action by monitoring and taking appropriate corrective measures; and

e. Compensating for the impact by replacing or providing comparable sensitive areas or vegetated corridors.

1.02.36 NEMA

National Electrical Manufacturers' Association.

1.02.37 "Or Equal," "Or Approved Equal," "Or Equivalent"

These terms indicate that the "equal" product is the same or better than the product or standard named or prescribed in function, performance, reliability, quality, and general configuration.

Determination of the quality in reference to the project design requirements will be made by the District. Contractor shall not use such "equal" products without prior written approval of the District.

1.02.38 ORS

Oregon Revised Statutes

1.02.39 Outfall

A point where collected and concentrated surface and storm water runoff is discharged.

1.02.40 Owner or Property Owner

The person who is the legal record owner of the real property, or where there is a recorded land sale contract, the purchaser thereunder.

1.02.41 Perennial flow

The flow in streams and springs that have year-round water or saturated soil within the channel in a year with wet to average precipitation patterns. A stream will be considered perennial unless determined to be intermittent using one of the criteria outlined in 1.02.33.

1.02.42 Person

Any individual, firm, partnership, joint venture, association, social, fraternal, educational, religious or charitable organization, fraternity, sorority, joint stock company, corporation, estate, trust, business trust, receiver, trustee, syndicate, municipal corporation, district or political subdivision or any legal entity whatsoever.

1.02.43 Plans

The drawings and designs that specify construction details as prepared by the Engineer.

1.02.44 Post-Construction Erosion Control

Re-establishing groundcover or landscaping prior to the removal of temporary erosion control measures.

1.02.45 The Property or The Site

The subject real property on which development or permitted activity takes or is proposed to take place. For activity occurring on property other than that which the applicant owns or controls, the property or the site shall mean the land within limits of the permanent and temporary construction easements.

1.02.46 Public/District's Sanitary Sewer(s) and Storm and Surface Water System

The sanitary sewer and storm and surface water collection systems, within easements dedicated to the public or District/City, which are operated and under the jurisdiction of and maintained by the District and/or City.

1.02.47 Redevelopment

Redevelopment is any activity that alters existing improved impervious area on the subject property. Redevelopment includes, but is not limited to: the expansion of or change to an existing building footprint or structure; reconfiguration of existing roadways, driveways, or parking lots; and land disturbing activities related to structural or impervious area modifications.

1.02.48 Replacement Area

The mitigation area required to compensate for an encroachment into the Vegetated Corridor or Sensitive Area.

Chapter 3

STANDARD DESIGN REQUIREMENTS FOR STORM AND SURFACE WATER AND VEGETATED CORRIDORS

Chapter 3

STANDARD DESIGN REQUIREMENTS FOR STORM AND SURFACE WATER AND VEGETATED CORRIDORS

3.00 Introduction

The purpose of this chapter is to outline design requirements for storm and surface water management. The provisions of this chapter are intended to prevent or reduce adverse impacts to the drainage system and water resources of the Tualatin River Basin. In combination with other state, federal, and local laws and ordinances, these requirements are intended to protect the beneficial uses of waters within the Tualatin River Basin and within the District.

3.01 Application and Interpretation of Chapter

The provisions of this chapter shall apply to storm and surface water systems within the District and City jurisdiction. Interpretations of such provisions and their application in specific circumstances shall be made by the District and City. Any City operating a local program may adopt stricter design specifications within its jurisdiction than the specifications stated in this chapter. No person shall undertake development activities within the District's jurisdiction without first obtaining a Storm Water Connection Permit from the District or its designee pursuant to Ordinance 27 and these rules, or receiving a written determination from the District that no Storm Water Connection Permit is required. Applicants may apply for permits as single project or as part of a master planned activity.

3.02 Sensitive Area and Vegetated Corridor Standards

3.02.1 Service Provider Letter and Permits Required

a. In order to determine if the proposed activity will require a service provider letter, the applicant may apply for a Prescreening Site Assessment. If no Water Quality Sensitive Areas appear to exist on or within 200 feet of the site, then no further site assessment or service provider letter is required. The Prescreening Site Assessment does not eliminate the need to evaluate and protect Water Quality Sensitive Areas if they are subsequently discovered on, or within 200 feet of, the site.

b. Prior to land use application or issuance of building permit for a development activity as defined in section 1.02.14, the Applicant shall secure a service provider letter from the District or its designee, which specifies the conditions and requirements associated with Vegetated Corridors and Sensitive Areas necessary for the District to issue a Storm Water Connection Permit pursuant to Ordinance 27 and these rules and regulations. If allowed by the land use jurisdiction, applicant may begin

the land use permit application process and secure the service provider letter prior to completing the land use permit application.

c. In order to secure a service provider letter from the District, the applicant shall perform a Natural Resource Assessment in accordance with Section 3.02.2. The applicant shall perform a Tier 1, 2 or 3 Alternatives Analysis pursuant to Section 3.02.6 if the proposed site plan can not meet the standards outlined Sections 3.02.3 and 3.02.4.

d. No person shall perform construction without first obtaining a Storm Water Connection Permit from the District or its designee as required pursuant to Ordinance 27, Section 4.B. The Storm Water Connection Permit shall be issued upon District approval of final construction plans showing that all of the applicable conditions from the service provider letter have been met. The Applicant must obtain and comply with all permits and approvals required under applicable local, state and federal law.

e. Exceptions to the process outlined in 3.02.1.a-d include:

1) For lot line adjustments that are not part of a land use or building permit application, and that do not result in any physical development, the Applicant shall complete a Prescreening Site Assessment. If Sensitive Areas appear to exist on or within 200 feet of the site, then further site assessment may be required. The lot line adjustment shall be reviewed by the District / City/ County to ensure the proposed configuration of the lots retain buildable status. Vegetated Corridor conditions shall not apply to the lot line adjustment approval process, but may apply to subsequent land use or development applications on the subject property.

2) For redevelopment, the standards in Section 3.02 shall apply only when the activity alters 10% or more of existing improved impervious area within 100 feet of the Sensitive Area. The process outlined in 3.02.1.a-d shall be followed.

3.02.2 Natural Resources Assessment Required

a. Prior to completion of a land use permit application or building permit issuance for development activity as defined in section 1.02.14, the Applicant shall provide a Natural Resource Assessment for any Sensitive Areas and Vegetated Corridors in accordance with Appendix C: Natural Resource Assessments. The Assessment shall consist of a reconnaissance and site certification. When Sensitive Areas are found to be present, the Applicant shall delineate the Sensitive Areas and determine the width and condition of the Vegetated Corridor. For qualifying projects, the

Applicant may perform a Simplified Site Assessment as described in Appendix C.

b. The Applicant shall measure the Vegetated Corridor as shown in Figure 3.2 and further outlined in Appendix C: Natural Resource Assessments. A minimum of three slope measurements along the Sensitive Area, spaced at no more than 100-foot increments, shall be made for each property for which development is proposed. The District may require additional measurements for sites with highly variable topography. The Applicant shall determine existing corridor conditions per Table 3.2 and Appendix C: Natural Resource Assessments and clearly mark them on scaled plans. The Applicant shall provide photos of the site conditions with the plans.

3.02.3 Sensitive Areas

a. Extent of Sensitive Areas

1) The Applicant shall determine the extent of the Sensitive Area using the methods outlined in Appendix C: Natural Resource Assessments.

2) Local land use codes may require additional natural resource analysis.

b. Requirements and Conditions Within Sensitive Areas

1) No person shall erect any structure, conduct any development or construction activities, establish or maintain any garden or lawn, clear native vegetation, remove non-native invasive vegetation other than with an integrated vegetation management approach, store uncontained hazardous materials, dump or dispose of materials of any kind (including pet waste), or conduct other activities within a Sensitive Area that may negatively impact water quality, except as allowed in 3.02.3.b.2.

2) The following activities are allowed within a Sensitive Area when impact is minimized through choice of mode, sizing, and placement:

a. Maintenance practices and enhancement activities, as defined or permitted by the DSL or COE, are allowed within the Sensitive Area per criteria set forth by DSL and/or COE.

b. Development within the Sensitive Area shall be allowed if the required permits are issued, when necessary, by the DSL and/or the COE.

c. On-site relocation of intermittent streams that drain less than 50 acres and have a perpendicular land slope of less than 25%, provided that the pre-existing discharge point off the site is maintained.

d. As approved by the District or its designee through an alternatives analysis set out in Section 3.02.6 of these rules, the activities listed in Section 3.02.4.b.2), 3), and 4). within Water Quality Sensitive Areas that are not regulated by DSL and the COE.

3) Mitigation shall be required per the DSL and COE rules and regulations or as determined by the District for areas or activities not regulated by COE or DSL.

3.02.4 Vegetated Corridors

a. Extent of Vegetated Corridors

1) The Vegetated Corridor may range from 15 to 200 feet wide, measured horizontally, from the defined boundaries of the Sensitive Area, except where approval has been granted by the District or City/County to modify the width of a portion of the corridor in accordance with section 3.02.4.a.2). Table 3.1 documents the Vegetated Corridor Widths and Figure 3.1 illustrates the requirement.

2) Modifications to the required Vegetated Corridor widths are allowed via averaging or reduction for Corridor areas certified by the District or Designee to be in marginal or degraded condition. Modifications are not allowed for Corridor areas certified by the District to be in good condition. Averaging shall be considered prior to reduction and cannot be used in conjunction with reduction.

a. The maximum encroachment allowed for averaging at a project site is 20% of the frontage length of the Vegetated Corridor by no more than 20% of the required width. The area of encroachment must be replaced at a 1:1 ratio. The replacement area must be incorporated into the remaining Vegetated Corridor on the project site and meet the "Good Corridor Condition" standards as defined in Table 3.2, regardless of its distance from the Sensitive Area.

b. If the Vegetated Corridor extends 125 feet or more from the boundary of the Sensitive Area, and Vegetated Corridor averaging is not practicable, the maximum encroachment allowed for reduction at a project site is 20% of the required Vegetated Corridor width. A stamped geotechnical report confirming that slope stability can be maintained with the reduced setback is

required. The remaining Vegetated Corridor shall be enhanced to meet the "Good Corridor Condition" standards as defined in Table 3.2.

c. When the slope is greater than 25% and the Vegetated Corridor extends 35 feet beyond the break in slope, the outer boundary of the Vegetated Corridor may be reduced from 35 feet to 15 feet beyond the break in slope, as long as the resulting Vegetated Corridor is no less than 50 feet beyond the edge of the Sensitive Area. This reduction is allowed only if a stamped geotechnical report confirms that slope stability can be maintained with the reduced setback from the break in slope.

3) If trees or native vegetation have been cleared from the Vegetated Corridor or Sensitive Area prior to applying for development and without District/City/County approval, the maximum Vegetated Corridor widths for the resource type and pre-existing site condition will apply. Mitigation and enhancement of the entire impacted Sensitive Area and/or Vegetated Corridor will be required for the full extent of the Sensitive Area and/or Vegetated Corridor in the impacted area. The following mitigation requirements shall apply to sites where native vegetation has been removed from Vegetated Corridors or Sensitive Areas without prior authorization:

a. Trees removed shall be replaced with a number of trees equal to the caliper divided by the largest size reasonably available, for a 1:1 replacement by caliper size. Tree density for the plant community shall meet or exceed the good corridor condition standard outlined in Table 3.2 and Appendix D, Table 1.

b. Shrub and herbaceous material replacement shall meet the good corridor condition standard outlined in Table 3.2 and per Appendix D, Table 1: Plant Communities for Revegetation.

4) The requirements of 3.02.4.a.3 do not apply to:

a. The removal of "hazard" trees if they threaten a structure or public area. Hazard trees shall be topped and standing trunks retained, if possible.

b. Vegetated Corridors or Sensitive Areas in which clearing occurred prior to February 22, 2000.

5) The Vegetated Corridor shall not be required to extend beyond an existing building or improved roadway separating the proposed development from the Sensitive Area. For the purposes of this section,

an “improved roadway” shall be gravel or paved, a minimum of 12-feet in width, and actively used for vehicular traffic. The building or roadway must remain as part of the proposed development and not planned for future demolition.

6) If the proposed activity is redevelopment and alters 10% or more of existing improved impervious area within 100 feet of the Sensitive Area, then a 25-foot Vegetated Corridor for streams, springs and wetlands, and a 50-foot Vegetated Corridor for the Tualatin River shall apply per Table 3.1. Vegetated Corridor averaging is permitted per 3.02.4.a.2.a and shall exclude any existing building footprint area already encroaching into the Vegetated Corridor. Exceptions to the Vegetated Corridor requirement on redevelopment sites include:

   a. Redevelopment of a single family residence is exempt, unless redevelopment is changing use (to commercial/ multifamily/ industrial, etc), or proposing to encroach further into the Vegetated Corridor.

   b. Redevelopment of an existing impervious area fully separated from the resource by a building (i.e. building divides the activity from the Sensitive Area) are exempt.

   c. Properties with pre-existing Vegetated Corridors or setbacks averaging at least 25 feet from streams and 50 feet for the Tualatin River, may maintain the pre-existing Vegetated Corridor width. Enhancement of existing Vegetated Corridor to good condition is required, if not already in good condition.

   d. Properties bordering wetlands at least 25 feet from stream may utilize the wetlands as the Vegetated Corridor. Enhancement of wetlands to a good condition for a width of 25 feet towards the stream is required, if not already in good condition.

b. Requirements and Conditions within a Vegetated Corridor

   1) No person shall erect any structure, conduct any development or construction activities, establish or maintain any garden or lawn, clear native vegetation, remove non-native invasive vegetation other than with an integrated vegetation management approach, store uncontained hazardous materials, dump or dispose of materials of any kind (including pet waste), or conduct other activities within a Vegetated Corridor which may negatively impact water quality, except as allowed in Section 3.02.4.b.2) and 3).

2) Upon review and approval by the District or Designee and other appropriate regulatory authorities, the following activities are allowed within a Vegetated Corridor when impact is minimized through choice of mode, sizing and placement.

a. Roads, pedestrian or bike paths crossing the Vegetated Corridor from one side to the other in order to provide access to the Sensitive Area or across the Sensitive Area;

b. Utility/service provider infrastructure construction (i.e. storm drainage, sanitary sewer, service laterals, outfalls, water, phone, gas, cable, etc.) Infrastructure construction shall not remove native trees greater than 6" dbh.

c. Stormwater facilities planted with appropriate native vegetation. Storm water facilities may encroach into the Vegetated Corridor in accordance with the Vegetated Corridor averaging or reduction allowances set out in Section 3.02.4.a.2); they may be integrated within a Vegetated Corridor of an intermittent stream draining less than 50 acres and having a slope less than 25%. Refer to Appendices B and D for design criteria and guidance.

d. An access way, path, or sidewalk (referred to as "path" henceforth) 10 feet or less in width. When the path is greater than 3 feet in width, the square footage of the excess path width shall be mitigated at a 1:1 ratio by enhancing additional Vegetated Corridor to a good condition. The following conditions apply to all paths:

1) The path shall avoid the Vegetated Corridor where possible.
2) The path shall be located in the outermost 40% of the Vegetated Corridor boundary as it runs near or parallel to the Sensitive Area.
3) Paths shall be constructed so as to minimize disturbance to existing vegetation and maintain slope stability;.

e. Grading for the purpose of enhancing the Vegetated Corridor;

f. Grading for purposes other than enhancement may occur under the following conditions:

1) The vegetated corridor condition is degraded,

2) The proposed grading is consistent with native ground,
3) The proposed grading does not result in the removal of native vegetation, and
4) The graded slopes are no more than 4H:1V;

g. Other uses, not listed in a) through f) above, as approved by the District or its Designee through an alternatives analysis process as described in Section 3.02.6.

3) District review for Vegetated Corridors is not required for the following activities. Other regulating jurisdictions may require review and approval.

a. Activities excluded from the definition of development in Section 1.02.14.b;

b. Enhancement of the riparian corridors for water quality or quantity benefits, and aquatic habitat;

4) Mitigation for negative impacts to the Vegetated Corridor and/or enhancement of the Vegetated Corridor to a "good" condition, as defined in Table 3.2, is required for activities identified in Section 3.02.4.b.2) and Chapter 12. Replacement mitigation, if required shall be at a 1:1 ratio or greater. Refer to Appendix D: Landscape Requirements for revegetation requirements.

5) When impact to Sensitive Areas is permitted by DSL and COE:

a. The Vegetated Corridor impact area shall be calculated based on the site conditions as they exist prior to the proposed impact and mitigated at a minimum 1:1 ratio either on site or in association with the required DSL / COE mitigation.

b. If Payment to Provide is approved by DSL for Sensitive Area impact, then Applicant shall provide a 1:1 replacement of the Vegetated Corridor as mitigation for impacted area or apply for Vegetated Corridor Payment to Provide. Applicant may pay a Vegetated Corridor Payment to Provide to the District, per the District's Rates and Charges Ordinance. The Payment will be assigned to an enhancement project within the subwatershed in which the impact occurs.

6) Wetlands may not be filled in order to create, expand, or eliminate a Vegetated Corridor.

3.02.5 General Requirements for Sensitive Areas and Vegetated Corridors

a. Prior to any site clearing, grading or construction, the Applicant shall survey, stake, and demarcate with standard orange construction fencing or equivalent the outer boundary of the combined Sensitive Area and Vegetated Corridor per approved plan. During construction the outer boundary of the combined Sensitive Area and Vegetated Corridor shall remain fenced and undisturbed except as allowed in Section 3.02.4.b and per approved plans.

b. For any development which creates multiple parcels or lots intended for separate ownership, the Sensitive Area and Vegetated Corridor shall be contained in a separate tract. The first 50 feet of Vegetated Corridor on intermittent streams draining 10-100 acres shall be contained in a separate tract; the remainder may be placed in an easement. The District, City, or County may also require that the Sensitive Area and Vegetated Corridor be signed, fenced, or otherwise physically set apart from parcels that will be developed. Signage for Sensitive Areas shall meet the requirements of Standard Detail No. 275. Signs may also be available for purchase from the District.

c. The District or City/County may require an easement over the Sensitive Area and Vegetated Corridor for surface and storm water management in order to prevent the owner of the Sensitive Area and Vegetated Corridor from carrying out activities and uses inconsistent with the purpose of the corridor and any easements therein.

d. The Applicant shall protect and enhance the Sensitive Area and Vegetated Corridor in accordance with the requirements listed in Table 3.2 and Appendix D: Landscape Requirements, per approved plans. For Vegetated Corridors 50 feet and greater in width, the Applicant shall enhance the first 50 feet closest to the Sensitive Area to meet or exceed “good” corridor condition as defined in Table 3.2. For Vegetated Corridors less than 50 feet wide, the Applicant shall enhance the entire corridor to meet or exceed “good” corridor condition as defined in Table 3.2.

e. The Applicant shall adequately protect drainage ditches that drain surface water systems or storm water infrastructure from erosion and, to the extent possible, integrate the appearance of such ditches into the Sensitive Area and Vegetated Corridor through the use of native vegetation and rock/wood placement.

3.02.6 Alternatives Analysis

a. The Applicant shall conduct an Alternatives Analysis if the proposed site plan can not meet the standards outlined in Section 3.02.4 and 3.02.5. In conducting the Alternatives Analysis:

1) The Applicant shall prepare the Submittal Requirements outlined in this section for the type of encroachment proposed;

2) The Applicant shall participate in one or more meetings with the District and City or County to negotiate the Vegetated Corridor encroachment and mitigation;

b. The District shall review the alternatives analysis pursuant to the Criteria for Acceptance as outlined in this section for the type of encroachment proposed; and

c. The District or its designee shall prepare a service provider letter documenting the results of the alternatives analysis and District's requirements necessary to comply with water quality protection.

d. Tier 1 Alternatives Analysis: For marginal or degraded Vegetated Corridors with encroachment up to 40% of the length by 30% of the width:

1) Submittal requirements

a. Natural Resource Assessment performed pursuant to Appendix C: Natural Resource Assessments and Section 3.02.2 of these rules.

b. Site Plan showing entire site with encroachment area and calculations of Vegetated Corridor encroachment and mitigation areas/plan.

c. Description of why the encroachment is needed.

2) Criteria for Acceptance

a. Encroachment area is mitigated by at least a 1:1 ratio on site.

b. Enhancement of the replacement area if not already in good condition, and either the remaining Vegetated Corridor on the project site or the first 50 feet of width closest to the resource, whichever is less, to a "good" corridor condition per Table 3.2 and Appendix D: Landscape Requirements.

c. District or its designee's Storm Water Connection Permit is likely to be issued based on proposed plans.

d. Location of development and site planning minimize incursion into the Vegetated Corridor; and

e. There is no practicable alternative to the location of the development that will not disturb the Sensitive Area or Vegetated Corridor.

c. Tier 2 Alternatives Analysis: For any good Vegetated Corridor encroachment or marginal/degraded Vegetated Corridor with encroachment greater than 40% of the length by 30% of the width and for activities listed in Section 3.02.4.b.2) which are proposed to occur within the Water Quality Sensitive Area.

1) Submittal requirements

a. Natural Resource Assessment performed pursuant to Appendix C: Natural Resource Assessments and Section 3.02.2 of these rules.

b. Site Plan showing entire site with encroachment area and calculations of water quality Sensitive Area and/or Vegetated Corridor encroachment and mitigation areas.

c. Description of why the encroachment is needed; and

d. Functional Analysis Report; see Appendix C 4.2.f.2

2) Criteria for Acceptance

a. Encroachment area is mitigated by a 1:1 ratio or greater and is located either on-site or off-site along the same stream or its watershed;

b. The mitigation protects the functions and values of the Sensitive Area and Vegetated Corridor;

c. Enhancement of the replacement area if not already in good condition, and either the remaining Vegetated Corridor on the project site or the first 50 feet of width closest to the resource, whichever is less, to a "good" corridor condition per Table 3.2 and Appendix D: Landscape Requirements;

d. A District or its designee's Storm Water Connection Permit is likely to be issued based on proposed plans;

e. Location and site planning minimizes encroachment into the Vegetated Corridor;

f. There is no practicable alternative to the requested development which will not disturb the Sensitive Area or Vegetated Corridor;

g. There are public benefits of the encroachments; and

h. If the application of these Vegetated Corridor regulations results in a lot being unbuildable the Vegetated Corridor shall be reduced to assure the lot will be buildable while still providing for the maximum Vegetated Corridor to the greatest extent practicable.

f. Tier 3 Alternatives Analysis: For Vegetated Corridors with pre-existing encroachment (Redevelopment as defined in Section 1.02.46):

1) Submittal requirements

a. Natural Resource Assessment performed pursuant to Appendix C: Natural Resource Assessments and Section 3.02.2 of these rules.

b. Site Plan showing entire site with encroachment area (including existing and proposed areas) and calculations of Vegetated Corridor encroachment and mitigation areas/plan if applicable.

c. Description of why the encroachment is needed under proposed redevelopment plan.

2) Criteria for Acceptance

a. Encroachment area is mitigated by at least a 1:1 ratio on site or off-site, or a Payment to Provide for Vegetated Corridor mitigation is applied.

b. Enhancement of the remaining Vegetated Corridor on the project site or the first 50 feet of width closest to the resource, whichever is less, to a "good" corridor condition per Table 3.2 and Appendix D: Landscape Requirements.

c. District or its designee's Storm Water Connection Permit is likely to be issued based on proposed plans.

d. Location of the redevelopment and site planning minimize incursion into the Vegetated Corridor; and

e. There is no practicable alternative to the location of the redevelopment that will not disturb the Sensitive Area or Vegetated Corridor.

3.02.7 Tables and Figures

Table 3.1 Vegetated Corridor Widths

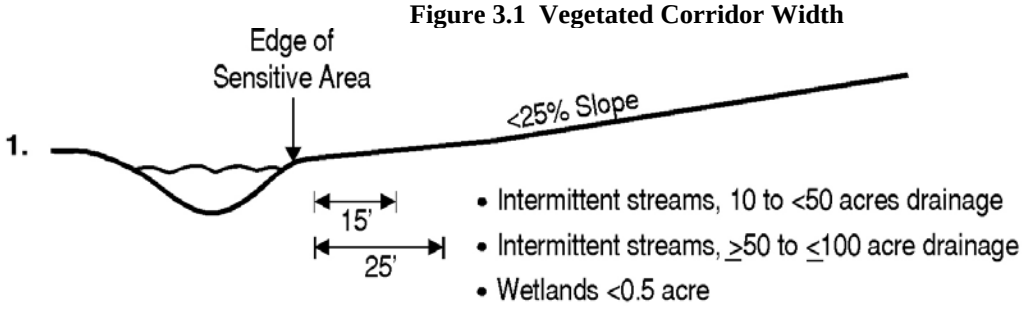
Sensitive Area Definition*	Land Slope Perpendicular to Sensitive Area	Width of Vegetated Corridor per Side
Figure 3.1 - Graphic 1		
• Streams with intermittent flow draining:		
• 10 to <50 acres	< 25%	15 feet
• ≥50 to 100 acres		25 feet
• Existing or created wetlands < 0.5 acre	<25%	25 feet
Figure 3.1 - Graphic 2		
• Existing or created wetlands ≥ 0.5 acre • Streams with perennial flow • Springs with perennial flow • Streams with intermittent flow draining >100 acres • Natural lakes, ponds, and in-stream impoundments	<25%	50 feet
Figure 3.1 - Graphic 3		
• Tualatin River	<25%	125 feet
Figure 3.1 - Graphic 4		
• Springs with intermittent flow	≥ 25%	15 feet
• Existing or created wetlands • Tualatin River • Streams with perennial flow • Streams with intermittent flow draining >100 acres • Springs with perennial flow • Natural lakes, ponds, and in-stream impoundments	≥25%	Variable from 50-200 ft**
Figure 3.1 - Graphic 5		
• Streams with intermittent flow draining 10-100 acres	≥25%	Variable from 50-200 ft***
Figure 3.1 – Graphic 6		
• Redevelopment sites adjacent to Water Quality Sensitive Areas other than the Tualatin River	<25%	25 feet
• Redevelopment sites adjacent to the Tualatin River	<25%	50 feet

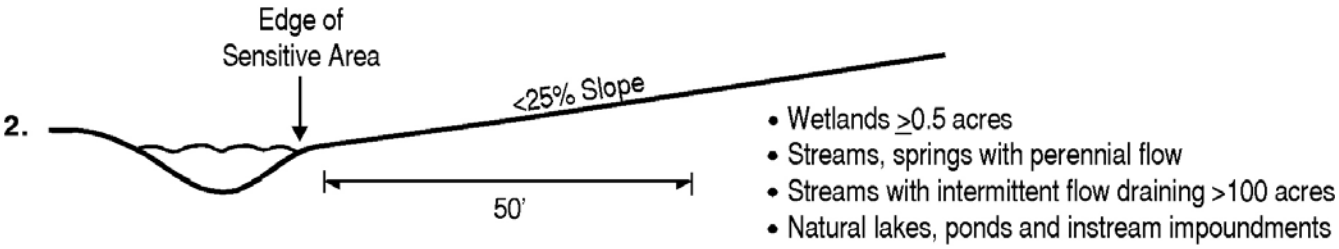
***** See Chapter 1: Definitions for Sensitive Area, Intermittent and Perennial Flow

** Measured in 25-foot increments from the edge of the Sensitive Area to the break in slope (i.e. <25%). Add 35 feet past the break in slope to determine the Vegetated Corridor width, not to exceed 200 feet. For land divisions, the entire Vegetated Corridor must be contained in a tract.

*** Measured in 25-foot increments from the edge of the Sensitive Area to the break in slope (i.e. <25%). Add 35 feet past the break in slope to determine the Vegetated Corridor width, not to exceed 200 feet. For land divisions, the first 50 feet closest to Sensitive Area must be placed in a tract; remaining area may be contained in easement.

Figure 3.1 Vegetated Corridor Width





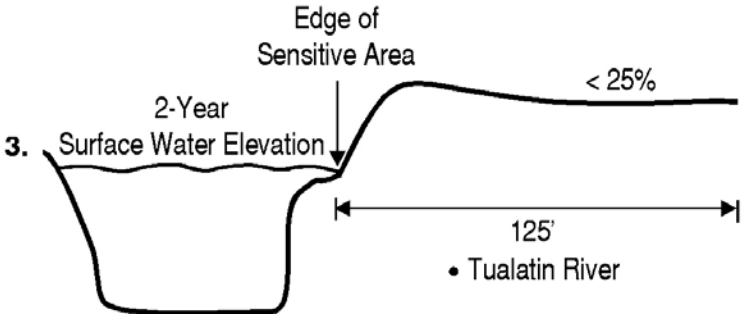
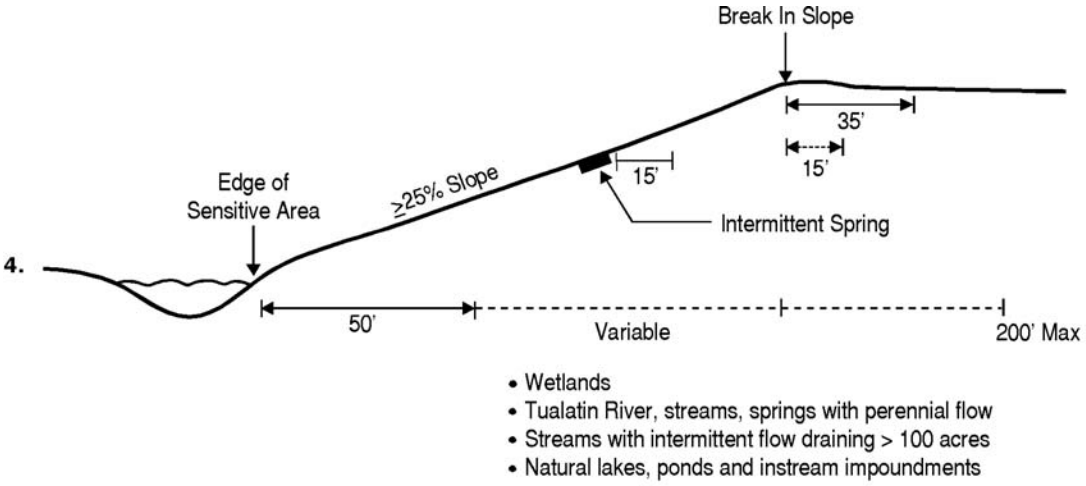
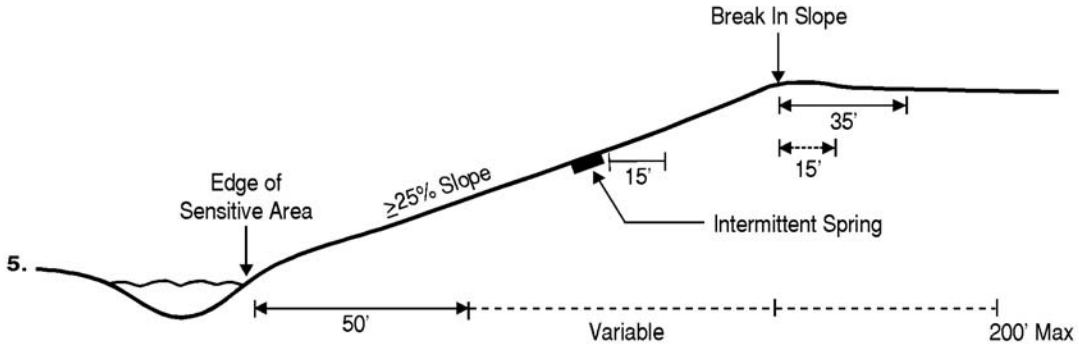


Figure 3.1 (continued)

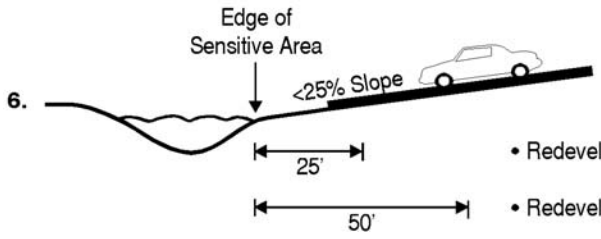


- Wetlands
- Tualatin River, streams, springs with perennial flow
- Streams with intermittent flow draining > 100 acres
- Natural lakes, ponds and instream impoundments



- Streams with intermittent flow draining 10 to 100 acres.

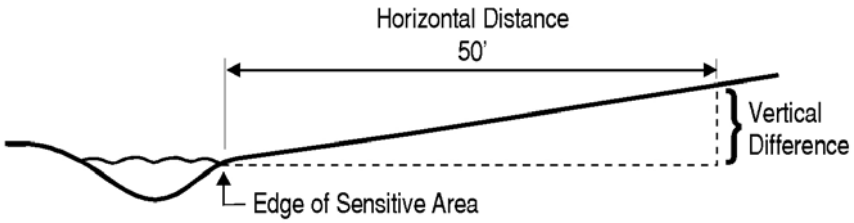
  First 50' in tract and remaining area in easement (easement limits tree/vegetation removal, no staging, grading, stockpiling)



- Redevelopment sites on streams, springs, wetlands, lakes, ponds
- Redevelopment sites on Tualatin River

Figure 3.2 Vegetated Corridor Measurement Methodology

1) Measure 50 feet horizontally from the Edge of the Sensitive Area (see Table 3.1).



2) Determine the slope
(Vertical difference/Horizontal distance) * 100 = percent slope

3) If slope is < 25%, apply the vegetated corridor per Table 3.1

(a) If stream or spring is intermittent, measure the drainage area from the upstream drainage point of the development determine appropriate width application. The width of the Vegetated Corridor may widen as it proceeds downstream, if the drainage acreage increases past the various acreage cut-off points outlined in Table 3.1.

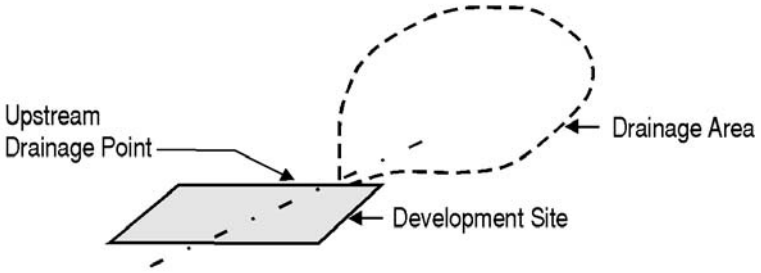
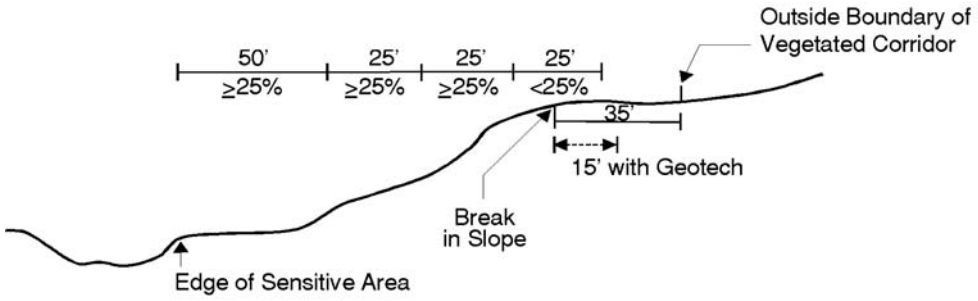


Figure 3.2 Vegetated Corridor Measurement Methodology (cont'd)

4) If the slope is > 25%, measure another 25 feet horizontally and perpendicular to the starting point up the slope until *either*:

   (a) A slope is encountered that is less than 25%. In this case, determine the break in slope and add an additional 35 feet to mark the outside boundary of the Vegetated Corridor; *or*



   (b) 200 feet is reached (all slope measurements >25%).

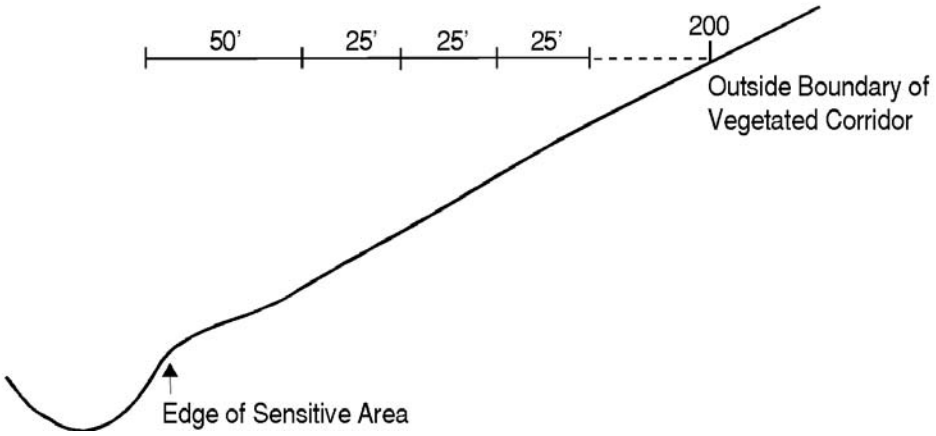


Table 3.2 Vegetated Corridor Standards

Vegetated Corridor Condition Definition[1]	Requirements of Vegetated Corridor Protection, Enhancement, and/or Mitigation
Good Corridor Condition • Combination of native trees, shrubs, and groundcover covering greater than 80% of the area and greater than 50% tree canopy exists (areal measure)	• Provide certification, per Appendix C: Natural Resource Assessments, to District or City/County that the vegetated corridor meets condition criteria. • Remove any invasive non-native species[2] within the corridor by hand and revegetate cleared area using low impact methods.[3] • If impact is to occur, provide District or City/County with a native plant revegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore condition. See Appendix D: Landscape Requirements. • Revegetate impacted area per approved plan to re-establish "good" corridor conditions
Marginal Corridor Condition • Combination of native trees, shrubs, and groundcover covering 50%-80% of the area and 26-50% tree canopy exists (areal measure) (Enhancement up to "good" corridor condition required regardless of planned impact)	• Provide certification, per Appendix C: Natural Resource Assessments, to District or City/County that the vegetated corridor meets condition criteria. • Remove any invasive non-native species within the corridor by hand or mechanically with small equipment, to minimize damage to existing native vegetation.[2] • Provide District or City/County with a native plant revegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore to a good corridor condition. See Appendix D: Landscape Requirements. • Vegetate corridor to establish "good" corridor conditions
Degraded Corridor Condition • Combination of native trees, shrubs, and groundcover covering is less than 50% of the area and less than 25% tree canopy exists (areal measure) (Enhancement up to "good" corridor condition required regardless of planned impact)	• Provide certification, per Appendix C: Natural Resource Assessments, to District or City/County that the vegetated corridor meets condition criteria. • Remove any invasive non-native species within the corridor by hand or mechanically.[2] • Provide District or City/County with a native plant revegetation plan appropriate to the site conditions developed by an ecologist/biologist or landscape architect to restore to a good corridor condition. See Appendix D: Landscape Requirements. • Vegetate Corridor to establish "good" corridor conditions

[1] When a single plant community type contains multiple condition characteristics, the higher quality condition shall prevail

[2] See Appendix C for plant lists and references.

[3] Refer to Integrated Vegetation Management Guidelines for appropriate methodology

Figure 3.3 Vegetated Corridor Averaging Example

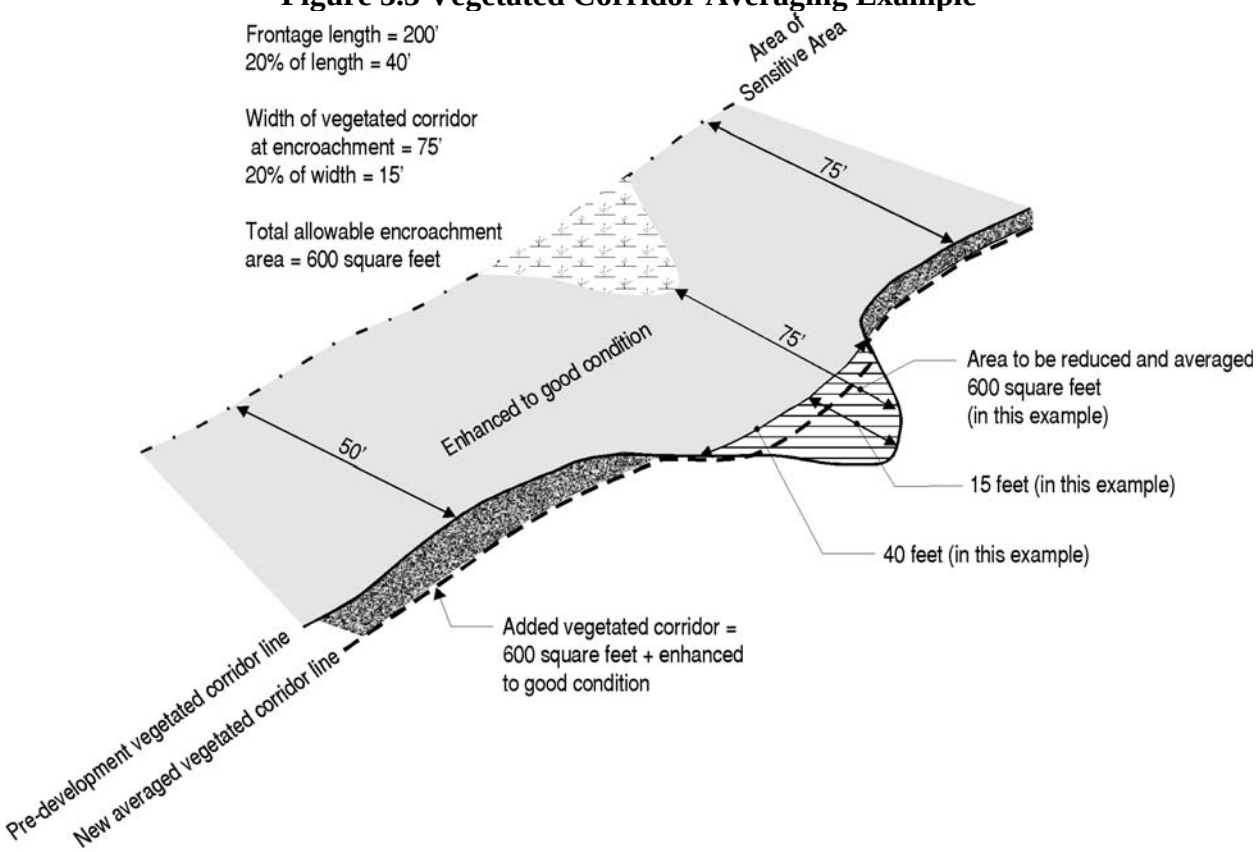
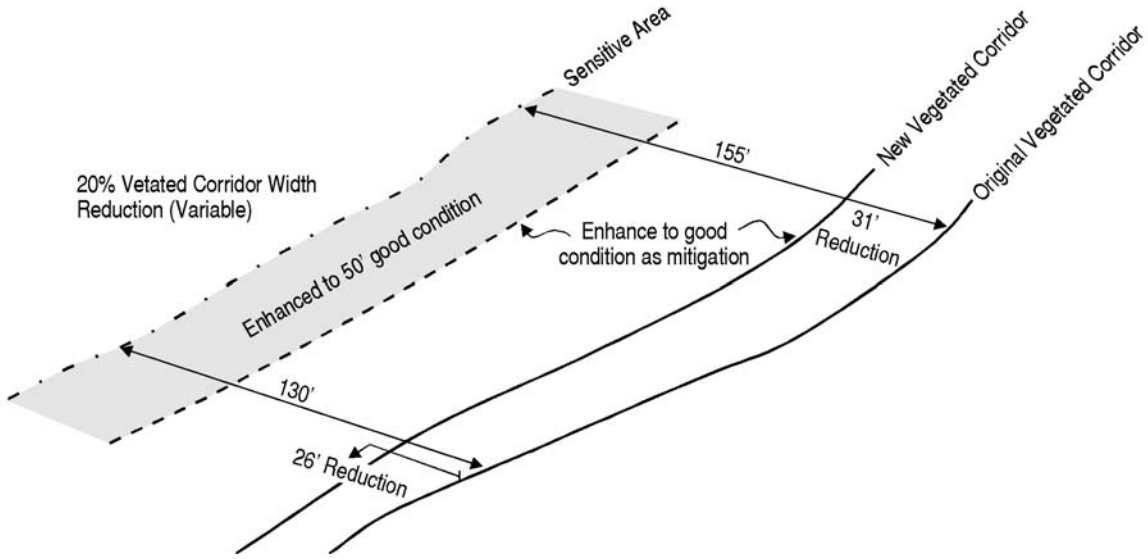


Figure 3.4 Vegetated Corridor Reduction Example



3.02.8 Enforcement

Failure to comply with any provision of Section 3.02 or with any term of a Storm Water Connection Permit shall be deemed a violation of this ordinance and subject to enforcement action pursuant to applicable District and City Ordinance and Resolutions and Orders, including all implementing rules and regulations.

3.03 Storm Water System: Engineering

3.03.1 General Provisions

All stormwater system elements (including, but not limited to conveyance systems, water quality facilities, water quantity facilities) shall be designed and constructed in accordance with all applicable rules and regulations of the District, and any District interpretations thereof including those set out in the Appendices and applicable technical guidance manuals, and with all applicable federal, state and local statues and rules.

3.03.2 Extension of Public Storm Sewer Systems

Public storm sewer systems shall be extended to the most distant upstream parcel boundary(s) to accommodate current and future storm flows entering the property, unless otherwise approved by the District or City. Except as otherwise provided, the extension of the public stormwater systems to serve any parcel or tract of land shall be done by and at the expense of the Property Owner or applicant. The District or City may require that a storm pipeline that serves or may serve more than one property be a public system.

3.03.3 Surveying

The Owner's Engineer or Surveyor shall be responsible for establishing the location of the storm sewer system by means of construction stakes offset along the center lines prior to commencement of construction.

3.03.4 Railroad Crossings

Crossing of railroad rights-of-way shall be done in a manner that conforms to the requirements of the railroad having jurisdiction. If any bonds and/or certificates of insurance protection are required, they shall be furnished by the Contractor or Owner to the railroad company concerned naming the District or City as an additional insured.

Actual permits or easements for such crossings shall be obtained by the Owner and all the terms for such permits or easements shall be met by the Owner and

Appendix D

NJDEP Model Stormwater Ordinance

New Jersey Stormwater Best Management Practices Manual

February 2004

http://www.state.nj.us/dep/watershedmgt/bmpmanualfeb2004.htm

A P P E N D I X D

DRAFT Model Stormwater Control Ordinance for Municipalities

Important note: *This sample ordinance is provided to assist municipalities in the incorporation of design and performance standards into municipal plans. It is provided for information purposes only. It is important that current legislation is carefully reviewed before any portion of this draft ordinace is adopted.*

Section 1: Purpose

A. Policy Statement

Flood control, groundwater recharge, and pollutant reduction through nonstructural or low impact techniques shall be explored before relying on structural BMPs. Structural BMPs should be integrated with nonstructural stormwater management measures and proper maintenance plans. Nonstructural measures include both environmentally sensitive site design and source controls that prevent pollutants from being placed on the site. Source control plans should be developed based upon physical site conditions and the origin, nature, and the anticipated loading of potential pollutants. Multiple stormwater management BMPs may be necessary to achieve the established performance standards for water quality, quantity, and groundwater recharge.

Note: Municipalities are encouraged to develop and adopt regional stormwater management plans and implement ordinances for specific drainage area performance standards that address local stormwater management and environmental characteristics.

B. Purpose

It is the purpose of this ordinance to establish minimum stormwater management requirements and controls for major development.

C. Applicability

This ordinance shall be applicable to any site plan or subdivision that requires preliminary or final site plan review.

D. Compatibility with Other Permit and Ordinance Requirements

Development approvals issued pursuant to this ordinance are to be considered an integral part of development approvals under the subdivision and site plan review process and do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare. This ordinance is not intended to interfere with, abrogate, or annul any other ordinances, rule or regulation, statute, or other provision of law except that, where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, the more restrictive provisions or higher standards shall control.

Section 2: General Standards

A. Design and Performance Standards for Stormwater Management Measures

1. Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards in this section. To the maximum extent feasible, these standards shall be met by incorporating nonstructural stormwater management strategies into the design. If these strategies alone are not sufficient to meet these standards, structural stormwater management measures necessary to meet these standards shall be incorporated into the design.

2. The standards in this ordinance apply only to new major development and are intended to minimize the impact of stormwater runoff on water quality and water quantity in receiving water bodies and maintain groundwater recharge. The standards do not apply to new major development to the extent that alternative design and performance standards are applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules. Such alternative standards shall provide at least as much protection from stormwater-related loss of groundwater recharge, stormwater quantity and water quality impacts of major development projects as would be provided under the standards in this subchapter.

3. For site improvements regulated under the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21, the RSIS shall apply in addition to this section except to the extent the RSIS are superseded by this section or alternative standards applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules.

Section 3: Stormwater Management Requirements for Major Development

A. The development shall incorporate a maintenance plan for the stormwater management measures incorporated into the design of a major development.

B. Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department' Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly Helonias bullata (swamp pink) and/or Clemmys muhlnebergi (bog turtle).

C. The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at Sections 3.F and 3.G:

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

D. A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at Sections 3.F and 3.G may be obtained for the enlargement of an existing public roadway or railroad; or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates through an alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of Sections 3.F and 3.G to the maximum extent practicable;

3. The applicant demonstrates that, in order to meet the requirements at Sections 3.F and 3.G, existing structures currently in use, such as homes and buildings would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under D.3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate for requirements of Sections 3.F and 3.G that were not achievable on-site.

E. Nonstructural Stormwater Management Strategies

1. To the maximum extent practicable, the standards in 3.F and 3.G shall be met by incorporating nonstructural stormwater management strategies at 3.E into the design. The applicant shall identify the nonstructural measures incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management measures identified in 3.E.2 below into the design of a particular project, the applicant shall identify the strategy considered and provide a basis for the contention.

2. Nonstructural stormwater management measures incorporated into site design shall:

   a. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

   b. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

   c. Maximize the protection of natural drainage features and vegetation;

d. Minimize the decrease in the "time of concentration" from pre-construction to post construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed;

e. Minimize land disturbance including clearing and grading;

f. Minimize soil compaction;

g. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

h. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas;

i. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. These source controls include, but are not limited to:

(1) Site design features that help to prevent accumulation of trash and debris in drainage systems;

(2) Site design features that help to prevent discharge of trash and debris from drainage systems;

(3) Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

(4) When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

3. Any land area used as a nonstructural stormwater management measure to meet the performance standards in Sections 3.F and 3.G shall be dedicated to a government agency, subjected to a conservation restriction filed with the appropriate County Clerk's office, or subject to an approved equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.

4. Guidance for nonstructural stormwater management measures is available in the New Jersey Stormwater Best Management Practices Manual. The manual is available on the Department of Environmental Protections's stormwater web page at http://www.njstormwater.org.

F. Erosion Control, Groundwater Recharge and Runoff Quantity Standards

1. This section contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

a. The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

b. The minimum design and performance standards for groundwater recharge are as follows:

(1) The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at Section 4, either:

(a) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100% of the average annual pre-construction groundwater recharge volume for the site; or

(b) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated.

(2) This groundwater recharge requirement does not apply to projects within the "urban redevelopment" area, or projects subject to (3) below.

(3) The following types of stormwater shall not be recharged:

(a) Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than 'reportable quantities' as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

(b) Industrial stormwater exposed to "source material". "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

(4) The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

c. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at Section 4, complete one of the following:

(1) Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 2, 10, and 100 year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

(2) Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2, 10, and 100 year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis

shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

(3) Design stormwater management measures so that the post-construction peak runoff rates for the 2, 10 and 100 year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The percentages shall not be applied to post-construction stormwater runoff into tidal flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge; or

(4) In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with 1, 2 and 3 above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

2. Any application for a new agricultural development that meets the definition of major development at Section 12 shall be submitted to the appropriate Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For the purposes of this section, "agricultural development" means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacturing of agriculturally related products.

G. Stormwater Runoff Quality Standards

1. Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff by 80 percent of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional 1/4 acre of impervious surface is being proposed on a development site. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollution Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 1. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

Table 1: Water Quality Design Storm Distribution			
Time (Minutes)	**Cumulative Rainfall (Inches)**	**Time (Minutes)**	**Cumulative Rainfall (Inches)**
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

2. For purposes of TSS reduction calculations, Table 2 below presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in Section 6, or found on the Department's website at www.njstormwater.org. The BMP Manual and other sources of technical guidance are listed in Section 6. TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the review agency. A copy of any approved alternative rate or method of calculating the removal rate shall be provided to the Department at the following address: Division of Watershed Management, New Jersey Department of Environmental Protection, PO Box 418 Trenton, New Jersey, 08625-0418.

3. If more than one BMP in series is necessary to achieve the required 80% TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

   $R = A + B - (AXB)/100$

   Where

   R = total TSS percent load removal from application of both BMPs, and

   A = the TSS percent removal rate applicable to the first BMP

   B = the TSS percent removal rate applicable to the second BMP

Table 2: TSS Removal Rates for BMPs	
Best Management Practice	**TSS % Removal Rate**
Bioretention Systems	90
Constructed Stormwater Wetland	90
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See Section 5.C
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

4. If there is more than one onsite drainage area, the 80% TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

5. Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards in Sections 3.F and 3.G.

6. Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in Section 6.

7. In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

8. Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC14 drainage. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

   a. The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

      (1) A 300-foot special water resource protection area shall be provided on each side of the waterway, measured perpendicular to the waterway from the top of the bank outwards or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided. (2) Encroachment within

the designated special water resource protection area under Subsection (1) above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment shall only be allowed where applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable. In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the top of bank of the waterway or centerline of the waterway where the bank is undefined. All encroachments proposed under this subparagraph shall be subject to review and approval by the Department.

b. All stormwater shall be discharged outside of and flow through the special water resource protection area and shall comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey", established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq.

c. If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey", established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., then the stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

   (1) Stabilization measures shall not be placed within 150 feet of the Category One waterway;

   (2) Stormwater associated with discharges allowed by this section shall achieve a 95% TSS post-construction removal rate;

   (3) Temperature shall be addressed to ensure no impact on receiving waterway;

   (4) The encroachment shall onlybe allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;

   (5) A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and

   (6) All encroachments proposed under this section shall be subject to review and approval by the Department.

d. A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan, or by a municipality through an adopted municipal stormwater management plan. If a stream corridor protection plan for a waterway subject to Section 2.G(8) has been approved by the Department of Environmental Protection, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway. A stream corridor protection plan for a waterway subject to G.8 shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined in G.8.a.(1) above. In no case shall a stream corridor protection plan allow the reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

e. This subsection does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before [effective date of the Stormwater Management Rules], provided that the construction begins on or before [five years from effective date of the Stormwater Management Rules].

Section 4: Calculation of Stormwater Runoff and Groundwater Recharge

A. Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

   a. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in the NRCS National Engineering Handbook Section 4 – Hydrology and Technical Release 55 – Urban Hydrology for Small Watersheds; or

   b. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction condition of a site or portion thereof is a wooded land use with good hydrologic condition. The term "runoff coefficient" applies to both the NRCS methodology at Section 4.A.1.a and the Rational and Modified Rational Methods at Section 4.A.1.b. A runoff coefficient or a groundwater recharge land cover for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of application. If more than one land cover have existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good hydrologic condition and conservation treatment (if the land use type is cultivation).

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from unconnected impervious cover, urban impervious area modifications as described in the NRCS Technical Release-55,Urban Hydrology for Small Watersheds and other methods may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

B. Groundwater recharge may be calculated in accordance with the following:

1. The New Jersey Geological Survey Geological Survey Report GSR-32 A Method for Evaluating Ground-Water Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at http://www.state.nj.us/dep/njgs/; or at New Jersey Geological Survey, 29 Arctic Parkway, P.O. Box 427 Trenton, New Jersey 08625-0427; (609) 984-6587.

Section 5: Standards for Structural Stormwater Management Measures

A. Standards for structural stormwater management measures are as follows:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example, environmentally critical areas, wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one-inch (1") spacing between the bars to the elevation of the water quality design storm. For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than one-third (1/3) the width of the diameter of the orifice or one-third (1/3) the width of the weir, with a minimum spacing between bars of one-inch and a maximum spacing between bars of six inches. In addition, the design of trash racks must comply with the requirements of Section 7.D.

3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement.

4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half inches in diameter.

5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at Section 7.

B. Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, groundwater recharge and water quality design and performance standards established by this subchapter.

C. Manufactured treatment devices may be used to meet the requirements of this subchapter, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

Section 6: Sources for Technical Guidance

A. Technical guidance for stormwater management measures can be found in the documents listed at 1 and 2 below, which are available from Maps and Publications, Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, as amended. Information is provided on stormwater management measures such as: bioretention systems, constructed stormwater wetlands, dry wells, extended detention basins, infiltration structures, manufactured treatment devices, pervious paving, sand filters, vegetative filter strips, and wet ponds.

2. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

B. Additional technical guidance for stormwater management measures can be obtained from the following:

1. The "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625; (609) 292-5540;

2. The Rutgers Cooperative Extension Service, 732-932-9306; and

3. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey, 08625, (609) 292-5540.

Section 7: Safety Standards for Stormwater Management Basins

A. This section sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This subchapter applies to any new stormwater management basin.

B. The provisions of this section are not intended to preempt more stringent municipal or county safety requirements for new or existing stormwater management basins.

Note: Municipal and county stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management basins to be retrofitted to meet one or more of the safety standards in Section 7.C.1, 7.C.2, and 7.C.3 for trash racks, overflow grates, and escape provisions at outlet structures.

C. Requirements for Trash Racks, Overflow Grates and Escape Provisions

1. A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

   a. The trash rack shall have parallel bars, with no greater than six inch spacing between the bars.

   b. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure.

   c. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

   d. The trash rack shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs/ft sq.

2. An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, such grate shall meet the following requirements:

a. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance.

b. The overflow grate spacing shall be no less than two inches across the smallest dimension.

c. The overflow grate shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs/ft sq.

3. For purposes of this subsection, escape provisions means the permanent installation of ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. Stormwater management basins shall include escape provisions as follows:

a. If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. With the prior approval of the reviewing agency identified in Section 7.D a free-standing outlet structure may be exempted from this requirement.

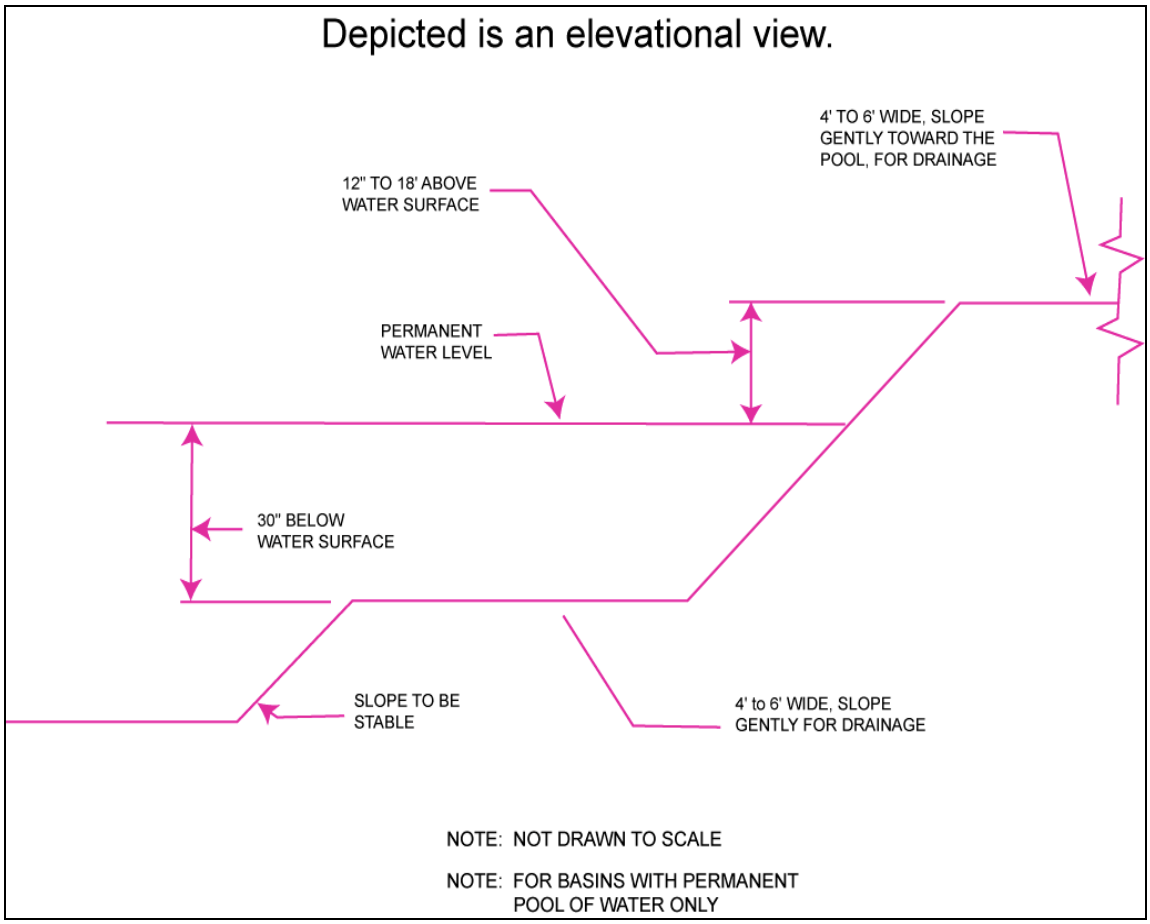
b. Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half feet. Such safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one-half feet below the permanent water surface, and the second step shall be located one to one and one-half feet above the permanent water surface. See Section 7.E for an illustration of safety ledges in a stormwater management basin.

c. In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than 3 horizontal to 1 vertical.

D. Variance or Exemption from Safety Standards

1. A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, county or Department) that the variance or exemption will not constitute a threat to public safety.

E. Illustration of Safety Ledges in a New Stormwater Management Basin



Section 8: Requirements for a Site Development Stormwater Plan

A. Submission of Site Development Stormwater Plan

1. Whenever an applicant seeks municipal approval of a development subject to this ordinance, the applicant shall submit all of the required components of the Checklist for the Site Development Stormwater Plan at 8.C below as part of the submission of the applicant's application for subdivision or site plan approval.

2. The applicant shall demonstrate that the project meets the standards set forth in this ordinance.

3. The applicant shall submit [specify number] copies of the materials listed in the checklist for site development stormwater plans in accordance with Section 8.C of this ordinance.

B. Site Development Stormwater Plan Approval

The applicant's Site Development project shall be reviewed as a part of the subdivision or site plan review process by the municipal board or official from which municipal approval is sought. That municipal board or official shall consult the engineer retained by the Planning and/or Zoning Board (as appropriate) to determine if all the checklist requirements have been satisfied and to determine if the project meets the standards set forth in this ordinance.

C. Checklist Requirements

The following information shall be required:

1. Topographic Base Map

The reviewing engineer may require upstream tributary drainage system information as necessary. It is recommended that the topographic base map of the site be submitted which extends a minimum of 200 feet beyond the limits of the proposed development, at a scale of 1"=200' or greater, showing 2-foot contour intervals. The map as appropriate may indicate the following: existing surface water drainage, shorelines, steep slopes, soils, erodible soils, perennial or intermittent streams that drain into or upstream of the Category 1 waters, wetlands and flood plains along with their appropriate buffer strips, marshlands and other wetlands, pervious or vegetative surfaces, existing man-made structures, roads, bearing and distances of property lines, and significant natural and manmade features not otherwise shown.

2. Environmental Site Analysis

A written and graphic description of the natural and man-made features of the site and its environs. This description should include a discussion of soil conditions, slopes, wetlands, waterways and vegetation on the site. Particular attention should be given to unique, unusual, or environmentally sensitive features and to those that provide particular opportunities or constraints for development.

3. Project Description and Site Plan(s)

A map (or maps) at the scale of the topographical base map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural facilities for stormwater management and sediment control, and other permanent structures. The map(s) shall also clearly show areas where alterations occur in the natural terrain and cover, including lawns and other landscaping, and seasonal high ground water elevations. A written description of the site plan and justification of proposed changes in natural conditions may also be provided.

4. Land Use Planning and Source Control Plan

This plan shall provide a demonstration of how the goals and standards of Sections 2through 5 are being met. The focus of this plan shall be to describe how the site is being developed to meet the objective of controlling groundwater recharge, stormwater quality and stormwater quantity problems at the source by land management and source controls whenever possible.

5. Stormwater Management Facilities Map

The following information, illustrated on a map of the same scale as the topographic base map, shall be included:

a. Total area to be paved or built upon, proposed surface contours, land area to be occupied by the stormwater management facilities and the type of vegetation thereon, and details of the proposed plan to control and dispose of stormwater.

b. Details of all stormwater management facility designs, during and after construction, including discharge provisions, discharge capacity for each outlet at different levels of detention and emergency spillway provisions with maximum discharge capacity of each spillway.

6. Calculations

a. Comprehensive hydrologic and hydraulic design calculations for the pre-development and post-development conditions for the design storms specified in Section 3 of this ordinance.

b. When the proposed stormwater management control measures (e.g. infiltration basins) depends on the hydrologic properties of soils, then a soils report shall be submitted. The soils report shall be based on onsite boring logs or soil pit profiles. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soil types present at the location of the control measure.

7. Maintenance and Repair Plan

The design and planning of the stormwater management facility shall meet the maintenance requirements of Section 9.

8. Waiver from Submission Requirements

The municipal official or board reviewing an application under this ordinance may, in consultation with the municipal engineer, waive submission of any of the requirements in Sections 8.C.1 through 8.C.6 of this ordinance when it can be demonstrated that the information requested is impossible to obtain or it would create a hardship on the applicant to obtain and its absence will not materially affect the review process.

Section 9: Maintenance and Repair

A. Applicability

1. Projects subject to review as in Section 1.C of this ordinance shall comply with the requirements of Section 9.B and 9.C.

B. General Maintenance

1. The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

2. The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual. If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to

assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

3. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

4. If the person responsible for maintenance identified under Section 9.B.2 above is not a public agency, the maintenance plan and any future revisions based on Section 9.B.7 below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

5. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

6. The person responsible for maintenance identified under Section 9.B.2 above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

7. The person responsible for maintenance identified under Section 9.B.2 above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

8. The person responsible for maintenance identified under Section 9.B.2 above shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by Sections 9.B.6 and 9.B.7 above.

9. The requirements of Sections 9.B.3 and 9.B.4 do not apply to stormwater management facilities that are dedicated to and accepted by the municipality or another governmental agency.

   (Note: It may be appropriate to delete requirements in the maintenance and repair plan that are not applicable if the ordinance requires the facility to be dedicated to the municipality. If the municipality does not want to take this responsibility, the ordinance should require the posting of a two year maintenance guarantee in accordance with N.J.S.A. 40:55D-53. Guidelines for developing a maintenance and inspection program are provided in the New Jersey Stormwater Best Management Practices Manual and the NJDEP Ocean County Demonstration Study, Stormwater Management Facilities Maintenance Manual, dated June 1989 available from the NJDEP, Watershed Management Program.)

10. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need of maintenance, the municipality shall so notify the responsible person in writing. Upon receipt of that notice, the responsible person shall have fourteen (14) days to effect maintenance and repair of the facility in a manner that is approved by the municipal engineer or his designee. If the responsible person fails or refuses to perform such maintenance and repair, the municipality or County may immediately proceed to do so and shall bill the cost thereof to the responsible person.

B. Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

C. Penalties

Any responsible person who violates any portion or section of this ordinance shall be subject to the following penalties: [Municipality to specify].

Section 10: Effective Date

This ordinance shall take effect upon the approval by the county review agency , or sixty (60) days after submission to the county review agency if they fail to act.

(NOTE: This model ordinance does not include a section on fees. The Department expects that the review of development applications under this ordinance would be an integral part of the municipal review of subdivisions and site plans. As a result, the costs to municipalities of reviewing development applications under this ordinance can be defrayed by fees charged for review of subdivisions and site plans under N.J.S.A. 40:55D 8.b)

Section 11: Severability

If the provisions of any article, section, subsection, paragraph, subdivision, or clause of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgment shall not affect or invalidate the remainder of any article, section, subsection, paragraph, subdivision, or clause of this ordinance.

Section 12: Definitions

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"CAFRA Planning Map" means the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

"CAFRA Centers, Cores or Nodes" means those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

"Compaction" means the increase in soil bulk density.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"County review agency" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

A county planning agency; or

A county water resource association created under N.J.S.A 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

"Department" means the New Jersey Department of Environmental Protection.

"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"Design engineer" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

"Development" means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. In the case of development of agricultural lands, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act, N.J.S.A 4:1C-1 et seq.

"Drainage area" means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"Environmentally constrained area" means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"Environmentally critical areas" means an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitat of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"Empowerment Neighborhood" means a neighborhood designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A 55:19-69.

"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

"Infiltration" is the process by which water that seeps into the soil from precipitation.

"Major development" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation. Projects undertaken by any government agency which otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. are also considered "major development."

"Municipality" means any city, borough, town, township, or village.

“Node” means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

“Nutrient” means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

"Person" means any individual, corporation, company, partnership, firm, association, or political subdivision of this State and any state, interstate or federal agency.

“Pollutant” means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. “Pollutant” includes both hazardous and nonhazardous pollutants.

“Recharge” means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

“Sediment” means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

“Site” means the lot or lots upon which a major development is to occur or has occurred.

“Soil” means all unconsolidated mineral and organic material of any origin.

“State Development and Redevelopment Plan Metropolitan Planning Area (PA1)” means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the state’s future redevelopment and revitalization efforts.

“State Plan Policy Map” is defined as the geographic application of the State Development and Redevelopment Plan’s goals and statewide policies, and the official map of these goals and policies.

“Stormwater” means water resulting from precipitation (including rain and snow) that runs off the land’s surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities.

“Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

“Stormwater management basin” means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

“Stormwater management measure” means any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

“Tidal Flood Hazard Area” means a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

“Urban Coordinating Council Empowerment Neighborhood” means a neighborhood given priority access to state resources through the New Jersey Redevelopment Authority.

"Urban Enterprise Zones" means a zone designated by the New Jersey Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et. seq.

"Urban Redevelopment Area" is defined as previously developed portions of areas:

(1) Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;

(2) Designated as CAFRA Centers, Cores or Nodes,

(3) Designated as Urban Enterprise Zones; and

(4) Designated as Urban Coordinating Council Empowerment Neighborhoods.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Wetlands" or "wetland" means an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

Appendix E

Pequannock River Headwaters Survey

Pequannock River Thermal Mitigation, Monitoring and Assessment Project

Grant Identifier: RP04-003

Pequannock River Headwaters Survey

Prepared by Ross Kushner
Pequannock River Coalition
P.O. Box 392
Newfoundland, NJ 07435

Date: 01/02/04

Project Introduction:

Several segments of the Pequannock River have been listed as impaired for water temperatures in excess of criteria established in the New Jersey Surface Water Quality Standards at N.J.A.C 7:9B. The specific listing addressed by this project is identified on the NJDEP 2002 and 2004 Integrated Lists as "Pequannock River above Pacock".

In this region of the upper Pequannock watershed one factor suspected as contributing to elevated temperatures is the impoundment of flows and removal of shading tree canopy by beaver colonies along the river and river tributaries. Past flooding by beaver dams has altered extensive land areas from forest to meadows. However, due to the size and inaccessibility of this river segment the full extent of these factors was unknown. A map of this area is attached labeled "Project Area - Headwaters". This area is found on the following USGS quadrangles: "Hamburg", "Wawayanda", "Franklin", "Newfoundland". It should be noted that this river reach is not properly identified on the USGS WEBRIT map where Pacock Brook is erroneously marked as "Pequannock River".

The purpose of this project is to conduct a survey of this area to determine the extent and location of beaver dams, beaver ponds and tree removal as the groundwork for future restoration and mitigation efforts. Impacted sites were to be identified with maps, GPS coordinates, field notes and digital photos. The information produced will be provided to the NJDEP Division of Watershed Management, Division of Fish and Wildlife, and Division of Science, Research and Technology.

The survey was conducted by inspecting the river in its entirety throughout the full length of the project area.

General Description of Project Area

The Pequannock River has its source in the borough of Vernon in Sussex County. From there the river flows in a south-westerly direction to the confluence with Pacock Brook in the town of Hardyston in Sussex County, the terminus of the project area.

In general this area is largely undeveloped. Only a few small housing developments are in close proximity to the river. There is no significant agricultural activity. Most of the upper watershed is owned by the City of Newark as part of their watershed holdings. Rt. 515, a 2-lane county road, crosses this portion of the Pequannock at several points and is the only other major human landcover influence.

The topography in this area is varied. The river flows through hilly sections with higher gradient as well as gently sloped valley sections. Overall this area is heavily wooded with typical second-growth forest. In some locations there are pure stands of non-native conifers planted in the 1930's as part of Depression-era public works projects.

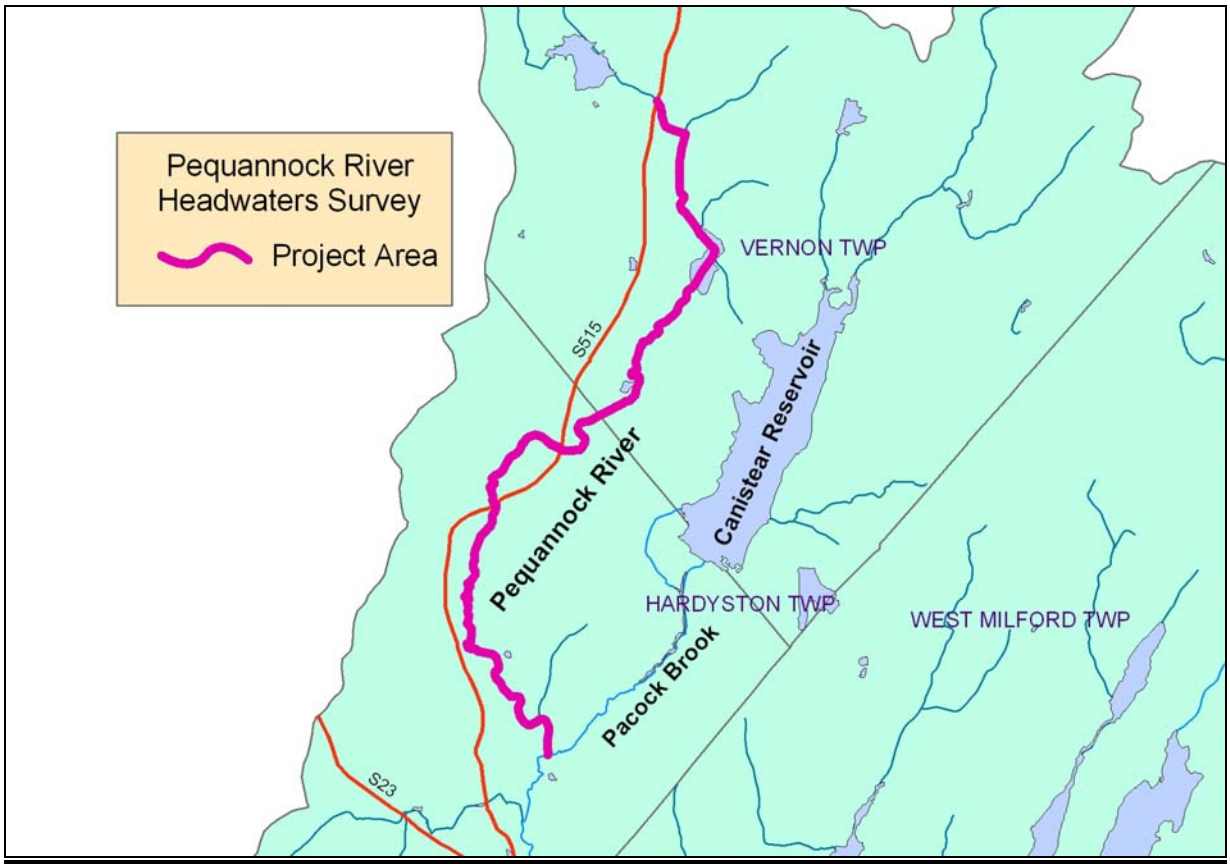


Figure 1 – Headwaters Survey Project Area

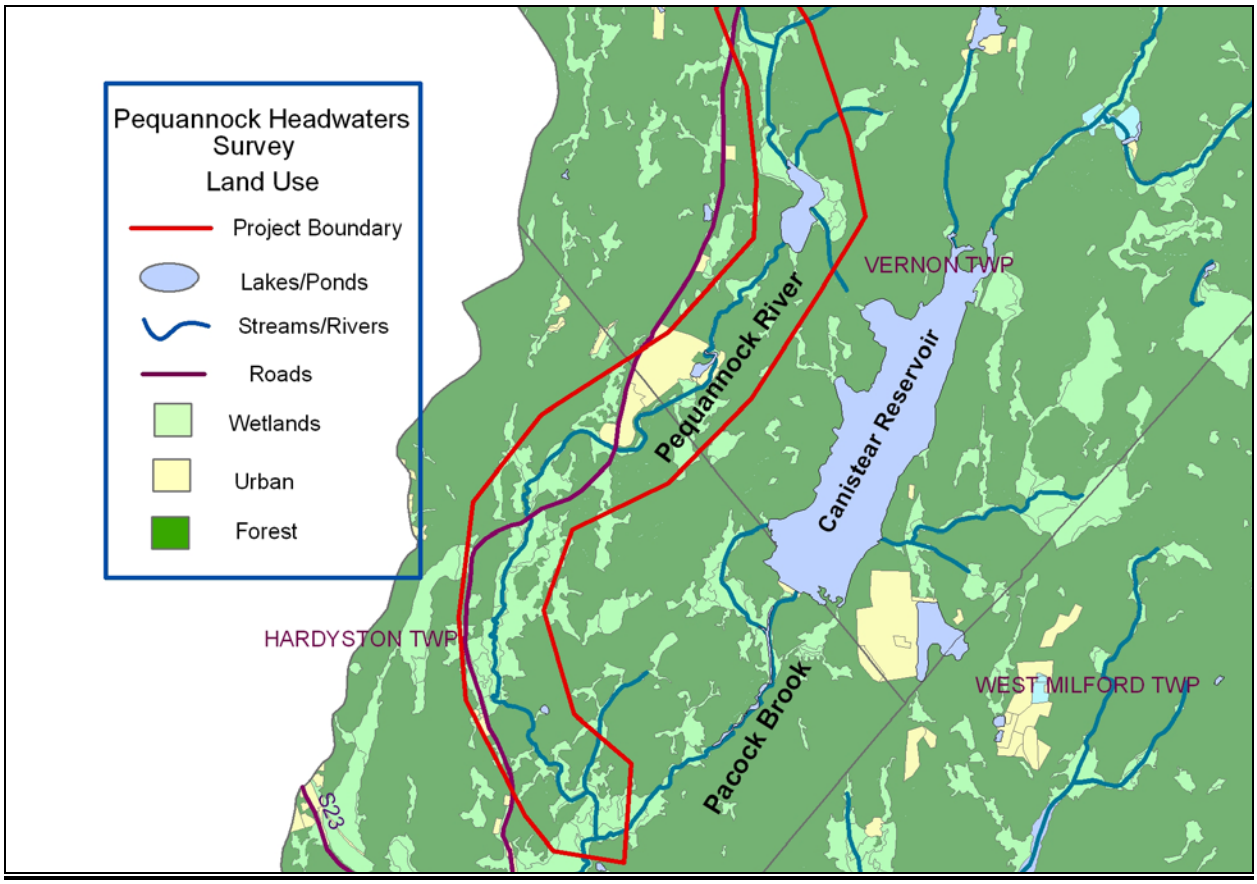


Figure 2 – Land Use in the Survey Area

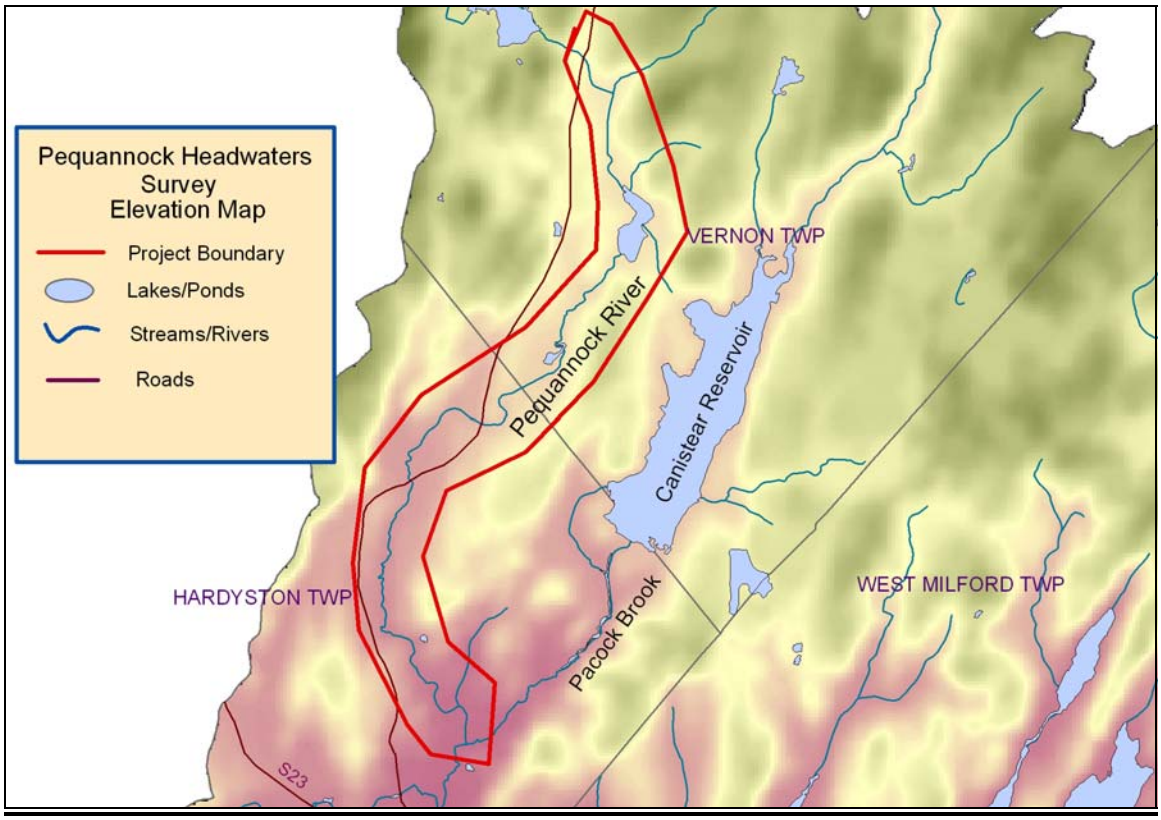


Figure 3 – Topography in the Survey Area

Report Introduction

As noted, the main purpose of this report is to identify locations in the project area where past and present beaver activity is impacting the Pequannock River. However, we have also chosen to list the general characteristics of each river section as a useful reference and to note other potential sources of degradation or sites where additional assessment may be needed.

This report breaks the river into separate reaches. Each of these reaches begins and ends at a significant feature or where characteristics of the river alter substantially. The reaches are contiguous in that the endpoint of one reach is the starting point of the next reach. Each significant feature and the start/end points of every reach are identified with GPS coordinates and described from field notes. The GPS coordinates are given in UTM readings (Universal Transverse Mercator, NAD 1983, Zone 18N).

It should be noted that the start/end points of river reaches on the GIS layers provided with this report may not agree precisely with GPS coordinates recorded in this report. This is due to several factors:

1) The course of a river may shift over time
2) Our GPS readings have a precision of +/- 60 meters.
3) The GIS layers depicting the river course may not be completely accurate

With this in mind we have chosen to adjust these start/end points slightly to agree with the river position on the GIS layers.

Reach 1

Reach 1 begins at the Rt. 515 bridge, coordinates 18542265E/4555160N, and ends at coordinates 18542300E/4555133N.

This reach is wooded and well shaded with a higher gradient. River substrate is large-medium cobble and gravel. There is a good pool/riffle ratio. See photos pqhw300, pqhw0305, pqhw0310.

There are no recommended improvements for this reach. This is a suitable site for a temperature monitor.

Reach 2

Reach 2 begins where the channel characteristics change substantially at coordinates 18542300E/4555133N and ends at coordinates 18542480E/4554590N.

The river enters a large brushy meadow, probably the remains of a beaver pond. The channel is overgrown with shrubs at the upper end of this reach. The river channel is narrow, deep and soft-bottomed. The lower end is bordered by mostly grass, and some phragmites. A beaver dam is still intact at lower end, creating a pool. The dam seems inactive. See photos pqhw0315, pqhw0320, pqhw0325, pqhw0330, pqhw0335, pqhw0340, pqhw0345, pqhw0350, pqhw0355, pqhw0360, pqhw0365.

There is a good opportunity for hand removal of the dam to expedite conversion of the meadow to woodland and accelerate flows. A temperature monitor below the dam site would show any elevation in temperature from the upstream meadow/dam.

Reach 3

Reach 3 begins at an old beaver dam, coordinates 18542480E/4554590N, and ends at coordinates 18542515E/4554428N.

In this short reach below the beaver dam there is a relatively good river channel. Trees and brush provide some shade and the river has a rocky substrate. There is one small debris dam in this reach. See photo pqhw0370.

The debris dam should be removed.

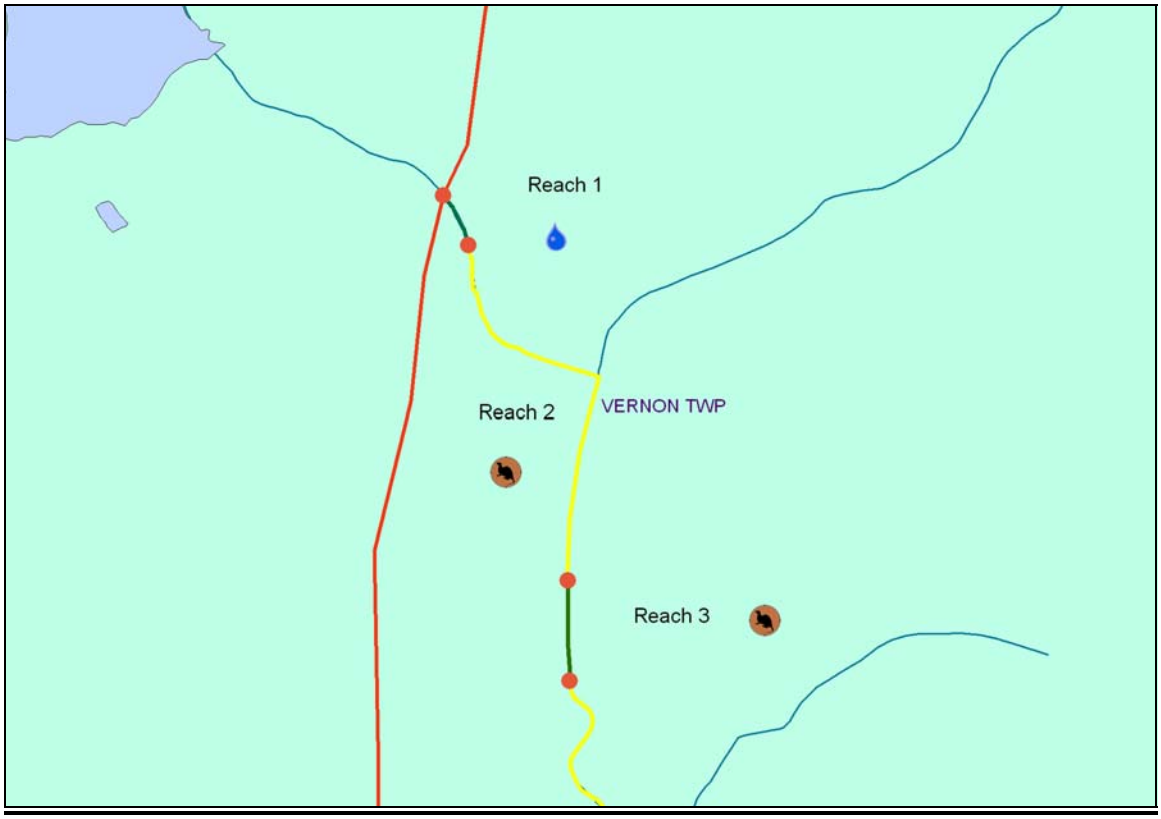


Figure 4 – Reach 1, 2, 3

Reach 4

Reach 4 starts at coordinates 18542515E/4554428N where river channel changes and ends at coordinates 18542593E/4553596N.

River flow slows, deepens in a meadow, then enters a large marsh/pond – actually a manmade reservoir owned by the City of Newark. There is much evidence of recent beaver activity in this area. At the marshy upper end of reservoir, the river channel is very deep (3-4 ft) and very soft-bottomed. See photos pqhw0375, pqhw0380, pqhw0385, pqhw0390, pqhw0395, pqhw0400.

The reservoir has 2 outlets. Westernmost outlet (NOT Pequannock River) drains to Canistear Reservoir through modified channel (rip-rapped bottom and banks). There is an active beaver dam across the head of this channel. This outlet stream is very uniform in depth/width due to channelization. It passes under a dirt road through culverts. See photos pqhw0405, pqhw0410, pqhw0415, pqhw0420, pqhw0425, pqhw0430, pqhw0435, pqhw0440.

The second outlet is the mainstem Pequannock River. This exits the reservoir via a concrete spillway. The spillway outlet is likely to elevate downstream temperatures. See photos pqhw0445, pqhw0450, pqhw0455, pqhw0460.

There is a valve in the dam structure that should be investigated as a potential bottom release. See additional comments listed for Reach 5.

Reach 5

Reach 5 starts at the reservoir outlet at coordinates18542593E/4553596N. Ends at 18542066E/4552832N.

This reach has predominately healthy cobble/gravel substrate. Good gradient and heavily wooded. Good pool/riffle ratio. See photo pqhw0465. These comments apply to times of higher flows. At lower flows little water escapes the reservoir outlet and flow rates are severely degraded. In the lower area of this reach there is very thick brush along/over the channel with some slowing of flow and a less rocky substrate.

A temperature monitor should be placed below the concrete dam to determine the influence of this reservoir. The flow rate issue at the reservoir outlet should also be addressed.

Reach 6

Reach 6 starts at coordinates 18542066E/4552832N where flow slows and the channel broadens substantially just before entering a manmade pond. Ends at coordinates 18541990E/4552645N.

River channel widens. Bottom becomes silt/sand before entering pond. There are a few houses and a small park adjacent to the pond. A few trees along the banks. The pond has a culvert outlet. Additional outlet in concrete box. See photos pqhw0470, pqhw0475, pqhw0480. Substantial dumping of leaves, grass clippings and other debris in the river just above the pond.

Dumping should be investigated.

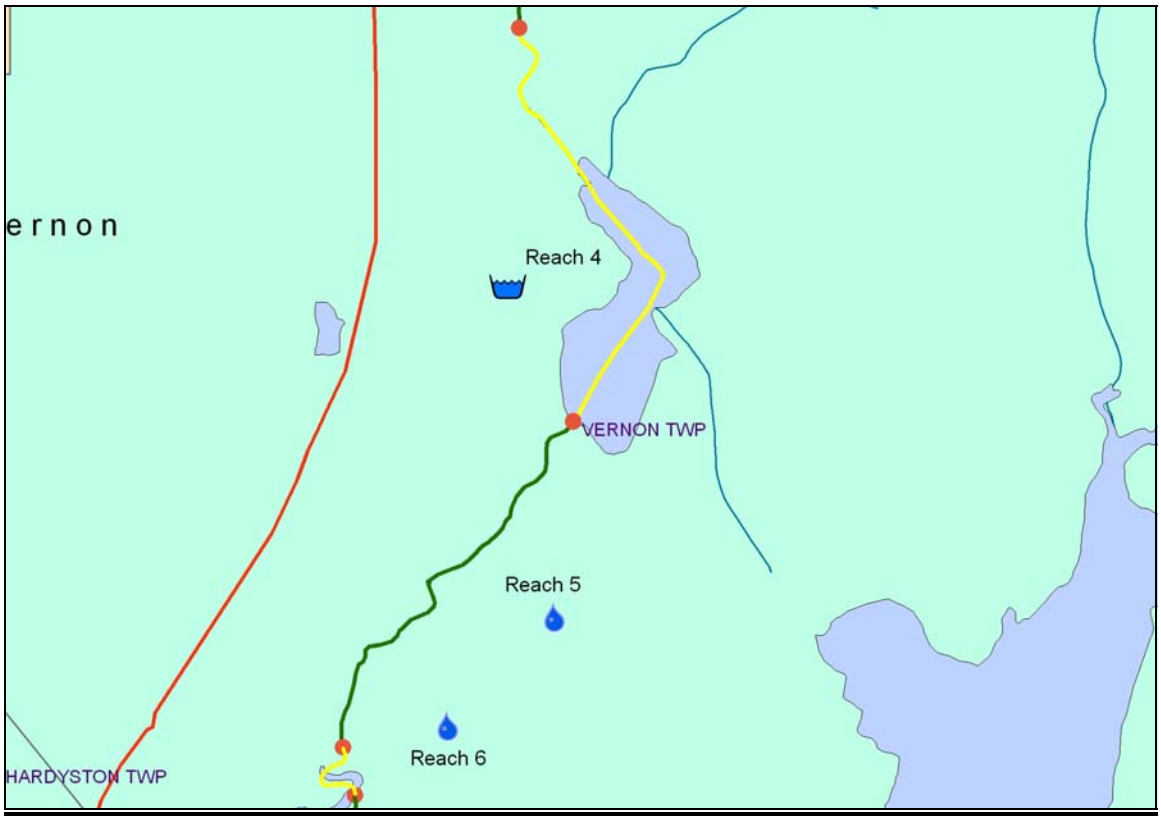
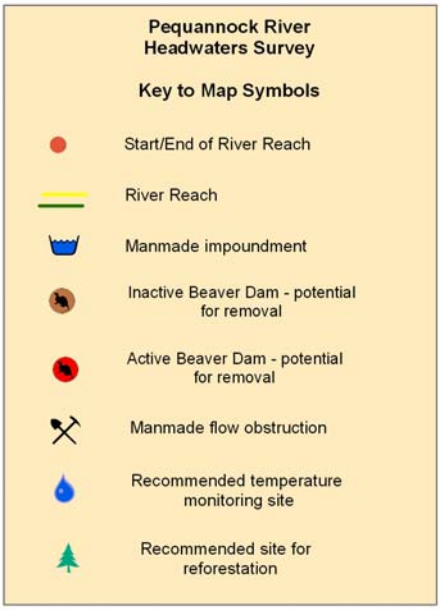


Figure 5 – Reach 4, 5, 6



Reach 7

Reach 7 begins at pond outlet at coordinates 18541990E/4552645N. Ends at coordinates 18541758E/4552506N.

There is a short stretch of channelized bed immediately below pond. See photo pqhw0482. Then river channel broadens into flooded brushy area with much braiding of channel. Substrate is silt/sand. These channel/bed characteristics seem to be a function of topography (low gradient) rather than impoundment. See photo pqhw0484.

As noted under Reach 6, temperature monitor should be placed above and below pond to determine influence. No other recommended improvements.

Reach 8

Reach 8 begins at coordinates 18541758E/4552506N where river flow accelerates and channel changes. Ends at coordinates 18541615E/4552163N.

River gradient increases. Substrate becomes gravel, rubble. There are a pair of low stone dams in this reach that could be hand-removed. Generally good riffle/pool ratio. Heavily wooded. See photos pqhw0486, pqhw0488, pqhw0490.

No recommended improvements other than removal of low stone dams.

Reach 9

Reach 9 begins at coordinates 18541615E/4552163N where current slows. Ends at coordinates 18541501E/4552160N.

Current slows. Few riffles in this reach. Bankside vegetation shifts from trees to brush. Substrate becomes silt/sand. Substantial stonework dam at lower end. See photos pqhw0492, pqhw0494.

Stonework dam could be removed, but may require equipment to accomplish.

Reach 10

Reach 10 begins below stonework dam at coordinates 18541501E/4552160N. Ends at 18541435E/4552137N.

This reach has a higher gradient with a rock/gravel substrate. It is heavily forested. See photo pqhw0496.

No recommended improvements.

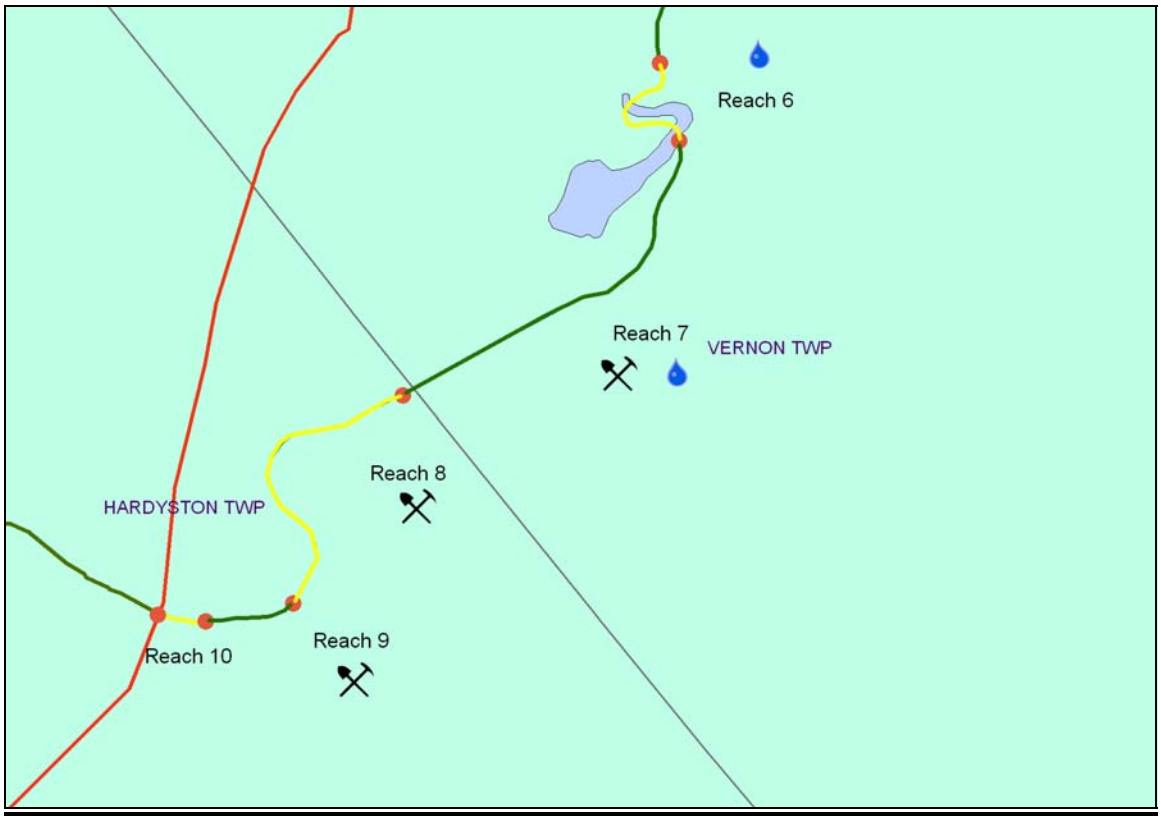


Figure 6 – Reach 7, 8, 9, 10

Reach 11

Reach 11 begins at coordinates 18541435E/4552137N where river enters a small pond. Ends at coordinates 18540934E/4552024N.

At the beginning of this reach is a small manmade pond below Rt. 515 bridge. Pond has spillway outflow and may elevate temperatures. Pond is privately owned with house adjacent. See photos pqhw0500, pqhw0510.

Below the pond this reach is heavily wooded, heavily shaded and has a higher gradient. Substrate is large-medium cobble and gravel. Good pool/riffle ratio. Some minor bank erosion. See photos pqhw0520, pqhw0530.

Temperature monitors should be placed above and below pond to determine influence.

Reach 12

Reach 12 starts at coordinates 18540934E/4552024N where current slows and vegetation changes. Ends at coordinates 18540702E/4551287N.

This reach is predominately meadow and brush with few large trees. Shade is moderate to poor. Lower gradient. Substrate is sand/silt. Few riffles. Substantial aquatic vegetation. Some braiding of channel. Channel is primarily narrow, deep and very sinuous. The high number of large dead trees throughout this area suggests past beaver activity. Meadow was probably once a beaver pond. See photos pqhw0540, pqhw0550, pqhw0560, pqhw0570, pqhw0580, Pqhw0590.

Good opportunity for a planting project to speed reforestation.

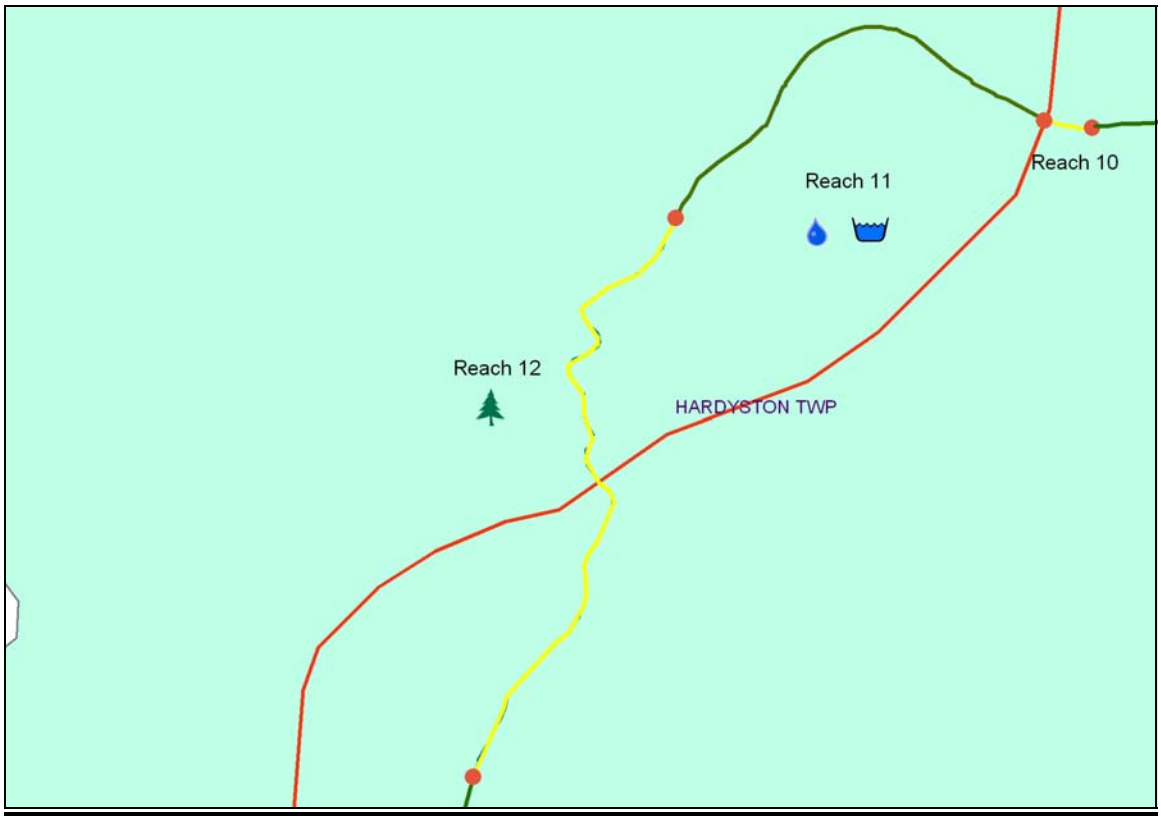


Figure 7 – Reach 11, 12

Reach 13

Reach 13 starts at coordinates 18540702E/4551287N where river characteristics change. Ends at 18540684E/4551086N.

In general this reach has more large trees than Reach 12 and slightly higher gradient. Substrate is sand/silt. Few riffles and some braiding of channel. Channel is primarily narrow and deep. Terminates at beaver dam. Substantial ponding/flooding above dam. Dam appears to be inactive. See photos pqhw0615, pqhw0620, pqhw0625.

Dam should be hand-removed.

Reach 14

Reach 14 starts below beaver dam at coordinates 18540657E/4551043N. Ends at coordinates 18540616E/4550861N.

Shortly below beaver dam this reach again becomes meadow/brush with few large trees. Shade is moderate to poor. Lower gradient. Substrate is sand/silt. Few riffles. Substantial aquatic vegetation. Some braiding of channel. Channel is primarily narrow, deep and sinuous. Much of meadow is flooded at all but lowest flows. See photos pqhw0630, pqhw0635, pqhw0640.

Reach terminates at active beaver dam. See photos pqhw0645, pqhw0650.

Dam could easily be removed by hand, although it would probably be rebuilt. Monitor should be placed below dam to determine influence of dam and/or removal.

Reach 15

Reach 15 starts at coordinates 18540616E/4550861N. Ends at coordinates 18540674E/4550414N.

This reach is similar to Reach 14. Meadow/brush with few large trees. Shade is moderate to poor. Lower gradient. Substrate is sand/silt. Few riffles. Substantial aquatic vegetation. Some braiding of channel. Channel is primarily narrow, deep and sinuous. Reach terminates at active beaver dam. See photos pqhw0655, pqhw0660.

Dam could easily be removed by hand, although it would probably be rebuilt. Monitor should be placed below dam to determine influence of dam and/or removal.

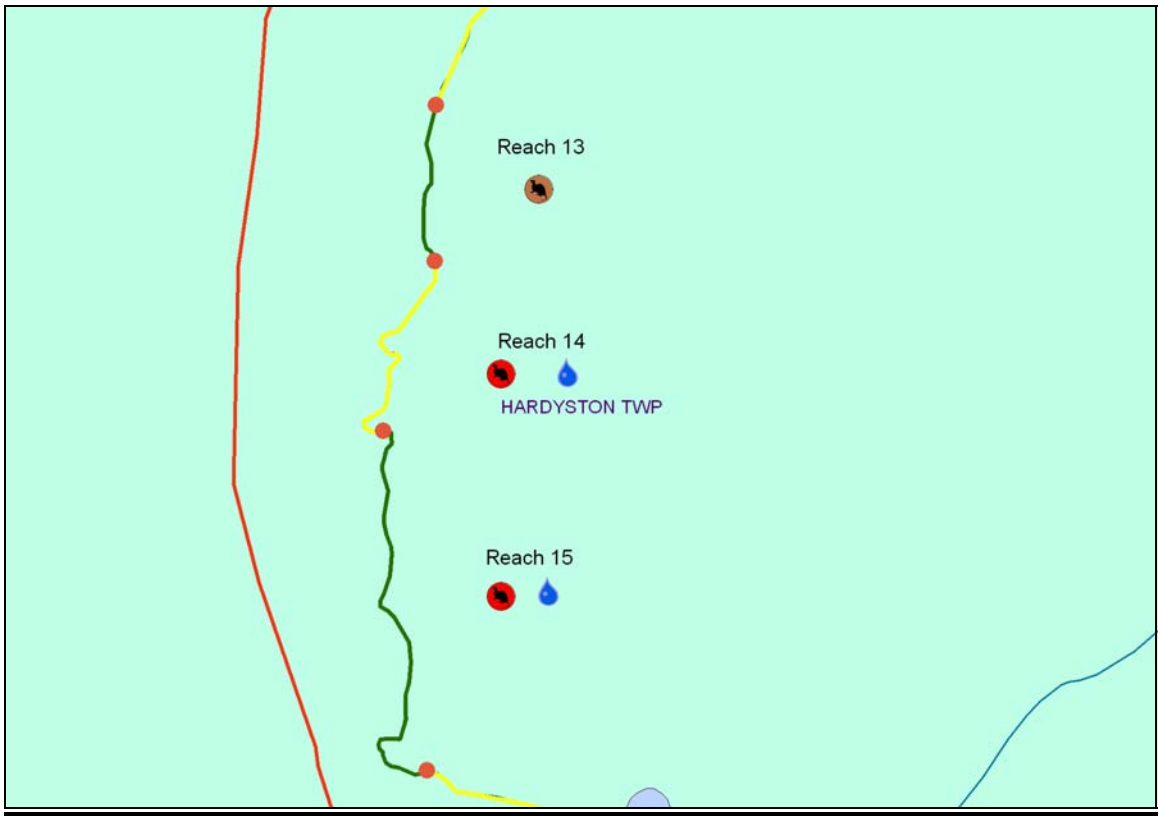
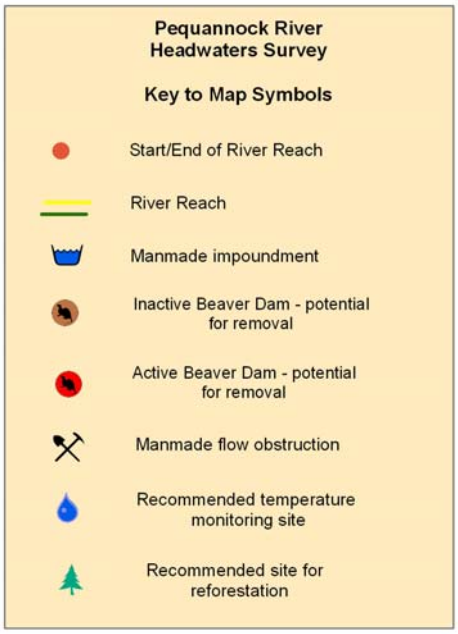


Figure 8 – Reach 13, 14, 15



Reach 16

Reach 16 starts below beaver dam at coordinates 18540674E/4550414N. Ends at coordinates 18541314E/4549798N.

Below beaver dam the river character changes dramatically. Substrate is rock/cobble/gravel. Shade is excellent from trees and tall shrubs. Gradient is higher. Riffle/pool sequence good. See photos pqhw0665, pqhw0670, pqhw0675.

No recommended improvements.

Reach 17

Reach 17 starts where river characteristics change at coordinates 18541314E/4549798E. Ends at coordinates 18541326E/4549478N.

Current slows. Substrate changes to silt. Few trees, more shrubs. Then fewer shrubs, more grass toward mouth of Pacock Brook. Channel narrows and deepens. Less gradient. See photos pqhw0680, pqhw0690, pqhw0700. Debris dam and derelict beaver dam in this reach. Beaver seen in this reach. See photos pqhw0710, pqhw0720, pqhw0730.

Debris dam and derelict dam could be hand-removed. Lower reach is a good area for reforestation, although access to area is difficult.

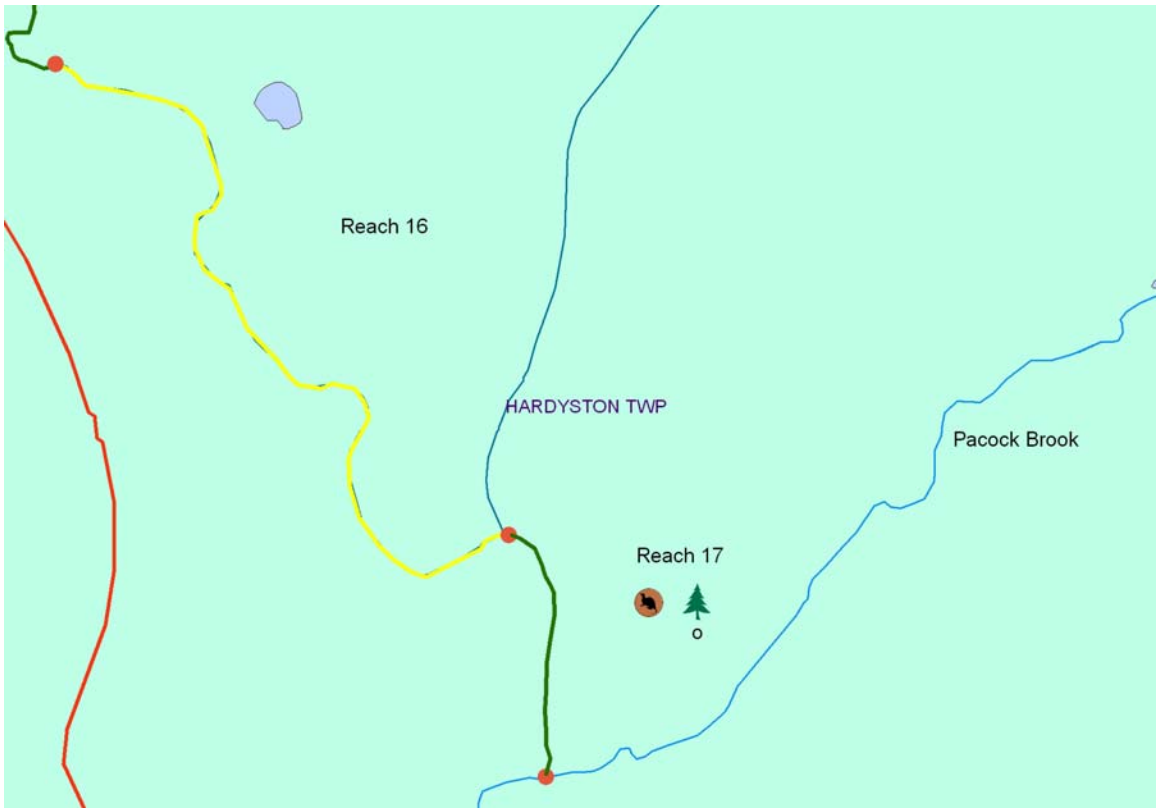


Figure 9 – Reach 16, 17

Note: Reach 17 is the last section within the project area. The following reach is described but is beyond the project scope.

Reach 18

Reach 18 starts at confluence of Pacock Brook at coordinates 18541326E/4549478E. Ends at coordinates 18541184E/4548659N.

At confluence of Pacock Brook is a large wet meadow, a former beaver pond. Remains of 2 large beaver dams immediately downstream. See photos pqhw0750, pqhw0760, pqhw0770. Remains of old dams could be hand-removed.

There is a short section of swift water with gravel substrate below old beaver dams. Then current slows. Substrate changes to silt. Few trees, mostly shrubs. Channel sinuous, narrow and deep. Less gradient. Several beaver dams and lodges in this reach. Dam coordinates are 18541097E/45488251N, 18541184E/4548659N. Lodges at 19541158E/4549049N and 100 feet above 1st dam on east bank. See photos pqhw0780, pqhw0790, pqhw0800, pqhw0810, pqhw820.

Summary and Recommendations:

It is obvious that potential sources of temperature elevation in this river area are numerous. In addition to degradation from beaver dams, the influence of manmade impoundments is particularly important. Our previous monitoring at other sites on the Pequannock River has shown that impoundments with spillway outlets can greatly elevate downstream water temperatures. Several impoundments of this type are present in the project area.

This study does identify a number of opportunities for improving water temperatures in the project area:

- The removal of inactive beaver dams should be considered in reaches 2, 13, and 17.
- Active beaver dams should be removed in reaches 14 and 15, although these dams may be rebuilt.
- Debris dams/stone dams should be removed in reaches 3, 8, 9, and 17.
- Reach 4 should be investigated for a potential bottom release from the manmade reservoir at that site.
- Reaches 12 and 17 are good targets for replanting projects.

In addition, we recommend temperature monitoring in Reaches 1, 2, 5, 6, 11, 14, and 15 since this may point to other problem sites or offer other opportunities for improvement.

Appendix F—Riparian Property List

Appendix F - Pequannock River Riparian Properties

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
Bloomingdale												
	19	1	0.4	Paul Kroepfl				Pequannock River	90	-2	0	2
				4 Locust Lane	Brunswick	ME						
	28	12	0	Borough of Bloomingdale				Pequannock River	1140	0	0	4
				101 Hamburg Tpk	Bloomingdale	NJ	07403					
	6	16	2	Montemarano & Pellosie, Inc.				Pequannock River	260	-1	0	3
				218 Hemlock Lane	Kinnelon	NJ	07405					
	6	17.0	5.5	Butler Printing and Laminating				Pequannock River	1170	0	0	4
				250 Hamburg Tpk.	Butler	NJ	07405					
	60	59	10.3	Borough of Butler				Pequannock River	1300	0	0	4
				1 Ace Rd	Butler	NJ	07405					
	62	1.01	11.25	Albert Shotmeyer				Pequannock River	2520	0	0	4
				1 Valley St.	Hawthorne	NJ	07442					
	62	2	12.1	NJDOT				Pequannock River	1820	0	0	4
	8	1	3.1	Iron Bridge Interests, LLC				Pequannock River	810	0	0	4
				7 Highview Rd	Newton	NJ	07860					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	8	2	0.5	Iron Bridge Interests, LLC				Pequannock River	360	-1	0	3
				7 Highview Rd	Newton	NJ	07860					
Butler												
	100	3	1.7	unknown				Pequannock River	65	-2	0	2
	102	2	4.55	Gennaro & Jacqueline Disaro				Pequannock River	751	0	0	4
				99 State St.	Hackensack	NJ	07601					
	102	3.01	1.26	City of Newark				Pequannock River	315	-1	0	3
				1294 MacBride Ave	Little Falls	NJ	07424					
	14	30	1.09	Borough of Butler				Kakeout Brook	290	-1	-1	2
				1 Ace Dr.	Butler	NJ	07405					
	15.01	10	1.66	Vibration Mounting & Control				Pequannock River	517	0	0	4
				Box 37	Bloomingdale	NJ	07403					
	25	20.0	3.5	Borough of Butler				Pequannock River	1300	0	0	4
				1 Ace Rd	Butler	NJ	07405					
	26	41	2.32	Butler Center Associates				Pequannock River	1500	0	0	4
				P.O. Box 8	Bayonne	NJ	07002					
	27.01	12.0	0.25	Borough of Butler				Kakeout Brook	140	-1	-1	2
				1 Ace Dr.	Butler	NJ	07405					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	300	32.0	0.33	Salvatore & Donna Lombardo				Pequannock River	140	-1	0	3
				355 Hamburg Tpk	Butler	NJ	07405					
	35	23	0.73	Borough of Butler				Kakeout Brook	170	-1	-1	2
				1 Ace Dr.	Butler	NJ	07405					
	72.02	20	5.96	Borough of Butler				Kakeout Brook	270	-1	-1	2
				1 Ace Dr.	Butler	NJ	07405					
	72.02	38	7.62	Eliezer & Samuel Hassine				Kakeout Brook	640	0	-1	3
				106-02 Rockaway Blvd.	Ozone Park	NY	11417					
Jefferson												
	513	11.0	6.4	Township of Jefferson				Pequannock River	650	0	0	4
				1033 Weldon Rd.	Lake	NJ	07849					
	569	1.01	2	Eastern Propane				Pequannock River	460	-1	0	3
				P.O. Box 288	Oak Ridge	NJ	07438					
	569	2	4.41	Mary, Joel & Ryan Brown				Pequannock River	1030	0	0	4
				817 West End Ave	New York	NY	10025					
Kinnelon												
	1.01	1	12.5	City of Newark				Pequannock River	3020	0	0	4
				1294 Macbride Ave	Little Falls	NJ	07424					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	1.03	1	10	City of Newark				Pequannock River	3700	0	0	4
				1294 Macbride Ave	Little Falls	NJ	07424					
	100	1	2.68	Paul A. Wohrman				Maple Lake Tributary	350	-1	-1	2
				325 Glenwild Ave	Bloomingdale	NJ	07403					
	11	181	8.58	Villas at Maple Lake LLC				Maple Lake Tributary	1025	0	-1	3
				233 Canoe Brook Rd	Short Hills	NJ	07078					
	11	195	4.24	Villas at Maple Lake LLC				Maple Lake Tributary	550	0	-1	3
				233 Canoe Brook Rd	Short Hills	NJ	07078					
	11	201	26.39	Villas at Maple Lake LLC				Maple Lake Tributary	1000	0	-1	3
				233 Canoe Brook Rd	Short Hills	NJ	07078					
	111	49.0	1.55	St. David's Church				Maple Lake Tributary	350	-1	-2	1
				90 Kiel Ave	Kinnelon	NJ	07405					
	2	2	21.9	NY Susquehanna & Western RR				Pequannock River	6140	0	0	4
				1 Railroad Ave	Cooperstown	NY	13326					
	2	3	2.31	Reservoir View Realty				Pequannock River	175	-1	0	3
				North Gate, Rt. 23 So.	Kinnelon	NJ	07405					
	2	4	3.11	City of Newark				Pequannock River	775	0	0	4
				1294 Macbride Ave	Little Falls	NJ	07424					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	26	115	536.7	Long Meadow Realty Corp.				Unnamed tributary	4600	0	-2	2
				No. Gate, Rt. 23 South	Kinnelon	NJ	07405					
	3	1.01	1.41	North Gate Realty Corp.				Smoke Rise Tributary	500	-1	-1	2
				No. Gate, Rt. 23 South	Kinnelon	NJ	07405					
	3	1.02	41.56	Long Meadow Realty Corp.				Smoke Rise Tributary	1000	0	-1	3
				No. Gate, Rt. 23 South	Kinnelon	NJ	07405					
	3	1.05	1.57	Reservoir View Realty Corp.				Smoke Rise Tributary	50	-2	-1	1
				No. Gate, Rt. 23 South	Kinnelon	NJ	07405					
	30	1	574	Pepperridge Tree Realty Group				Unnamed Tributary	4500	0	-2	2
				No. Gate, Rt. 23 South	Kinnelon	NJ	07405					
	30	59.0	2.03	John Alden Talbot, Jr.				Unnamed Tributary	300	-1	-2	1
				1 Talbot Dr.	Kinnelon	NJ	07405					
	38	1	1.68	Borough of Butler				Kakeout Brook	175	-1	-2	1
				1 Ace Dr.	Butler	NJ	07405					
	6	6	7.7	Smoke Rise Club				Smoke Rise Tributary	1000	0	-1	3
				9 Perimeter Rd.	Kinnelon	NJ	07405					
	99	1	0.22	unknown				Pequannock River	75	-2	0	2

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	99	2	0.08	unknown				Pequannock River	85	-2	0	2
	99	3	0.14	unknown				Pequannock River	125	-1	0	3
	99	4	0.22	Allen E. & Carol T. Shenise				Pequannock River	175	-1	0	3
				515 Hamburg Tpk	West Milford	NJ	07480					
	99	5	2.68	Norman & Lois Watt				Pequannock River	600	0	0	4
				11 Bogue Dr.	Bloomingdale	NJ	07403					
Riverdale												
	12	1	1.83	Dube Development				Valley Spring Lake	400	-1	-1	2
				P.O. Box 176	Riverdale	NJ	07457					
	12	27	0.51	Charles Palmer Mathews				Valley Spring Lake	55	-2	-1	1
				13 Hemlock St.	Riverdale	NJ	07457					
	6	2	0.7	Albert Shotmeyer				Pequannock River	200	-1	0	3
				1 Valley St.	Hawthorne	NJ	07506					
	6	21	0.96	Wolos Realty LLC				Pequannock River	322	-1	0	3
				18 Paterson Hamburg	Riverdale	NJ	07457					
	6.01	1	0.31	unknown				Pequannock River	180	-1	0	3

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	8.01	2	0.06	Gary Stanton				Pequannock River	40	-2	0	2
				4 Morris Ave	Riverdale	NJ	07457					
	8.01	3	0.07	Timothy May				Pequannock River	90	-2	0	2
				2 Morris Ave	Riverdale	NJ	07457					
	8.01	40	0.15	William J. & Marian Budesheim				Pequannock River	90	-2	0	2
				3 Curtis St.	Riverdale	NJ	07457					
West Milford												
	12501	24	18	Yoon Suh & Kyung Chun				Apshawa Brook	1700	0	-2	2
				29G Concord Rd.	West Milford	NJ	07480					
	12501	41	285	Camp Vacamas Inc.				Johns Lk Outlet	6750	0	-1	3
				256 Macopin Rd	West Milford	NJ	07480					
	12602	1	1	NY Susquehanna & Western RR				Pequannock River	220	-1	0	3
				1 Railroad Ave	Cooperstown	NY	13326					
	12604	2	1.3	Peter Brown				Pequannock River	300	-1	0	3
				8 Federal Place	Riverdale	NJ	07457					
	12702	1.01	1	Norman & Lois Watt				Pequannock River	700	0	0	4
				515 Hamburg Tpk	West Milford	NJ	07480					
	12702	2	0.7	Norman & Lois Watt				Pequannock River	260	-1	0	3
				515 Hamburg Turnpike	West Milford	NJ	07480					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	13906	9	2	Mountain Springs Assoc.				Apshawa Brook	560	0	-2	2
				26 Peach Tree Lane	West Milford	NJ	07480					
	13906	14	2	Ross Imbroglia				Apshawa Brook	320	-1	-2	1
				77 Union Blvd.	Wallington	NJ	07057					
	14001	21	8	Bruce & Judith Ziegler				Apshawa Brook	560	0	-2	2
				673 Macopin Rd	West Milford	NJ	07480					
	14108	1.02	3	Robert Kunz				unnamed tributary	230	-1	-1	2
				POB 1637	Wayne	NJ	07470					
	14113	14	1	Forest Hill Park Homeowners Assoc.				unnamed tributary	120	-1	-2	1
				47 Forest Hill Dr.	West Milford	NJ	07480					
	14201	14	4	Tree Market Landscaping Inc.				unnamed tributary	320	-1	-2	2
				350 Germantown Rd	West Milford	NJ	07480					
	14605	7	1.1	Orlando & C. Cordaci				Pequannock River	250	-1	0	3
				43 Adelaide Terrace	West Milford	NJ	07480					
	15804	4.02	1.5	Joseph & Joanne D'Onorfrio				Pequannock River	200	-1	0	3
				56 East Shore Trail	Sparta	NJ	06495					
	15804	17	0.5	Nancy & Donato DeAngelo				Pequannock River	270	-1	0	3
				16 Lantern Lane	Ramsey	NJ	07446					

Township	Block	Lot	Acres	Owner Information				Waterway	Water frontage feet	Water frontage rank	Waterway rank	Total rank
	15804	19	0.4	George Strus				Pequannock River	160	-1	0	3
				6 Spruce Rd	North Caldwell	NJ	07007					
	15903	1	8.9	Robert & Denise Hamilton				Pequannock River	340	-1	0	3
				50 Towpatch Rd	Denville	NJ	07834					
	15903	4	4.6	Joel & May Brown				Pequannock River	1080	0	0	4
				156 5th Ave	New York	NY	10010					
	16102	1	0.8	Eastern Propane				Pequannock River	500	0	0	4
				Scenic Drive	Oak Ridge	NJ	07438					

Appendix G—Model Water Conservation Ordinances

CITY OF ALAMOGORDO, NEW MEXICO
WATER CONSERVATION ORDINANCE REQUIREMENTS

The City of Alamogordo is a Southwestern Desert Community and as such we take water conservation very seriously. The following is a verbatim copy of our ordinance with regard to conservation and, should it become necessary, water rationing. Code Administration in conjunction with the Department of Public Safety enforces these requirements. During the year we publish reminders of these requirements to insure that the general public is aware of the requirements in force at the time.

28-03-033. Water conservation.

The following water conservation measures shall be in effect at the times specified. No person, firm or corporation shall use any water in violation of any provision of this section.

(a) The following water conservation measures shall be in effect for all users on the Alamogordo water works system during the period of the year when daylight savings time is in effect.

(1) Outdoor use of water through a sprinkler system or use of water through a hose to water any grass, trees, plants or other vegetation shall be determined as follows.

a. Users with odd numbered addresses shall be permitted to use water in the above manner on each Wednesday, Friday and Sunday.

b. Users with even numbered addresses shall be permitted to use water in the above manner on each Tuesday, Thursday and Saturday.

c. Watering in the above manner shall be prohibited on each Monday.

d. Newly seeded or sodded lawns or newly planted trees or shrubs shall be exempted from these restrictions for the time period needed to establish the lawn, tree or shrub which time period shall not exceed sixty (60) days.

e. Newly seeded or sodded shall mean an area that visibly lacks vegetation. Watering shall be restricted to an area that covers newly seeded or sodded portions of a lawn without extending unnecessarily to areas with established vegetation.

f. Newly seeded or sodded lawns and newly planted trees or shrubs shall be exempted from the odd-even watering scheme, but are not exempted from the hours when watering is permitted.

(2) The conservation measures detailed in paragraph (1) above shall be in effect during the period that daylight savings time is in effect and shall apply to all residences and to all businesses and institutions having grass, trees, plants or other vegetation and shall be

followed at all parks and public buildings which are watered with treated water. Areas watered using effluent water or wells are exempted from these restrictions. These conservation measures shall not apply to any person, firm or corporation engaged in the business of growing or selling plants of any kind.

(3) Beginning with the implementation of daylight savings time and continuing throughout the duration of daylight savings time, outdoor watering of grass, trees, plants or other vegetation shall be prohibited between the hours of 10 a.m. and 6 p.m.

(4) The provisions of this section taking place during daylight savings time may be implemented at other times of the year by the city manager upon determination that conditions surrounding the city's water supply warrant the imposition of such conservation measures. Should the city manager implement conservation measures at a time when daylight savings time is not in effect, the commission will consider such implementation at its next regular meeting and either ratify the manager's actions or remove the conservation measures.

(Ord. No. 948, § 1, 6-13-95; Ord. No. 1008, 4-8-97; Ord. No. 1056, 3-23-99)

28-03-034. Nonessential water use restrictions.

1. The following restrictions shall apply to all customers of or persons who use or receive treated water from the City of Alamogordo: The use of a free-flowing hose to wash any vehicle is prohibited. Vehicles may be washed only from a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rinses. This prohibition also includes the operation of vehicle washes such as fund-raisers held at commercial businesses, but does not apply to the washing of vehicles when conducted as part of normal business operations on the premises of a commercial car wash or a commercial service station.

2. "Wasting water" is prohibited. The following practices are wasting water:

(a). Using treated water for any purpose in such a way that it flows, sprays, or is otherwise excessively discharged upon any street, alley or other public right-of-way, ditch or drain;

(b). Failing to repair a leak in a system which delivers water within five (5) working days of the discovery of same;

3. All swimming pools, which are constructed after the effective date of this ordinance must be equipped with filtration, pumping and recirculation systems. For purposes of this ordinance, a swimming pool is any structure more than twenty-four (24) inches in depth and containing more than one thousand one hundred twenty-two (1,122) gallons of water and intended primarily for recreational use.

4. New or replacement bleeder lines from evaporative coolers shall not be larger than one-eighth-inch inside diameter. Bleeder lines shall not be routed into the sewer system where the effluent can be used to water landscaping or other outdoor vegetation, except where this would be impractical or unfeasible.

5. Restaurants shall provide drinking water to customers only upon request.

(Ord. No. 948, § 2, 6-13-95)

28-03-035. Water rationing.

1. The following water conservation stages shall be in effect at the times specified. When Stage 1, Stage 2, or Stage 3 water rationing is in effect, no person, firm or corporation shall use any water in violation of any provision of this ordinance.

(a) Stage 1: Water rationing. Whenever the storage facilities for the city's water system contain less than fifty (50) percent of capacity, the city manager shall have the authority to impose Stage 1 water rationing. The city commission shall consider the actions of the city manager at its next meeting at which time the city commission shall approve or disapprove the action taken by the city manager. The following requirements shall be in effect.

(1) The city manager shall make public announcements, through the print and broadcast media concerning the Stage 1 water rationing, whenever Stage 1 is in effect. The announcement will include a description of the rationing restrictions.

(2) Use of water through a sprinkler system or use of water through a hose to water any grass, trees, plants or other vegetation shall be determined as follows:

a. Users with odd numbered addresses shall be permitted to use water in the above manner on each Wednesday and Sunday.

b. Users with even numbered addresses shall be permitted to use water in the above manner on each Tuesday and Saturday.

c. Watering in the above manner shall be prohibited between the hours of 10 a.m. and 6 p.m.

(3) These restrictions shall apply to all residences and to all businesses and institutions having lawns, gardens, trees, or shrubs, and shall be followed at all parks and public buildings which are watered with treated water. Areas watered with effluent or well water are exempted from these restrictions. These restrictions shall not apply to any person, firm or corporation engaged in the business of growing or selling plants of any kind.

(4) No swimming pools shall be filled. Swimming pools that were filled before Stage 1 water rationing went into effect may have water added to make up losses through

evaporation or splashing. Water lost through draining or through leaks in the pool may not be made up during Stage 1 water rationing.

(5) Newly seeded or sodded lawns or newly planted trees or shrubs shall be exempted from Stage 1 water rationing for the time needed to establish the lawn, tree or shrub, provided the vegetation was planted before Stage 1 was imposed and the time needed to establish the lawn, tree or shrub does not exceed sixty (60) days. No lawns shall be newly seeded or sodded or trees or shrubs planted after Stage 1 is imposed. Newly seeded and sodded shall be defined and subject to restrictions as stated in Section 28-03-033.

(6) No water shall be used for fund-raising car washes.

(b) Stage 2 water rationing. Whenever the storage facilities for the city's water system contain less than thirty-five (35) percent of capacity, the city manager shall have the authority to impose Stage 2 water rationing. The following requirements will be in effect:

(1) The city manager will make public announcements through the print and broadcast media that Stage 2 is in effect. The announcements will include a description of the rationing restrictions.

(2) The city commission shall be called into emergency session in accordance with the current open meetings resolution after the imposition of Stage 2 to consider ratifying the city manager's action or to amend or lift the Stage 2 water rationing as circumstances warrant.

(3) Use of water through a sprinkler system or use of water through a hose to water any grass, trees, plants or other vegetation shall be determined as follows:

a. Users with odd numbered addresses shall be permitted to use water in the above manner on each Friday.

b. Users with even numbered addresses shall be permitted to use water in the above manner on each Tuesday.

c. Watering in the above manner shall be prohibited between the hours of 10 a.m. and 6 p.m.

(4) These restrictions shall apply to all residences and to all businesses and institutions having lawns, gardens, trees, or shrubs and shall be followed at all parks and public buildings which are watered with treated water. Areas watered with effluent or well water are exempt from these restrictions.

(5) No water shall be used to wash any vehicle (including fund raising car washes at commercial businesses), except at places of business where autos are washed on every business day either with attendants, with automatic equipment or by self service.

(6) No swimming pools will be filled and no water shall be added to any swimming pool. Indoor pools used for medical or rehabilitative purposes shall be exempt from this section.

(7) Washing sidewalks, driveways, parking areas, tennis courts, patios or other impervious surface areas with a hose except in emergencies to remove spills of hazardous materials or to eliminate dangerous conditions which threaten the public health, safety, or welfare, is prohibited.

(c) Stage 3 water rationing. Whenever the storage facilities of the city's water system contain less than twenty-five (25) percent of capacity, the city commission finds that the city is in a state of emergency and the following measures are necessary to protect the health and welfare of the citizens. The city manager shall have the authority to impose Stage 3 water rationing. The following requirements will be in effect:

(1) The city manager will make public announcements in the print and broadcast media that Stage 3 water rationing is in effect. The announcements will include a description of the provisions in effect.

(2) The city commission shall be called into emergency session in accordance with the current open meetings resolution after the imposition of Stage 3 to consider ratifying the city manager's action or amend or lift the Stage 3 water rationing as circumstances warrant.

(3) Use of water through a sprinkler system or use of water through a hose to water any grass, trees, plants or other vegetation shall be determined as follows:

a. Users located north of 10th Street with odd numbered addresses shall be permitted to use water in the above manner on each Friday.

b. Users located south of 10th Street with odd numbered addresses shall be permitted to use water in the above manner on each Wednesday.

c. Users located north of 10th Street with even numbered addresses shall be permitted to use water in the above manner on each Thursday.

d. Users located south of 10th Street with even numbered addresses shall be permitted to use water in the above manner on each Tuesday.

e. Watering in the above manner shall be prohibited between the hours of 10 a.m. and 6 p.m.

(4) All watering of grass, trees, plants or other vegetation at all parks and public buildings owned by the City of Alamogordo which are watered using treated water shall be prohibited. Areas watered with effluent or well water are exempt from these restrictions.

(5) No water shall be used to wash any vehicle (including fund raising car washes at commercial businesses), except at places of business where autos are washed on every business day either with attendants, with automatic equipment or by self service. The hours of operation of such businesses shall be limited to ten (10) hours per day.

(6) No swimming pools will be filled and no water shall be added to any swimming pool.

(7) It shall be the policy of the City of Alamogordo to keep Stage 3 in effect for no longer than absolutely necessary. The city manager and the city commission shall take steps to lift the Stage 3 restrictions as soon as lifting the restrictions will not endanger the water supply by reducing amounts of water in storage.

2. No person shall be convicted of violating this section unless such person in fact turned on water, directed the turning on of water, or kept water turned on after learning it was turned on in violation of this section, or failed to turn off automatic devices capable of turning on water in violation of this section. It will not be necessary, however, to present a witness who saw the accused turning on the water, if circumstances indicate the accused did turn on the water.

3. The city manager will make written reports to the city commission at every regular city commission meeting (including emergency sessions called under this section) while water rationing is in effect. The city manager will make weekly written reports to the city commission while Stage 3 water rationing is in effect.

4. Any person, firm, or corporation violating any provision of this section shall be fined not more than five hundred dollars ($500.00) for each offense, and a separate offense shall be deemed committed on each day during or on which a violation occurs or continues in accordance with the general violation provisions of the Code of Ordinances.

(Ord. No. 919, 7-26-94; Ord. No. 948, § 3, 6-13-95; Ord. No. 1008, 4-8-97)

ORDINANCE 2004-0518B

An Ordinance Amending Title 8 , Chapter 1, Section 14 Of the Code of Ordinances of the Village of Sugar Grove, Kane County, Illinois

For the Village of Sugar Grove, Illinois

BE IT ORDAINED by the President and Board of Trustees of the Village of Sugar Grove, Kane County, Illinois, as follows;

WHEREAS, the Village is not a home rule municipality within Article VII, Section 6A of the Illinois Constitution and, pursuant to the powers granted to it under 65 ILCS 5?3.1-300-5:

WHEREAS, the President and Board of Trustees of the Village of Sugar Grove have determined that it is in the best interests of the Village and its citizens to amend the Code of Ordinances for the Village of Sugar Grove.

NOW, THEREFORE, BE IT ORDAINED, by the President and Board of Trustees of the Village of Sugar Grove, Kane County, Illinois, as follows:

SECTION ONE: Title 8, Chapter 1, Section 14, Paragraph 1: Water Conservation, of the Sugar Grove Village Code is Hereby amended to read as follows:

8-1-14-1: WATER CONSERVATION:

Definitions

The following words and phrases when used in this Article shall, for the purpose of this Article, have the following meanings:

Drip-Irrigation System: A soaking hose that when in use does not result in an actual dissipation of Water.

Drip-Line: Pertaining to a tree or shrub, the ground area immediately beneath the branches of the tree or shrub.

Landscape/Landscaping: Gardens, trees, shrubs, and other living plants excluding New Sod and Seeded Turf Lawns.

New Sod and/or Seeded Turf Lawns are areas of mowed or cultivated grass species, including but not limited to rye grass, fescue, bentgrass, Bermuda, and/or zoysiagrass, exceeding 100 square feet in area, placed or planted from July 1st to August 31st of any given year.

Permitted Hours of Water Use: A time period between 6:00 AM and 9:00 AM and between 6:00 PM and 9:00 PM each day.

Person: Any individual, firm, partnership, association, corporation, company, organization, or entity of any kind.

Village: The Village of Sugar Grove.

Water: The water provided by and obtained by a person from the Village water supply and distribution system.

A. Application

1. The provisions of this Article shall apply to all Persons using Water, and to all properties within the Village or unincorporated areas that are connected to the Village's Water supply and distribution system, regardless of whether any Person using the Water has a contract for service with the Village.

2. Pursuant to Section (2) below, the provisions of this Article shall apply annually from January 1st through December 31st, subject to any modifications thereof, including application of these or other regulations during this or any other time, by an Emergency Proclamation.

B. Restricted Hours and Days for Specified Uses

1. There shall be no restrictions as to hours or days when Water from the Village water distribution system may be used for the following:

a. Landscape watering or sprinkling where such watering or sprinkling is done by a person using a handheld watering device;

b. Filling swimming pools with a volume of fifty (50) gallons or less;

c. The automatic watering of trees and shrubs by means of automatic root feed or Drip-Irrigation within the drip line of the tree or shrub;

d. Vehicle and equipment washing; or

e. Any other lawful use of Water from the Village water distribution system such as bathing, clothes washing, and other normal household uses not otherwise specifically restricted by the provisions of this Article.

2. Water from the Village Water distribution system may only be used for the watering or sprinkling of gardens, lawns, (except new sod and seeded turf lawns) shrubs or other outdoor plants or for filling swimming pools, as follows:

a. All properties with even numbered street numbers (i.e., numbers ending in 0, 2, 4, 6, 8) may use village distributed water for outdoor plant watering or pool filling on even numbered calendar dates during Permitted Hours of Water Use.

b. All properties with odd numbered street numbers (i.e., numbers ending in 1, 3, 5, 7, 9) may use village distributed water for outdoor plant watering or pool filling on odd numbered calendar dates during Permitted Hours of Water Use.

C. Restrictions for Sod Laying and Lawn Seeding for New Lawns

Notwithstanding the provisions of Section B above, the following special regulations shall apply:

1. Use of Water from the Village water distribution system for sod laying or lawn seeding for the establishment of a New Sod and/or Seeded Turf Lawn or new landscaping is prohibited from July 1st through August 31st each year unless the source of watering for said sod, lawn seeding and/or planting of landscaping is derived from an imported water source or means other than the Village of Sugar Grove Water system. This prohibition shall not apply to soil erosion and sedimentation plans required pursuant to Village ordinances (with approved plans) or for restorations due to required repairs of public utilities (e.g. water main breaks). Any required sedimentation plans or utility repair restorations shall follow the schedule delineated in Section C (2)a-c below.

2. From May 1st through June 30th and from September 1st through September 30th, Water from the Village water distribution system may be used for the establishment of New Sod and/or Seeded Turf Lawns, only as follows:

   Prior to sod laying or lawn seeding, a **Sod Watering Permit** must be obtained from the Village of Sugar Grove.

   a. On the day new sod or seed has been placed on a property, a Person may use an automatic sprinkling device to apply Water to the sod or seed for a total period of time not to exceed eight (8) hours.

   b. For the next nine (9) days thereafter, a Person may apply water to said sod or seed each day during Permitted Hours of Water Use.

   c. Following the first ten (10) days after the sod or seed is placed, the provision of Section B shall apply.

3. Prior to the execution of any real estate contract for the sale of newly constructed property, the builder or owner of such new construction shall:

   a. Inform prospective purchasers of the restrictions upon the installation of new lawns set forth in this Article;

   b. Attach a Copy of these regulations to the contract; and

   c. Obtain the signature of the purchaser(s) on a statement that he, she or they has (have) been informed of the new lawn installation restrictions set forth in this Article.

4. The applicant for a certificate of occupancy for any newly constructed property shall submit as a part of his application, a copy of said signed statement. When an application for certificate of occupancy is submitted prior to sale of the property, and the future occupant is unknown, the applicant shall submit his signed statement that he shall comply with the requirements of this Section at the time the real estate contract is executed.

D. Waste of Water Prohibited

No Person shall allow a continuous stream of Water to run off into any gutter, ditch, drain, or street inlet while using Water for restricted purposes during the Permitted Hours of Water Use.

E. Exceptions

The provisions of the article shall not apply to any commercial or industrial entity for which use of Water is necessary to continue normal business operations, or to maintain stock or inventory. Provided, however, this exception shall not apply to any and all uses of Water not essential to normal business operations or maintenance of inventory or stock, and specifically shall not apply to landscape watering or pool filling.

F. Bulk Water Rates

Bulk Water rates shall be increased to two times the non-resident Water rate.

G. Hydrant Use Prohibited

Hydrants connected to the Village Water supply and distribution system are for the purpose of providing Water for fire fighting and protection. Fire hydrants shall not be opened by any Person, other than authorized Village personnel, Fire District personnel or permitted users.

H. Emergency Proclamation

1. Whenever the Water supply of the Village is diminished from any cause, including but not limited to prolonged dry period, increased Water demand, equipment failure, or Water quality concerns, to an amount which in the opinion of the Utilities Supervisor or the Director of Public Works is or is likely to become dangerous to the health and safety of the public, the Village President, Village Administrator or his designee is hereby authorized and empowered to issue an Emergency Proclamation in the form of a public notice containing other additional regulations or restrictions on the use of water from the Village Water distribution system.

2. Such regulations or restrictions may provide for the limitations on usage of Water, limitations on days and hours of use for some or all purposes and the prohibition of specified uses.

3. Upon issuing such Proclamation, the Village President, Village Administrator or his designee shall make the contents thereof known to the public by news release to the local newspapers and radio media and may also notify the citizens in any other practical manner that shall be devised. Further, the Village President, Village Administrator or his designee shall immediately notify all members of the Village Board of the nature of the emergency and the regulations that have been imposed.

4. The Emergency Proclamation of the Village President, Village Administrator or his or her designee and the regulations imposed thereby, shall remain in full force and effect until any one of the following shall occur:

   a. The Village President, Village Administrator or his designee determines that the emergency no longer exists and that the emergency proclamation, and the regulations imposed thereby, shall no longer continue in effect.

   b. The Village Board modifies, repeals or makes permanent the Emergency Proclamation, and the regulations imposed thereby, by means of ordinance passed at any regular or special meeting of the Village Board.

5. Any Village employee or officer may, at the direction of the Village Administrator or his designee, notify and warn any Persons of the effect of said Emergency Proclamation and direct said Person to comply with said watering or sprinkling restrictions. If any said Person, after having first been warned about said restrictions of the Emergency Proclamation, shall continue to violate said restrictions of the proclamation, they shall be deemed in violation of this section and penalties assessed as stated in Section I.

I. Penalty.

1. Any person who or which violates, disobeys, neglects, fails to comply with or resists enforcement of the provisions of this Article other than Section C (1) above, shall, within ten (10) days of receiving notice of such violation, pay at the Village of Sugar Grove, a fine, as follows:

   a. $50.00 for a first offense;

   b. $125.00 for a second offense; and

   c. $500.00 for each subsequent offense.

2. Any person who violates Section C (1) of the Article shall, within thirty (30) days of receiving a notice of such violation, shall be subject to imposition of a fine up to $750.00 for each offense.

3. Each day a violation occurs or continues shall be considered a separate violation for purposes of this article.

4. The amount of any fine due, if not paid as provided therein, shall be added to the bill for water consumption for the property at which the offense occurred.

SECTION TWO: To the extent that this ordinance is in conflict with any presently existing ordinances or portions thereof enforced in the Village Of Sugar Grove as of the effective date hereof, such prior and conflicting ordinances or portions thereof are hereby repealed. The repeal of any ordinance by this Ordinance shall not affect any right accrued or liability incurred under such repealed ordinance to the effective date hereof.

SECTION THREE: This Ordinance shall be in full force and effect from and after is passage, approval and publication in pamphlet form as provided by law.

PASSED AND APPROVED by the President and Board of Trustees of the Village of Sugar Grove, Kane County, Illinois this 18th day of May, 2004.