STORMWATER MANAGEMENT PLAN FOR FAIRFIELD

FINAL REPORT

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Prepared for:

Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488
Tel. / 802.524-9031
E-Mail / denisefnlc@gmail.com

Prepared by:

Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier, VT 05602
Tel. / 802.229.4541
E-Mail / sei@stone-env.com

STONE ENVIRONMENTAL INC

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1. INTRODUCTION

Water knows no political boundaries, and thus evaluations of water quality tend to be undertaken within watershed boundaries and involve land areas in multiple towns. From a water quality perspective, it would be ideal to manage water resources along watershed lines—but the reality is that many decisions, particularly those about land use, are made at the level of towns or individual sites.

A Town-wide Stormwater Management Plan is responsive to existing landscape characteristics across all watersheds within local political bounds. It connects land use, stormwater management, floodplain management, river management, and public infrastructure needs to more effectively address all of the issues which contribute to water quality impairment or improvement. Within this Plan, localized stormwater problems are examined at a larger scale (e.g., town-wide) to determine their relative contributions, and aid in setting priorities for addressing challenges related to stormwater runoff. As adjoining towns also take increasingly comprehensive views of stormwater management issues and planning, these plans are one-stop resources that can improve coordination and increase opportunities for collaboration in meeting watershed-related needs across political boundaries.

1.1. Project Background

As precipitation falls on an undisturbed, natural landscape and moves through the hydrologic cycle, it flows through a complex system of vegetation, soil, groundwater, and surface waters. Natural events have shaped these components over time to create a system that can efficiently handle stormwater through evaporation, transpiration, infiltration, and runoff. Alterations to the landscape change the way it responds to precipitation events. Management of land use, rainfall, storm runoff, and surface water (streams and lakes) are interrelated, and the management practices chosen all influence water quality and stream health.

Watersheds are interconnected networks in which a change at any location can carry throughout the system. There are many factors that influence exactly how stormwater runoff from a particular site will affect other areas of the watershed. The degree and type of impact varies from location to location, but it can be significant relative to other sources of pollution. Stormwater runoff affects water quality, water quantity, habitat and biological resources, public health, and the aesthetic appearance of the receiving water. Stormwater controls, in contrast, are typically conceived and implemented on a project-by-project basis. These projects are analyzed for their individual stormwater impacts, not in the context of their impact on an interconnected hydrologic and hydraulic system. It is well documented, however, that the cumulative effects of individual land surface changes dramatically influence flooding conditions and contribute to degradation of water quality (NRC 2009).

What is a watershed?

A **watershed** is any area of land in which all water runoff from its surface flows to the same drainage point. Watersheds are sometimes referred to as drainage areas.

Watersheds are important because they are the basic unit of analysis for all surface water management. They come in all shapes and sizes, and are defined based on the intended study area.

Watershed management practices have direct impacts on water quality in local creeks and streams (e.g., Wanzer Brook, Black Creek), as well as downstream waterbodies (e.g., Lake Champlain). Any decisions that affect land use have stormwater management ramifications and, in turn, impact all downstream water resources. The findings of one recent study (Troy et al. 2007) suggest that “land-use changes in the Basin have increased phosphorus levels in Lake Champlain, especially conversion of agricultural areas and forests to developed uses.”

Vermont's streams, rivers, and Lake Champlain are vital economic resources. The quality of local receiving waters affects both economic interests and quality of life in the surrounding areas. Throughout the Champlain Valley, the local economy depends, in part, on the revenue gained from outdoor activities enjoyed in and on the water. Protecting the quality of surface waters is one of the most important commitments communities can make to protect the economic interests of residents.

Taken together, these elements emphasize the need for a holistic planning effort that considers the interconnected nature of land use, stormwater management, and river management in order to achieve overall watershed goals.

1.2. Project Goals

One of the stated goals of the Fairfield Town Plan is to: *Ensure that development within the shoreline areas of lakes, streams and rivers is compatible with the natural beauty of the area, protects existing vegetation, is set back sufficiently to prevent erosion along stream banks or pollution from subsurface sewage disposal systems, and where possible retains visual and physical access to the water bodies* (Fairfield Town Plan, 2009). In order to achieve this goal, the quality and quantity of stormwater runoff from existing development in shoreline areas must be well-managed.

The Town has taken a number of steps to address stormwater runoff concerns in shoreline and non-shoreline areas alike, such as partnering with the Better Backroads Program to address road-related runoff. The ultimate goal of this stormwater management planning project is to build on these efforts by providing the Town of Fairfield with a list of high priority water resource concerns and conceptual solutions, which will support the development and implementation of future restoration projects in an efficient and targeted manner.

This Stormwater Management Plan first incorporates information from existing plans and datasets to create a single, town-specific resource to guide future stormwater management activities. The resulting Stormwater Management Planning Library, included as Appendix B, is a valuable resource for water quality-related work in Fairfield.

This Stormwater Management Plan also:

- Identifies stormwater-related areas of active erosion or other sources of sediment that are being delivered directly to water bodies in the Town of Fairfield;
- Develops recommendations to address stormwater problems, including:
    - A list of problem areas that can assist stakeholders in directing resources to high priority projects; and
    - Conceptual solutions for high-priority problem areas (Section 4.3), and
    - Potential revisions to town ordinances that would encourage consideration of stormwater management opportunities as development and redevelopment projects are pursued locally.

2. GENERAL DESCRIPTION OF THE STUDY AREAS

The Town of Fairfield is located in Franklin County in northwest Vermont, and is bordered by eight towns (Swanton, St. Albans, Georgia, Fairfax, Fletcher, Bakersfield, Enosburg, and Sheldon). The town has a total area of 67.4 square miles, 70 percent of which is classified as farmland, woodland, or open land. Concentrated development has mostly occurred in Fairfield village, East Fairfield, around Fairfield Pond, and in the vicinity of VT Route 36 near the St. Albans town line. As of the 2010 Census, the population of the town was 1,891 (U.S. Census Bureau, 2011).

Fairfield lies fully within the Lake Champlain basin, and has a number of rivers and streams within its borders, including portions of Dead Creek, Black Creek, Fairfield River, Elm Brook, and Wanzer Brook. Dead Creek drains the western third of town. Fairfield River, Wanzer Brook, and numerous unnamed brooks drain the central third of town. Elm Brook and assorted Black Creek headwater streams (including Chester Brook, an impaired surface water) drain the eastern third of town. Ponds and wetlands also dot the landscape, with two waterbodies – Fairfield Pond and Fairfield Swamp – being of particular note. Each of these watersheds is described below, and watershed boundaries are shown on Map 1 in Appendix A.

2.1. Black Creek

Black Creek, with a watershed area of 122 square miles, is one of the largest tributaries to the Missisquoi River. The Black Creek watershed, including its tributaries the Fairfield River, Wanzer Brook, Elm Brook, and Dead Creek, drains more than 90% of Fairfield, as well as sections of surrounding towns to the southeast. The main stem of Black Creek begins at Metcalf Pond in Fletcher before flowing southeast through Cambridge and bending northwest through the heart of Fairfield. It exits Fairfield at the northern town line and meets the Missisquoi River in central Sheldon. Along its length, the creek flows through a variety of land uses and landscapes including wetland, hay and corn fields, pastureland, forest, and concentrated development. There are a number of natural and manmade obstructions altering its flow including beaver dams, manmade dams, and road crossings. Twelve miles of the Black Creek's main channel, from the creek's terminus extending upstream to East Fairfield, have been classified by the state as "stressed" due to nutrient enrichment, turbidity, thermal changes, sedimentation, and the loss of riparian buffers (VTDEC, 2012).

2.2. Elm Brook

Elm Brook is a 5.5 mile long tributary to Black Creek with an 8 square mile catchment. It originates on the northern slopes of Gison Mountain, and its confluence with Black Creek is downstream (west) of East Fairfield. It passes through primarily agricultural land, as well as the Elm Brook State Wildlife Management Area (WMA) managed by the Vermont Department of Fish and Wildlife.

2.3. Fairfield River

Fairfield River is 6.5 miles long and drains 21 square miles. It originates in a wetland northwest of Gison Mountain, and flows through agricultural land and the eastern edge of Fairfield village before meeting Black Creek south of Chester A. Arthur Road. Several undersized culverts have been identified along the run of the Fairfield River, and the river also lacks connection with its floodplain in a number of locations (The Johnson Company, 2009).

2.4. Fairfield Swamp/Dead Creek

Dead Creek originates in the extensive, 1,500-acre Fairfield Swamp wetland complex. The wetland originates in northern Fairfax and extends to the southeast corner of Swanton, where it drains to Dead Creek. Fairfield Swamp is part of the St. Albans conservation district, which limits its development (Town of St. Albans, 2005). From Fairfield Swamp, Dead Creek flows northeast where it meets Black Creek near St. Rocks Farm. A near equal amount of farmland and woodland abut Dead Creek along its length.

2.5. Wanzer Brook

Wanzer Brook drains an area of 7.2 square miles in northern Fairfield. Except for its northernmost headwaters, this watershed lies completely within the Town of Fairfield. Just over half of the watershed is woodland, and about a third is in active agriculture. The brook has been classified as impaired by the state due to nutrient and sediment pollution from agricultural runoff (VTDEC, 2012). A significant restoration project along Wanzer Brook was completed by VTDEC, USFWS, and USDA NRCS in 2007. This project included the purchase of a river corridor easement and restoration of a floodplain along 2,000 feet of Wanzer Brook (VTANR, 2010).

2.6. Fairfield Pond

Fairfield Pond covers 446 acres in northwest Fairfield, close to the border with St. Albans Town. The pond’s watershed area is about 5.6 square miles, of which one-tenth is in active agriculture; the dominant land cover in the watershed is forest. There are scattered residences in the upland areas of the watershed, but a high concentration of mostly seasonal homes along the pond’s shores. The pond experienced severe eutrophication from the early 1980s until the early 1990s. During this time, water quality declined dramatically, but has since improved due to changing agricultural practices and the closure of two adjoining farms. Once classified as impaired, it is now only considered stressed (VTDEC, 2012). Fairfield Pond is also impacted by Eurasian water milfoil, which adversely affects recreational use of the pond.

2.7. Other Watersheds in Fairfield

Small land areas near Fairfield’s boundaries drain to other water bodies as follows: the southwest corner drains to Mill River, the northwest corner drains to Hungerford Brook, and the northeast corner drains to Goodsell Brook and Tyler Branch. With the exception of Mill River, all of the aforementioned waters eventually drain to the Missisquoi River; Mill River discharges directly to Lake Champlain. Chester Brook, located in eastern Fairfield, is a small tributary to Black Creek and is listed as impaired surface water (VTDEC, 2012).

3. EXISTING PLANS AND DATA

Numerous and varied groups and individuals have invested considerable effort in evaluating Fairfield's water resources, and the important interface between water resources and local land use decisions. At times, these evaluations have followed watershed boundaries, while and other times they have followed political boundaries. The following sections identify evaluations completed over the past ten years, with emphasis on work most relevant to the Town of Fairfield, and on efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Fairfield. A more detailed review of each assessment is included as Appendix B of this report.

3.1. Watershed-Based Assessments

The ongoing assessments described below are generally led by the State of Vermont's Agency of Natural Resources (ANR). These include:

- Basin planning efforts, the main purpose of which is to guide ANR in its own work and in collaborative projects with the public, municipalities, and other state and federal agencies. The basin plans have a five-year scope. The *Missisquoi River Basin Water Quality Management Plan*, most recently revised in March of 2013, overviews water resources and identifies concerns and threats to water quality within the more than 619 square miles of Vermont that drain to the Missisquoi River. In addition, in 2008, the USDA's Natural Resource Conservation Service (NRCS) completed the *Missisquoi Areawide Plan*, a watershed-based plan specifically structured to inform and help guide the conservation efforts of partner agencies and cooperating farmers.
- Stream geomorphic assessment work, undertaken to understand the natural tendencies of a particular reach of stream or river, its current condition, and what changes may be anticipated in the future. Stream geomorphic assessments have been completed for two stream/river segments within Fairfield: Black Creek and Wanzer Brook.
- In-stream water quality assessment work, including water chemistry and biological assessments. Annual biomonitoring data on macroinvertebrate and fish community health are available for Black Creek, and water quality samples for Black Creek and Wanzer Brook were collected between 2007 and 2011.
- Total Maximum Daily Load (TMDL) development, to establish the maximum amount of a pollutant (e.g., bacteria, nutrients, excess stormwater flows) that a waterbody can assimilate and still meet state-established water quality standards. TMDLs are based on the relationship between pollution sources and in-stream water quality conditions. A TMDL addresses a single pollutant or stressor for a waterbody, so more than one TMDL may need to be developed for a particular receiving water. The previously approved Lake Champlain phosphorus TMDL is currently under review by EPA Region 1, and may ultimately require the application of additional best management practices (BMPs) throughout the Lake Champlain watershed. Wanzer Brook and Chester Brook are listed as impaired surface waters in need of a TMDL.

3.2. Town-Wide Assessments and Programs

In addition to the watershed-based assessments, a number of data sources are developed on a municipality-by-municipality basis. These are important to fold into any effort to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Fairfield. These include direct feedback from the Town, work by the Vermont Agency of Transportation, and past and current planning initiatives.

- In meetings with Stone Environmental, Town officials identified 20 areas of concern and priority projects throughout Fairfield, ranging from areas of active stream erosion to road flooding during high-water events. See Figure 14 and Table 3, Appendix B, p. 56) for a map and table of concern areas and priority projects, as well as a map of the locations of concerns identified in the stream geomorphic assessments.
- VTrans-sponsored programs, including both routine inspections of bridges and culverts and grant opportunities provided by the Better Backroads Program, have identified a number of potential projects to protect existing infrastructure whose implementation would also improve stormwater management.
- Fairfield's Town Plan recognizes both the important recreational opportunities that the Town's surface water resources provide, and that pollution problems continue to adversely impact water quality. It outlines a basic framework for how Fairfield's water resources should be managed going forward.

4. STORMWATER PROBLEM AREAS

One of the goals of this plan is to “develop a comprehensive list of stormwater problems.” To achieve this goal, a thorough effort was made to identify existing problem areas, and then to evaluate existing conditions and potential solutions.

4.1. Identification of Problem Areas

The first task was to identify the location and nature of existing drainage problems and stormwater management concerns, and where appropriate, to gather field data for further analysis. The approach to identifying potential problem areas included the following elements:

- Reviewing existing plans and data, as described in Section 3 above, and noting the location of any concerns related to stormwater
- Engagement with local officials, including:
  - May 3rd, kick-off meeting with Town Manager and Road Foreman
  - May 23rd, meeting with Road Foreman and technical advisor (Jim Smith)
- Targeted site visits to verify problems areas (June and July 2013)
- Documentation (with photos) of existing problem areas

A “problem area data sheet” was developed and used as a guide to ensure that consistent information was collected as site visits were completed. More than 25 potential problem areas were identified and geo-located. The data sheets for all of the problem areas identified in the Town of Fairfield are provided in Appendix C of this report.

4.2. Evaluation of Problem Areas

Working from the list of potential problem areas, the Consultant Team visited each potential problem area to directly observe the site. Where an unresolved problem was found, photos were taken of any areas of active erosion, and observations were recorded about the source or cause.

Each problem area was given a score, with the intent of generally assessing the severity of existing problems, removing low priority problem areas from the dataset, and providing general guidance on the relative order in which the problems should be addressed when considered town-wide (Appendix C). Scores were assigned as follows:

Level	Classification
1	Outside of project scope, or infeasible to remedy due to project size.
2	Stable, but problem could escalate with future change in surrounding land use.
3	Small to moderate erosion and/or drainage problems are present; issues could be readily addressed.
4	Significant erosion and/or drainage problems are present; issues may be readily addressed.

4.3. Conceptual Solutions to High Priority Problem Areas

The 11 problem areas that were assigned a Level 3 or 4 classification were subject to more detailed investigation. The first phase of the detailed investigation involved desktop analysis to determine:

- Drainage area contributing to the known problem,

- Underlying soils, with particular attention to the presence of highly erodible soils (e.g., k > 0.17),
- Location of any existing stormwater infrastructure,
- Proximity to the nearest surface water feature,
- Whether the Town identified the area as a priority area for planned future growth, and
- Potential location or locations most suitable for stormwater treatment practices, taking into account topography and existing development (if any).

A map of each high-priority problem area including all of these features was prepared (Appendix D). These sites were revisited to further investigate treatment potential and gather information for conceptual solutions, including more detailed information on the contributing drainage area, soil conditions, and traffic and pedestrian flow. These data were collected in order to better evaluate anticipated water quality benefits and constructability. In some locations, conceptual solutions were not developed for one of the following reasons:

- The stormwater concerns involve issues where it would not be appropriate for the Town to assume a leadership role (e.g., wholly on private property);
- The stormwater concern did not rise to the level of demanding immediate action.

In total, six conceptual solutions were developed to address problem areas that were assigned a Level 3 or 4 classification. The following sections describe each of the conceptual solutions.

4.3.2. Pumpkin Village Road (Problem Area ID: BC-8)

The portion of Pumpkin Village Road that runs from North Road to Wanzer Road was found to be in poor condition (see highlighted area on Figure 1, below). Sediment from the road surface washes to and accumulates at areas where the road shoulder is low, including the Black Creek crossing.

The problems along Pumpkin Village Road could be addressed by crowning the road surface to shed water toward the ditches and at the same time improving the roadside ditches and reducing the high shoulder that runs most of the length of the road to promote sheetflow.

Figure 1. Pumpkin Village Road Problem Area. An area of eroding road surface on Pumpkin Village Road is highlighted.

4.3.3. Shenang Road

Shenang Road is a gravel road that runs from VT Rte. 36 north to Dodd Road. Significant work appears to have been recently completed on the southern portion of the road, including the lining of ditches along the western side of the road with crushed stone and the installation of several new culverts. However, two additional stormwater improvement opportunities were found:

- Erosion from the unlined ditches on the east side of Shenang Road has clogged ditches and check dams on the western side.
- A corrugated metal culvert that is both undersized and too short, located approximately 2000 feet north of the intersection with Route 36.

The location of each opportunity is shown in Figure 2, and both areas are described in more detail in the subsections that follow.

Figure 2. Shenang Road Problem Areas. Northern highlighted area indicates the culvert replacement opportunity; highlighted location toward the southern end of Shenang Road indicates the ditch improvement opportunity.

4.3.3.1. Roadside Ditch Maintenance (Problem Area ID: BC-19)

The stone lined ditches on the west side of Shenang Road are in need of cleaning (Figure 3). There is a significant buildup of sediment behind each of the stone check dams. The ditches along the east side of the road are deep and narrow, which has resulted in bottom incising. There appears to be enough space at the road shoulder to create parabolic (wide “U” shaped) ditches, replacing the narrow “V” shaped ditches. Ditches with gradual side slopes (maximum 2H: 1V ratio) and a wide bottom (at least 2 feet) are preferred. Seed and mulch should be applied to all raw earth surfaces with grades less than 2%, biodegradable, non-welded matting and seed should be used on ditches with grades between 2% and 5%, and stone lining should be installed in ditches with grades greater than 5%. Stone check dams could also be incorporated into the design, especially on slopes greater than 5%. Check dams should be comprised of a well graded stone matrix 2 to 9 inches in size. Dams should not exceed 2 feet in height and check dam crest should be at least 6” below the top of the ditch.

Figure 1. Ditch erosion along eastern side of Shenang Rd, and heavy sediment buildup behind check dams along western side of the road.

4.3.3.2. Undersized Culvert Replacement (Problem Area ID: BC-5)

A culvert, which conveys an unnamed tributary to the Black Creek beneath Shenang Rd, is too short for the current width of the road, resulting in unstable conditions at both the inlet and outlet. Generally, vegetated slopes should be at least to 2:1 (horizontal to vertical) to maintain stable conditions. Erosion of the over-steepened slopes surrounding the culvert will lead to deteriorating road shoulder conditions in the near- to medium-term. In addition, the existing culvert pipe is undersized (approximately one-half bankfull width) and perched approximately six inches above the stream bottom at the culvert outlet.

In general terms, the replacement culvert should be long enough to accommodate 2:1 slopes at the inlet and outlet, and sized such that it matches the stream's bankfull width and can be buried 1/6th bankfull stream width to provide a natural bottom.

Figure 2. Outlet of undersized culvert carrying unnamed tributary to Black Creek under Shenang Rd.

4.3.4. Ridge Road (Problem Area ID: FR-2)

Portions of the roadside ditch along Ridge Road, starting about four miles east of the intersection with South Rd, are narrow with steep backslopes. This ditch geometry has increased the velocity of water in the ditch during storm events, leading to incision and bank slumping. Ditches could be stabilized by making them wider, with a parabolic-shaped bottom. The ditch may need to be stone lined in sections where the grade is steeper than 5%. Stone check dams are also recommended in order to reduce flow velocities and limit sediment transport.

Figure 5. Ridge Road problem area. An area of ditch erosion is highlighted.

4.3.5. Chester A. Arthur Road (Problem Area ID: WB-4 and WB-6)

Chester A. Arthur Road is a paved road that runs from North Road to West Enosburg Road, with several stream crossings in both the Wanzer Brook and Black Creek watersheds. A number of the crossings appear to have been recently improved; however, two improvement opportunities were found within the Wanzer Brook watershed portion on this route:

- An undersized bridge crossing near 2958 Chester A. Arthur Road.
- Shoulder maintenance to promote sheet flow just east of the junction with Dodd Road.

The location of each opportunity is shown in Figure 6, and both are described in more detail in the subsections that follow.

Figure 6. Locations of two potential improvement areas along Chester A. Arthur Rd are highlighted.

4.3.5.2. Undersized Bridge Crossing

A small bridge crossing, located near 2958 Chester A. Arthur Road, is less than half bankfull width, resulting in the formation of a large scour pool immediately downstream of the bridge. The bridge crossing appears to have been constructed fairly recently, so replacement seems unlikely. Rip rap armor will help to stabilize the banks and reduce future erosion.

Additionally, 1-3 inch gravel lips have formed on the shoulder of the road, east of the crossing. The lip prevents stormwater runoff from leaving the road surface as sheetflow, which results in significant sediment transport along the road edge, which is eventually deposited on the bridge crossing. The gravel shoulder should be lowered; one approach would be to use a shouldering disk to remove the lip and allow for better drainage.

4.3.5.3. Shoulder Maintenance

A culvert east of the junction with Dodd Road that carries Wanzer Brook under Chester A. Arthur Road appears to have been recently constructed. The banks above the newly installed culvert are steep and comprised of loose gravel that does not appear to have been compacted, resulting in an unstable condition. Additionally, a lip of vegetation at the road shoulder near the culvert prevents runoff from leaving the road surface and entering the existing ditch as sheetflow. This condition leads to concentrated flows from the road surface being discharged over the bank at the culvert, exacerbating bank erosion.

One option would be to replace the gravel material above the culvert inlet and outlet with a more stable material (i.e. rip rap); another option is to install erosion protective mats that will allow vegetation to establish to help stabilize the bank. The shoulder lip should also be removed in order to allow stormwater runoff to enter the ditch, and minimize conveyance of stormwater flows along the road surface.

4.3.6. Bradley Road (Problem Area ID: FR-4)

Sections of Bradley Road have a ridge between the road crown and the ditch, which prevents runoff from leaving the road surface and entering the ditches as sheetflow. The excess water has formed a "secondary swale" in the roadway near the edge of the travel surface, leading to increased sediment transport and accelerated erosion. Measures to prevent this type of erosion include:

- Crowning the roadway so water does not remain on the road surface. For roadways that are not super-elevated, this generally means a 2-4% (1/4" - 1/2" per ft) crown for gravel roads and a 1-2% (1/8" - 1/4" per ft) crown for paved roads to promote sheeting of water.
- Avoiding creation of a ridge or berm between the crown and the ditch when grading gravel roadways. Any berm along the roadway shoulder that prevents the proper sheeting of water should be removed.
- Roadways should have at least a 15-inch thick processed gravel subbase, with the top 3 inches (minimum) as crushed gravel.

The Federal Highway Administration's *Gravel Roads: Maintenance and Design Manual* is a good reference guide.

Figure 4. Berm at road edge prevents runoff from leaving road surface.

Figure 4. Formation of "secondary swale" on road surface.

4.3.7. Northrop Road (Problem Area ID: WB-3)

Several stormwater improvement opportunities were identified on the portion of Northrop Road west of Talcott Road (Figure 9). This is another area where a ridge has formed between the road crown and the ditch, which prevents runoff from leaving the road surface and entering the ditches as sheetflow. The excess water has formed a “secondary swale” in the roadway near the edge of the travel surface, leading to increased sediment transport and accelerated erosion. Sediment from the road surface is now clogging portions of the ditches near Talcott Rd. Additionally, the existing ditches are too narrow and deep, which has led to bottom incising and bank slump. Again, there appears to be enough space at the road shoulder to create parabolic ditches to replace the narrow “V” shaped ditches. Ditches with gradual side slopes (maximum 2H: 1V ratio) and a wide bottom (at least 2 feet) are preferred, and should incorporate stone lining and check dams in steeper sections to control water velocities.

Figure 9. Location of potential improvement area along Northrop Rd.

5. NEXT STEPS

This document represents an extensive effort to identify and evaluate potential stormwater problem areas throughout the Town of Fairfield. Several high priority potential stormwater improvement projects, including conceptual solutions, were identified in Section 4 that the Town could pursue directly, or could work with partners to pursue funding to address.

Beyond addressing the specific problem areas identified in this plan, there are often opportunities to improve management of stormwater runoff that arise as part of routine municipal projects, such as the substantial reconstruction of a road surface or intersection. Grant funds may be available to cover the incremental cost of addressing stormwater runoff as part of such projects, if stormwater management is considered early enough in the design project. It is often significantly more cost-effective and efficient to incorporate stormwater management measures into a planned municipal project as compared to the construction of a “stand alone” stormwater management retrofit.

In addition to exploring opportunities to address current stormwater management needs, the Town of Fairfield can take steps to prevent future stormwater problems by expanding how stormwater management is addressed in zoning regulations. Specifically, the Town could consider incorporating one or more of the following elements into the zoning regulations:

- Require a certain amount of stormwater runoff be treated as part of all development and redevelopment projects; and
- Articulate a clear preference for low impact development practices that seek to infiltrate and soak away, as opposed to store and release, stormwater runoff into the land use and development regulations.

Some specific examples of how this might be accomplished include:

- Modifying access requirements to minimize impervious surfaces. Thoughtful siting and design of streets helps achieve stormwater control “at the source,” which means less runoff requiring management and less impact on downstream waterbodies. Reducing the width of paved surfaces also lowers development and maintenance costs.
  - Fairfield’s current design policy for roads (Town of Fairfield, 2006) with an anticipated average daily traffic of 0-25 cars requires a right-of-way be “at least 20 feet wide”. For roads of any size, “If cul-de-sacs or dead end turn-arounds are accepted, the minimum radius shall be sixty feet.”
    - Consider further subdividing the “Anticipated Average Daily Traffic” for 0-25 cars in order to specify narrower minimum road widths for particularly low traffic roads.
    - Strategies that reduce the imperviousness of cul-de-sac design include reducing the required radius (to 30 or 35 feet), incorporating a landscaped island into the center of the cul-de-sac that can be used to treat stormwater, or creating a hammerhead-shaped turnaround.
- Revising parking standards to encourage minimal use of impervious surface. For example:
  - Changing the definition of a “parking space” to no longer require a minimum of 200 square feet of space; 9’ by 18’ parking spaces (162 square feet) are more typical.

- Recommend or require smaller stalls for compact cars, up to 30% of the total number of parking spaces.
- Re-evaluate specified parking requirements to prevent the creation of surplus parking. This could involve establishing parking requirements which reflect average parking demand rather than maximum demand. The Board of Adjustment could also be given the power to reduce parking requirements conditionally rather than to only “require additional or shared parking and loading space, if it is found that the specified standards are not sufficient”.

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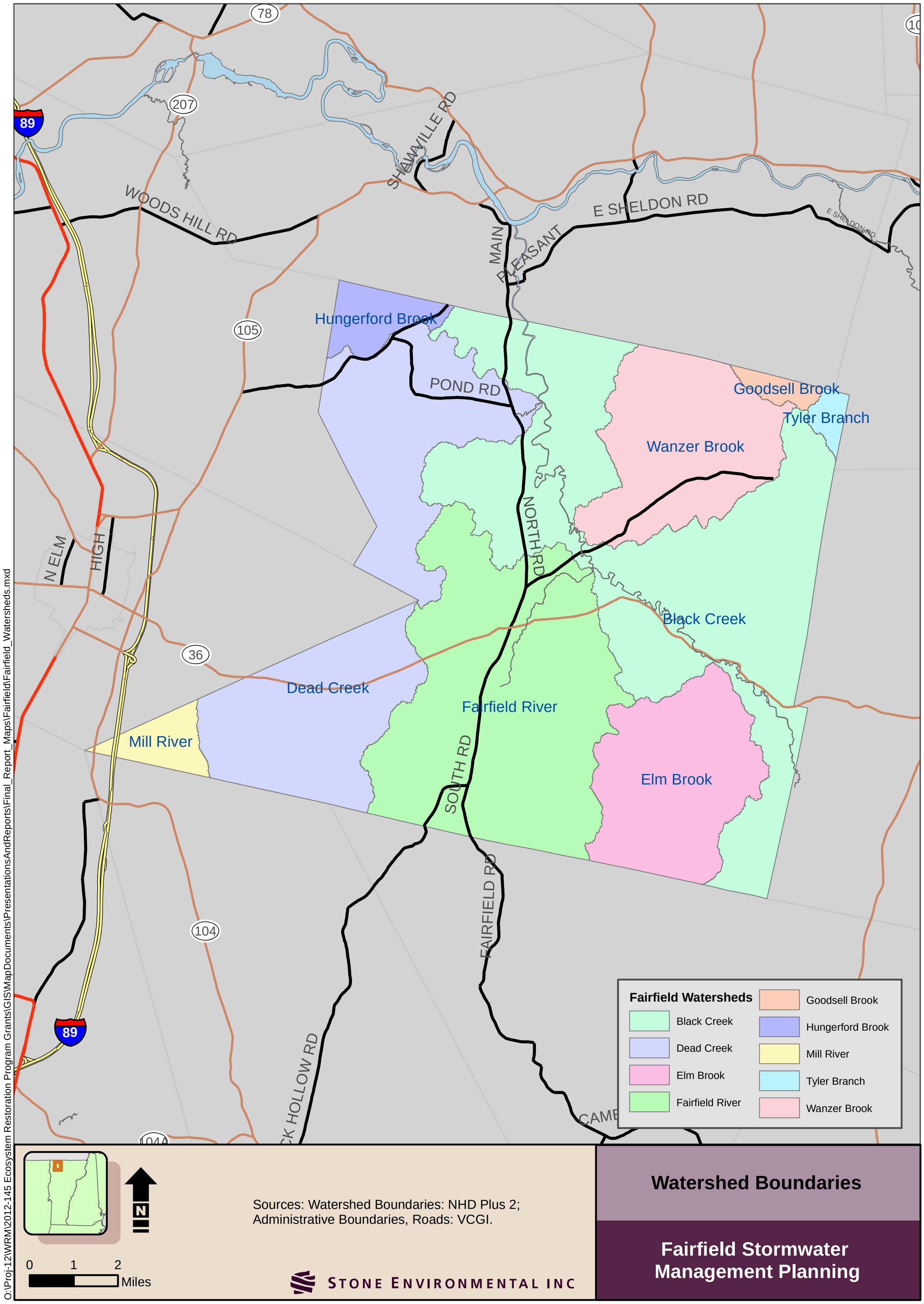
APPENDICES

APPENDIX A : WATERSHED MAP


Watershed Boundaries
Fairfield Stormwater Management Planning
Fairfield Watersheds
Black Creek
Dead Creek
Elm Brook
Fairfield River
Goodsell Brook
Hungerford Brook
Mill River
Tyler Branch
Wanzer Brook
Sources: Watershed Boundaries: NHD Plus 2;
Administrative Boundaries, Roads: VCGI.
STONE ENVIRONMENTAL INC
0 1 2
Miles
N
Hungerford Brook
Goodsell Brook
Tyler Branch
Wanzer Brook
Black Creek
Dead Creek
Fairfield River
Mill River
Elm Brook
WOODS HILL RD
E SHELDON RD
SHAWVILLE RD
MAIN
PLEASANT
POND RD
NORTH RD
SOUTH RD
FAIRFIELD RD
N ELM
HIGH
89
78
207
105
36
104
O:\Proj-12\WRM\2012-145 Ecosystem Restoration Program Grants\GIS\MapDocuments\PresentationsAndReports\Final_Report_Maps\Fairfield\Fairfield_Watersheds.mxd

APPENDIX B : STORMWATER MANAGEMENT PLANNING LIBRARY

STORMWATER MANAGEMENT PLANNING LIBRARY

TOWN OF FAIRFIELD

July 1, 2013

Prepared for:

Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488
Tel. / 802.933.6677
E-Mail / info2FNLC@gmail.com

Prepared by:

Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier, VT 05602
Tel. / 802.229.4541
E-Mail / info@stone-env.com
Stone Project ID / 12-145

STONE ENVIRONMENTAL INC

TABLE OF CONTENTS

1. BACKGROUND

Water knows no political boundaries, and so evaluations of water quality tend to be undertaken along watershed boundaries and to involve land areas in multiple municipalities, counties, and, in the case of Lake Champlain, countries. For example, the Missisquoi River watershed area includes part or all of twenty northern Vermont communities in three counties. Although from a strict water quality perspective it would be ideal to manage our water resources along watershed lines, the reality is that many decisions, in particular decisions about land use, are made at the local level. This report is designed to summarize the information currently available from the suite of reports that speak to water quality in the various rivers, lakes, and streams that pass through or are located wholly within the Town of Fairfield, Vermont. Although water quality assessment data dating back to the early 1970s is available for the Missisquoi River watershed, this summary focuses on assessments and reports that have been prepared in the past twenty years. This report will serve as the basis for developing a Fairfield-specific list of strategic, prioritized projects that could be undertaken to improve water quality.

2. INTRODUCTION

The Town of Fairfield is located in Franklin County in northwest Vermont. The town has a total area of 67.4 square miles. As of the 2010 census the population of the town was 1,891.[1] Fairfield has a number of rivers, streams and ponds within its borders, including portions of the Dead Creek, Black Creek, Fairfield River, Elm Brook, and Wanzer Brook (See Figure 1 for a map of watershed boundaries). Development in the area is primarily concentrated in Fairfield and East Fairfield.

Black Creek, and its tributaries Dead Creek, Fairfield River, and Elm Brook, drain the majority of Fairfield. Dead Creek drains the western 1/3 of town, the Fairfield River, Wanzer Brook, and numerous unnamed brooks drain the central 1/3 of town. Elm Brook and assorted unnamed Black Creek headwaters (namely Chester Brook, an impaired surface water) drain the eastern 1/3 of town. Small portions on the edges of the town drain to various water bodies as follows: the southwest corner drains to Mill River, the northwest corner drains to Hungerford Brook, and the northeast corner drains to Goodsell Brook and Tyler Branch. With the exception of Mill River, all of the aforementioned waters eventually drain to the Missisquoi River; Mill River discharges directly to Lake Champlain. Fairfield Pond, in northwestern Fairfield, is one of the two major lakes/ponds in the Missisquoi bay watershed.

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Fairfield's water resources, and the important interface between water resources and local land use decisions. At times these evaluations have followed watershed boundaries and other times they have followed political boundaries. The following sections identify evaluations that have been done to date and pull out the pieces 1) most relevant to Fairfield and 2) most relevant to future efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Fairfield.

[1] Derived from US Census data, hosted by VT Center for Geographic Information: http://vcgi.org/

3. WATERSHED-BASED ASSESSMENTS

The ongoing assessments described below are generally led by the State of Vermont's Agency of Natural Resources (ANR). These include:

- Basin planning efforts, whose main purpose is to guide ANR in its own work and in collaborative projects with the public, municipalities, and other state and federal agencies. The basin plans have a five-year scope. The town of Fairfield is within the Missisquoi Basin, last updated in March of 2013.
- Stream geomorphic assessment work, undertaken to understand the natural tendencies of a particular reach of stream or river, its current condition, and what changes may be anticipated in the future. Stream geomorphic assessments have been completed for two stream/river segments within Fairfield: Black Creek and Wanzer Brook.
- In-stream water quality assessment work, including the water chemistry and biological assessments.

3.1. Missisquoi River Watershed Water Quality Management Plan[2]

The Missisquoi River Basin Water Quality Management Plan, most recently revised in March of 2013, overviews water resources, and identifies concerns and threats to water quality within the more than 619 square miles of Vermont that drain to the Missisquoi River. Utilizing recommendations from a broad array of stakeholders, the Plan summarizes strategies and specific actions to guide efforts to sustain and improve water quality and aquatic habitat over the next five years.

The Plan's high priority strategies include:

- Implement projects to meet the phosphorus reduction targets for Lake Champlain and Lake Carmi, and to meet the bacteria reduction targets for Berry, Godin and Samsonville Brooks.
- Evaluate the feasibility of removing the Swanton Dam.
- Augment stormwater system mapping and address 13 suspected illicit discharges identified in the town of Enosburg Falls, North Troy, Richford, and Swanton.
- Support stormwater master planning and plan implementation in Swanton, Highgate, Enosburg Village and Falls, and Richford.
- Assist town road foremen with the identification and remediation of erosion from town roads by promoting Better Backroads inventories and projects in Lowell, Albany, Troy, Jay, Westfield, Berkshire, and Highgate.
- Work with towns, VTrans and private landowners to use existing culvert assessments to identify appropriate replacement size and placement to improve fish passage and the geomorphic stability of the stream.
- Use the Critical Source Area study to direct technical and financial agricultural resources to identified critical sources.

[2] http://www.vtwaterquality.org/mapp/docs/mp_Basin06Plan.pdf

- Work with towns to protect river corridors and promote flood resiliency by establishing Fluvial Erosion Hazard zones and buffer zones in local zoning.
- Identify wetlands on agricultural lands for phosphorus retention, and in the river corridor for sediment attenuation, and then prioritize and conserve and/or restore.
- Encourage use of the basin's rivers and lakes to increase people's appreciation of the water resources.
- Assist the towns to address specific wastewater treatment infrastructure upgrade needs identified in the Clean Water Fund's forthcoming Water Survey.

More specifically, the Plan identifies the following concerns for the Mid Missisquoi River, as described below:

- Black Creek, from its mouth to East Fairfield, has been identified as a body of "water in need of further assessment" due to agricultural runoff concerns.
- Fairfield Pond has been identified as an altered water body due to the presence of Eurasian water milfoil.

3.2. Missisquoi Areawide Plan[3]

In 2008, the NRCS completed the Missisquoi Areawide Plan, a watershed-based plan designed to reduce the phosphorus load delivered to Missisquoi Bay. The document was structured to inform and help partner agencies and cooperating farmers. The Areawide Plan consists of a series of water quality improvement strategies that target efforts to specific priority areas. The strategies were developed in consultation with local stakeholders and representatives of various state and federal agencies. The Areawide Plan was designed to help move conservation implementation actions away from a "first come, first served basis" in order to target financial and technical resources to the areas of the watershed with the greatest conservation need. The plan includes a considerable amount of geospatial data, including information on farmstead location, annual crop and hay lands, and the adjacency of cropland to areas with steep slopes.

3.3. Identification of Critical Source Areas of Phosphorus in the Vermont Sector of the Missisquoi Bay Basin[4]

Critical Source Areas are areas of the landscape that, absent proper management, are likely to produce disproportionate amount of phosphorus loading to adjacent waterways. Detailed data about the distribution of potential Critical Source Areas (CSAs) of phosphorus to Missisquoi Bay were developed using a Soil and Water Assessment (SWAT) model. The areas identified using this modeling approach were selected primarily by their soils, landscape features, proximity and connectivity to streams, and the land use or farm crop practices that are in place or are likely to be in place. To view this data in an interactive map, visit lcbp.stone-env.com.

From a stormwater management standpoint, phosphorous critical source areas are areas of development (including roads) with a high potential for stormwater runoff. In general, roads with steep grades are particularly vulnerable to runoff and likely to be identified as CSAs. In Fairfield the CSAs identified by the model include:

[3] http://www.nrcs.usda.gov/wps/portal/nrcs/detail/vt/technical/dma/?cid=stelprdb1176944

[4] http://www.lcbp.org/wp-content/uploads/2013/04/63_Missisquoi_CSA.pdf

- Intersection of Route 36 and South/North Pond Road
- Route 36 between Pond Road and Hill Road
- Ridge Road east of South Road
- Mitchell Road (East of Dodd Road)

3.4. Stream Geomorphic Assessment Final Reports[5]

Stream geomorphic assessments have been completed for two stream/river segments within Fairfield: the Black Creek and Wanzer Brook. The assessment results are designed to direct future stream corridor restoration and protection measures. See Appendix B, Figures 2 – 13 for SGA maps of Fairfield-area rivers and streams.

3.4.1. Black Creek Corridor Plan[6]

This document utilizes the Phase 2 stream geomorphic assessment data for 17 reaches of the Black Creek to identify primary concerns and prioritize restoration projects. The Plan finds that although the watershed is largely undeveloped, land use change, erosion, and stream channel adjustment have limited the Black Creek watershed's nutrient attenuation abilities. As a result, there are numerous opportunities for restoration through establishment of buffers, removal of floodplain encroachments, and replacement of undersized infrastructure (bridges and culverts). Below are specific project recommendations from the Plan of reaches assessed that fell within the boundaries of Fairfield:

M02: Protect river corridor, plant stream buffer and Ag BMPs, targeting areas with buffers less than 25ft in width.

Project Location: From the confluence with Dead Creek to .8 miles downstream (end of reach M01).

M03A/B: Protect river corridor, plant stream buffer and Ag BMPs, targeting areas with buffers less than 25ft in width, restore incised reach, and remove berm (800ft) along left bank.

Project Location: Confluence with Dead Creek to 4.5 miles upstream.

M04A/B: Protect river corridor, plant stream buffer and Ag BMPs, targeting areas with buffers less than 25ft in width and field ditches.

Project Location: End of reach M03 to one mile upstream.

M05A/B: Protect river corridor, plant stream buffer and Ag BMPs (cattle exclusion), targeting areas with buffers less than 25ft in width, remove berm (2,000 ft).

Project Location: Confluence with Fairfield River upstream to Bruso Road crossing.

M06: Protect river corridor, plant stream buffer and Ag BMPs and remove berm (500 ft) on left bank northeast of Rt. 36.

Project Location: South of Bruso road to 1,000 ft south of Rt. 36.

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[5] https://anrnode.anr.state.vt.us/SGA/finalReports.aspx

[6] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=56_CPA&option=download

M07: Protect river corridor, plant stream buffer and Ag BMPs and remove berm (1,000 ft) south of Rt. 36.

Project Location: Confluence with Elm Brook to East Fairfield village.

M08: Protect river corridor and remove berm along entirety of reach.

Project Location: End of M07 to 1.1 miles upstream.

T2.01A: Protect river corridor and plant stream buffer.

Project Location: Tributary confluence with Black Creek to 1 mile upstream.

T4.01: Restore incised reach.

Project Location: Tributary confluence with Black Creek to.6 miles upstream.

T4.05A: Plant stream buffer and install cattle fencing.

Project Location: End of T4.04 to 0.8 miles upstream.

Under the Ecosystem Restoration Program there is an ongoing project to remove 1,200 feet of railroad berm (M03A/B, M05A/B, M06, M07 and M08) along the Black Creek (see section 4.2.4).

3.4.2. Wanzer Brook Corridor Plan[7]

This document summarizes Phase 2 geomorphic assessment data for 12 reaches of the Wanzer Brook to identify and evaluate stressors and prioritize restoration/conservation projects. Below is a summary of priority reach project recommendations.

(Tributary ditch to) T3.3S1.01: Stabilize headcut and divert barnyard runoff.

Project Location: Ryan/Magnan Farms.

T3.3S1.01: Stabilize headcut, plant stream buffers, and exclude cattle.

Project Location: Boomhower Farm.

T3.2S1.01: Replace stream ford with appropriate crossing, re-route/attenuate farm road runoff flow, and protect corridor (stream buffer planting).

Project Location: Tiffany Farm.

T3.3S1.01: Exclude cattle and improve/plant stream buffers.

Project Location: Ryan farm upstream of Chester A. Arthur Road.

T3.05-B: Exclude cattle and improve/plant stream buffers.

Project Location: Riley Farm downstream of Pumpkin Village Road.

T3.05-B: Restore wetland, relocate driveway and manage beavers.

Project Location: Callan Farm upstream of Pumpkin Village Road.

In addition to reach-level priorities, this document identifies three primary watershed level management options; improve road maintenance practices, [improve] crossing structures, and [utilize] town planning.

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[7] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=52_P2A&option=download

Improved road maintenance should include stabilizing road surfaces, improving roadside ditches, alternative grading, re-orientation of culvert crossings, and culvert heading protection. Priority sites for improved maintenance include Pumpkin Village Road (reach T3.05 and T3.5S1.01), Chester A. Arthur Road (reaches T3.3S1.02 and T3.3S1.4S1.01), and Wanzer Road (reach T3.01).

At least two of the projects identified by this SGA have been completed since 2005 (see section 4.2.4 for more details).

- Boomhower Farm: VT DEC, USFWS, and USDA NRCS restored the segment of the Wanzer Brook running through Boomhower Farm (reach T3.3S1.01). This project included the purchase of a river corridor easement and restoration of a floodplain along 2,000 feet of Wanzer Brook. Completed 2007.[8]
- Chester A. Arthur Road: Funding from the Better Backroads program was used to stabilize ditches and edges of the road.

3.5. Ambient Biomonitoring Data[9] (1985 – present)

ANR's biomonitoring program evaluates the abundance and composition of the stream insect (macroinvertebrate) community to assess the overall environmental condition of wadable streams and rivers throughout the state. Assessed streams are given a qualitative ranking, ranging from Poor to Excellent. Data on fish communities is often collected at the same time. ANR is able to use this data to assess impacts of wastewater treatment plants, acid rain, agricultural practices, and the removal of streamside vegetation. In Fairfield, there is biomonitoring data for the Black Creek. Macroinvertebrate and fish data are summarized in the table below.

Location	Assessment Type (Fish/Macroinvertebrate)	River Mile	Date	Assessment
Black Creek	Fish	15.4	2008	N/A
Black Creek	Fish	14.5	2009	Good
Black Creek	Macroinvertebrate	15.5	2009	Good

3.6. LaRosa Volunteer Data[10] (2007 – 2011)

Since 2007, water samples have been collected by the Missisquoi River Basin Association at two sites in Fairfield; one on Black Creek and one on Wanzer Brook. Samples were collected from both water bodies between 2008 and 2011, and additionally from Black Creek in 2007. Samples were analyzed by the VT DEC's LaRosa laboratory for total nitrogen, total phosphorous, and turbidity. All sample results are available online at the source listed below.

Between 2008 and 2011 data analysis suggests higher average total nitrogen, total phosphorous, and turbidity levels in Black Creek than in the Wanzer Brook. 2010 was an exception, with higher average total nitrogen and

[8] http://www.vtwaterquality.org/rivers/docs/rv_RiverCorridorEasementGuide.pdf

[9] Courtesy of Rich Langdon, VT DEC (Rich.Langdon@state.vt.us)

[10] http://www.vtwaterquality.org/cfm/larosavm/mp_larosavolmon.cfm

turbidity concentrations in Black Creek than in Wanzer Brook. Despite generally higher average concentrations in Black Creek, pollutant levels often followed a similar trend in both water bodies with concentrations spiking and attenuating during the same time periods. That said, pollutant concentrations did differ occasionally between the two bodies of water. See Table 1 for a tabulated summary of pollutant concentration averages.

In July and August of 2008, the total nitrogen and total phosphorus concentrations spiked in Wanzer Brook, relative to Black Creek. In June of that year the turbidity concentration in Black Creek spiked substantially. Concentrations through 2009 trended without notable fluctuations. In September of 2010, total phosphorus and turbidity concentrations in Wanzer Brook spiked. In June of 2011, total phosphorus and turbidity levels trended higher in Black Creek than in Wanzer Brook.

Unfortunately, it is not possible to determine what portion of the measured pollutant load is attributable to runoff from agricultural areas as opposed to developed land.

3.7. Impaired Surface Waters[11]

Every two years, under section 303(d) of the Clean Water Act (CWA), states are required to list impaired waters in need of total maximum daily loads (TMDL). Impaired waters are those that continually fail to meet quantitative water quality criteria (Vermont Water Quality Standards (VWQS) in the case of Vermont waters). TMDLs are load allocations for point and nonpoint sources of pollution appropriate for a particular body of water for it to meet water quality standards. The following are water bodies within Fairfield listed under section 303(d) as impaired surface waters in need of TMDL.

- Wanzer Brook: Fails to meet VWQS because of nutrient and sediment pollution due to agricultural runoff. Wanzer Brook has a high TMDL priority, suggesting completion of TMDL within 1-3 years.
- Chester Brook: Fails to meet VWQS because of nutrient and sediment pollution due to agricultural runoff. Chester Brook has a high TMDL priority, suggesting completion of TMDL within 1-3 years. Chester Brook is located in the eastern half of the Black Creek watershed.

4. MUNICIPALITY-SPECIFIC ASSESSMENTS

In addition to the watershed-based assessments, a number of pieces of data are developed on a municipality-by-municipality basis. These are important to fold into any effort to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Fairfield. These include direct feedback from the Town, work by the Vermont Agency of Transportation, as well as past and current planning initiatives.

4.1. Town Feedback

In meetings with Stone Environmental, Town officials identified 20 areas of concern and priority projects throughout Fairfield, ranging from areas of active stream erosion to road flooding during high-water events. See Figure 15 and Table 2 for a map and table of concern areas and priority projects; Figure 14 and Table 2

[11] http://www.vtwaterquality.org/mapp/docs/mp_2012_303d_Final.pdf

also include the locations of concerns identified in the stream geomorphic assessments as described in Section 3.4.

4.2. Vermont Agency of Transportation-Sponsored Programs

4.2.1. Vermont Online Bridge and Culvert Inventory Data[12]

Vermont has 2,699 long structures (bridges and culverts) greater than 20 feet on interstate, state, and town routes and another 1,276 short structures between 6 and 20 feet on the state system that the state Agency of Transportation (VTrans) inspects. Inspections are conducted every 24 months on long structures and every 60 months on short structures unless conditions warrant more frequent inspections. Data collected as part of these inspections can help identify not only bridges and culverts with structural deficiencies but also structures that may be adversely impacting water quality. The system contains a detailed accounting of the 24 bridges and 383 culverts in Fairfield.

4.2.2. Stream Geomorphic Assessment, Failure Modes Data[13]

Failure Modes- Problems and Causes

This document records the failure modes of a select group of bridges and culverts along the Missisquoi River through Fairfield. The tables provide a structure number and a road name for the structure. Typical problems with structures are scouring of the bank, other erosion issues, and poor structure placement.

Structure Failure Modes

This document is similar to the Failure Modes Problems and Causes, but includes issues such as sediment deposits, obstructed structures, floodplain problems, and beaver dams.

4.2.3. Better Backroads Program[14]

The Town of Fairfield has been successful in obtaining grants from the Agency of Natural Resources and the Better Backroads Program to address some of the most pressing erosion issues that threaten local roads and bridges.

Starting in the summer of 2013, the administrative and technical assistance functions of Better Backroads Program will move from Northern Vermont Resource Conservation and Development Council to VTrans. These changes are being made in response to federal funding requirements and program needs. VTrans will be making a variety of changes, including use of state, rather than federal, funding for municipal grants.

4.2.4. Ecosystem Restoration Program Projects[15]

The State of Vermont maintains a database of project completed with full or partial funding from the Ecosystem Restoration Program (ERP). There are 13 projects in the ERP database that have taken place in

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[12] http://apps.vtrans.vermont.gov/BridgeAndCulvert/Login.aspx?ReturnUrl=%2fBridgeAndCulvert%2fDefault.aspx

[13] https://anrnode.anr.state.vt.us/SGA/datasets/selectReport.aspx?sortType=Town&bid=06&bnm=Missisquoi

[14] http://www.vtwaterquality.org/erp/htm/backroads.htm

[15] http://www.vtwaterquality.org/erp/projects/

Fairfield; the projects range from planning and assessment through to project implementation. Below is a brief description of each project and its status:

Project	ERP Program	Description	Start Year	Status
Juaire Road	Better Backroads	Stabilize ditch	2004	Complete
Mitchell Road	Better Backroads	Stabilize ditch	2004	Complete
Bradley Road	Better Backroads	Stabilize eroding ditch	2004	Complete
Bradley Road	Better Backroads	Stabilize ditch and slope	2005	Complete
Shenane Road	Better Backroads	Stabilize eroding ditch	2005	Complete
Morey Road	Better Backroads	Stabilize ditch and slope	2005	Complete
Wanzer Brook	River Management	River corridor project planning and development (fluvial erosion hazard risk assessment, mapping, Phase 3 SGA, etc.)	2005	Ongoing
Tyler Branch	River Management	River corridor project planning and development (Phase 2 SGA, landowner outreach, fluvial erosion hazard risk assessment, etc.)	2005	Ongoing
Chester Arthur Road	Better Backroads	Stabilize ditch and slope	2006	Complete
Callan Road	Better Backroads	Replace undersized culvert	2006	Complete
Black Creek	River Management	River corridor implementation project (remove rail embankment)	2007	Ongoing
Ridge Road	Better Backroads	Install stone lined ditch with check dams	2007	Complete
Gilbert Hill Road	Better Backroads	Install stone lined ditch	2008	Complete
Ryan Road	Better Backroads	Install stone lined ditch	2011	Complete
Pumpkin Village Road	Better Backroads	Erosion control	2012	Complete

4.3. Vermont DEC Stormwater Permitting Program

4.3.1. State Stormwater Permits

Currently, Vermont DEC requires that a stormwater permit be obtained when any construction, new development, or redevelopment, results in impervious or disturbed area equal to or greater than one acre, with stricter requirements in watersheds that are classified as stormwater impaired. The State has developed a suite of technical standards for stormwater-related mitigation that are outlined in the Vermont Storm Water Management Manual, Volumes I and II. For example, the goal of a stormwater management program during construction is to mitigate sediment loss during storm events—while during and after construction, the objective is to maintain as much of the pre-developed hydrology as possible.

4.3.2. Environmental Research Tool[16]

ANR's Environmental Research Tool allows the user to look up the location of stormwater permits that have been issued by ANR, as well as hazardous waste sites, brownfields, and spills. There are approximately 10 documented stormwater permits that have been issued to sites in the Town of Fairfield. Although all 10 of the issued permits are up-to-date (they have not expired), the age, style, size, and upkeep of an existing permitted facility may make it an excellent candidate for improvement to enhance stormwater management capabilities.

4.4. Fairfield Town Plan[17]

Four sections of the 2009 Fairfield town plan relate to stormwater management: Chapter 3, Utilities and Water (pg. 39) and Environment (pg. 49); and Chapter 4, Development Patterns (pg. 85) and Statement of Policy (pg. 101).

Within Chapter 3, the Utilities and Water section contains a brief description of the water supply system and wastewater treatment methods. Currently, all wastewater in Fairfield is treated onsite. The town is investigating alternative methods to wastewater treatment in case future development requires town management of wastewater. In 2011, Aldrich and Elliott Engineers completed phase 1 of a Wastewater Evaluation Study.[18] This phase included a homeowner survey, on site investigations, and GIS resource mapping in Fairfield Center, East Fairfield, and Fairfield Pond.

The homeowner survey found that 37% of both Fairfield Center and East Fairfield respondents would be willing to pay for a municipal wastewater system. Fewer Fairfield Pond respondents (21%) were interested in paying for a municipal wastewater system. Aldrich and Elliott visited 10 properties in Fairfield Center and identified, among other things, concerns with the Fairfield School's wastewater disposal system and 5 properties with insufficient area and conditions for a complying replacement wastewater system. Of the 11 properties visited in East Fairfield, Aldrich and Elliott identified a number of issues, ranging from one failed septic system overflowing into the Black Creek, to a couple of systems not meeting surface water setback requirements. Assessors found five properties with insufficient area and conditions for a complying replacement wastewater system. Around Fairfield Pond, Aldrich and Elliott visited 10 properties and found four properties with insufficient area and conditions for a complying replacement wastewater system, in addition to a few other issues, including surface water setback and seasonal high groundwater.

The Environment section includes a summary of surface wetlands, floodplains, and water (Black Creek, Fairfield Pond) and groundwater resources. There are over 2,000 acres of wetlands in Fairfield, including, most notably, the Fairfield swamp. Home to a variety of rare species and vital wetlands habitat, the swamp is an important natural resource in Fairfield. FEMA has recognized flood hazard areas in Fairfield, and the Town Plan recommends continued revisions the town's zoning regulations to meet NFIP standards.

A substantial portion of Black Creek "has been altered to the point that it is no longer viable…" due largely to agricultural runoff. To address the Town's water quality concerns the Town Plan recommends planting of

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[16] http://www.anr.state.vt.us/WMID/StormWater.aspx

[17] http://www.fairfieldvermont.us/wordpress/wp-content/uploads/2011/03/FairfieldPlanLR.pdf

[18] http://www.fairfieldvermont.us/Documents/Sewer%20Project/FF_Sewer_Survey.zip

vegetated buffers along stream and river banks, implementing Ag BMPs, and revising setback and vegetated buffer standards (Fairfield's 2006 Zoning Bylaws require a minimum 25 foot buffer from the edge of streams). This is especially noteworthy considering many of the high priority projects identified by the SGA reports, referenced in section 3.4, recommend planting of vegetated buffers.

The Town Plan also notes the eutrophic status of Fairfield Pond and its high phosphorus concentrations and frequent algal blooms. A 1992 VT DEC study found that three tributaries to the north and northwest (See Figure 14 for the location of tributaries T10, T1, and T2) contribute substantially to the lake's high phosphorus levels.[19] Addressing nutrient loading due to poor land use practices along these tributaries is one of the recommended ways to address water quality concerns. In summarizing groundwater resources in Fairfield, the Town Plan emphasizes the importance of maintaining surface water quality to prevent contamination of groundwater resources.

Within Chapter 4, the Development Patterns and Statement of Policy sections broadly summarize the corresponding information in Chapter 3 and list relevant town policies. For example, under Wetlands, the Town Plan notes that the policy is "development in proximity to natural areas should take place in such a way as to preserve their value for education, science, research, aesthetics, and recreation."

5. OTHER RELATED INFORMATION

There are a significant number of farm operations in the Town of Fairfield. Farmsteads (barn areas) often contain a large amount of impervious surface and may be an important source of stormwater pollution.

5.1. NRCS Conservation Practice #558—Roof Runoff Structure[20]

NRCS Standard #558 addresses the management of stormwater from farm structures; specifically, where roof runoff from precipitation needs to be:

- diverted away from structures or contaminated areas;
- collected, controlled, and transported to a stable outlet; or
- collected and used for other purposes such as irrigation or animal watering facility.

The total barn roof area on a farm can be substantial, often in excess of one acre (the threshold for state stormwater regulation in the developed landscape) and therefore roof runoff from farm barns can be an important source of unmanaged stormwater.

6. CONCLUSIONS

This report is being developed as part of a larger project, funded by Vermont DEC, which will ultimately lead to a set of community-specific, prioritized projects to address stormwater runoff. Rather than starting from scratch in identifying stormwater management needs, the project (and this report) is drawing from the

[19] Courtesy of Megan McIntyre, VT DEC (megan.mcintyre@state.vt.us)

[20] http://efotg.sc.egov.usda.gov//references/public/VT/VT558-0311.pdf

extensive library of water quality assessments and information that already exists, and augmenting it with interviews with local officials.

As this report demonstrates, there are numerous agencies and entities whose activities touch on various aspects of water quality in the Missisquoi watershed in general, and in the Town of Fairfield more specifically. This work is dynamic and ongoing, and so while this summary is believed to be comprehensive, it will be important to periodically review and update the content to ensure the most current information can be incorporated. A comprehensive inventory of existing water quality assessments serves as a basis for connecting land use, stormwater management, floodplain management, river management activities; and public infrastructure needs to more effectively address all of the issues which contribute to degradation of a watershed.

APPENDIX B: FIGURES

Figure 1. Fairfield watershed boundaries.

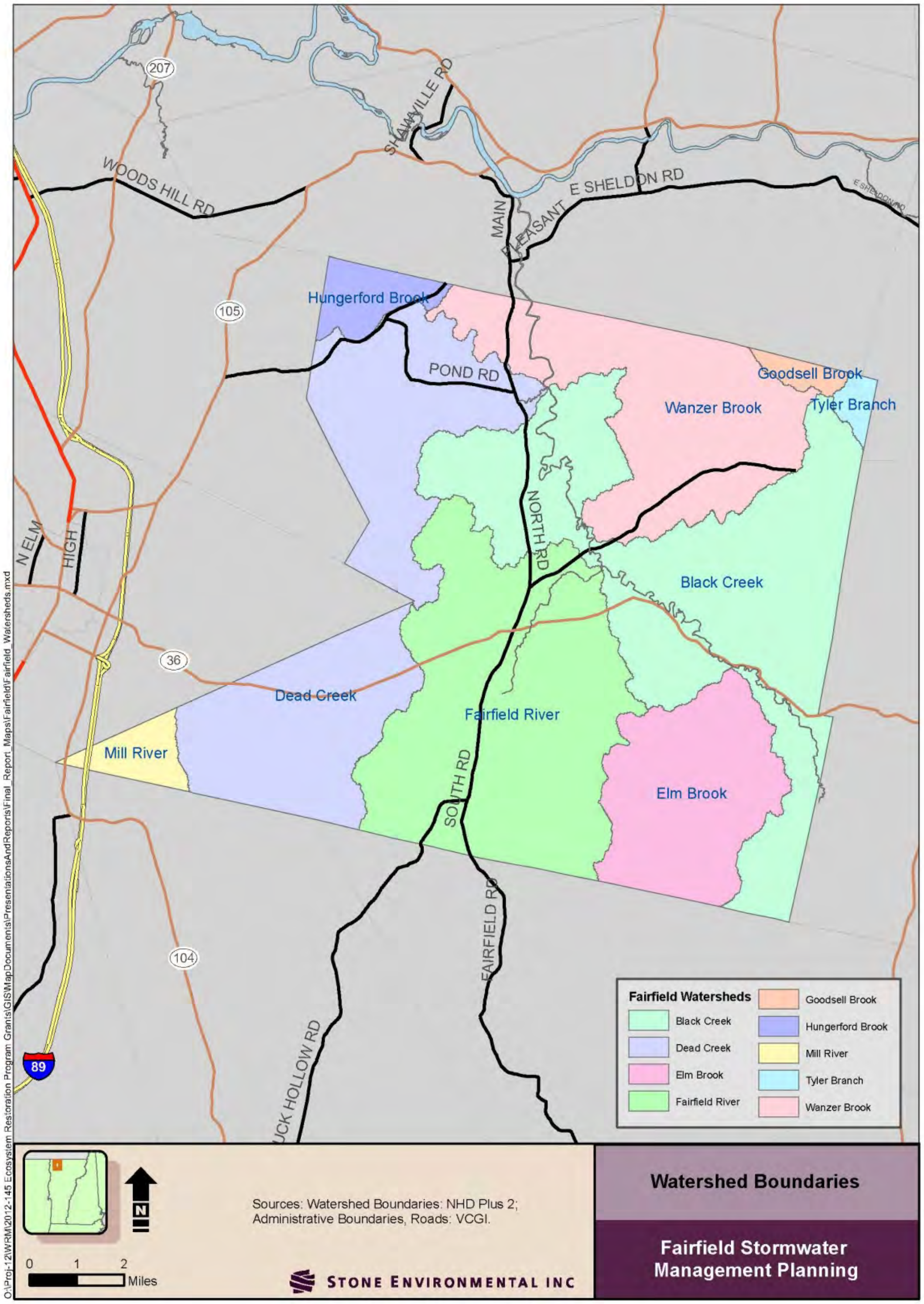


Figure 2. Dead Creek Reach Segment 1.

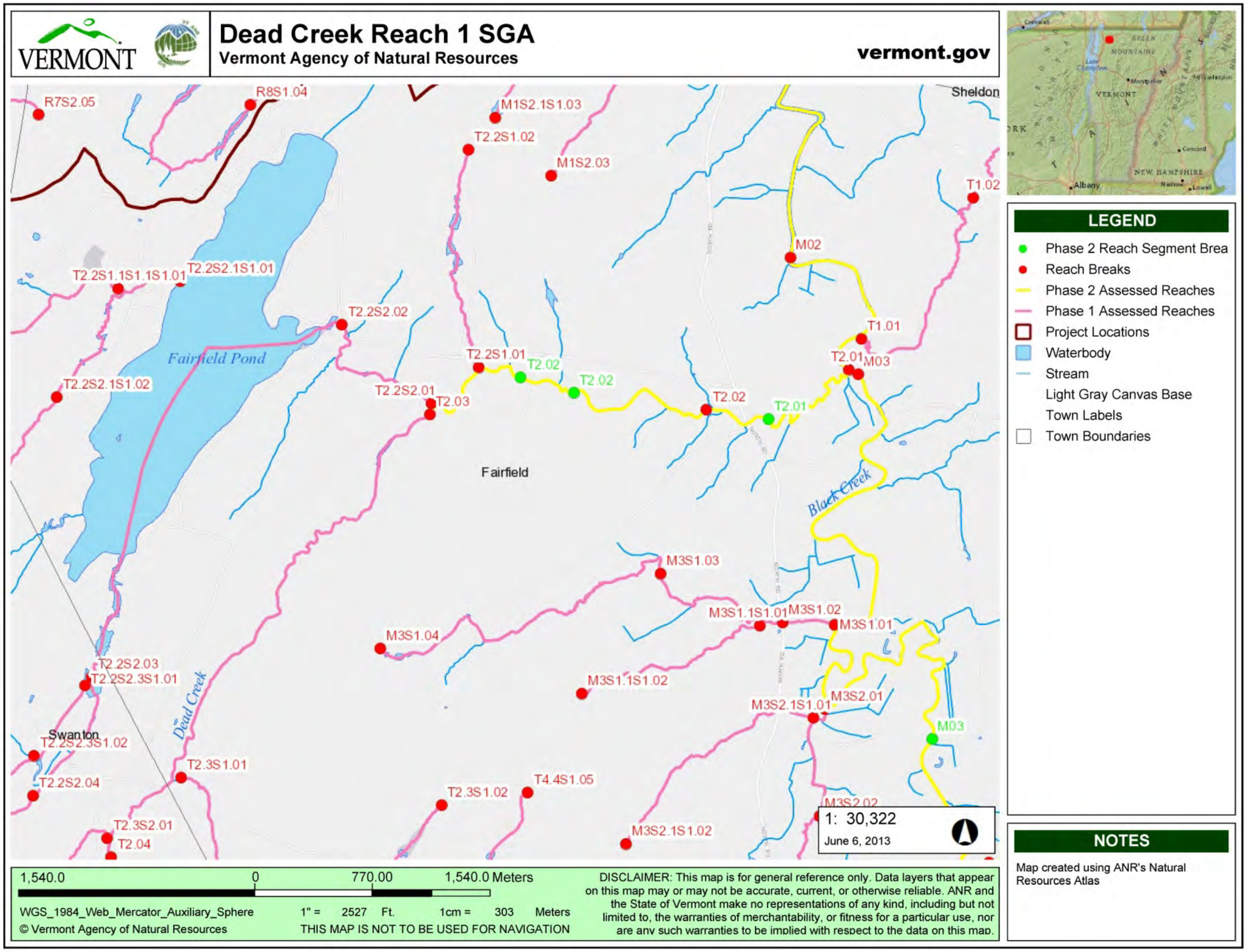


Figure 3. Dead Creek Reach Segment 2.

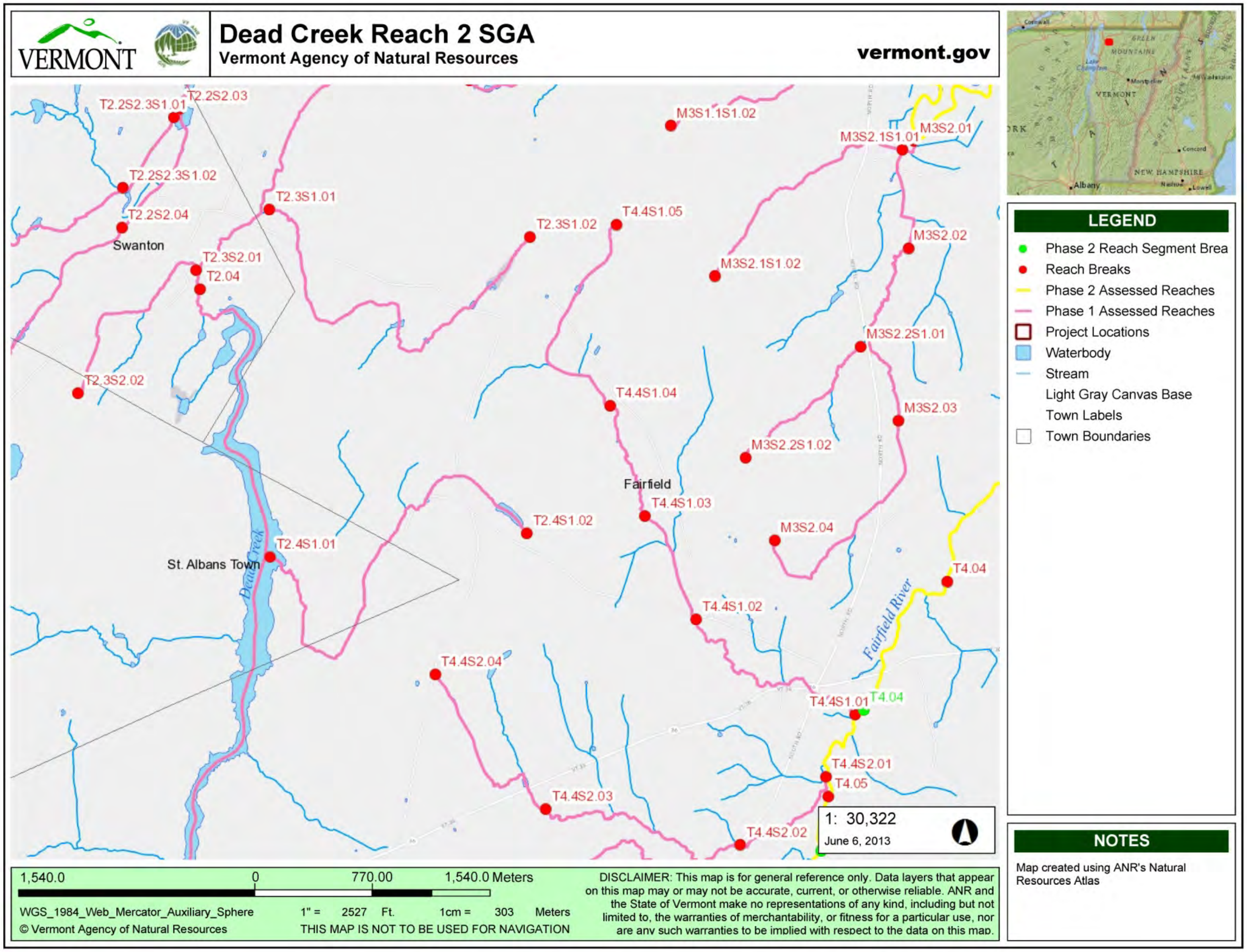


Figure 4. Dead Creek Reach Segment 3.

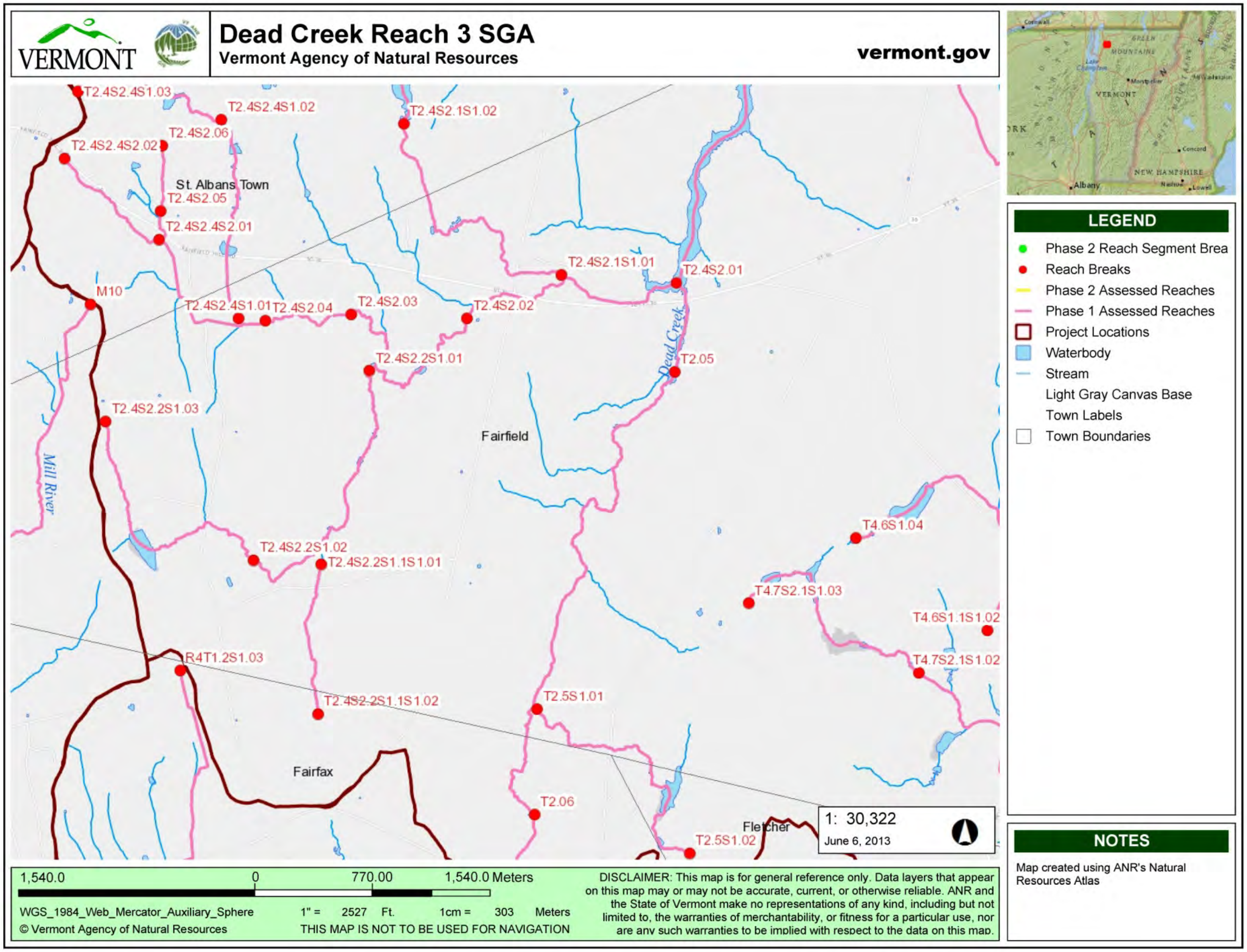


Figure 5. Black Creek Reach Segment 1.

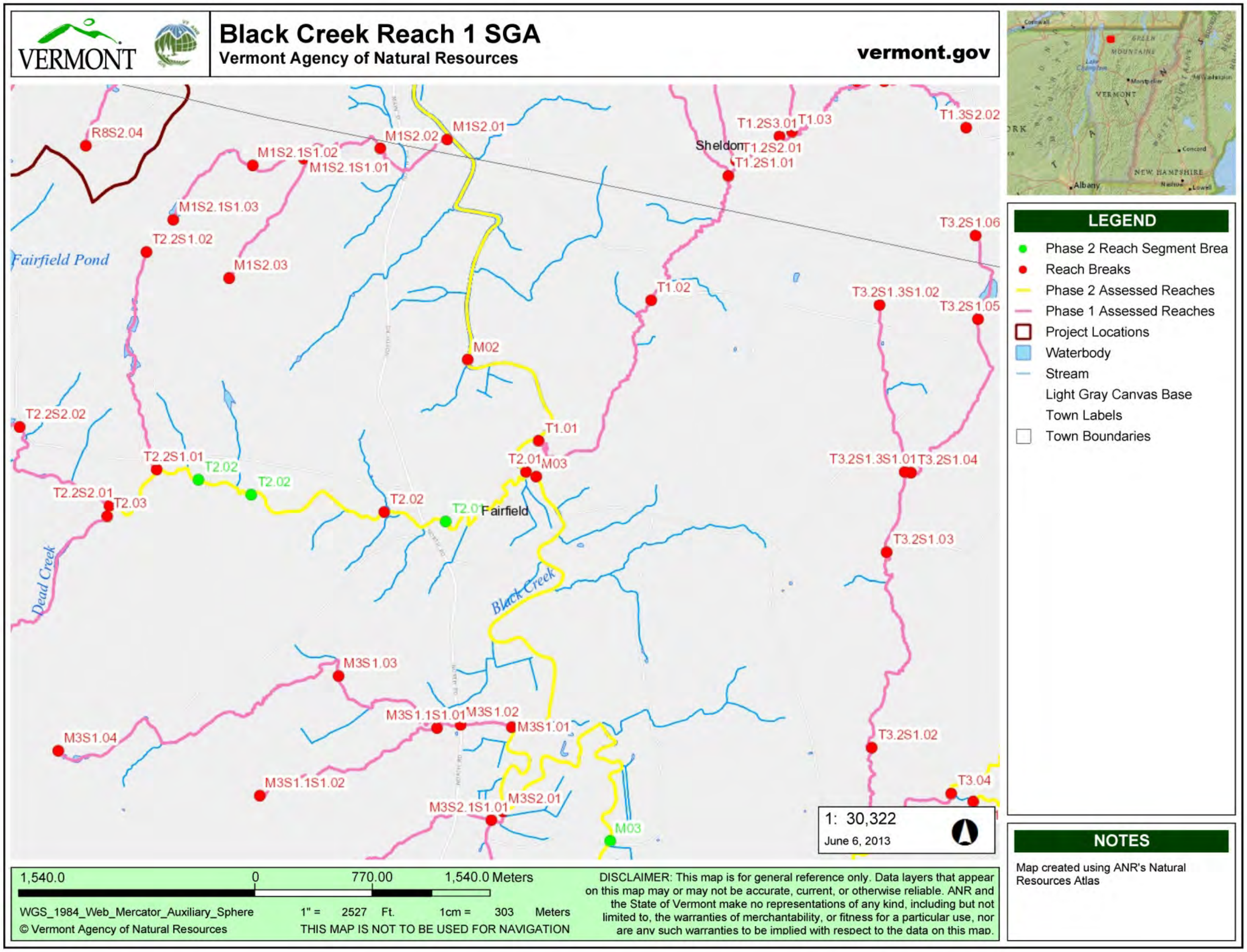


Figure 6. Black Creek Reach Segment 2.

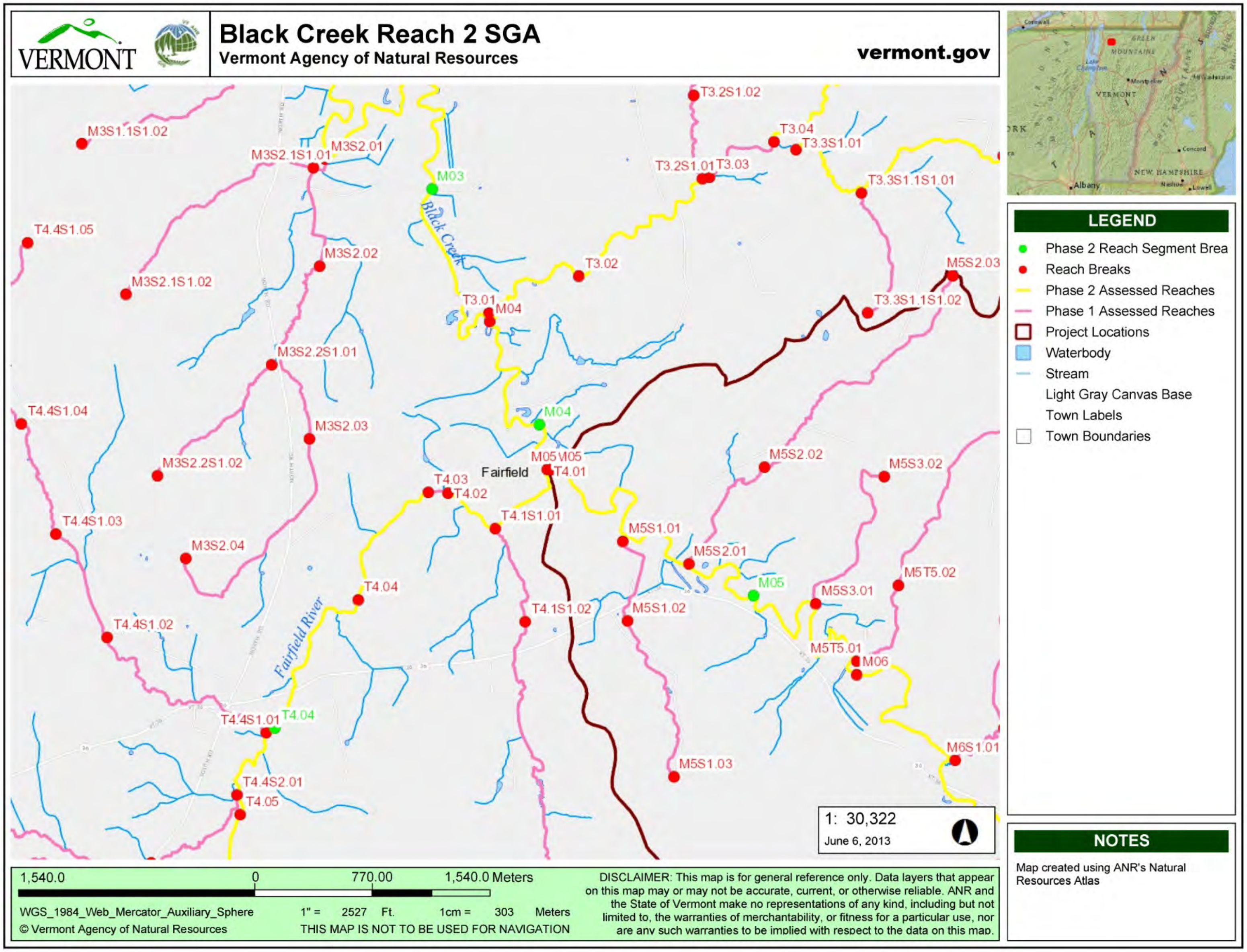


Figure 7. Black Creek Reach Segment 3.

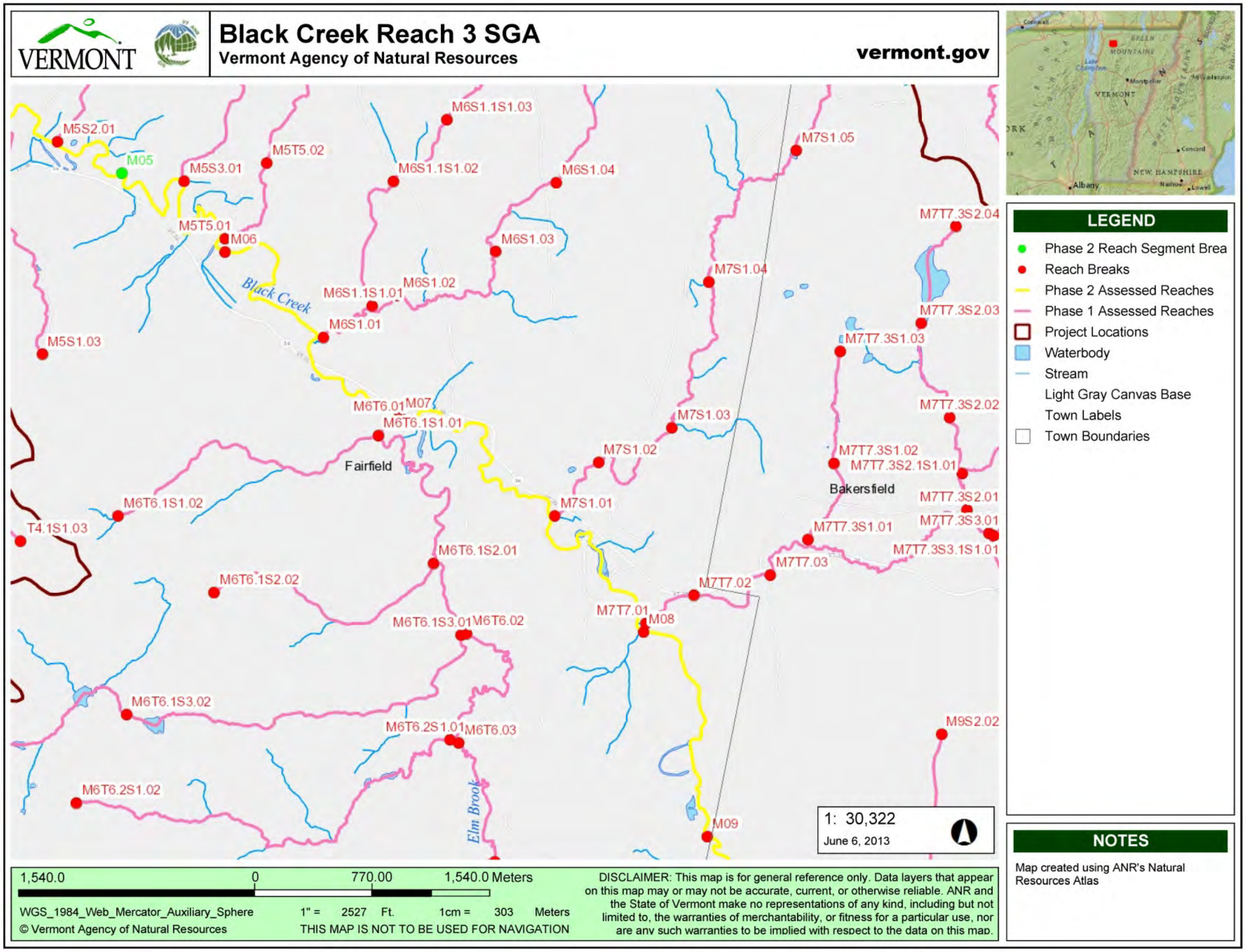


Figure 8. Fairfield River Reach Segment 1.

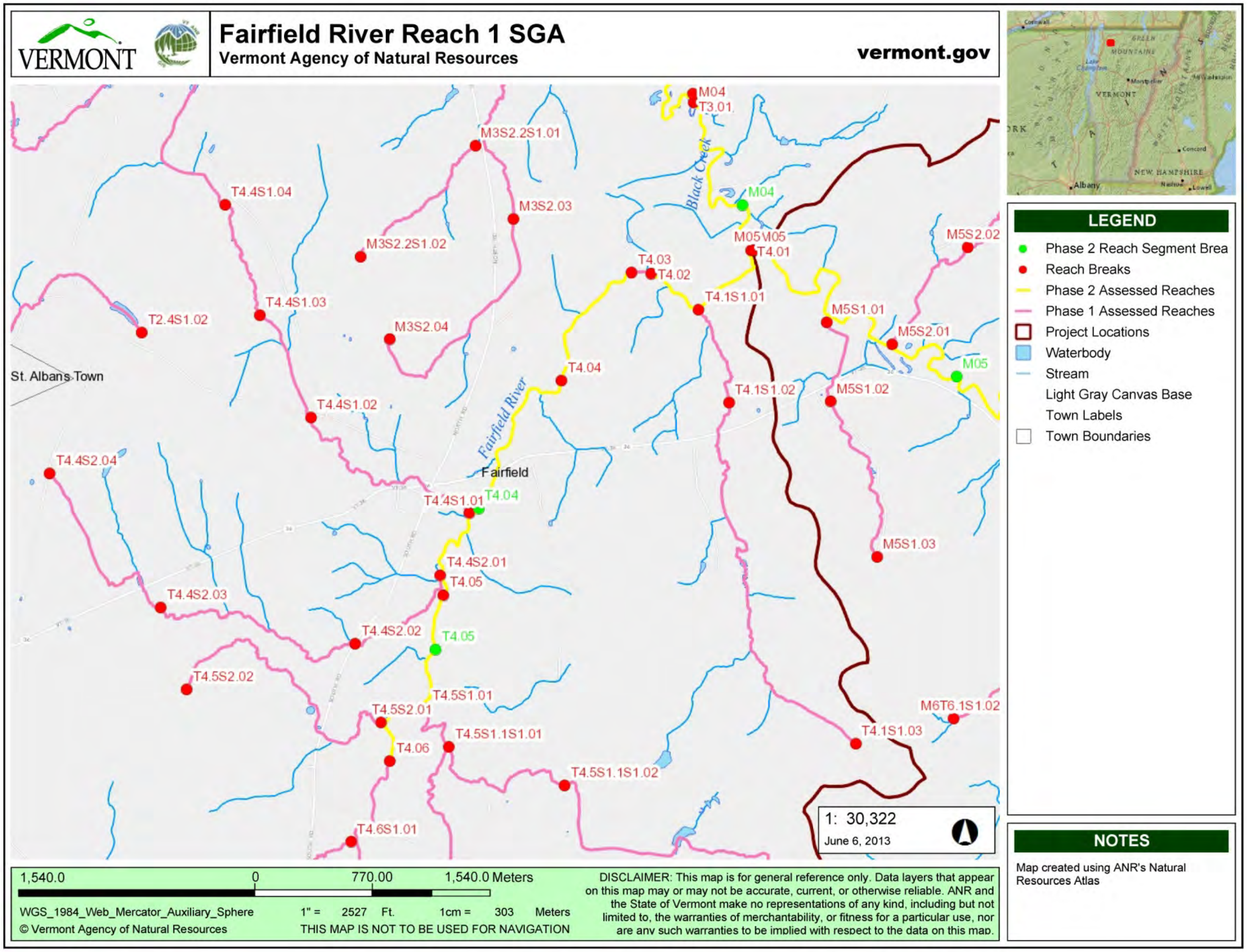


Figure 9. Fairfield River Reach Segment 2.

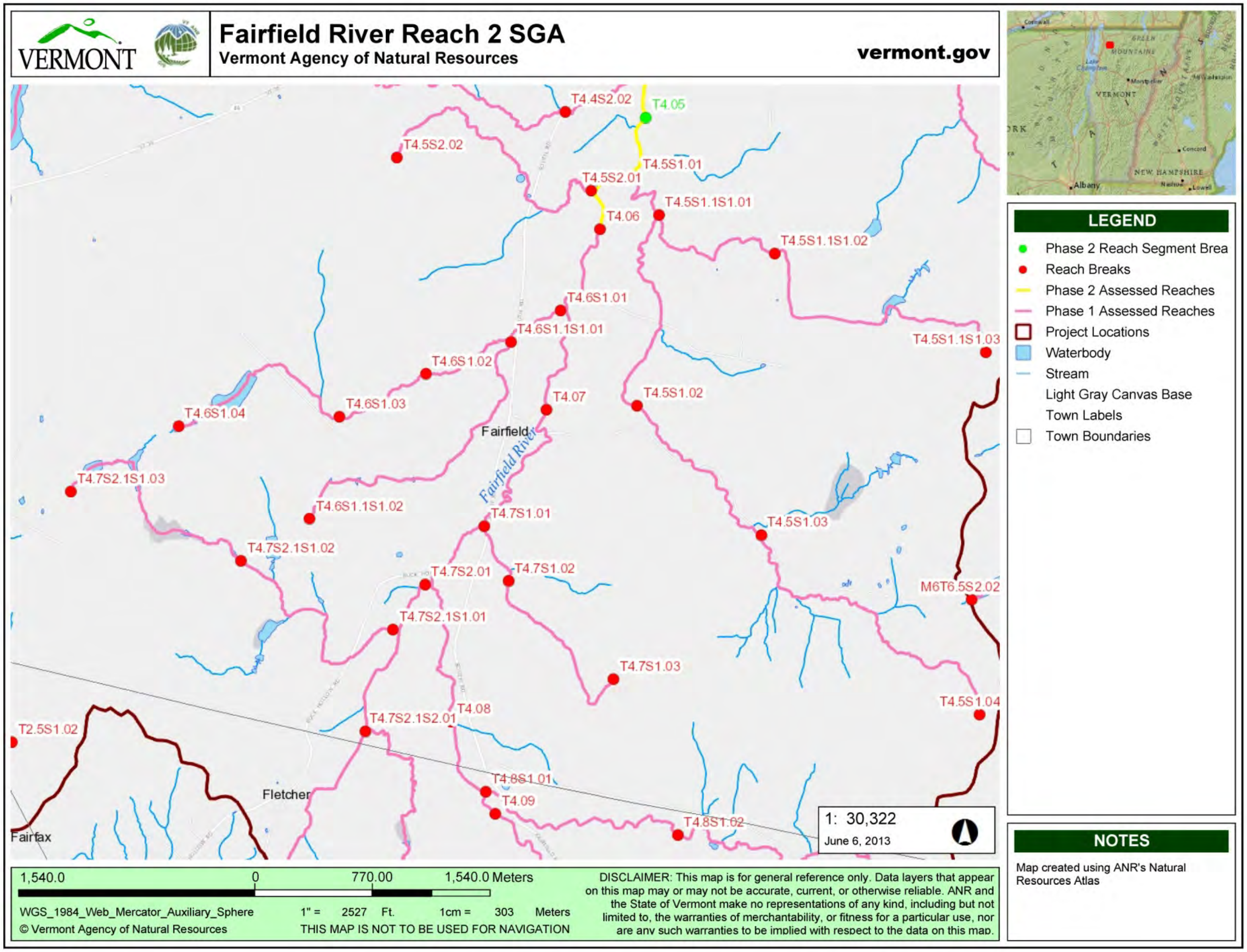


Figure 10. Elm Brook Reach Segment 1.

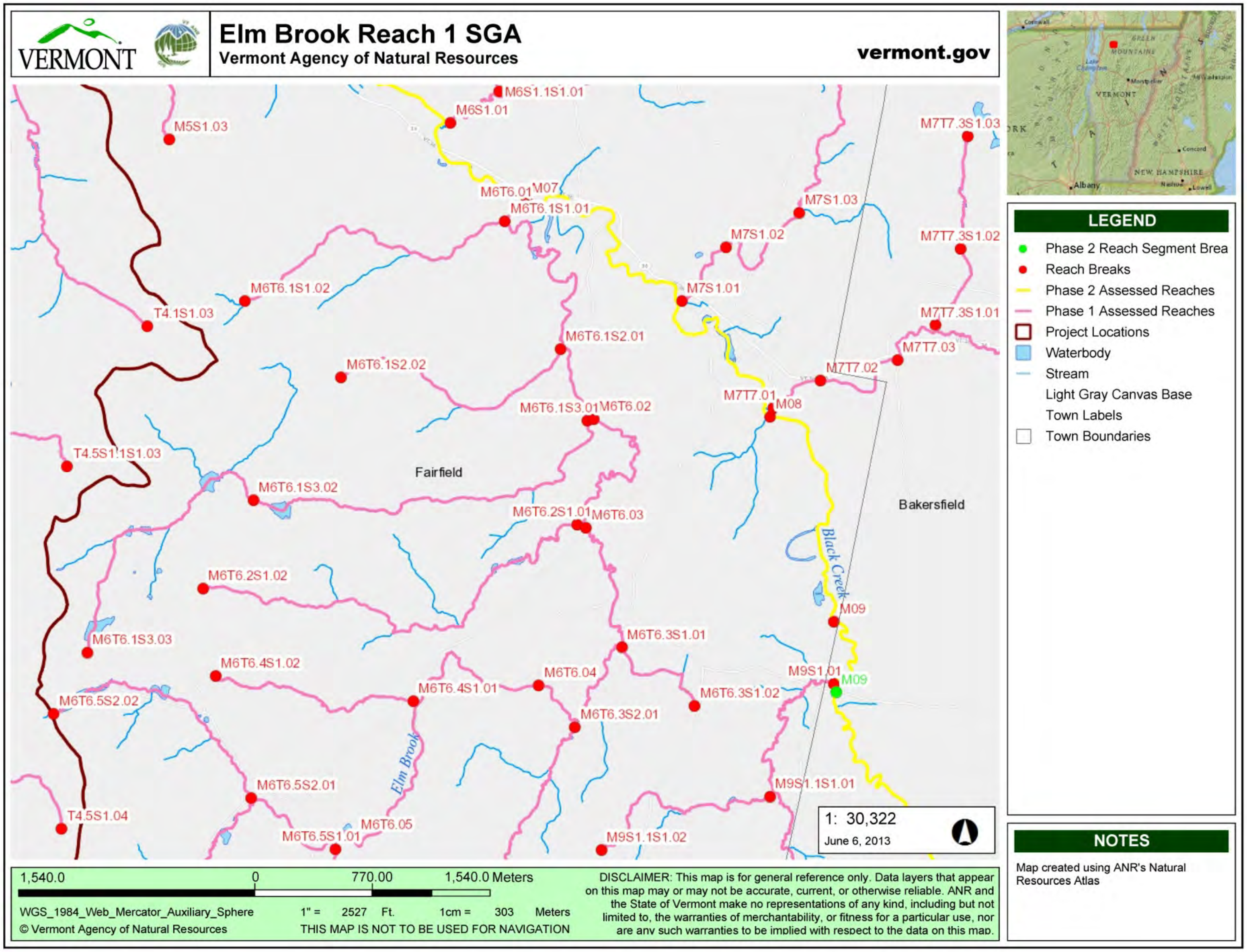


Figure 11. Elm Brook Reach Segment 2.

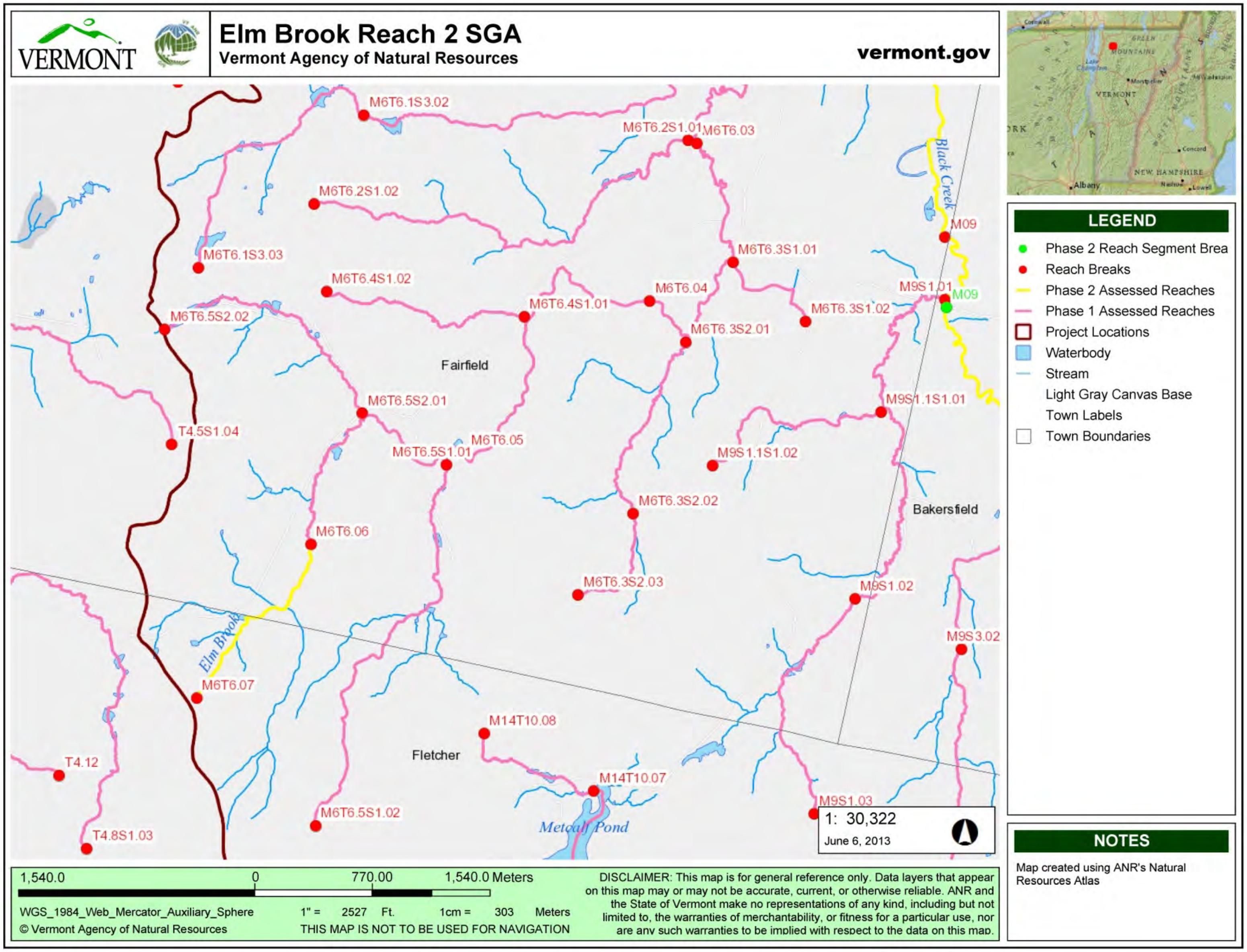


Figure 12. Wanzer Brook Reach Segment 1.

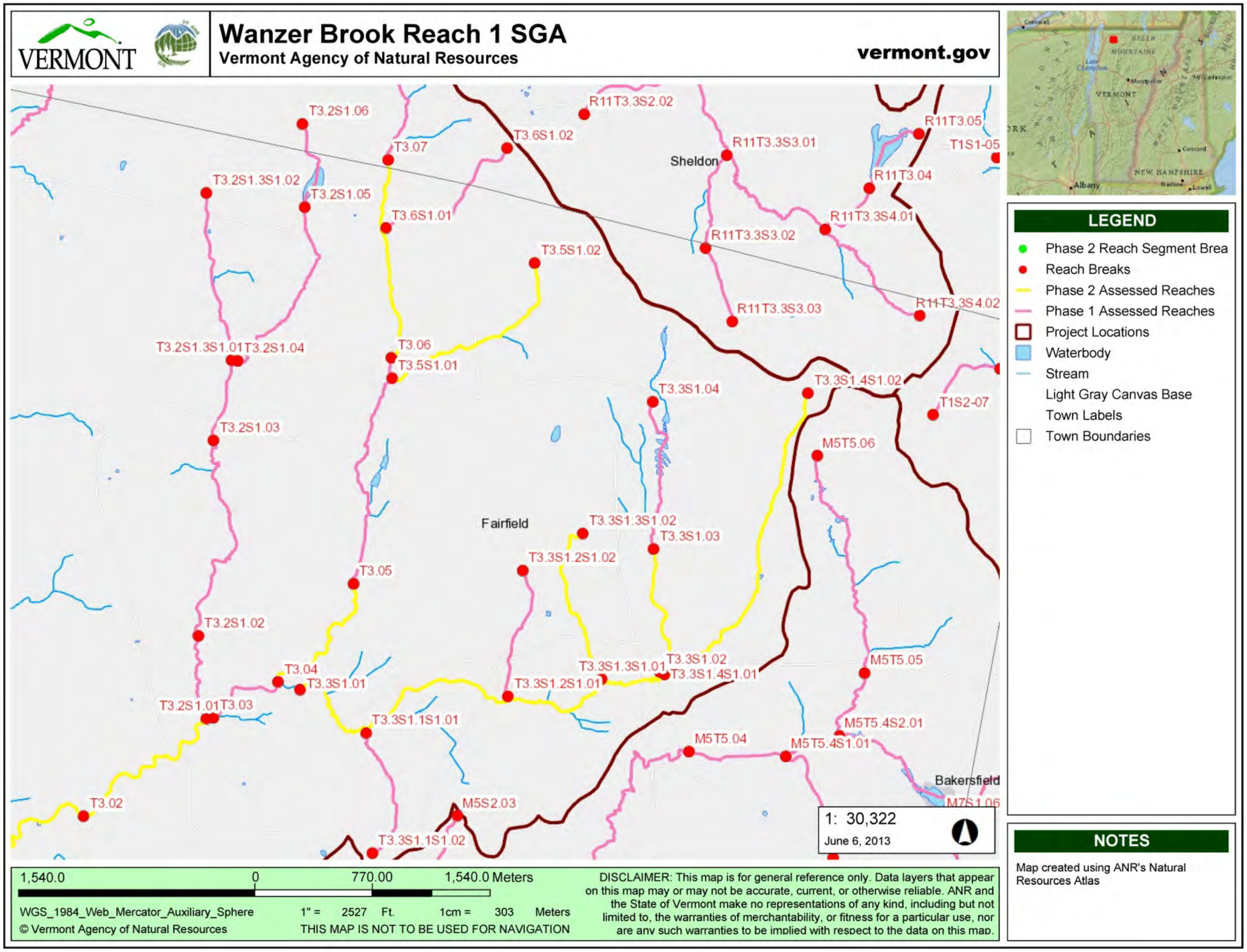


Figure 13. Wanzer Brook Reach Segment 2.

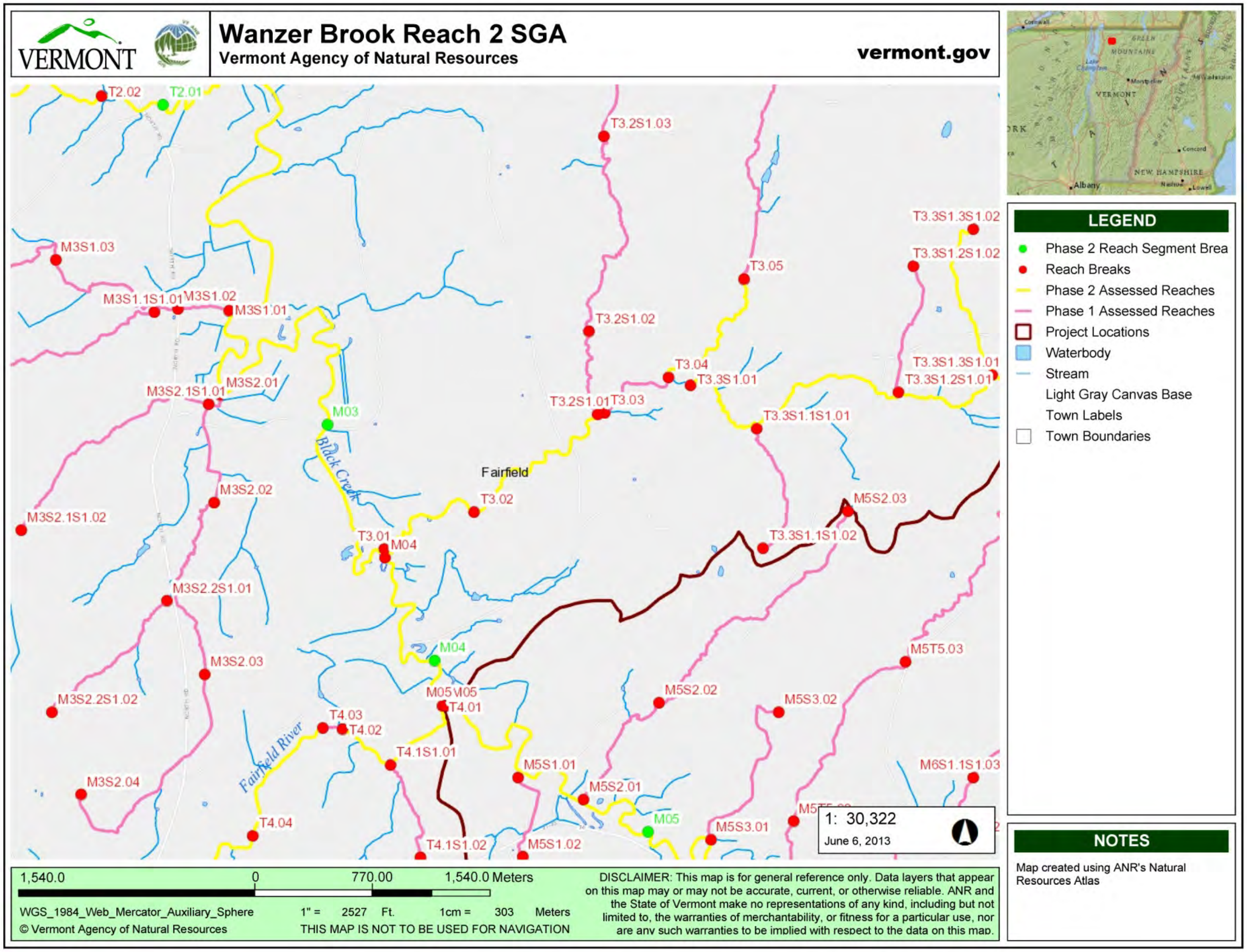


Table 1. Tabulated summary of pollutant concentrations for LaRosa Volunteer Data monitoring sites in Fairfield.

Fairfield: LaRosa Monitoring Sites	Avg. Total Nitrogen (mg/l)	Avg. Total Phosphorus (ug/l)	Avg. Turbidity (NTU)
2007			
Black Creek	0.79	58.87	11.44
2008			
Black Creek	0.45	41.62	6.48
Wanzer Brook	0.53	36.70	1.89
2009			
Black Creek	0.60	73.90	10.84
Wanzer Brook	0.53	38.74	4.18
2010			
Black Creek	0.49	48.16	6.34
Wanzer Brook	0.55	47.73	20.56
2011			
Black Creek	0.58	45.03	7.50
Wanzer Brook	0.46	24.46	1.08

Figure 14. Areas of concern and priority projects identified by town officials and SGA reports.

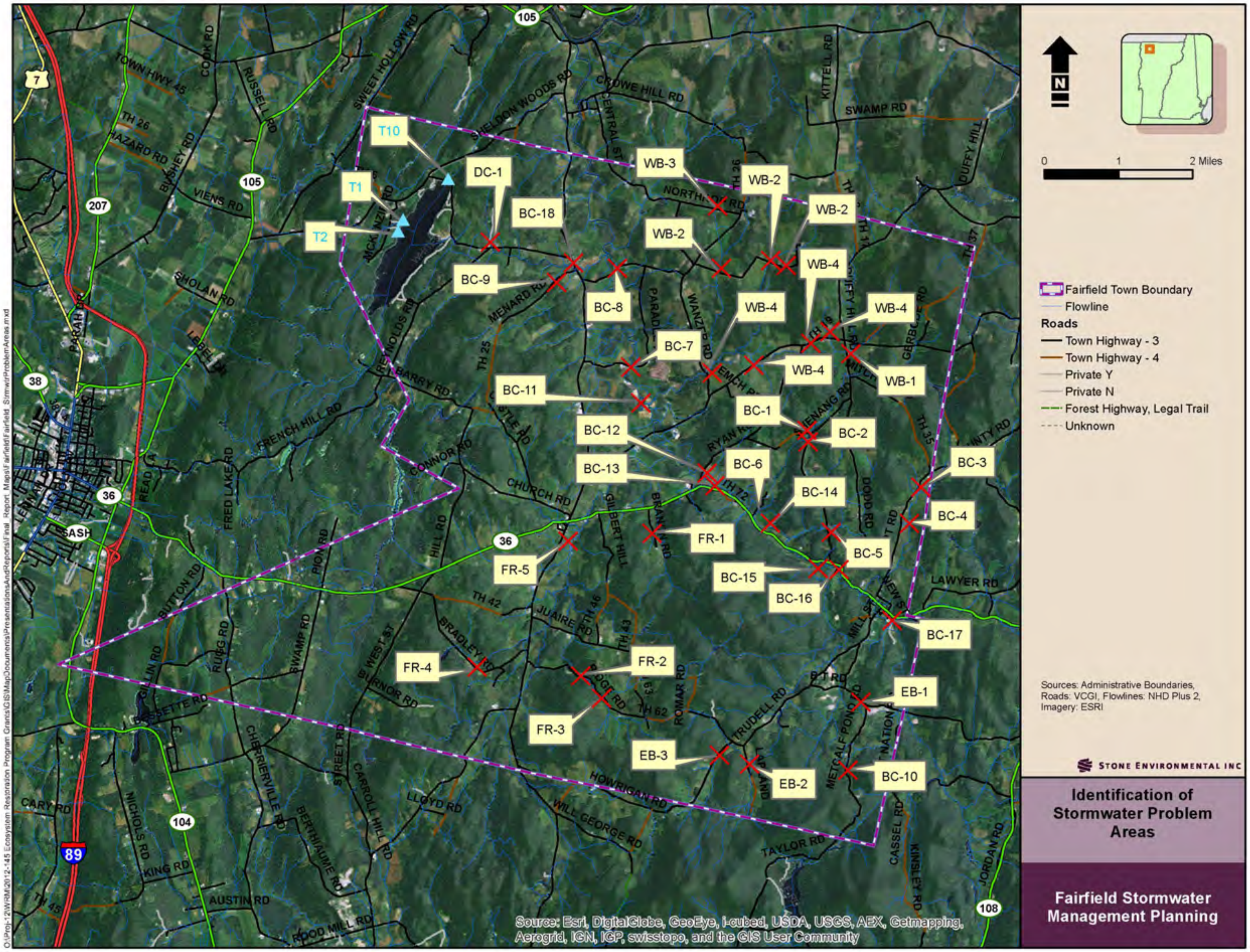


Table 3. Areas of concern and priority projects identified by town officials and SGA reports.

ID	Watershed	Problem Type	Description	ID Source
WB-1	Wanzer Brook	Erosion	Stream erosion upstream and downstream of bridge. Brook channel plugged with gravel.	Town Feedback
WB-2	Wanzer Brook	Erosion	Roadside erosion, needs drainage work and stone lining. Possible private contribution. Possible road maintenance needed along road.	Town Feedback/Geomorph Assessment
WB-3	Wanzer Brook	Infrastructure	Roadside erosion, ditch undercutting, undersized culverts.	Town Feedback
WB-4	Wanzer Brook	Infrastructure	Possible road maintenance needed along road.	Geomorph Assessment
WB-5	Wanzer Brook	Infrastructure	Possible road maintenance needed along road.	Geomorph Assessment
BC-1	Black Creek	Erosion	Stream overtops road during high-water events, causing roadway erosion.	Town Feedback
BC-2	Black Creek	Erosion	Stream bank erosion downstream of TH 32.	Town Feedback
BC-3	Black Creek	Erosion	Erosion upstream of 9' culvert.	Town Feedback
BC-4	Black Creek	Erosion	Culvert outlet erosion.	Town Feedback
BC-5	Black Creek	Erosion	Stream bank erosion downstream of culvert.	Town Feedback
BC-6	Black Creek	Erosion	Water overtops road during high-water events, causing roadway erosion.	Town Feedback/Geomorph Assessment
BC-7	Black Creek	Erosion/Infrastructure	Stream overtops road during high-water events, causing roadway erosion.	Town Feedback/Geomorph Assessment
BC-8	Black Creek	Erosion	Water overtops road during high-water events, causing roadway erosion.	Town Feedback
BC-9	Black Creek	Erosion	Road edge erosion, needs stone lining.	Town Feedback
BC-10	Black Creek	Erosion	Stream overtops roadway.	Town Feedback
BC-11	Black Creek	Berm	800' of berm along left bank impedes floodplain connection.	Geomorph Assessment
BC-12	Black Creek	Infrastructure	Replace undersized bridge, private bridge 1,000' ft downstream of Bryan Road may need replacement too.	Geomorph Assessment
BC-13	Black Creek	Berm	2,000' of berm along left bank impedes floodplain connection.	Geomorph Assessment
BC-14	Black Creek	Berm	500' of berm along left bank impedes floodplain connection.	Geomorph Assessment
BC-15	Black Creek	Berm	1,000' of berm along left bank impedes floodplain connection.	Geomorph Assessment

ID	Watershed	Problem Type	Description	ID Source
BC-16	Black Creek	Infrastructure	Replace two undersized bridges.	Geomorph Assessment
BC-17	Black Creek	Infrastructure	Replace two culverts (at private crossing and rail crossing), may be a few more culverts at rail crossing ~3,000' upstream.	Geomorph Assessment
BC-18	Black Creek	Infrastructure	Replace undersized culvert.	Geomorph Assessment
EB-1	Elm Brook	Erosion	Stream bank erosion downstream of 9' culvert.	Town Feedback
EB-2	Elm Brook	Erosion	Stream overtops roadway.	Town Feedback
EB-3	Elm Brook	unknown	unknown	Town Feedback
FR-1	Fairfield River	Infrastructure	Water overtops road during high-water events, culvert undersized.	Town Feedback
FR-2	Fairfield River	Erosion	Roadside ditch erosion, needs stone lining.	Town Feedback
FR-3	Fairfield River	Erosion	Stream erosion upstream and downstream of bridge. Brook channel obstructed with fallen trees. High stream banks.	Town Feedback
FR-4	Fairfield River	Erosion	Road edge erosion, needs stone lining.	Town Feedback
FR-5	Fairfield River	Berm	600' of berm along left bank impedes floodplain connection.	Geomorph Assessment
DC-1	Dead Creek	Infrastructure	Replace undersized bridge.	Geomorph Assessment

APPENDIX C : PROBLEM AREA DATA SHEETS

MEMO

STONE ENVIRONMENTAL INC

535 Stone Cutters Way
Montpelier, Vermont
05602 USA

Phone / 802.229.4541
Fax / 802.229.5417
Web Site / www.stone-env.com

To: Denise Smith
Executive Director
Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488

From: Julie Moore
Direct Phone: 802-229-1881
E-Mail: jmoore@stone-env.com

SEI No. 12-145
Re: Stormwater Problem Area Data Sheets for the Town of Fairfield

---

Stone Environmental has combed through existing reports and also worked directly with the Town of Fairfield to identify current problem areas (e.g., actively eroding sites, roadway flooding and/or water ponding areas, culverts or other structures with insufficient hydraulic capacity) that are a direct, or indirect, result of stormwater runoff.

The approach to identifying problem areas included the following elements:

- Engagement with local officials, including:
  - May 3rd, kick-off meeting with Town Manager and Road Foreman
  - May 23rd, meeting with Road Foreman and technical advisor (Jim Smith)
- Targeted site visits to verify problems areas (June and July 2013)
- Documentation (with photos) of existing problem areas

A "problem area data sheet" was developed and used as a guide to ensure consistent information was collected as site visits were completed. The data sheets for all of the problem areas identified in Fairfield are attached to this memo. Each problem area was given a preliminary classification according to the following system:

Level	Classification
1	Infeasible to remedy issue/outside of project scope.
2	Stable, but problem could escalate with future change in surrounding land use.
3	Small to moderate erosion and/or drainage problems are present; issues could be readily addressed.
4	Significant erosion and/or drainage problems are present; issues may be readily addressed.

Going forward, we will work with the Friends of Northern Lake Champlain to combine the information collected during this phase of the project in a scoring matrix that considers both the municipality's priorities and anticipated water quality benefits of addressing each problem area to develop a short of 6-10 high priority projects for implementation.

Problem Area Data Sheet

Problem Area ID:	**BC-2**	Latitude: 44°49’06”N	Longitude: 72°52’46”W

Watershed:	Black Creek
Location:	Shenang Road just south of TH 32 junction
Problem Type:	Erosion
Identification Source:	Town Feedback
Ownership:	Local
Classification:	2

Date of Field Data Collection: 7/11/2013

Description of Observed Conditions:

Stream bank erosion downstream of TH 32.

Undersized culvert leading to scour pool and bank erosion downstream.

Field Photos

Photo 1. Scour pool downstream from culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	1	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID:	**BC-3**	Latitude: 44°48'29"N	Longitude: 72°50'59"W
Watershed:	Black Creek		
Location:	Egypt Road just west of Fairfield town boundary		
Problem Type:	Erosion		
Identification Source:	Town Feedback		
Ownership:	Private		
Classification:	2		

Date of Field Data Collection: 7/11/2013

Description of Observed Conditions:

Erosion upstream of 9' culvert.

Banks upstream from culvert are eroding and slumping due to incising. Downstream side appears okay

Field Photos

Photo 1. Eroding banks

Photo 2. Pooling and incision upstream from culvert

Prioritization Ranking Factors

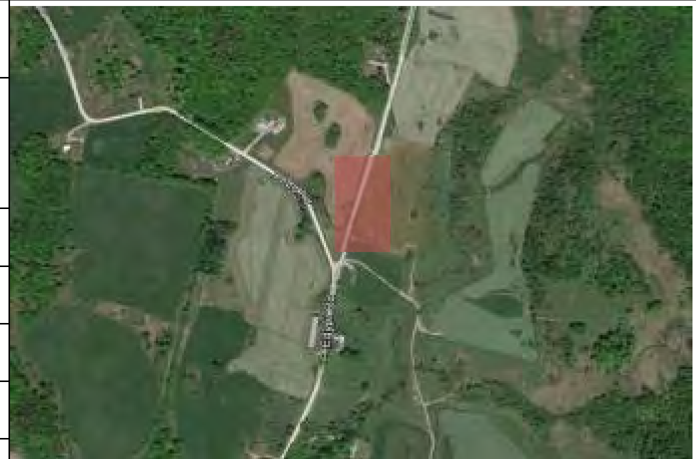
Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	No	No	No	No

Problem Area Data Sheet

Problem Area ID: **BC-4**

Latitude: 44°47'43”N

Longitude: 72°51'22”W



Watershed: Black Creek

Location: Egypt Road north of Dodd Road junction

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/11/2013

Description of Observed Conditions:

Culvert outlet erosion.

Downstream bank is unstable and shearing into scour pool. Soil behind the culvert inlet bank retaining wall is washed out with large void.

Field Photos

Photo 1. Culvert outlet, bank erosion and scour pool

Photo 2. Behind retaining wall at culvert inlet

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	3	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-5**	Latitude: 44°48'02"N	Longitude: 72°52'28"W
Watershed:	Black Creek		
Location:	Shenang Road just north of Rt 36 junction		
Problem Type:	Erosion		
Identification Source:	Town Feedback		
Ownership:	Local		
Classification:	3		

Date of Field Data Collection: 7/11/2013

Description of Observed Conditions:

Stream bank erosion downstream of culvert.

Culvert is undersized contributing to downstream erosion. Animals have access to stream. Outlet is perched 8-10"

Field Photos

Photo 1. Downstream bank erosion

Photo 2. Culvert outlet, perched 8"

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	3	2	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID:	BC-6	Latitude: 44°48'12"N	Longitude: 72°53'39"W

Watershed:	Black Creek
Location:	Bruso Road by Black Creek crossing
Problem Type:	Erosion
Identification Source:	Town Feedback /Geomorphic Assessment
Ownership:	Local
Classification:	2

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Water overtops road during high-water events, causing roadway erosion.

Undersized bridge causing bank erosion up and downstream. Road had recently been graded and no evidence of the stream overtopping the road was readily apparent. There were however a few large sediment deposits along the roadside and in the adjacent field. No sediment appeared to reach the creek.

Field Photos

Photo 1. Gravel from road deposited in adjacent field

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	1	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-8**	Latitude: 44°51'02"N	Longitude: 72°55'58"W

Watershed: Black Creek

Location: Pumpkin Village Road by Black Creek crossing (just east of North Road junction)

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Water overtops road during high-water events, causing roadway erosion.

Water from road cannot enter swale due to ledge. Large sediment deposits at various locations along roadside. Deposits show evidence of sediment reaching the Black Creek.

Field Photos

Photo 1. Evidence of roadway eroding into adjacent field

Photo 2. Road shoulder erosion

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	3	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-9**	Latitude: 44°50'52”N	Longitude: 72°57'00”W

Watershed: Black Creek

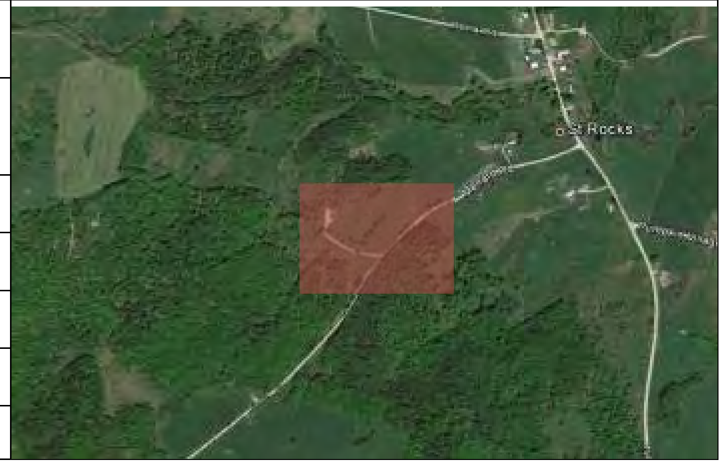
Location: Menard Road

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 2



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Road edge erosion. Shoulder/ditch eeds stone lining.

Gullying at road edge. Some sediment deposits in ditch. Ditches that have been stone-lined with check dams appear to be functioning properly.

Field Photos

Photo 1. Road shoulder erosion

Photo 2. Sediment deposit in ditch

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-12**	Latitude: 44°48'41”N	Longitude: 72°54'31”W

Watershed: Black Creek

Location: Ryan Road by Black Creek crossing

Problem Type: Infrastructure

Identification Source: Geomorphic Assessment

Ownership: Local/Private

Classification: 1

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Private bridge 1,000 ft downstream of Ryan Road shows evidence of scour and may be undersized.

Field Photos

Photo 1. Scour pool downstream of undersized bridge

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	1	2	1	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-13**
Latitude: 44°48'43”N	Longitude: 72°54'34”W
Watershed:	Black Creek
Location:	Ryan Road by Black Creek crossing
Problem Type:	Berm
Identification Source:	Geomorphic Assessment
Ownership:	Local
Classification:	1

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

2,000' of berm along left bank impedes floodplain connection.

Field Photos

Photo 1. Small berm along streambank

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	1	2	1	Yes	No	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-16**	Latitude: 44°47'32"N	Longitude: 72°52'16"W

Watershed:	Black Creek
Location:	Elm Brook Rd. by Black Creek crossing and railroad bridge just north of crossing.
Problem Type:	Infrastructure
Identification Source:	Geomorphic Assessment
Ownership:	Local
Classification:	1

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Two undersized bridges where Elm Brook Rd. crosses Black Creek

Large eddies observed due to eroded and widened stream banks.

Field Photos

Photo 1. View downstream from easternmost bridge

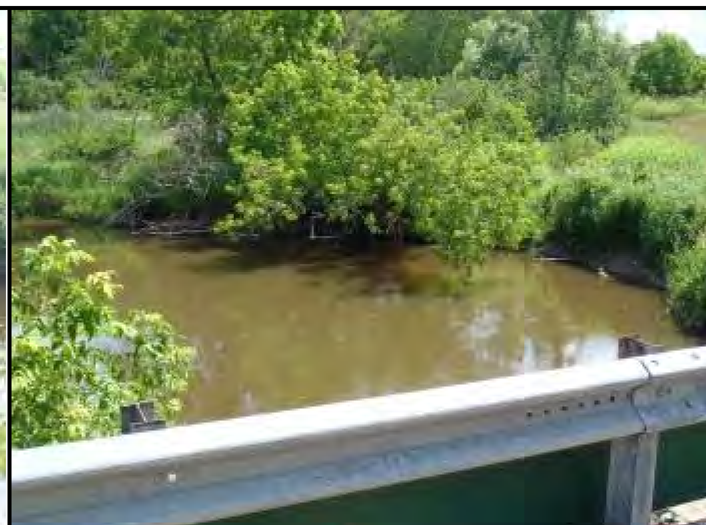


Photo 2. Scour pool downstream of westernmost bridge

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	1	No	No	No	No

Problem Area Data Sheet

Problem Area ID:	**BC-17**	Latitude: 44°46'50”N	Longitude: 72°51'22”W

Watershed:	Black Creek
Location:	Black Creek just south of Reads Road
Problem Type:	Infrastructure
Identification Source:	Geomorphic Assessment
Ownership:	Local/Private
Classification:	2

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Two undersized culverts (at private crossing and rail crossing), may be a few more culverts at rail crossing ~3,000' upstream.

Crossing at rail line (A) looks relatively new and is much larger than downstream farm road crossing (B)

Field Photos

Photo 1. Rail Crossing, three 20’ culverts, upstream

Photo 2. Farm road crossing, two 8’ culverts, downstream

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID:	**BC-18**	Latitude: 44°51'03"N	Longitude: 72°56'38"W

Watershed: Black Creek

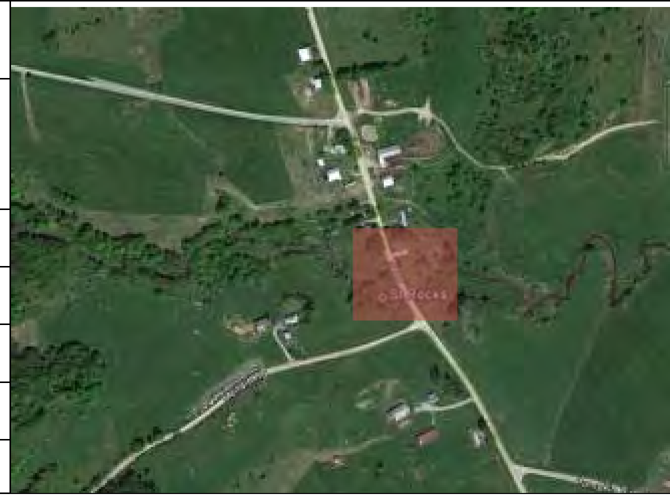
Location: North Road by Black Creek crossing just south Pond Road junction

Problem Type: Infrastructure

Identification Source: Geomorphic Assessment

Ownership: Local

Classification: 2



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Undersized culvert.

Culvert is one-quarter bankfull width and perched 3', preventing passage of aquatic organisms.

Field Photos

Photo 1. Upstream end of culvert

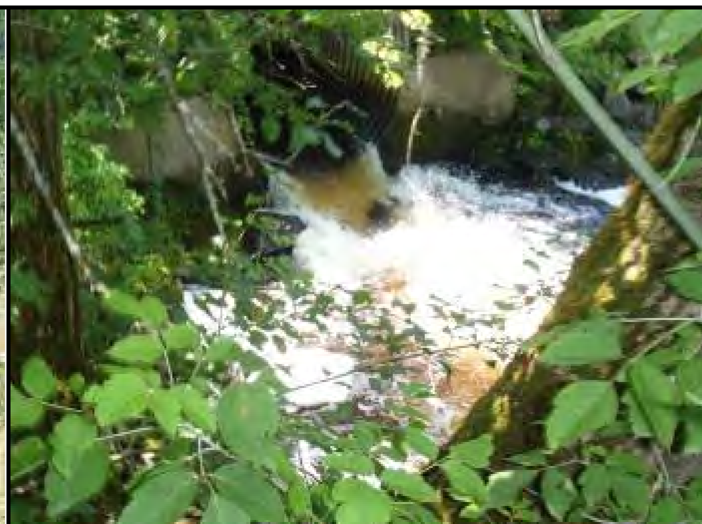


Photo 2. Perched outfall

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	2	2	No	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**BC-19**	Latitude: 44°47'52"N	Longitude: 72°52'26"W
Watershed:	Black Creek		
Location:	Shenang Rd. near junction of Rt. 36		
Problem Type:	Infrastructure		
Identification Source:	SWMP Assessment		
Ownership:	Local		
Classification:	4		

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Ledge prevents water from leaving road. Roadside ditch is incising. Road surface has begun to collapse into ditch. Heavy sediment accumulation at check dams in rock lined ditch.

Field Photos

Photo 1. Road shoulder erosion

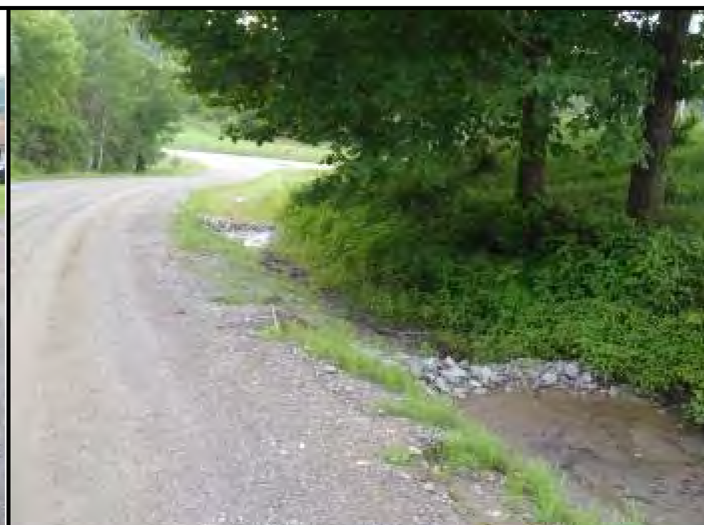


Photo 2. Check dam in need of on-going maintenance

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	3	2	Yes	Yes	Yes	Yes

Problem Area Data Sheet

Problem Area ID:	BC-20	Latitude: 44°45'40"N	Longitude: 72°51'19"W

Watershed:	Black Creek
Location:	Lost Nation Road
Problem Type:	Drainage
Identification Source:	SWMP Assessment
Ownership:	Private
Classification:	2

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Crop filed has been tiled, but flow path is heavily eroded

Field Photos

Photo 1. Drain tile opening set directly beneath 12” culvert.

Photo 2.

Prioritization Ranking Factors							
Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	3	2	No	No	No	No

Problem Area Data Sheet

Problem Area ID:	**WB-1**	Latitude: 44°49'49"N	Longitude: 72°52'06"W

Watershed: Wanzer Brook

Location: Dodd Road just south of Chester A Arthur Road junction

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Stream erosion upstream and downstream of bridge. Brook channel plugged with gravel.

Animals have access to stream upstream from culvert. Some bank erosion observed upstream. Very large sediment deposit observed downstream from culvert (photo 2). Undersized culvert has caused scour pool. Stream is on private property. Property owner has worked with NRCS in the past and is interested in improvements. Mentioned most of the damage has occurred in the past 2-years. Current condition may be preventing passage of aquatic organisms.

Field Photos

Photo 1. Direct animal access

Photo 2. Sediment accumulation downstream from culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	3	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	WB-2	Latitude: 44°51'05"N	Longitude: 72°53'17"W
Watershed:	Wanzer Brook		
Location:	Pumpkin Village Road just west of Callan Road junction and assorted places along road		
Problem Type:	Erosion		
Identification Source:	Town Feedback /Geomorphic Assessment		
Ownership:	Local		
Classification:	2		

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Roadside erosion, needs drainage work and stone lining. Possible private contribution. Possible road maintenance needed along road.

Small scour pool at culvert outlet. Some sediment deposited in wooded ditch. Rill erosion at road edge.

Field Photos

Photo 1. Roadside erosion

Photo 2. Evidence of sediment deposits

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	2	1	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	WB-3	Latitude: 44°51'52"N	Longitude: 72°55'12"W

Watershed: Wanzer Brook

Location: Northrop Road at Talcott Road

Problem Type: Infrastructure

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Roadside erosion, ditch undercutting, undersized culverts.

Large portions of the road shoulder are eroding, clogging downhill ditches. Some portions of the ditch are incised.

Field Photos

Photo 1. Roadside sediment deposit.

Photo 2. Failing road shoulder

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	3	2	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**WB-4**
Latitude:	44°49'45"N
Longitude:	72°54'02"W
Watershed:	Wanzer Brook
Location:	Assorted places along Chester A Arthur Road
Problem Type:	Infrastructure
Identification Source:	Geomorph Assessment
Ownership:	Local
Classification:	3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Bridges are undersized. Sediment from road shoulder has eroded and is deposited at road edge near Wanzer Brook. Ledges prevent water from leaving road edge.

Field Photos

Photo 1. Sediment deposited at bridge

Photo 2. Sediment deposits along road edge

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID: **WB-5**

Latitude: 44°49'59”N

Longitude: 72°54'35”W

Watershed: Wanzer Brook

Location: Assorted places along Wanzer Road

Problem Type: Infrastructure

Identification Source: Geomorphic Assessment

Ownership: Local

Classification: 1

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Stone-lined ditch with check-dams appears to have recently been installed and functioning properly. Bridge is properly sized, but water flowing beneath is very turbid with no apparent source. Future investigation is needed to determine source of turbid water.

Field Photos

Photo 1. Recently installed stone

Photo 2. Visibly turbid water

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
1	3	1	1	No	No	No	No

Problem Area Data Sheet

Problem Area ID:	**WB-6**	Latitude: 44°50'12"N	Longitude: 72°52'01"W

Watershed:	Wanzer Brook
Location:	Chester A. Arthur Rd, Just east of Dodd Rd.
Problem Type:	Infrastructure
Identification Source:	SWMP Assessment
Ownership:	Local
Classification:	3

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Appears to be recent culvert repair. Road shoulder above culvert at both the inlet and outlet is uncompacted gravel, which is slumping into the stream. There is a large sediment deposit in the stream directly downstream from the crossing. Further erosion of shoulder may result in damage to the roadway.

Field Photos

Photo 1. Shoulder slumping into stream

Photo 2. Shoulder slumping

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	3	2	3	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**FR-1**	Latitude: 44°47'57”N	Longitude: 73°55’19”W

Watershed: Fairfield River

Location: Branon Road, near end

Problem Type: Infrastructure

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Water flows over section of Branon Rd. where no drainage structure (culvert) or storage exists. Water is coming from culvert beneath adjacent road section.

Field Photos

Photo 1. Water flowing over Branon Road

Photo 2. Evidence of road surface erosion

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	3	2	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	**FR-2**	Latitude: 44°46'16”N	Longitude: 73° 56'28”W

Watershed: Fairfield River

Location: Ridge Road east of Fairfield River crossing

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Roadside ditch erosion, needs stone lining.

Ditch is incising and banks are slumping.

Field Photos

Photo 1. Roadside ditch erosion

Photo 2. Bank slumping

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	2	2	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	FR-4	Latitude: 44°46'19"N	Longitude: 73°58'07"W

Watershed: Fairfield River

Location: Bradley Road west of Pelkey Road junction

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:
Road edge erosion, needs stone lining.

Field Photos

Photo 1. Road shoulder erosion

Photo 2. More road shoulder erosion

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	Yes	Yes	Yes	No

Problem Area Data Sheet

Problem Area ID:	EB-1	Latitude: 44°45'53"N	Longitude: 73°51'16"W

Watershed:	Elm Brook
Location:	Lost Nation Road just west of Taylor road junction
Problem Type:	Erosion
Identification Source:	Town Feedback
Ownership:	Local
Classification:	2

Date of Field Data Collection: 7/11/13

Description of Observed Conditions:

Stream bank erosion downstream of 9' culvert.

Animals have access to stream.

Field Photos

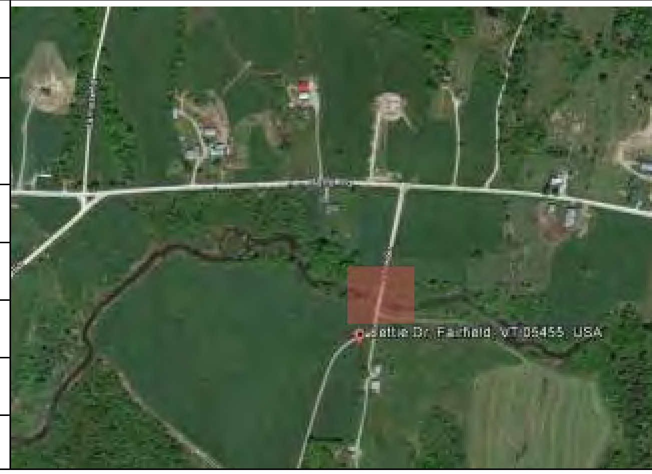
Photo 1. Failing streambank in active pasture

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	2	2	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID:	**DC-1**
Latitude: 44°51'11”N	Longitude: 72°57'43”W
Watershed:	Dead Creek
Location:	Jettie Road by Dead Creek crossing.
Problem Type:	Infrastructure
Identification Source:	Geomorphic Assessment
Ownership:	Local
Classification:	2



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Undersized bridge.

Bridge is 1/2 bank full width.

Field Photos

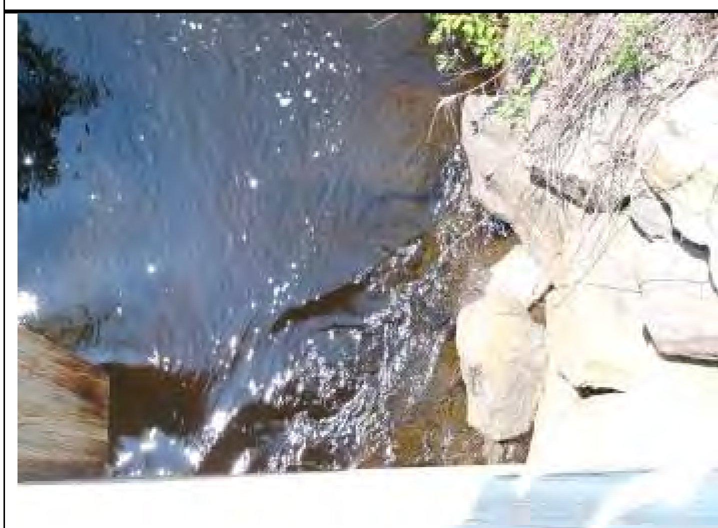


Photo 1. Upstream end of undersized bridge

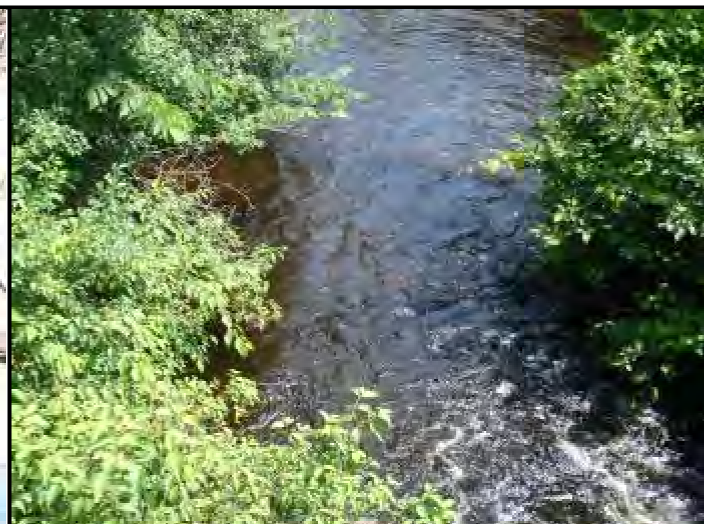
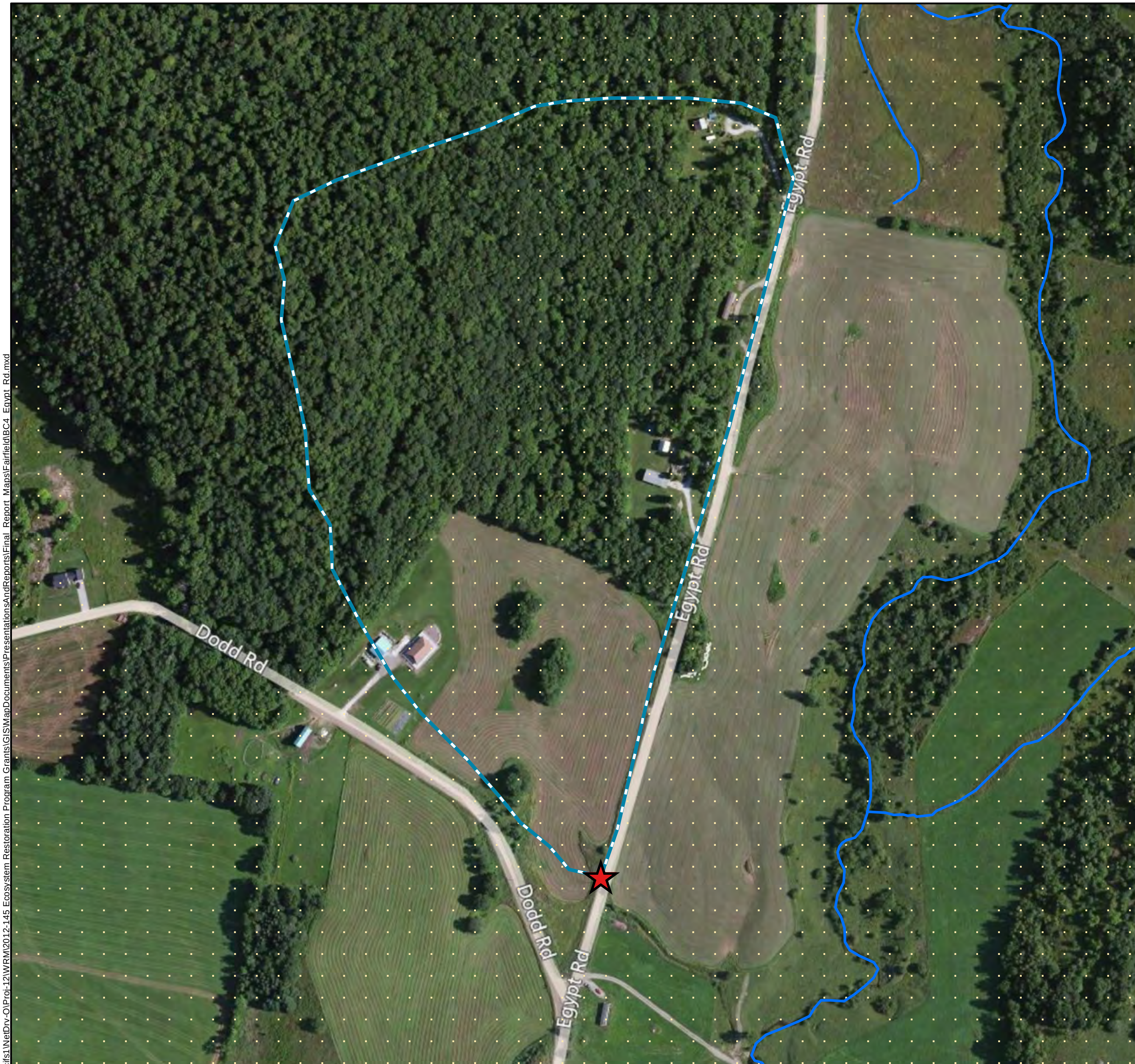


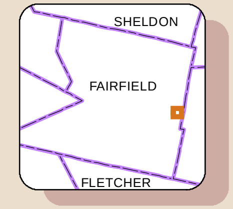
Photo 2. Scour pool downstream of undersized bridge

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	1	Yes	No	Yes	No

APPENDIX D : DRAINAGE AREA MAPS FOR PRIORITY STORMWATER PROBLEM AREAS





N

0 100 200 400
Feet

SW Treatment Opportunity

River or Stream

Drainage Area (37 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Egypt Road, North of Dodd Road

BC-4

Fairfield Stormwater Management Planning

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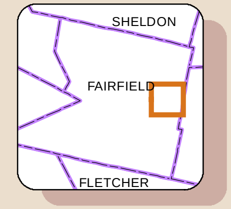

0 385 770 1,540
Feet

SW Treatment Opportunity
River or Stream
Drainage Area (663 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Shenang Road, North of Route 36

BC-5

Fairfield Stormwater Management Planning

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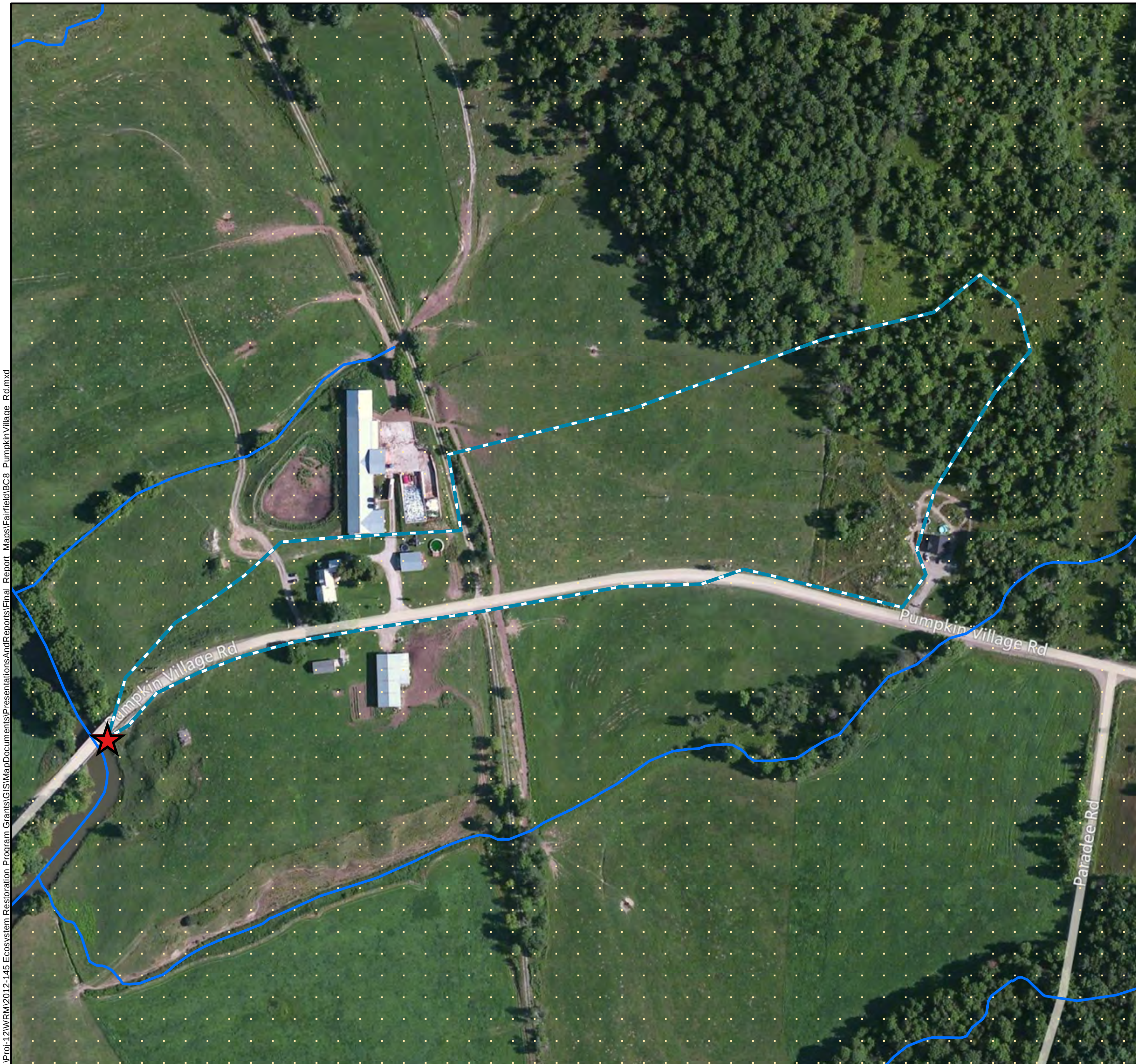

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Pumpkin Village Rd, East of North Rd

BC-8

Fairfield Stormwater Management Planning

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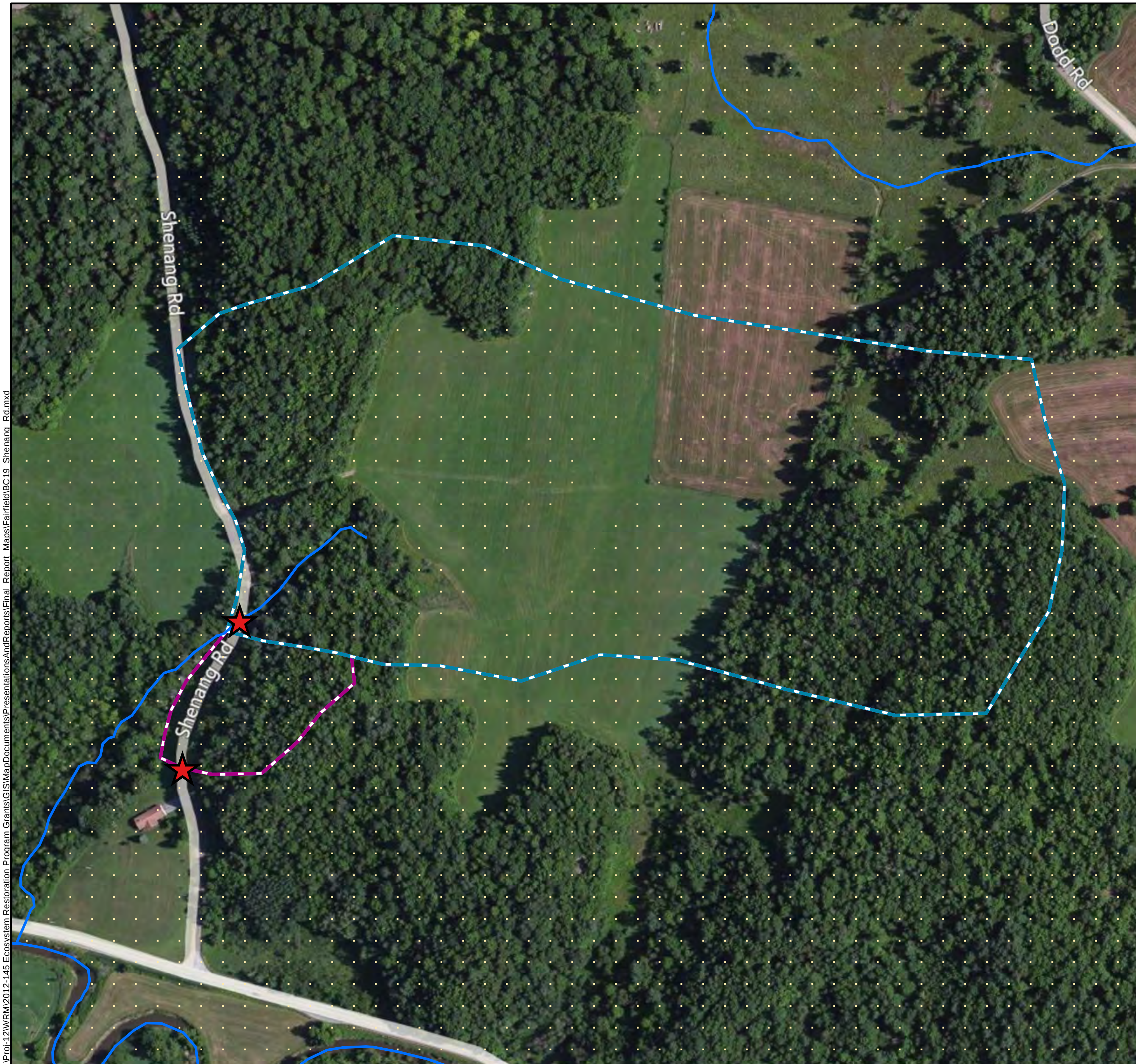

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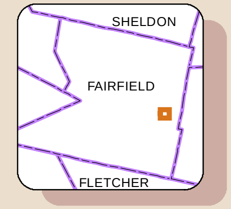

0 100 200 400
Feet

SW Treatment Opportunity
River or Stream
Drainage Area A (45 Acres)
Drainage Area B (2.7 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Shenang Road, North of Route 36

BC-19

Fairfield Stormwater Management Planning

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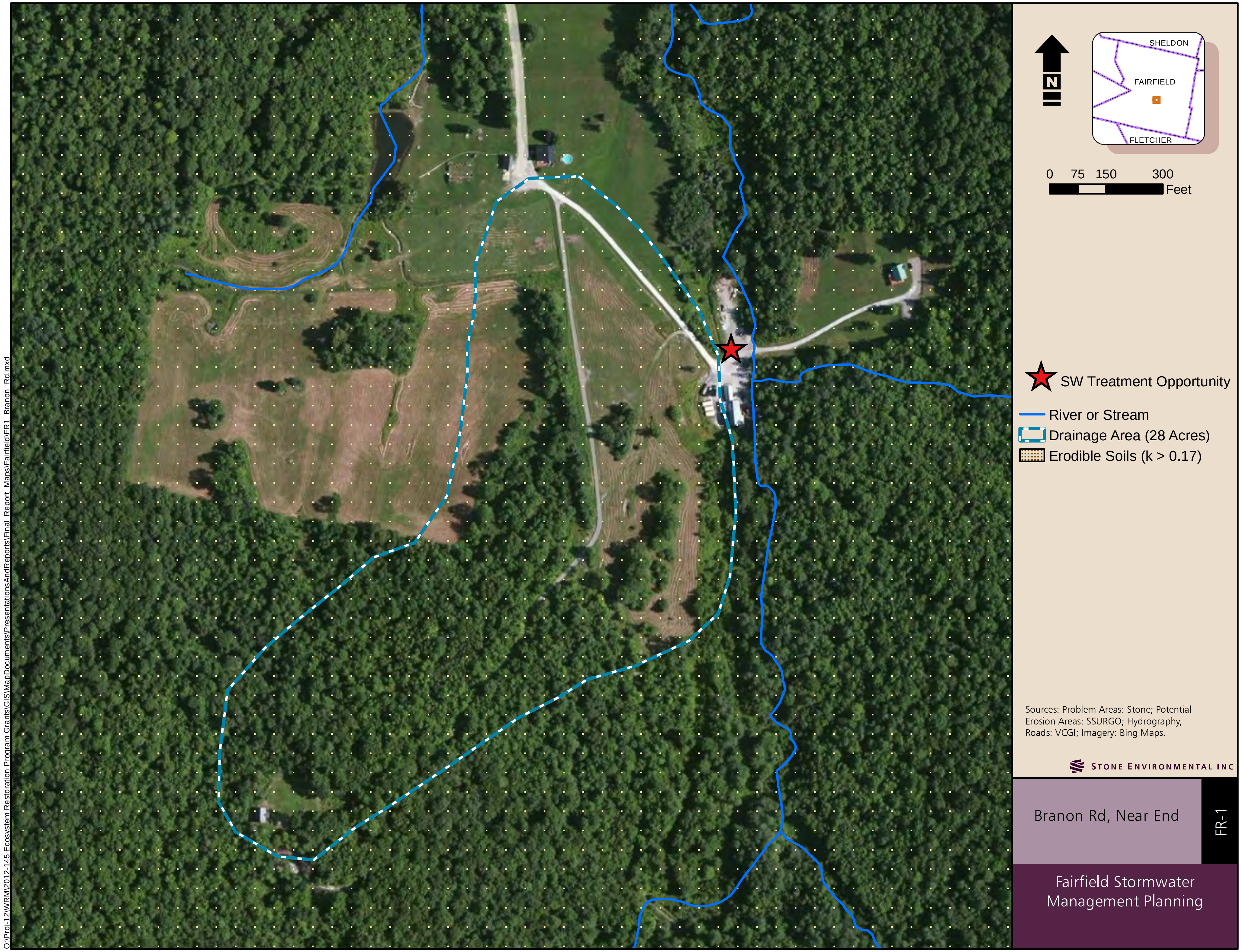

SHELDON
FAIRFIELD
FLETCHER
N
0 75 150 300
Feet
SW Treatment Opportunity
River or Stream
Drainage Area (28 Acres)
Erodible Soils (k > 0.17)
Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.
STONE ENVIRONMENTAL INC
Branon Rd, Near End
FR-1
Fairfield Stormwater Management Planning
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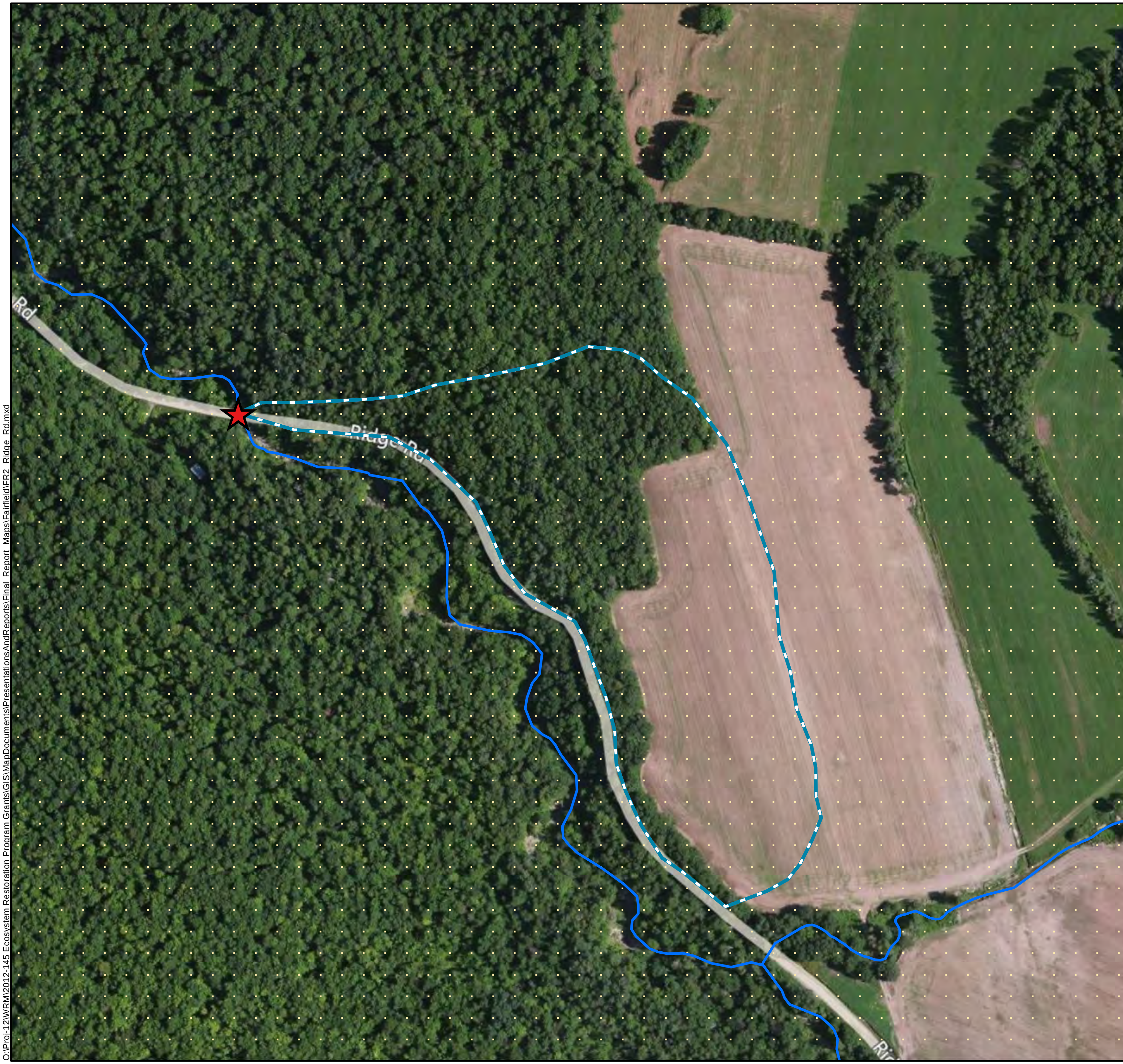

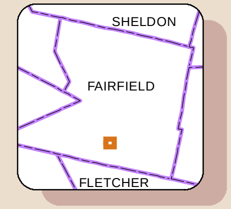

N

0 100 200 400 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (17.5 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Ridge Rd, East of Fairfield River Crossing

FR-2

Fairfield Stormwater Management Planning

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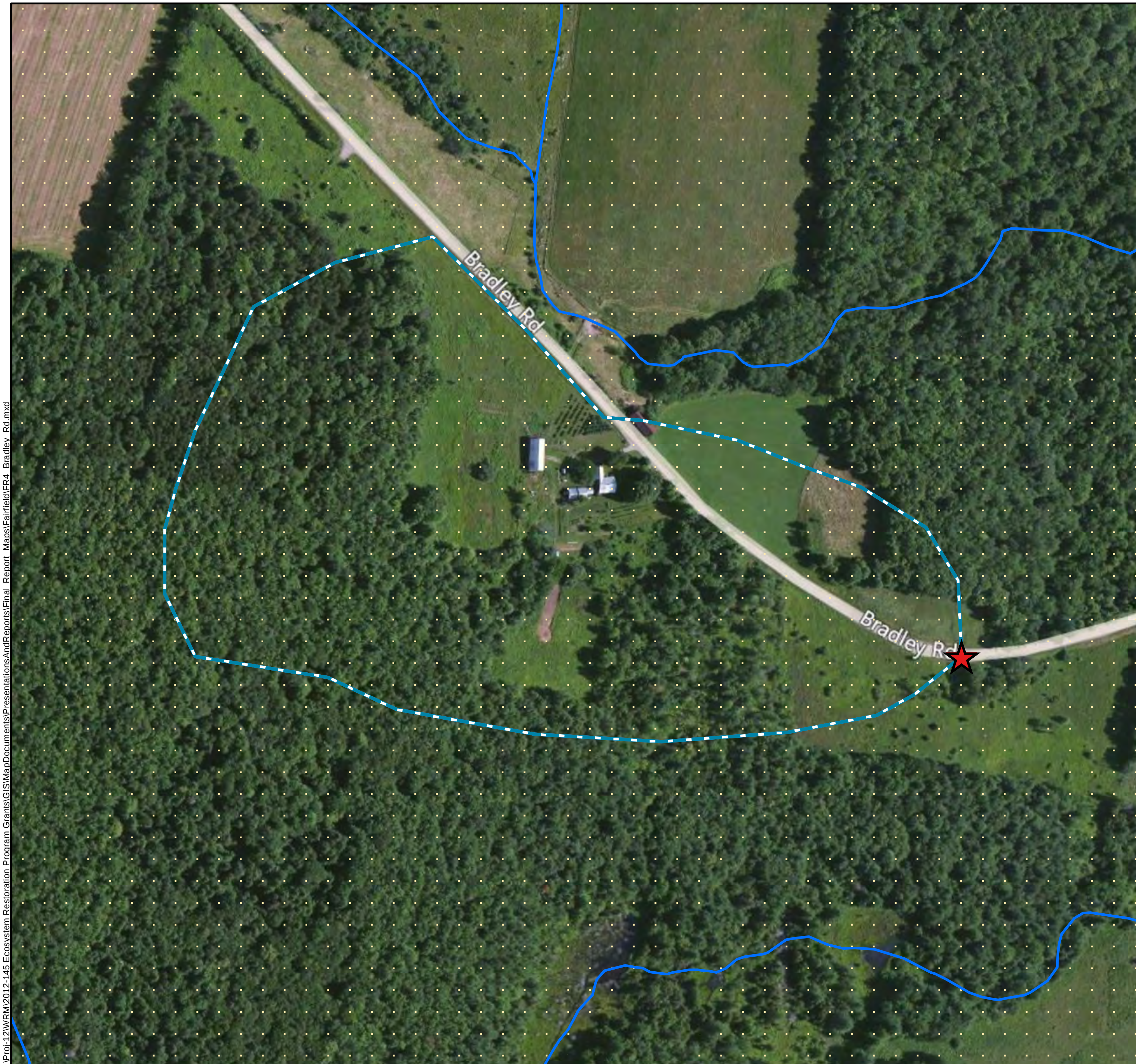

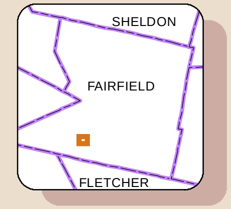

N

0 75 150 300 Feet

SW Treatment Opportunity
River or Stream
Drainage Area (31 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Bradley Rd, West of Pelkey Rd Junction

FR-4

Fairfield Stormwater Management Planning

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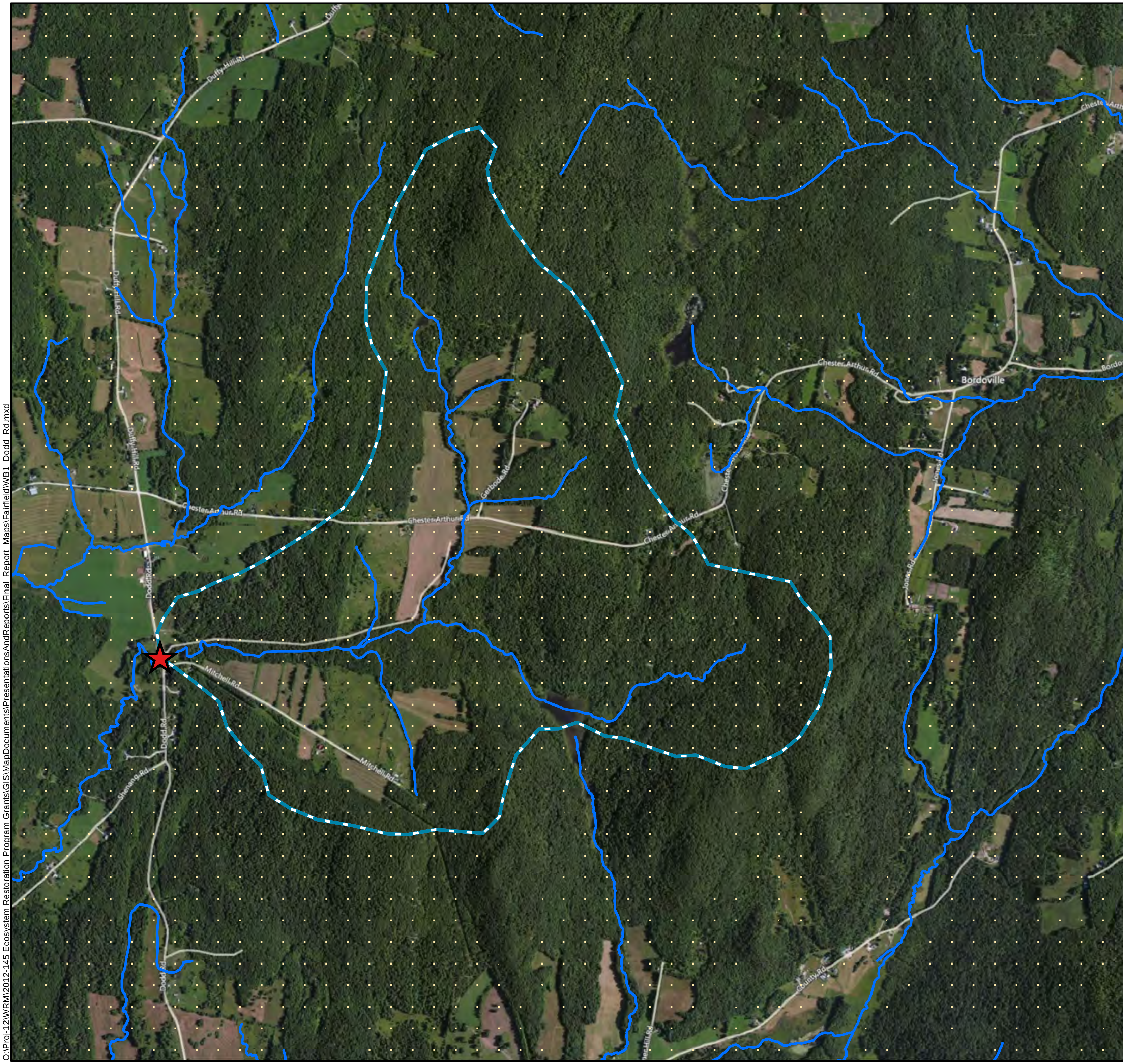

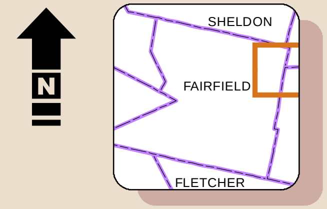

0 625 1,250 2,500 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (1,226 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Dodd Rd, South of Chester A Arthur Rd Junction

WB-1

Fairfield Stormwater Management Planning

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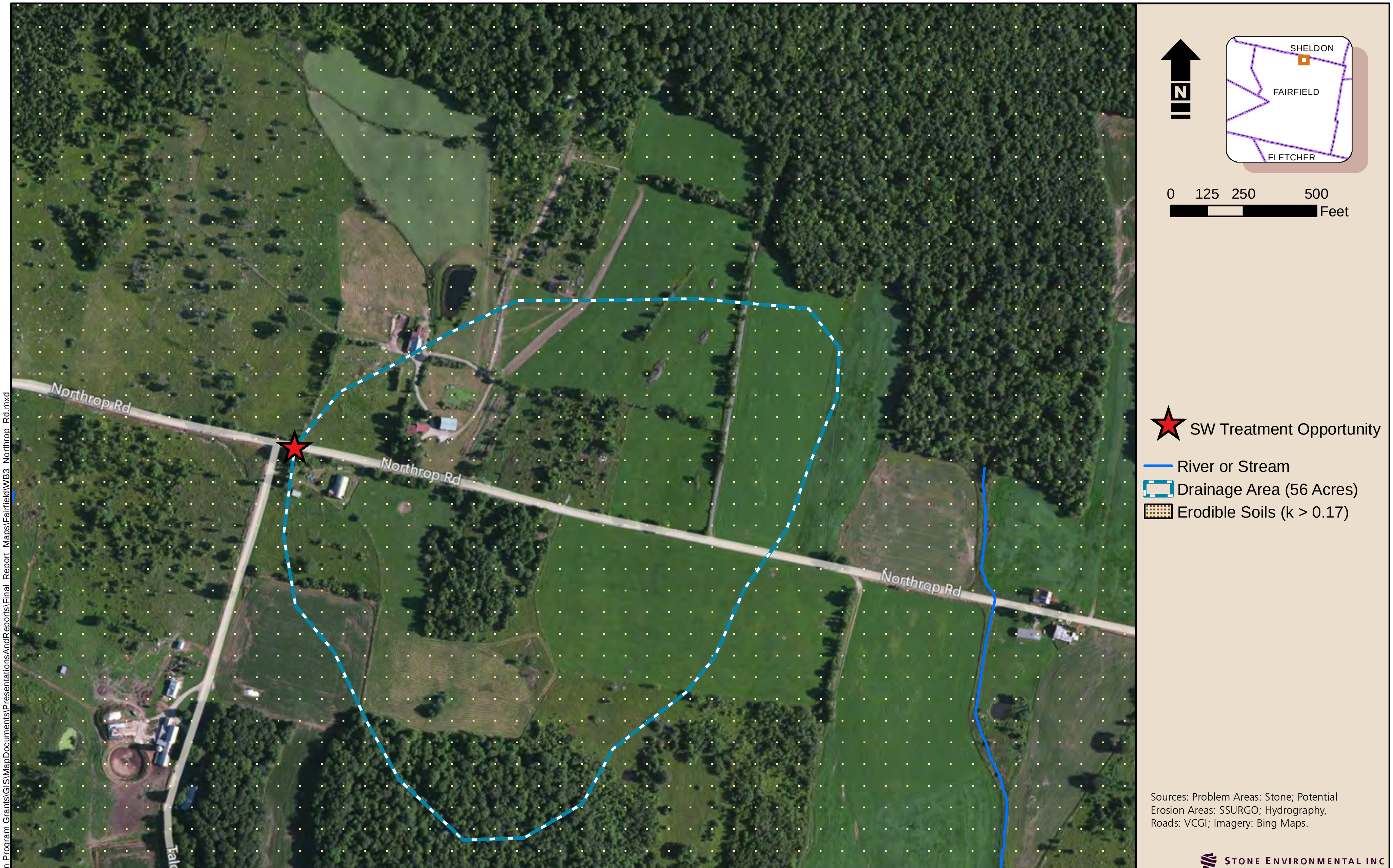

Northrop Rd at Talcott Rd

WB-3

Fairfield Stormwater Management Planning

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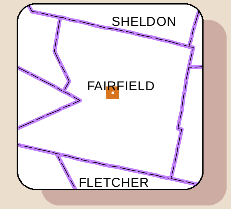

N

0 100 200 400 Feet

SW Treatment Opportunity
River or Stream
Drainage Area (32 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Chester A. Arthur Rd

WB-4

Fairfield Stormwater Management Planning

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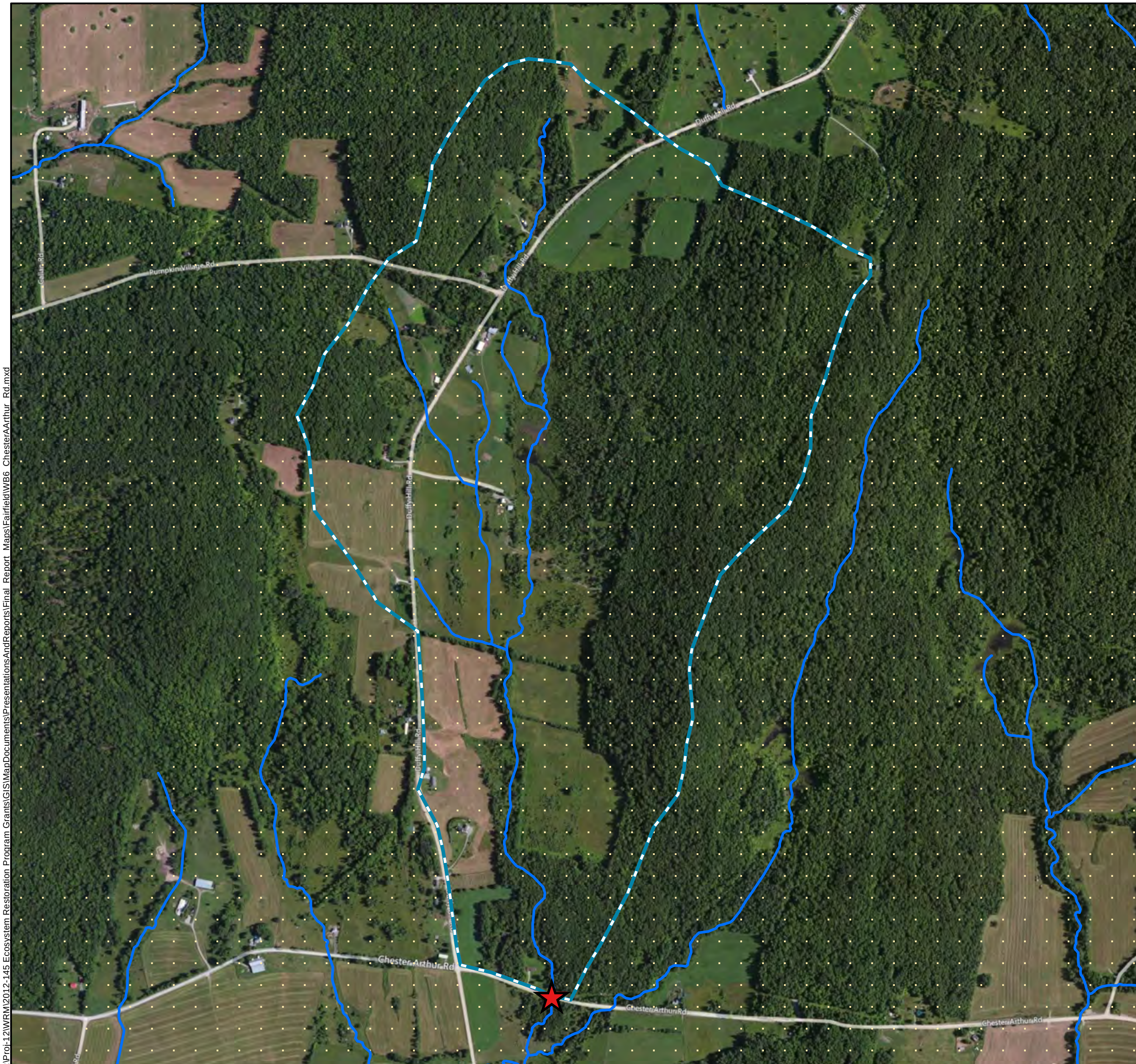

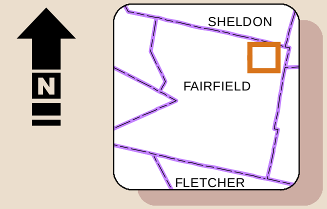

0 260 520 1,040
Feet

SW Treatment Opportunity
River or Stream
Drainage Area (448 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Chester A. Arthur Rd

WB-6

Fairfield Stormwater Management Planning

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