



**Company ENVIRONMENTAL SCIENCE AND ENGINEERING SOLUTIONS**

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March 20, 2007

Ms. Bethany Remmers, Staff Planner  
Northwest Regional Planning Commission  
155 Lake Street  
Saint Albans, VT 05478

Re: Tyler Branch Watershed Project Developer Report  
JCO Job No.: 1-1470-6

Dear Bethany:

The Johnson Company is pleased to present the following Tyler Branch Watershed Project Developer Report. We look forward to meeting with the Committee on March 23<sup>rd</sup>.

## **1.0 INTRODUCTION AND BACKGROUND**

The Johnson Company was retained by Northwest Regional Planning Commission (NRPC) to conduct restoration project development activities within the Tyler Branch watershed in northwestern Vermont. Funding for the project was provided through a grant from Vermont Rivers Management Program (VT RMP). Phase 2 Geomorphic Assessments were previously conducted in the summer and fall of 2005 and the results documented in The Johnson Company's March 2006 Phase 2 Stream Geomorphic Assessment Report for the Tyler Branch Watershed. Most of the reaches were not found to have departed from their reference stream type of C-gravel riffle pool, however nearly all were undergoing some level of adjustment. Results of the Phase 2 Assessments revealed the dominant adjustment processes within the watershed to be historic minor to moderate degradation, and active aggradation, widening, and planform adjustments. Most of the reaches studied were found to be in evolution stage II (downcutting) or III (widening). Active and historic channel management (straightening and gravel mining) was found to be the major stressor, in conjunction with several human made and naturally occurring constrictions. These stressors, in conjunction with several large flood events in recent years, have led to the observed instability in the watershed. The goal of the project was to select potential restoration and/or conservation sites and utilize alternatives analyses to select strategies which would result in increased sediment and nutrient retention potential, reduce conflicts between landowners and the river, and help move the system toward geomorphic equilibrium conditions.

## **2.0 METHODOLOGY**

Potential project areas were selected by evaluating the results of the Phase 2 Geomorphic Assessments. In conjunction with the steering committee (composed of representative from NRPC, VT RMP, United States Fish and Wildlife Service, and Vermont Department of Agriculture) seven potential project areas were selected for further study within the following

stream reaches; M01/M02, M04, M07, M09, T1-02, and T1-03/T1-05. Project packages for each of the seven areas are included in Appendix 1. Landowner contact information is included in Appendix 2.

Each potential project area was evaluated using the Phase 2 Geomorphic data in conjunction with historical and recent topographic and aerial photos to determine what stressors are contributing to the current instability there. The initial phase of the project involved delineating the river corridor for each reach. This was done by updating and running the Stream Geomorphic Assessment Tool (SGAT) GIS application for the watershed. On the ground observations, and recent and historic aerial photos and topographic maps were used to revise the river belt width corridors calculated by SGAT. These data, combined with the current and future potential constraints, were used to perform an alternatives analysis to select which alternatives would provide the greatest benefit and contribute toward re-establishment of geomorphic equilibrium conditions. Each selected alternative was evaluated based on the following criteria:

- Potential degree of landowner interest/cooperation
- Overall reduction of nutrient and sediment input
- Relative cost – cost items to be considered
- Feasibility
- Additional data needed prior to design
- Permitting issues
- Degree to which treatment will meet River Management Program's project Review Criteria

These evaluations, combined with a description of the selected alternatives and Corridor/Restrictions Maps are included in the Project Packages in Appendix 1. Initial contact letters were sent out to each potentially affected landowner and follow up phone calls were made to set up personal meetings to discuss the potential projects. Details of the landowner contact effort are shown in Appendix 2.

### **3.0 RESULTS**

The results for each individual project area are shown in Appendix 1. A figure is included with each potential project area which shows the calculated SGAT corridor, in addition to a revised river corridor which takes into account on the ground observations and historic topographic maps and aerial photos. The figure also shows the various constraints and features (i.e. grade controls, rip-rap, erosion, etc.) for each area. Potential projects identified within the watershed include replacement of undersized and miss-aligned bridges and removal of berms and other encroachments. The Johnson Company has also been working with Ben Gabos, CREP Coordinator for the Missisquoi Watershed, to implement buffer and cattle exclusion plans on some of the potential project areas. Based on the stressors and constraints identified the most effective restoration/conservation technique for many of the project areas is corridor protection

Ms. Bethany Remmers, Staff Planner  
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Saint Albans, VT

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coupled with buffer enhancement. These projects involve limiting channel management activities within the river corridor to allow the expected channel evolution processes to move forward and move the stream toward geomorphic equilibrium. Once geomorphic equilibrium is reached and floodplain access restored sediment and nutrient retention will be greatly increased. By protecting the river corridor and limiting further encroachments, future landowner conflicts will be diminished and a more sustainable relationship can be maintained between neighboring property owners and the river system.

We appreciate the opportunity to be involved in this interesting and important project. Please feel free to contact me with any questions or comments you may have.

Sincerely yours,  
THE JOHNSON COMPANY, INC.

By:



Adam W. Robtoy  
Project Scientist  
[arobtoy@jcomail.com](mailto:arobtoy@jcomail.com)

cc: S.Schuyler

**APPENDIX 1**  
**PROJECT PACKAGES**

## **Reach M01/M02 Tyler Branch Project**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: From confluence with Missisquoi River upstream to just beyond Sheldon/Enosburg town line.

Landowner: Steve and Shirley Harness

Project Alternatives: River Corridor Easement, CREP Buffer, Combination CREP and Corridor Easement

### **Background**

The proposed project area is located in Reach M01 and the downstream end of M02 of the Tyler Branch watershed and extends from its confluence with the Missisquoi River to the Sheldon/Enosburg town line located approximately one mile upstream. The Phase 2 assessment completed during the summer of 2005 indicated that the dominant stream type for the project area was C-gravel, riffle-pool, which is consistent with the reference type as indicated in the Phase 1 assessment. The dominant adjustment process was found to be aggradation, with several large gravel bars and steep riffles noted throughout the reaches. Based on the data collected during the Phase 2 assessment, and recent flooding events during the past few years, these reaches are only slightly to moderately incised (incision ratios of 1.1, 1.2, 1.3, 1.1, 1.2, and 1.7 for the six cross sections completed in the two reaches) and do have some connection to the floodplain during high flow events. There is also evidence that significant planform adjustments are likely to occur in the future. Flooding during the summer of 2006 caused the channel to create a floodchute across the field where the CREP project is proposed (Figure 2). Figure 1 shows two alternate historic river lines from around 1924 and 1962. These two river lines were created by overlaying the 1924 USGS topographic map and 1962 Vermont Orthophoto onto the 2003 aerial photo. These three river lines demonstrate the extensive channel management which has occurred in the last 80 years. Due to the high bed load and extensive straightening which has occurred (in these reaches as well as upstream), significant planform adjustments can be expected during floods.

The project area is dominated by agriculture, predominantly hay and cornfields with several areas of rip-rap located throughout. Potential constraints within the project area include Tyler Branch Road, which runs along the southern edge of the river corridor in M02, the network of hay and cornfields which dominate the land use in the area, a farm road which runs along the left streambank in M01, two stream fords maintained in M01 to allow for the passage of heavy equipment to fields located on the northern side of the river, and historic gravel mining activities from two large point bars within M01.

The site was chosen as an opportunity to look for other ways for the landowners to have a sustainable relationship with the river. There have been present and historic conflicts

between the river and landowners including flooding and bank erosion during the summer of 2006 which caused erosion and crop damage in one field (shown on Figure 2). In addition, this site is a strategic location at the mouth of the Tyler Branch, and represents an opportunity to maintain floodplain connection and enhance sediment and nutrient attenuation assets, which were historically a feature in this reach. Any selected potential projects for this area would need to relieve the stressors which dominate it, including the historic channel management (i.e. straightening, bank armoring, etc.), high bed load, lack of stream bank buffers, and lack of sediment and nutrient storage.

Given the current geomorphic condition, list of stressors which dominate the project area, and the overall project goal of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique for reaches M01/M02 appears to be protection of the river corridor to allow the expected channel evolution to progress, and reestablish a more natural meander pattern and enhance floodplain connection. Enhancement of stream buffers would not help to move the system toward geomorphic equilibrium, though they would enhance the sediment and nutrient retention within the reaches and would be relatively easy to implement. There are no head cuts, berms, or other structures which are contributing to the instability within the reach, so arresting head cuts, removing berms and/or structures are not valid restoration techniques here. There is currently only one large area of bank erosion located near the confluence with the Missisquoi. Stabilizing this bank would be very expensive and would not contribute to the restoration of geomorphic equilibrium conditions, so this is not a recommended restoration technique for this area. Based on the information described above, the three alternatives considered reasonable for this project area are protecting the river corridor, enhancing stream bank buffers, or a combination of river corridor protection and stream bank buffer enhancement.

### **Corridor Easement Alternative**

The River Corridor Easement Alternative involves eliminating or changing channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention within the project area. As described above, this portion of the Tyler Branch has been extensively managed in the past. As part of the Easement Alternative the landowners would be paid an upfront payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. agricultural crop production) would be allowed to continue with a minimum floating buffer area (35') maintained between cropland and the stream bank. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the current landowners is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on

the attached Figure 1. The belt width corridor is calculated to be 87 acres, and is proposed as the easement corridor.

### Overall Sediment/Nutrient Reduction and Attenuation

The River Corridor Easement option would provide the maximum level of long term sediment and nutrient attenuation through the natural evolution of the river to a more stable form. Sediment and nutrients would be stored in the channel and on the floodplain as the river naturally progresses toward its historic depositional sediment regime as opposed to the current transport regime where sediment and nutrients are carried through the system and into the larger Missisquoi River watershed. This process would be gradual, as it may take years for the river to regain a more natural meander pattern and floodplain connection. During this process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts and some level of soil erosion occurs. This passive floodplain and meander redevelopment would act to restore the reach to its historic role as a high deposition zone and would in the long term result in much greater sediment storage capacity.

### Project Constraints

Potential constraints which will need to be addressed prior to final design of the corridor easement are mainly related to landowner negotiations. The river corridor shown on Figure 1 represents a significant portion of the landowners' tillable cropland, some of which may be lost as channel evolution occurs. While the easement would compensate the landowners for these potential losses, there may be certain areas they are unwilling to lose despite the potential compensation. Other issues and/or concerns mentioned by Mr. Harness include his ability to continue to remove gravel from two large bars (see Figure 1 for locations) within M01 and M02 where he has historically had a permit issued by RMP to do so, and his ability to maintain two stream crossing points in M01 which are his only access to the fields located on the northerly side of the river. A farm road that runs along the left bank of the river may have to be relocated as well. During negotiations for the easement, a review of the current and/or future gravel mining practices would need to be done to determine how much gravel extraction could be done and at what locations to accommodate the landowners' needs while still allowing the preferred channel evolution changes to occur. Tyler Branch Road also represents a minor constraint to the corridor as it is defined on Figure 1. The southern corridor boundary has been moved northward to reflect the location of the road.

### Additional Data Needed

The main pieces of additional data needed prior to implementation of the corridor easement are a final delineation of the river corridor after evaluation of the constraints and negotiations with the landowners. Other questions that need to be answered include whether or not the landowners may be willing to relocate the stream fords currently used to access fields on the other side of the river and the farm road that currently skirts the

left bank of the river. As mentioned above, the degree and extent to which the landowners may want to resume or initiate gravel mining operations within the project area will also have to be addressed. Moving these features would be necessary to allow the channel evolution process to move forward.

### Permitting Issues

There are two potential permitting issues which may apply to the corridor easement alternative. If either of the existing stream crossings need to be relocated or reconstructed due to movement of the channel and/or flooding then a stream alteration permit may be necessary depending on the type and magnitude of activity required. Information on Stream Alteration Permit requirements is included at the end of this document. In addition, a Gravel Removal Permit would be needed for removal of over 50 cubic feet of gravel per year. Removal of less than 50 cubic feet does not require a permit, but does require notification to RMP within 72 hours of the removal action.

### Cost and Feasibility

The relative cost of the alternative will depend on the final size of the corridor included in the easement and the payment terms (i.e. \$/acre) which will have to be worked out between RMP and the landowners. A relatively large upfront payment would be paid to the landowners in exchange for relinquishment of their channel management rights to compensate them for the anticipated loss of some amount of land during channel evolution. The landowners would not only be allowed to continue farming in the easement corridor on lands not eroded by the river, they would be compensated for potential lost production value, and would benefit by not incurring the cost of channel management techniques (rip-rap, fill, etc.) that they have previously utilized. The benefit from the easement would be sediment and nutrient attenuation within the project area, a more stable relationship between the landowners and the river, and hopefully fewer conflicts between upstream and downstream landowners and the river as the project moves the system toward a more stable state. The feasibility of the project depends solely on the willingness of the landowners to relinquish some or all of their channel management rights in exchange for financial compensation.

### Degree of Landowner Interest

During initial discussions with Mr. Harness during the fall 2006, he seemed rather reluctant to the idea of losing channel management rights, however he indicated that he would be willing to discuss the possibility once a better idea of the financial terms of the easement process were more fully developed.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the Corridor easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the CREP Buffer Alternative

discussed for a portion of M01/M02. As is shown in the table, the Corridor Easement Alternative does meet all six of the RMP's criteria.

### **CREP Buffer Alternative**

The potential Conservation Reserve Enhancement Program (CREP) buffer alternatives are shown on Figure 2. The field selected (cornfield along Tyler Branch Road) was chosen based on a request from Mr. Harness, who indicated that flooding and erosion have been an issue with the field in the past particularly in the summer of 2006. Three potential CREP buffers scenarios are possible, a minimum 35 foot buffer (totaling 1.5 acres), a slightly wider 50 foot buffer (totaling 2.3 acres), and an expanded buffer which includes the entire western portion of the field (totaling 5.3 acres). The expanded buffer option was included because this area is where the majority of the flooding has occurred in the past and due to the limited production value of that portion of the field after removal of the 35 or 50 foot buffer (ie. the remaining portion would be too narrow to harvest practically). Each of the buffer options could be for either a forested buffer, grassed filter strip, or a combination of the two for the wider buffer options. An additional option presented to Mr. Harness was the harvestable grass buffer known as the Vermont Agricultural Buffer Program (VABP). This option would be similar to the CREP buffers except that the grass buffer could be harvested between June and September, the compensation rate is 40% of the CREP rate, and the enrollment is for a maximum of 5 years compared to the renewable 15 year contracts available through CREP. All of these options were presented to Mr. Harness on January 4, 2007 so that he could choose which, if any, of these he would like to consider. Cost estimates were not provided for the 35 foot wide buffer scenario as the typical flood elevation in the field extends beyond the 35 foot mark. Mr. Harness' main concern was to prevent flood damage to future crops within the field, so an emphasis was made on the wider two buffer scenarios. There may be additional buffer opportunities along other portions of M01 and M02, however at this time Mr. Harness only expressed interest in the one field. The Harness farm is in the process of obtaining a large farm operations permit from the Department of Agriculture which when implemented will require a minimum 25 foot buffer along all waterways.

### Overall Sediment/Nutrient Reduction and Attenuation

Any of the proposed CREP or VABP alternatives would provide some level of nutrient reduction and attenuation with the wider buffers providing the greatest benefit. The benefit for these alternatives is lower than that for the Corridor Easement alternative, and would do little toward achieving geomorphic dynamic equilibrium conditions.

### Project Constraints

There are no foreseeable constraints for any of the buffer alternatives. Mr. Harness will need to decide which buffer alternative works best for him in terms of balancing the financial incentive payments with loss of crop production and increased land maintenance costs (replanting crops, filling in flood damage).

### Additional Data Needed

No additional data are needed prior to implementation of the buffer alternatives.

### Permitting Issues

There are no permitting issues to deal with for the buffer alternatives. There will be some contracts and other paperwork associated with the CREP and/or VABP which will need to be worked out between NRCS and the landowners.

### Cost and Feasibility

The cost for the 5.3 acre forested buffer alternative is \$30,846.00 (paid out as an upfront payment of \$10,891.50 and 15 annual payments of \$1,330.30 through the CREP program). The cost for the 5.3 acre grassed filter strip alternative is \$29,892.00 to be paid out under similar terms. The costs for the 1.5 acre option are \$8,730.00 for the forested buffer and \$8,460.00 for the grass filter strip option. Similarly for the 2.3 acre option the costs are \$13,386.00 and \$12,972.00. The VABP option costs would be 40% of the CREP rate/acre/year for 5 years plus \$123/acre to cover the cost of seeding down the fields.

### Degree of Landowner Interest

Due to flooding which occurred on two separate occasions in 2006 (which required two additional corn plantings that provided diminished yields) Mr. Harness has shown a high level of interest in pursuing some alternative land use for this field. All of these options were presented to Mr. Harness on January 4, 2007, so that he could choose which, if any, of these he would like to consider.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP Buffer Alternatives will meet the River's Management Project Criteria is shown in the Table below along with the Corridor Easement Alternative discussed above. As shown in the table, the various buffer alternatives would result in some level of sediment and nutrient reduction and attenuation, though would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

### **River Corridor Easement and CREP Combination**

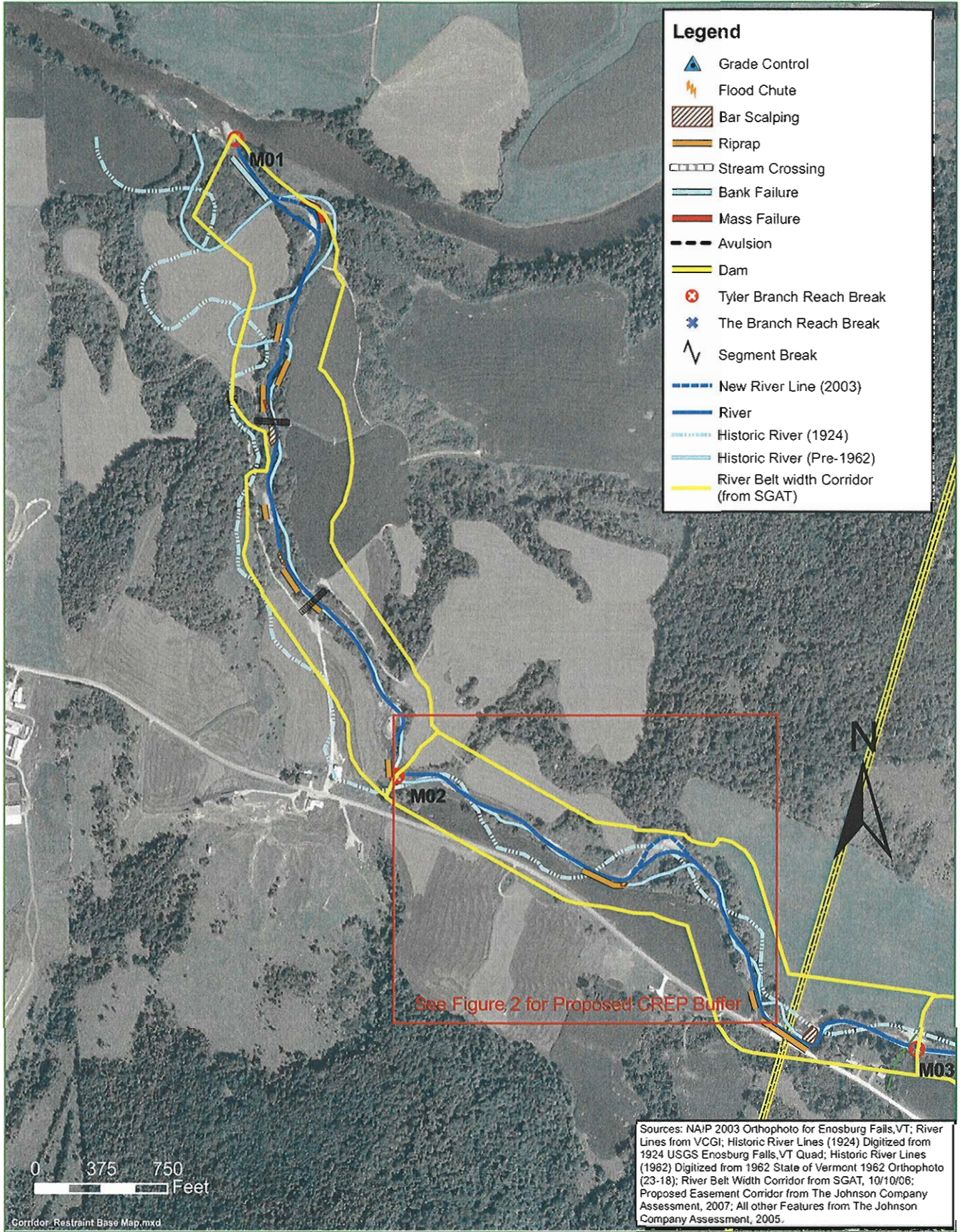
A third potential alternative for the Site would be to combine certain elements of the Corridor Easement and the CREP Buffer Alternatives. This project would likely involve delineating a partial corridor easement by selecting certain areas amenable to the landowners where channel evolution could be allowed to progress. Other portions of the

Project Area would likely remain similar to their current use, though CREP buffers may be used to enhance nutrient attenuation in these areas, and channel management may be needed to maintain this state. Additional data needed prior to implementation of this alternative would include an analysis of which portions of the Project Area would result in the greatest level of benefit combined with which areas the landowners would be willing to enroll into an easement program rather than the CREP buffer program. The level of sediment and nutrient attenuation for this alternative would likely be greater than the CREP alternative, though less than the complete Corridor Easement alternative and would depend on how large an area was enrolled in each option. The constraints would be similar to those discussed for each of the two alternatives discussed separately. Project feasibility depends on which areas are selected for corridor protection and to what extent those areas would facilitate channel evolution toward equilibrium conditions. Cost for this alternative would likely be somewhat less expensive than the complete corridor easement alternative and somewhat more expensive than the CREP buffer alternative.

### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

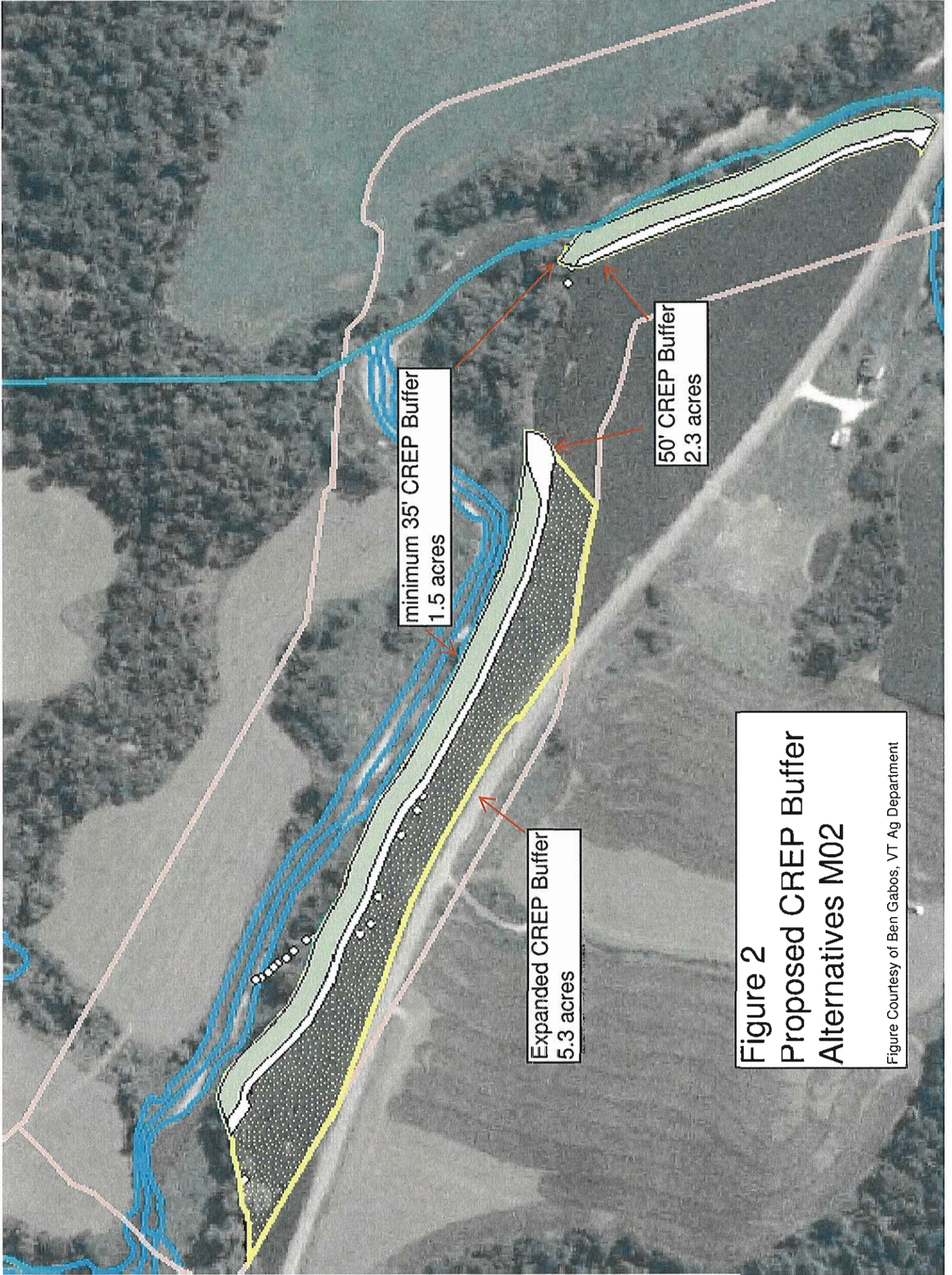
<b>Rivers Management Project Review Criteria Table for Reaches M01/M02</b>			
Rivers Management Project Criteria	Corridor Easement Alternative	Corridor Easement/CREP Buffer Alternatives Combined	CREP Buffer Alternative
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Possibly	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the short term. In the long term sediment loading may increase if channelization practices are sustained in the reach.
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Possibly	Maintenance and extension of the existing transport regime in what would be a sediment deposition reach may not be sustainable.
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	Possible	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	Will contribute to restoration of equilibrium conditions in other reaches	Will Possibly contribute to restoration of equilibrium conditions in other reaches	Will not contribute to restoration of equilibrium conditions
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes, but moderated as described above



**Figure 1**  
**Harness Farm Corridor/Restraints Map**

**THE JOHNSON COMPANY, INC.**  
*Environmental Sciences and Engineering*  
 100 STATE STREET      MONTPELIER, VT 05602

DATE: 3/22/07      PROJECT: 1-1470-6  
 DRAWN BY: MJR      SCALE: 1" = 750'



**Figure 2**  
**Proposed CREP Buffer**  
**Alternatives M02**

Figure Courtesy of Ben Gabos, VT Ag Department



State of Vermont  
**PERMIT AND LICENSE INFORMATION**

**STREAM ALTERATIONS/STREAM CROSSINGS STRUCTURE**

<b>SUMMARY DESCRIPTION OF PERMIT</b>	Permit regulating the alteration of streams; permit is intended to prevent creation of flood hazards, protect against damages to fish life, and protect rights of neighboring landowners and assure compliance with VT Water Quality Standards.
<b>EXAMPLE OF REGULATED ACTIVITY</b>	Streambank stabilization, mineral prospecting, municipal roadway improvements encroaching on streams, utility crossings under streambeds, Section 401 federal clean water act, municipal or private bridge construction or repair.
<b>CRITERIA FOR JURISDICTION</b>	For Title 10 Permit: Movement, excavation or fill involving 10 or more cubic yards annually in any watercourse with a drainage area greater than 10 square miles or in any designated outstanding resource water. No person may remove gravel from any watercourse, regardless of size, primarily for construction or sale. Exemption for 50 cubic yards annually for riparian landowners but must be reported to the Agency 72 hours prior to excavation. Exemptions for town's emergency protective measures with reporting requirements and for Accepted Agricultural Practices as defined by the Commissioner of Agriculture. Approval required for use of sluice boxes for mineral prospecting. Approval required for municipal or private stream crossings greater than 1.0 square mile watershed.
<b>INFORMATION REQUIRED</b>	Requires specific information regarding stream/river involved, location where proposed work to be done, length of stream affected, adjacent and opposite landowners, working dates, maps/drawings, plans, and fee, notification of application to adjoining and the municipality.
<b>WEB ADDRESSES</b>	<a href="http://www.anr.state.vt.us/dec/waterq/permits/htm/pm_streamalt.htm">http://www.anr.state.vt.us/dec/waterq/permits/htm/pm_streamalt.htm</a>  <a href="http://www.anr.state.vt.us/dec/waterq/permits/htm/pm_streamcrossing.htm">http://www.anr.state.vt.us/dec/waterq/permits/htm/pm_streamcrossing.htm</a>
<b>FEES</b>	\$105.00 for Title 10 Stream Alteration Permit. Municipalities exempt.
<b>APPLICATION TIME FRAME</b>	The performance standard for processing a complete application is 40 days.

**ADMINISTERING  
AGENCY**

**AGENCY OF NATURAL RESOURCES  
DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
WATER QUALITY DIVISION**

Please check the above website to locate the correct Stream Alteration Engineer.

**CONTACT:** For projects in the northeastern & central portion of Vermont, including the Lake Memphremagog, Nulhegan, Passumpsic River, Upper Winooski, Mad River, and Little River watersheds, contact:

Patrick Ross, Engineer  
McFarland House, 5 Perry Street, Ste #80  
Barre, VT 05641-4268  
Phone: 802-476-2679 Fax: 802-476-0131  
E-mail: [patrick.ross@anr.state.vt.us](mailto:patrick.ross@anr.state.vt.us)

For projects in the northwestern & central portion of Vermont, south to the Leicester River & Lemon Fair watersheds, contact:

Chris Brunelle, Stream Alteration Engineer  
Essex Regional Environmental Office  
111 West Street, Essex Junction, VT 05452.  
Phone: 802 879-5631 Fax: 802 879-3871  
E-mail: [chris.brunelle@anr.state.vt.us](mailto:chris.brunelle@anr.state.vt.us)

For all projects in the southern portion of Vermont, including the White and Ottauquechee watersheds south, contact:

Fred Nicholson, Stream Alteration Engineer  
Rutland Regional Environmental Office  
50 ASA Bloomer State Office Building  
Rutland, VT 05701-5903  
Phone: 802-786-5906 Fax: 802-786-5915  
E-mail: [fred.nicholson@anr.state.vt.us](mailto:fred.nicholson@anr.state.vt.us)

**AUTHORITY**

10 VSA Chapter 41, VT Water Quality Standards

**APPEAL  
PROCESS**

Effective January 31, 2005, within 30 days of the date of an act or decision, any person aggrieved by an act or decision of the secretary, or any party by right, may appeal to the environmental court in accordance with the provisions of 10 VSA Chapter 220.

**OTHER PERMITS**

Local flood zoning, Army Corps of Engineers permits, 401 Water Quality Certification (see sheet) and approvals may apply. If an alteration is related to a commercial use, contact a Permit Specialist for a Project Review Sheet.

<http://www.anr.state.vt.us/dec/ead/pa/index.htm>

## **Reach T1-03/T1-05 The Branch Project**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: The Branch – Reaches T1-03 and T1-05A

Landowners: Warren and Marie Hull (Dalestead Farms)

Project Alternatives: River Corridor Protection, CREP Buffer/Cattle Exclusion, Combination CREP and Corridor Easement

### **Background**

The proposed project area is located in Reaches T1-03 and T1-05A within The Branch Watershed. The reaches were combined as they were found to be undergoing similar adjustment processes, and the land around both is owned by one person which may more easily facilitate completing projects in these areas. The Phase 2 assessment completed during the summer of 2005 indicated that the dominant stream type for both reaches was B-gravel, riffle-pool, which represents a stream type departure from the C-gravel reference type indicated in the Phase 1 assessment. The dominant adjustment process was found to be historic straightening and degradation which accounted for the stream type departure. Both reaches were moderately to very highly incised (incision ratios of 1.5, 2.3, 1.8 and 2.2 for the four cross sections completed within the reaches) and have connection to the floodplain during only the highest flow events. There is also evidence that historic straightening has occurred and that future planform adjustments are likely to occur. This is particularly evident in the upper portion of T1-03 where the channel was pushed against the valley wall on the right and has begun to work its way back toward the historic channel which is still visible in the left side the field. In addition, two flood chutes were noted during the Phase 2 assessment. Figure 1 shows the historic river line from 1962, which was created by overlaying the 1962 and 2003 orthophotos. The planform adjustments in T1-03 are evident when comparing the two photos. The two reaches are separated by T1-04 which contains two major constrictions and grade controls, a large bedrock gorge located in the upper portion of the reach, and a large dam built into another bedrock gorge located in the lower portion of the reach.

The project area is dominated by agriculture, predominantly hay and pasture with several areas of rip-rap located throughout. Potential constraints within the project area include VT Route 108, which runs just outside the western edge of the river corridor, the network of hay fields and pasture which dominate the land use in the area, structures located within the corridor including a barnyard and milkhouse waste pit in T1-05A and a house and garage located in T1-03, a stream ford in T1-05A, numerous cattle crossing points, and the relatively narrow valley.

The site was initially chosen based on field observations during the Phase 2 assessment as an opportunity to look for ways to limit nutrient inputs into the river by excluding cattle,

and enhancing buffer establishment. The geomorphic data also indicates that due to the historic straightening and degradation, the area may provide an opportunity to re-establish a more natural meander pattern and enhance floodplain connection to allow for sediment and nutrient storage and move the system toward geomorphic equilibrium. Any selected potential projects for this area would need to relieve the stressors which dominate it including the historic channel management (i.e. straightening, bank armoring, etc.), lack of stream bank buffers, and lack of floodplain access.

Given the current geomorphic condition, list of stressors which dominate the project area, and the overall project goals of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique for reaches T1-03 and T1-05A appears to be protection of the river corridor to allow the expected channel evolution to progress, reestablish a more natural meander pattern and enhance floodplain connection. Enhancement of stream buffers and cattle exclusion would not necessarily help move the system toward geomorphic equilibrium, though they would reduce the sediment and nutrient inputs, particularly considering the large amount of agriculture within the reaches, and would be relatively easy and inexpensive to implement. There are no head cuts, berms, or other structures which are contributing to the instability within the reaches (the dam located between the two reaches is constructed within a bedrock gorge, is partially breached, and does not retain much more water than the gorge would by itself so removing it would not significantly change the sediment regime of the area, and the farm bridge located in T1-05A represents a minor flood plain constriction, though replacing it would not significantly improve the geomorphic condition of the reach), so arresting head cuts, removing berms and/or structures are not valid restoration techniques here. There are currently only a few small areas of bank erosion located within the reaches. Stabilizing them would not contribute to the restoration of geomorphic equilibrium conditions and would not provide a significant amount of nutrient retention, so this is not a recommended restoration technique for this area. Based on the information described above, the three alternatives considered reasonable for this project area are protecting the river corridor, enhancing stream bank buffers and implementing cattle exclusion measures, or a combination of river corridor protection and stream bank buffer/cattle exclusion.

### **Corridor Easement Alternative**

The river corridor easement Alternative involves eliminating and/or limiting channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention. As described above, this portion of the Tyler Branch has been extensively managed in the past. As part of this alternative the landowners would be paid an upfront payment in order to relinquish their current channel management rights as part of a deeded easement. Current land use within the corridor (i.e. hay and/or pasture) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between the ag-land and the stream bank. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river

equilibrium objective. It is anticipated that over time, as the channel evolution process continues, some land may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowners is intended to compensate them for these anticipated losses. The proposed river corridor easement area is shown on the attached Figure 1. While the river belt width corridor is shown for the entire area, T1-04 was not included in the corridor easement area as it is dominated by naturally occurring bedrock gorges and grade controls and would not benefit from inclusion in the easement. The corridor shown is the belt width corridor calculated using SGAT which has been slightly modified to take into account on the ground observations, the historic river line from the 1962 aerial photo, and the human infrastructure within the reaches. Of particular interest within this project area is reach T1-03, where the historic channel location is evident on the opposite side of the pasture through which it flows. Through the corridor protection project it is expected that the channel will migrate back to this historic location. The total area for the proposed easement in T1-03 and T1-05 is approximately 15.8 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

The river corridor easement option would provide the maximum level of long term sediment and nutrient attenuation through the natural evolution of the river to a more stable form. Sediment and nutrients would be stored in the channel and on the floodplain as the river naturally progresses toward its historic depositional sediment regime as opposed to the current transport regime where sediment and nutrients are carried through the system to downstream reaches. This process would be gradual, as it may take years for the river to regain a more natural meander pattern and floodplain connection. During this process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts and some level of soil erosion occurs. This passive floodplain and meander redevelopment would act to restore the area to its historic role as a C-type stream and would in the long term result in much greater sediment storage capacity.

#### Project Constraints

Potential constraints which will need to be addressed prior to final design of the corridor easement are mainly related to landowner negotiations and human infrastructure located within the historic river corridor. The river corridor shown on Figure 1 represents a significant portion of the relatively narrow valley where suitable agricultural land is at a premium. During channel evolution some of this useable land may become unusable as the stream begins to meander through the corridor. While the easement would compensate the landowners for these potential losses, they may not be able to afford to give up productive land despite the potential compensation. A significant portion of Dalestead Farm's barnyard and milkhouse waste storage pit are located within the historic corridor and will have to be protected from stream bank erosion. Other issues which need to be considered include the bridge located near the barn in T1-05A, and the animal crossing and stream ford located at the downstream end of T1-03. Both of these

crossings will need to be maintained to allow access to pasture and cropland located on the eastern side of the stream.

#### Additional Data Needed

The main pieces of additional data needed prior to implementation of the corridor easement are a final delineation of the river corridor after further evaluation of the constraints and negotiations with the landowners. Another question that needs to be answered is whether or not the landowners may be willing to relocate the stream fords and/or farm bridge currently used to access fields on the other side of the river should channel evolution threaten these areas.

#### Permitting Issues

One permitting issue which may apply to the corridor easement alternative is the potential need for a stream alteration permit depending on the type and magnitude of activity required should relocation of the bridge and/or stream fords become necessary.

#### Cost and Feasibility

The relative cost of the alternative will depend on the final size of the corridor included in the easement and the payment terms (i.e. \$/acre) which will have to be worked out between RMP, the easement holder, and the landowners. A relatively large upfront payment would be paid to the landowners in exchange for relinquishment of their channel management rights to compensate them for the anticipated loss of some amount of land during channel evolution. The landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river, would be compensated for potential lost production value, and would benefit by not incurring the cost of future channel management techniques (rip-rap, fill, etc.) that they may have otherwise incurred. The benefit from the easement would be sediment and nutrient attenuation within the project area, a more stable relationship between the landowners and the river, and hopefully less conflicts between upstream and downstream landowners and the river as the project moves the system toward a more stable state. The feasibility of the project depends solely on the willingness of the landowners to relinquish some or all of their channel management rights in exchange for financial compensation.

#### Degree of Landowner Interest

During initial discussions with Mr. Hull during the fall and winter of 2006, he seemed opposed to the idea of relinquishing channel management rights and stressed the importance of retaining what little available tillable land he currently has. Mr. Hull was much more receptive to pursuing some sort of buffer/cattle exclusion plan which is discussed below.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the corridor easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for T1-03 and T1-05A. As is shown in the table, the corridor easement alternative does meet all six of the RMP's criteria.

### **CREP Buffer/Cattle Exclusion Alternative**

The potential Conservation Reserve Enhancement Program (CREP) buffer/cattle exclusion alternative is shown on Figures 2 and 3. The area chosen for the project is the barnyard and cattle feeding area located in T1-05A. Currently, nearly the entire stream channel is accessible by cows and the streambanks are virtually bare with very little vegetation. No major areas of erosion were noted along this area, so by excluding the cows, and planting buffers the nutrient inputs from this area would be greatly reduced and wildlife habitat improved. Through discussions with Mr. Hull and Ben Gabos (CREP Coordinator for the Missisquoi Watershed), the proposed fencing scheme was developed which excludes stream access to the cows with the exception of the culvert and tributary located in the upper right corner of Figure 3 which is necessary to cross the cows under the road. The total land area converted to buffer space as part of this alternative is approximately 0.9 acres. There may be additional buffer/cattle exclusion opportunities along other portions of Dalestead Farm, including the barnyard located in T1-03, and some pasture lands located on tributaries of The Branch which will be examined by Ben Gabos during the spring.

### Overall Sediment/Nutrient Reduction and Attenuation

The CREP/cattle exclusion alternative would provide a relatively large amount of nutrient retention associated with the prevention of animal feed, manure, and runoff entering the stream. This alternative would do nothing toward achieving geomorphic dynamic equilibrium conditions.

### Project Constraints

There are no foreseeable constraints associated with the alternative shown on Figure 3. The main constraint for the project is ensuring that access is retained to both pastures located to the north of Route 108, and on the eastern side of The Branch. A water source for the cows is located outside the barn, so the stream is not needed for this. The bridge is already in place and represents an ideal place for the cows to cross as it is easier on their feet, and allows for safer stream crossing during high flow events.

### Additional Data Needed

No additional data are needed prior to implementation of the buffer/cattle exclusion alternative other than to determine the cost of the project and locate funding sources.

### Permitting Issues

There are no permitting issues to deal with for the buffer/cattle exclusion alternative. There will be some contracts and other paperwork associated with the CREP and other programs which may share some of the cost of the project.

### Cost and Feasibility

The cost for the project would be relatively inexpensive given the level of benefit for the watershed. The main cost associated with the project would be the purchase and installation of the fencing and gates required likely to be a few thousand dollars. The 0.9 acres of buffer would be eligible under CREP for reimbursement as marginal pastureland at a rate of approximately \$160/acre/year. It is anticipated that CREP and the US Fish and Wildlife Service would be able to pay for a significant portion of the project including most of the fencing and buffer planting cost. The fencing associated with the alleyway located on the eastern side of the stream would probably not be eligible for CREP, however EQUIP and/or other related agricultural assistance programs may defray some of the cost.

### Degree of Landowner Interest

Based on conversations with Mr. Hull, he is prepared to implement the project providing that a majority of the costs can be covered by the above mentioned programs.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer/cattle exclusion alternatives will meet the River's Management Project Criteria is shown in the Table below along with the corridor easement alternative discussed above. As shown in the table, the buffer alternative would result in some level of sediment and nutrient reduction and attenuation, but would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

### **River Corridor Easement and CREP Combination**

A third potential alternative for the Site would be to combine the corridor easement and the CREP buffer/cattle exclusion alternatives. This project would involve implementing the buffer/cattle exclusion shown on Figure 3 in conjunction with the corridor easement shown on Figure 1. This alternative would provide even greater sediment and nutrient attenuation than either of the alternatives as it would combine the elements of both. There would be no conflicts between the two as there would be required buffers as parts of the corridor alternative were it to proceed on its own. One of the constraints for the corridor

easement alternative would require some channel management in the area around the barnyard to protect infrastructure, so the two projects would transition together well. Additional data needed prior to implementation of this alternative would be similar to that for the corridor alternative. The constraints would be similar to those discussed for each of the two alternatives discussed separately. Cost for this alternative would likely be slightly more expensive than the corridor easement alternative.

### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

<b>Rivers Management Project Review Criteria Table for Reaches T1-03/T1-05</b>			
Rivers Management Project Criteria	Corridor Easement Alternative	Corridor Easement/CREP Buffer Alternatives Combined	CREP Buffer Alternative
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Yes	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Yes	Maintenance and extension of the existing transport regime in what would be a sediment deposition reach may not be sustainable.
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	Possible	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	<b>Will</b> contribute to restoration of equilibrium conditions in other reaches	<b>Will</b> contribute to restoration of equilibrium conditions in other reaches	<b>Will not</b> contribute to restoration of equilibrium conditions
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes, but moderated as described above

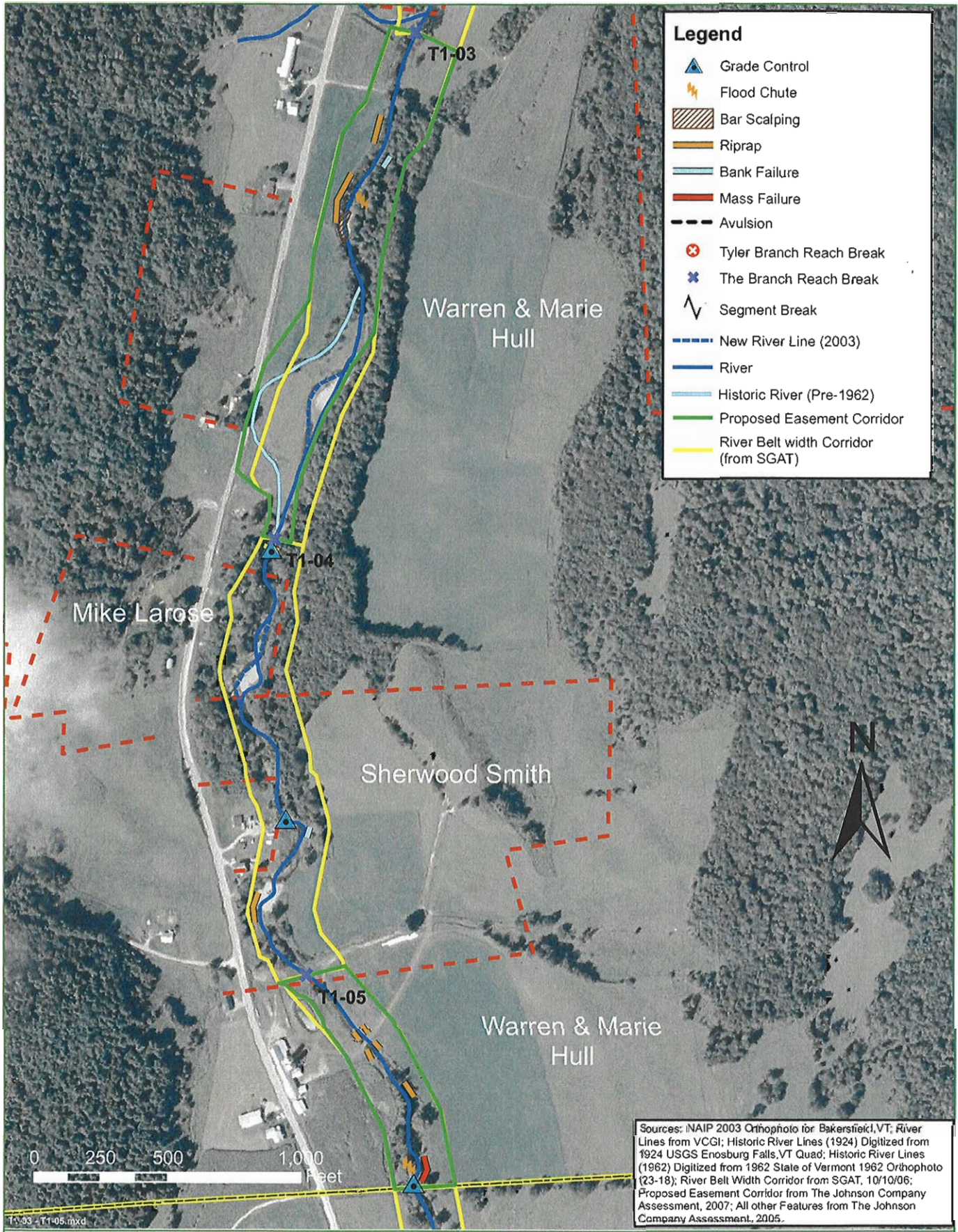
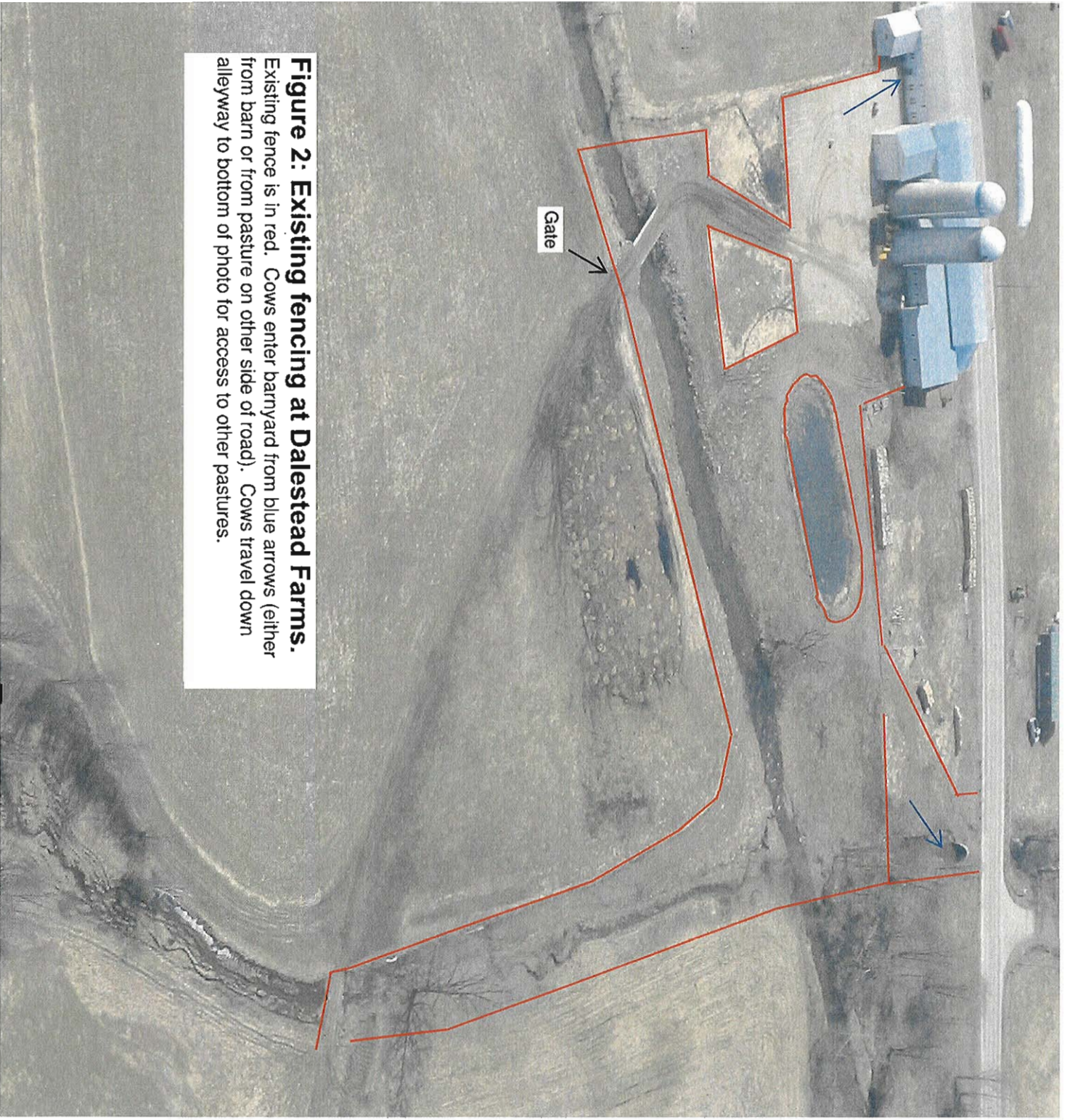


Figure 1: The Branch (T1-03 - T1-05) Corridor/Restrains Map

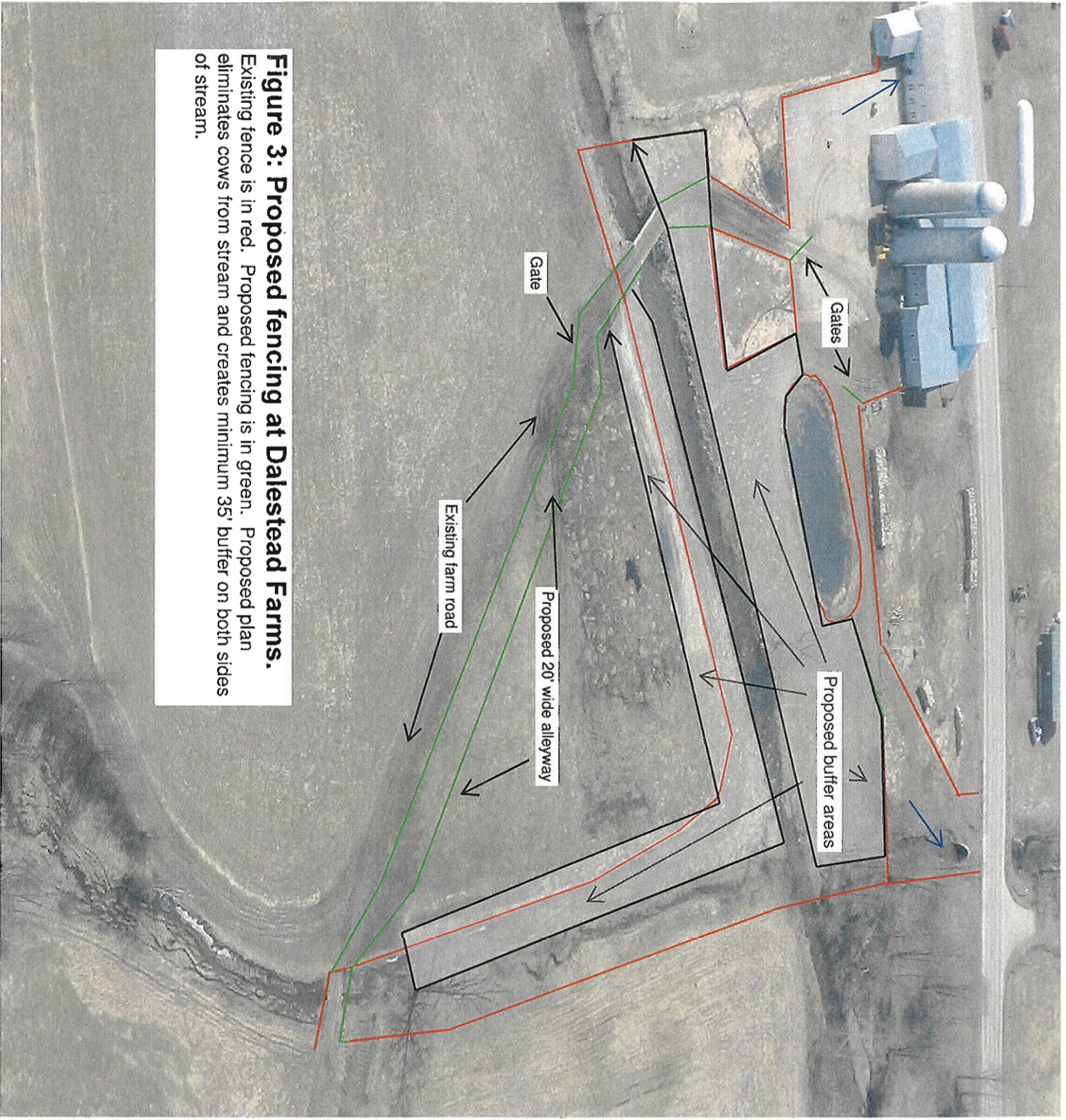
**THE JOHNSON COMPANY, INC.**  
*Environmental Sciences and Engineering*  
 100 STATE STREET MONTPELIER, VT 05602

DATE: 2/16/07 PROJECT: 1-1470-6  
 DRAWN BY: MJR SCALE: 1" = 500'



**Figure 2: Existing fencing at Dalestead Farms.**

Existing fence is in red. Cows enter barnyard from blue arrows (either from barn or from pasture on other side of road). Cows travel down alleyway to bottom of photo for access to other pastures.



**Figure 3: Proposed fencing at Dalestead Farms.**

Existing fence is in red. Proposed fencing is in green. Proposed plan eliminates cows from stream and creates minimum 35' buffer on both sides of stream.

## **Reach T1-02 The Branch Project (Sweet Parcel)**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: From VT Route 108 bridge located near intersection with St. Pierre Road downstream to property boundary with Marcel Parent.

Landowner: Margaret Sweet

Project Alternatives: River Corridor Easement with CREP Buffer Enhancement, and CREP Buffer

### **Background**

The proposed project area is located in the lower portion of Reach T1-02 and approximately 500 feet of the upstream end of T1-01 on the parcel of land owned by Margaret Sweet. The Phase 2 assessment completed during the summer of 2005 indicated that the dominant stream type for the project area was C-gravel, riffle-pool, which is consistent with the reference type as indicated in the Phase 1 assessment. The dominant adjustment process was found to be aggradation and widening, with several large gravel bars and steep riffles noted throughout the reaches. Based on the data collected during the Phase 2 assessment, and recent flooding events during the past few years, this reaches is moderately incised (incision ratio of 1.5), having connection to floodplain during only the higher flow events. There is also evidence that significant planform adjustments are likely to occur in the future. Flooding during the summer of 2006 caused the channel to create a floodchute across the field which is shown on Figure 1 and Figure 2 (from a fly over conducted by RMP in the spring of 2006). The floodchute has since been filled in and corn was planted in the field during the 2006 growing season. Figure 1 shows an alternate historic river line from 1962 which was created by overlaying the 1962 aerial photo and the more recent 2003 aerial photo. Based on the recent flooding and historical aerial photo, significant planform adjustments can be expected in the future.

The project area is dominated by agriculture, predominantly hay and cornfields with a few small areas of rip-rap as shown on Figure 1. Potential constraints within the project area include the Route 108 bridge, which is located at the upstream end of the project area, the network of hay and cornfields which dominate land use in the area, and the relatively large mass failure located a few hundred feet downstream of the bridge where the stream has bumped against the valley wall.

The site was chosen as an opportunity to look for other ways for the landowner to have a sustainable relationship with the river and to re-establish geomorphic equilibrium and enhance sediment and nutrient attenuation assets which were historically a feature in this reach. There have been present and historic conflicts between the river and landowner including flooding and bank erosion during the summer of 2006 which caused erosion

and crop damage in one field. Any selected potential projects for this area would need to relieve the stressors which dominate it including the historic channel management (i.e. straightening, bank armoring, etc.), relatively high bed load, lack of stream bank buffers in some areas, and lack of sediment and nutrient storage.

Given the current geomorphic condition, list of stressors which dominate the project area, and the overall project goal of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique appears to be protection of the river corridor to allow the expected channel evolution to progress, and reestablish a more natural meander pattern and floodplain connection. Enhancement of stream buffers would not help to move the system toward geomorphic equilibrium, though it would enhance the sediment and nutrient retention within the reach and would be relatively easy to implement. There are no head cuts, berms, or other structures which are contributing to the instability within the reach, so arresting head cuts, removing berms and/or structures are not valid restoration techniques here. There is currently only one relatively large mass failure located a few hundred feet downstream of the bridge. Stabilizing this bank would be expensive, would not contribute to the restoration of geomorphic equilibrium conditions, and given the instability within the reach would have a high likelihood of failure, so this is not a recommended restoration technique for this area. Based on the information described above, the two alternatives considered reasonable for this project area are protecting the river corridor and enhancing stream bank buffers, and enhancing stream bank buffers without protecting the river corridor.

### **Corridor Protection/Easement Alternative with Buffer Enhancement**

The river corridor protection/easement alternative involves curtailing channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention within the project area. As described above, this portion of the Tyler Branch has been managed in the past, and significant planform adjustments are expected in the future. As part of the Easement Alternative the landowner would be paid an upfront payment in order to relinquish their current channel management rights as part of a deeded easement. Current land use within the corridor (i.e. agricultural crop production) would be allowed to continue with a minimum floating buffer (35 feet) maintained between cropland and the stream bank to enhance nutrient retention. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowner is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated by SGAT which has been modified based on on-the-ground observations, and historic topographic maps and aerial photos (14.3 total acres).

## Overall Sediment/Nutrient Reduction and Attenuation

The river corridor easement and buffer enhancement option would provide the maximum level of long term sediment and nutrient attenuation through the natural evolution of the river to a more stable form. Sediment and nutrients would be stored in the channel and on the floodplain as the river naturally progresses toward its historic depositional sediment regime as opposed to the current transport regime where much of the sediment and nutrients are carried downstream. This process would be gradual, as it may take years for the river to regain a more natural meander pattern and floodplain connection. During this process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts and some level of soil erosion occurs. This passive floodplain and meander redevelopment would act to restore the reach to its historic role as a deposition zone and would in the long term result in much greater sediment storage capacity.

## Project Constraints

Potential constraints which will need to be addressed prior to final design of the corridor easement are mainly related to landowner negotiations. Currently Ms. Sweet rents the land to Terry Magnan, a local farmer who uses the project area to grow corn and hay. Implementation of the corridor easement and its associated buffer would reduce the amount of tillable acreage so Ms. Sweet may have to renegotiate the rental terms with Mr. Magnan. Another potential constraint to the project would be the transition from the corridor protection area on Ms. Sweet's land and the neighboring property owned by Marcel Parent. According to Ben Gabos (CREP Coordinator for the Missisquoi watershed) he spoke with Mr. Parent regarding potential use of CREP on his farm and Mr. Parent did not want any State involvement on his property. There will need to be some sort of transition between the corridor protection area and Mr. Parent's property to ensure that implementation of the alternative does not cause excess erosion or planform adjustments downstream of the project area.

## Additional Data Needed

The main pieces of additional data needed prior to implementation of the corridor easement are a final delineation of the river corridor after evaluation of the constraints and negotiations with the landowner.

## Permitting Issues

There are no potential permitting issues associated with the corridor easement alternative.

## Cost and Feasibility

The relative cost of the alternative will depend on the final size of the corridor included in the easement and the payment terms (i.e. \$/acre) which will have to be worked out between RMP, the easement holder and the landowner to determine adequate

compensation for relinquishment of channel management rights and potential loss of tillable acreage. A relatively large upfront payment would be paid to the landowner in exchange for relinquishment of their channel management rights to compensate them for the anticipated loss of some amount of land during channel evolution. The landowner would not only be compensated for potential lost production value, but would be allowed to continue farming in the easement corridor on lands not eroded by the river and benefit from not incurring the cost of channel management techniques (rip-rap, fill, etc.) that they have previously utilized. The benefit from the easement would be sediment and nutrient attenuation within the project area, a more stable relationship between the landowner and the river, and hopefully less conflicts between upstream and downstream landowners and the river as the project moves the system toward a more stable state. The feasibility of the project depends solely on the willingness of the landowner to relinquish some or all of her channel management rights in exchange for financial compensation.

#### Degree of Landowner Interest

Adam Robtoy of The Johnson Company and Ben Gabos of Vermont Department of Agriculture met with Ms. Sweet on January 5, 2007. Ms. Sweet indicated a general willingness to participate in some restoration efforts on her property, including the general concept of a corridor protection plan.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the corridor easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the CREP buffer alternative. As is shown in the table, the corridor easement alternative does meet all six of the RMP's criteria.

#### **CREP Buffer Alternative**

The potential Conservation Reserve Enhancement Program (CREP) buffer alternative would involve implantation of a 35 to 50 foot wide buffer between the existing hay and cornfields and the stream channel. Some portions of the fields currently have a narrow buffer of up to approximately 25 feet wide, but these buffers would be increased to 35 or 50 feet if the alternative is implemented. The approximate acreage for the 35 foot buffer alternative is 4 acres, while the 50 foot buffer is 5.7 acres. Through the CREP program the buffer could be either a forested buffer, grass filter strip, or a combination of the two and could be enrolled for either 15 or 30 years. Landowner compensation would range from approximately \$160 to \$327 dollars per acre per year. The buffer would do nothing toward moving the system to geomorphic equilibrium conditions, but would provide some sediment and nutrient retention within the reach.

#### Overall Sediment/Nutrient Reduction and Attenuation

The proposed CREP alternative would provide some level of nutrient reduction and attenuation with the wider buffer providing the greatest benefit. The benefit for these

alternatives is lower than that for the corridor easement alternative, and would do nothing toward achieving geomorphic dynamic equilibrium conditions.

#### Project Constraints

There are no foreseeable constraints for the buffer alternative other than delineating the final buffer design, and confirming Ms. Sweet's willingness to participate in the program. Ms. Sweet's rental agreement with Terry Magnan will also have to be worked out prior to implementing the alternative.

#### Additional Data Needed

No additional data are needed prior to implementation of the alternative other than a final delineation of the area to be included and the details of the CREP contract including the level of compensation and duration of the agreement.

#### Permitting Issues

There are no permitting issues to deal with for the buffer alternatives. There will be some contracts and other paperwork associated with the CREP and/or VABP which will need to be worked out between NRCS and the landowner.

#### Cost and Feasibility

The cost for the buffer would range from approximately \$160 to \$327 per acre per year depending on the type of crop grown on the land within the last 10 years, and the soil type. The total area for the 35 foot wide buffer is approximately 4 acres while the wider 50 foot buffer is approximately 5.7 acres. The only other cost associated with the alternative would be the purchase and planting of the trees and shrubs or grass within the buffer. The alternative would be relatively simple to implement once it is decided if it is the preferred alternative.

#### Degree of Landowner Interest

Adam Robtoy of The Johnson Company and Ben Gabos of Vermont Department of Agriculture met with Ms. Sweet on January 5, 2007. Ms. Sweet indicated a general willingness to participate in some restoration efforts on her property, including the general concept of a corridor protection plan.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer alternatives will meet the River's Management Project Criteria is shown in the Table below along with the corridor easement alternative discussed above. As shown in the table, the buffer alternative would result in some level

of sediment and nutrient reduction and attenuation, though would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

### Partnering Agencies

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

<b>Rivers Management Project Review Criteria Table for Reaches T1-02</b>		
<b>Rivers Management Project Criteria</b>	<b>Corridor Easement Alternative</b>	<b>CREP Buffer Alternative</b>
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the short term. In the long term sediment loading may increase if channelization practices are sustained in the reach.
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Maintenance and extension of the existing transport regime in what would be a sediment deposition reach may not be sustainable.
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	<b>Will</b> contribute to restoration of equilibrium conditions in other reaches	<b>Will not</b> contribute to restoration of equilibrium conditions
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes, but moderated as described above

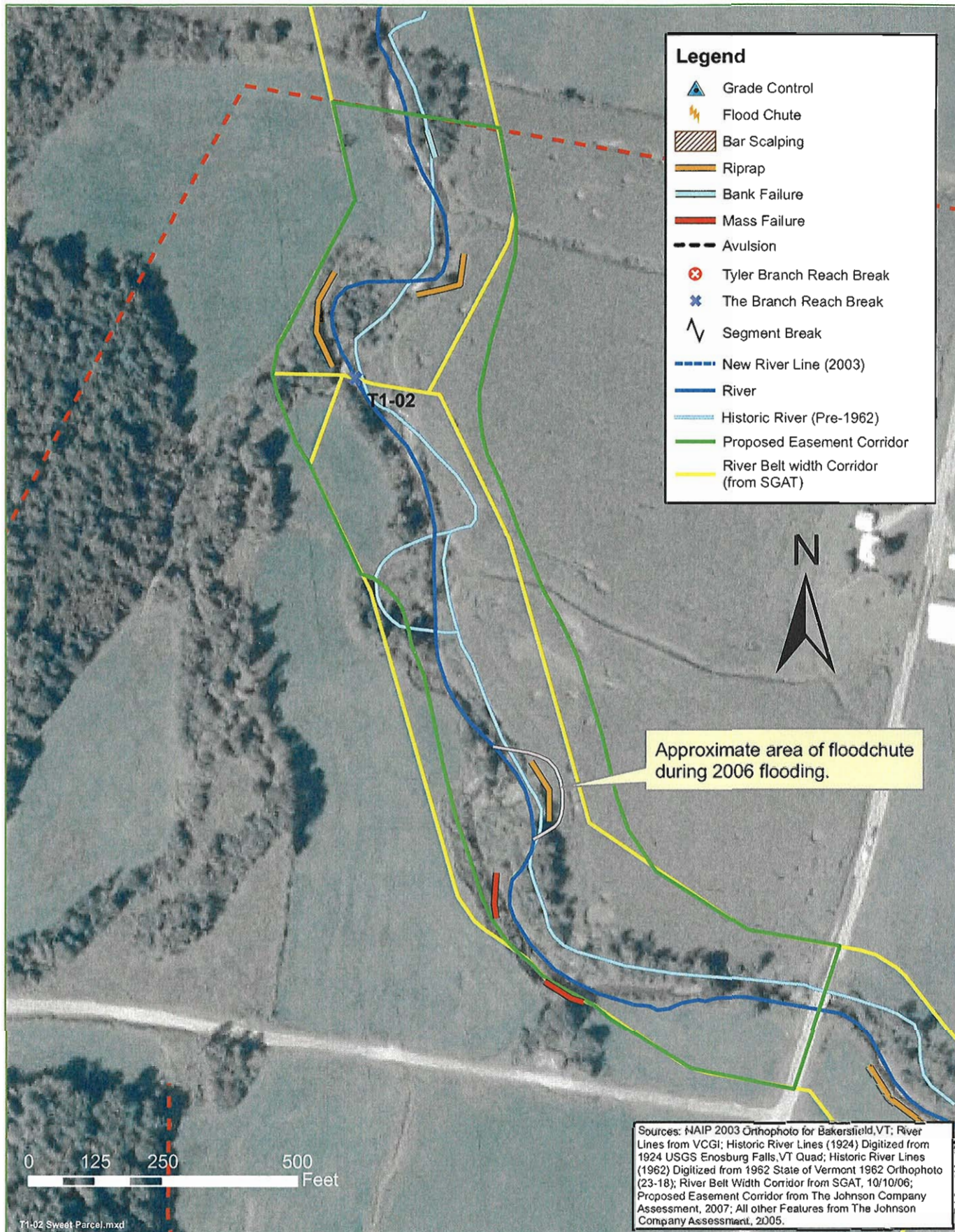


Figure 1: Sweet Parcel (T1-02)  
Corridor/Restrains Map

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Environmental Sciences and Engineering

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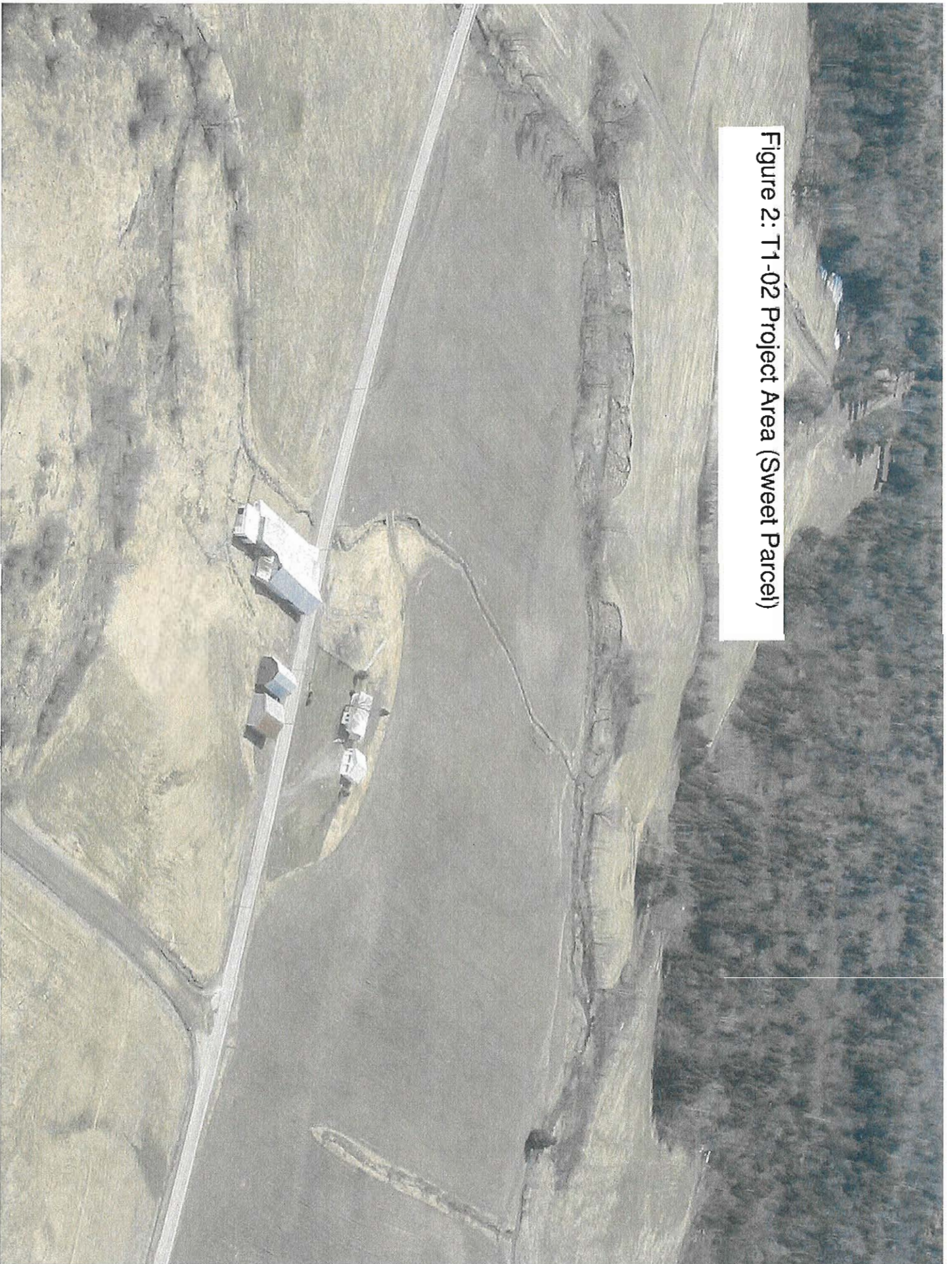
DATE: 2/19/07

PROJECT: 1-1470-6

DRAWN BY: MJR

SCALE: 1" = 250'

Figure 2: T1-02 Project Area (Sweet Parcel)



## **Reach T1-02 The Branch Project (Mongeon Parcel)**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: T1-02 formerly Mark Mongeon's property

Landowner: currently unknown, Mark Mongeon sold the property in February 2007

Project Alternatives: Bridge Replacement, Bridge Replacement with River Corridor Protection and CREP Buffer, River Corridor Protection with CREP Buffer, CREP Buffer only

### **Background**

The proposed project area is located in the upstream portion of Reach T1-02 on the parcel of land formerly owned by Mark Mongeon. According to Ben Gabos of VT Department of Agriculture, Mr. Mongeon sold the property in February 2007, and the current owner is unknown. The Phase 2 assessment completed during the summer of 2005 indicated that the dominant stream type for the project area was C-gravel, riffle-pool, which is consistent with the reference type as indicated in the Phase 1 assessment. The dominant adjustment process was found to be aggradation, widening, and planform adjustments, with several large gravel bars and steep riffles noted throughout the reach. Based on the data collected during the Phase 2 assessment, and recent flooding events during the past few years, this reach is moderately incised (incision ratio of 1.5), having connection to the floodplain during higher flow events. There is also evidence that significant planform adjustments are likely to occur in the future based on the bank erosion currently occurring near the private bridge located in the middle of the project area and flooding during the summer of 2006 downstream of the project area that caused the channel to create a floodchute across an adjoining field (see project package for Sweet Parcel in T1-02). The project area is shown on Figure 1 and 2. Figure 2 shows the area as it appeared in March 2006 during a fly over by Vermont River Management Program.

The project area is dominated by agriculture, predominantly hay fields with a few small areas of rip-rap on either side of the bridge as shown on Figure 1. Potential constraints within the project area include the bridge and private driveway which connects the buildings on the east side of The Branch to Route 108 on the west side, the network of hay fields which dominate the land use in the area, and the cemetery located a few hundred feet downstream of the bridge which is partially located in the belt width river corridor.

The site was chosen due to the channel instability observed, as an opportunity to look for other ways for the landowner to have a sustainable relationship with the river, and to re-establish geomorphic equilibrium and enhance sediment and nutrient attenuation assets. Any selected potential projects for this area would need to relieve the stressors which dominate it including the encroachment of the undersized bridge, historic channel

management (i.e. straightening, bank armoring, etc.), relatively high bed load, lack of stream bank buffers in some areas, and lack of floodplain access.

Given the current geomorphic condition, list of stressors and adjustment processes which dominate the project area, and the overall project goals of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique for this area appears to be replacement of the bridge combined with corridor protection and buffer enhancement to allow the expected channel evolution to proceed and enhance floodplain connection without conflicting with adjacent landowners. Enhancement of stream buffers would not move the system toward geomorphic equilibrium, though it would reduce the sediment and nutrient inputs within the reach and improve wildlife habitat conditions. There are no head cuts, or berms which are contributing to the instability within the reach though replacing the bridge in T1-02 would be a valid restoration technique here. Stream bank stabilization, while limiting some sediment inputs into the system, would not be a permanent solution to the overall instability of the area and would likely fail in the future should the current stressors remain in place. Based on the information described above, the four alternatives considered reasonable for this project area are replacement of the bridge, replacement of the bridge combined with corridor protection and enhanced buffering, protection of the river corridor combined with buffer enhancement, and CREP buffering alone.

### **Bridge Replacement**

The bridge replacement alternative involves replacing the existing private bridge located in the middle of T1-02 (Figure 2) with a wider bridge which could accommodate high flow events and would no longer act as a constriction. Currently the structure is not a channel constriction, but is not wide enough to accommodate high flow events. Replacing the bridge would prevent the backup of water during high flow events and allow for more effective movement of sediment and debris through the system. Figure 2 shows the location of the current structure and Reach T1-02 as it appeared in March 2006 during a fly over conducted by Vermont Rivers Management Program. The photo clearly shows how the bridge is undersized.

### Overall Sediment/Nutrient Reduction and Attenuation

Simply replacing the bridge would not in and of itself enhance the overall sediment and nutrient retention potential of the reach, however it would help to restore the area to a more stable geomorphic condition, which in the long term would result in greater sediment storage and reduced erosion hazard. By removing the constriction, the sediment transport capacity of the river would be restored and channel evolution could proceed. Floodplain enhancement and re-development would occur, which would increase the sediment and nutrient retention in the project area. During the channel evolution and floodplain development process it would be expected that a short term increase in sediment and nutrient output would occur as the channel adjusts and some of the sediment currently stored behind the bridge is moved downstream through the system.

### Project Constraints

Potential constraints which will need to be addressed prior to final design and implementation of the bridge replacement are largely related to proper sizing and location of the new bridge. Portions of the adjoining driveway may also have to be altered to accommodate the new structure. Adjacent land use near the bridge is mainly hay, which may represent a constraint to the new location of the road and bridge. Potential landowner conflicts may also occur during channel adjustment following bridge replacement. A further constraint is the cemetery located downstream of the structure which is partially located in the river corridor and will have to be protected should the channel migrate toward it.

### Additional Data Needed

Additional data needed prior to design includes a more detailed assessment of the project area including Phase 3 geomorphic assessments of the area near the bridge to more thoroughly document the current and predicted future adjustment processes. A detailed survey of the current bridge as well as detailed cross sections of the channel would be needed so that modeling could be conducted to accurately size the new structure.

### Permitting Issues

Permitting issues which may apply to replacement of the bridge include State of Vermont stream alteration permits, permits from the Army Corps of Engineers or State of Vermont Conditional Use Determination for potential wetland impacts.

### Cost and Feasibility

The relative cost for replacing the bridge will depend on the final design and size of the structure, but would likely be tens of thousand of dollars. As the structure is privately owned there would be no opportunity to share costs with the transportation department as would be the case if it were on a public road. While the benefit of the project to the river system would be substantial, the cost would be large, and more overall benefit may be accomplished through implementing the bridge replacement in conjunction with corridor protection to increase the likelihood of success.

### Degree of Landowner Interest

None of the neighboring landowners have as of yet been directly contacted about the potential project. An Initial contact letter was sent out in the fall of 2006 to inform Mr. Mongeon that the area was being studied. Several telephone messages were left with Mr. Mongeon in November and December 2006, however as of yet no direct contact has been made with him. Based on information from Ben Gabos, it appears that Mr. Mongeon has recently sold the parcel, so there may be a new landowner involved in the process.

## Degree to which Project Meets RMP's Project Review Criteria

The degree to which the bridge replacement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for reach T1-02. As is shown in the table, the alternative does meet most of the RMP's criteria.

### **Bridge Replacement with River Corridor Protection and Buffer Enhancement**

This alternative involves implementing the bridge replacement discussed above with the addition of corridor protection and buffer enhancement. Replacement of the bridge will remove the current constriction which is one of the main stressors impacting the reach. Replacing the bridge would prevent the backup of water during high flow events and allow for more effective movement of sediment and debris through the system. In addition to replacing the structure this alternative would protect the river corridor upstream and downstream of the bridge to limit potential landowner conflicts during the expected channel adjustments that would occur (most notably meander re-development and enhanced floodplain connection). The river corridor easement portion of the alternative involves curtailing channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance sediment and nutrient retention with the project area. As part of the project, the landowner would be paid an upfront payment in order to relinquish their current channel management rights as part of a deeded easement. Current land use within the corridor (i.e. agriculture) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between cropland and the stream bank to reduce nutrient inputs. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective.. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowner is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The 1962 river line shown on Figure 1 was drawn by overlaying the 1962 and 2003 aerial photos. The proposed corridor area for the project area totals 12.3 Acres.

### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to a geomorphic equilibrium state. By removing the constriction, the sediment transport capacity of the river would be restored and channel evolution could proceed. Meander and floodplain enhancement and re-development would occur, which would increase the sediment and nutrient retention in the project area. During the channel evolution and floodplain development process it would be

expected that a short term increase in sediment and nutrient output would occur as the channel adjusts and some of the sediment currently stored behind the bridge is moved downstream through the system.

### Project Constraints

As with the bridge replacement only alternative discussed above, the following potential constraints will need to be addressed prior to final design and implementation of the bridge replacement: proper sizing and location of the new bridge, relocation of portions of the private road, reclamation of adjacent land to accommodate the new structure, and potential landowner conflicts which may occur upstream and downstream of the structure as channel adjustments happen following the bridge replacement. Additional constraints to adding the corridor protection/easement alternative is the willingness of the landowner within the corridor (currently unknown as the parcel was recently sold by Mr. Mongeon) to take part in the easement process and determining how to transition between the easement area where channel adjustments are expected and the downstream and upstream parcels where the current landowners may wish to maintain the stream in its current state.

### Additional Data Needed

In addition to the data needed for redesign of the bridge (a more detailed assessment of the project area including Phase 3 geomorphic assessments of the area upstream and downstream of the bridge, and a detailed survey of the current bridge including detailed cross sections of the channel) a more precise delineation of the proposed corridor will be needed after evaluation of the project constraints and negotiations with the affected landowner (which will also have to be determined). The transition zone between the corridor protection area and upstream and downstream reaches will have to be worked out as well.

### Permitting Issues

Permitting issues for this alternative would be similar to those needed for the bridge replacement only alternative which includes State of Vermont stream alteration permits, and permits from the Army Corps of Engineers or Vermont Conditional Use Determination and potential wetland impact permits.

### Cost and Feasibility

The cost of combining bridge replacement with corridor protection would be higher than solely replacing the bridge, though by adding the corridor protection the likelihood of success would be much greater. With the corridor protected, potential conflicts with adjacent landowners would be greatly diminished and the anticipated channel adjustments likely have a higher probability of success. By selling their channel management rights, the landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river and would save the cost of bank stabilization measures which they may have implemented, and may or may not have

prevented erosion of their land. Feasibility of the project would depend on availability of sufficient funding sources as well as willingness of the affected landowner to participate in the project.

#### Degree of Landowner Interest

Based on available information, it appears that the project area has recently been sold by Mr. Mongeon within the past few weeks. The name of the current landowner and their interest in the project are currently unknown.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the bridge replacement/corridor protection/easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for this area. As is shown in the table, the alternative does meet most of the RMP's criteria.

#### **River Corridor Protection and Easement with Buffer Enhancement**

This alternative involves implementing the river corridor easement alternative described above without replacement of the bridge in the middle of the project area. Given the presence of the bridge, which acts as a constriction, complete geomorphic equilibrium may never be reached; though by procuring the easement, potential landowner conflicts with the river may be partially alleviated. As part of the project, the landowner would be paid an upfront payment in order to relinquish their current channel management rights as part of a deeded easement. Current agricultural land use within the corridor would be allowed to continue with a minimum floating buffer area (35 feet) maintained between cropland and the stream bank to filter out excess nutrients. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective.. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowner is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The 1962 river line shown on Figure 1 was drawn by overlaying the 1962 and 2003 aerial photos. The proposed corridor area for the project area totals 12.3 Acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to more equilibrated state and enhanced floodplain

connection has been established. Over time floodplain connection would be enhanced as the channel continues to widen and develop a more natural meander pattern.

### Project Constraints

The most significant potential constraint to the corridor protection/easement alternative is the willingness of the new landowner within the corridor (formerly Mark Mongeon) to take part in the easement process. The other large constraints to the project are the bridge and road in the middle of the project area which need to be maintained to provide access to lands on the eastern side of the stream, and determining how to transition between the easement area where channel adjustments are expected and the downstream and upstream parcels where the current landowners may wish to maintain the stream in its current state.

### Additional Data Needed

A more precise delineation of the proposed corridor after evaluation of the project constraints and negotiations with the affected landowner would be needed prior to initiating the project. Issues related to the bridge and road will need to be worked out to ensure that access to the eastern side of the stream is maintained throughout the project. The level of financial compensation for the affected landowner also would need to be determined.

### Permitting Issues

No Permitting issues are anticipated for this alternative. Should work become necessary to protect the bridge and/or road from damage due to movement of the channel a stream alteration permit may become necessary.

### Cost and Feasibility

The cost of implementing the corridor protection alternative would be less expensive than the alternatives which include bridge replacement and would provide a relatively high level of benefit through sediment nutrient and storage in the watershed and potentially limiting landowner conflicts within the stream corridor on other areas upstream and downstream of the project area. The total corridor area is approximately 12.3 acres. Landowners would be paid on a per acre basis to relinquish their channel management rights. By relinquishing their channel management rights, the landowner would not only be compensated by VT RMP, but would be allowed to continue farming in the easement corridor on lands not eroded by the river and would and save the cost of bank stabilization measures which they may have utilized in the future in an attempt to prevent erosion. The project would be highly feasible given sufficient landowner interest in it.

### Degree of Landowner Interest

Based on available information, it appears that the project area has recently been sold by Mr. Mongeon within the past few weeks. The name of the current landowner is unknown.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the corridor protection/easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for this area. As is shown in the table, the alternative does meet most of the RMP's criteria.

### **CREP Buffer Alternative**

The potential Conservation Reserve Enhancement Program (CREP) buffer alternative would involve implantation of a 35 to 50 foot wide buffer between the existing hay and cornfields and the stream channel. Given the ongoing channel instability within the reach, some areas may require a larger buffer to accommodate the anticipated channel migration which continues to occur. Some portions of the fields upstream of the bridge currently have a buffer ranging from 25 to 50 feet wide, but approximately 2,000 feet of stream banks near and downstream of the bridge have virtually no buffers. These areas are where the planting of buffers would be targeted. The approximate acreage for the 35 foot buffer alternative is nearly 2 acres, while the 50 foot buffer is approximately 2.5 acres. Through the CREP program the buffer could be either a forested buffer, grass filter strip or a combination of the two and could be enrolled for either 15 or 30 years. Landowner compensation would range from \$160 to \$327 dollars per acre per year depending on the type of agricultural activity and soil type. The buffer would do nothing toward moving the system to geomorphic equilibrium conditions, but would provide some sediment and nutrient retention within the reach and once established enhance bank stability and reduce erosion.

### Overall Sediment/Nutrient Reduction and Attenuation

The proposed CREP alternative would provide some level of nutrient reduction and attenuation with the wider buffer providing the greatest benefit. The benefit for these alternatives is lower than that for the corridor easement alternative, and would do nothing toward achieving geomorphic dynamic equilibrium conditions.

### Project Constraints

The largest constraint associated with the CREP buffer alternative is the current ongoing instability within the project area which may threaten vegetation planted in the buffer area if continued channel migration occurs. The new landowner's willingness to participate in the program may also be a constraint.

### Additional Data Needed

No additional data are needed prior to implementation of the alternative other than a final delineation of the area to be included and the details of the CREP contract including the level of compensation and duration of the agreement.

### Permitting Issues

There are no permitting issues to deal with for the buffer alternatives. There will be some contracts and other paperwork associated with the CREP and/or VABP which will need to be worked out between NRCS and the landowner.

### Cost and Feasibility

The cost for the buffer would range from \$160 to \$327 per acre per year depending on the type of crop grown on the land within the last 10 years, and the soil type. The total area for the 35 foot wide buffer is approximately 4 acres while the wider 50 foot buffer is approximately 5.7 acres. The only other cost associated with the alternative would be the purchase and planting of the trees and shrubs or grass within the buffer. The alternative would be relatively simple to implement if it is decided this is the preferred alternative.

### Degree of Landowner Interest

Based on available information, it appears that the project area has recently been sold by Mr. Mongeon within the past few weeks. The name of the current landowner is unknown.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer alternatives will meet the River's Management Project Criteria is shown in the Table below along with the corridor easement alternative discussed above. As shown in the table, the buffer alternative would result in some level of sediment and nutrient reduction and attenuation, though would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

<b>Rivers Management Project Review Criteria Table for Reaches M04</b>				
<b>Rivers Management Project Criteria</b>	<b>Bridge Replacement</b>	<b>Bridge Replacement with Corridor Protection</b>	<b>Corridor Protection with Buffer Enhancement</b>	<b>Buffer Enhancement</b>
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Yes	Yes, though with the bridge still in place the system will remain unstable	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Yes	Yes	None
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	None	None	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will not contribute to restoration of equilibrium conditions</b>
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes	Yes, but moderated as described above

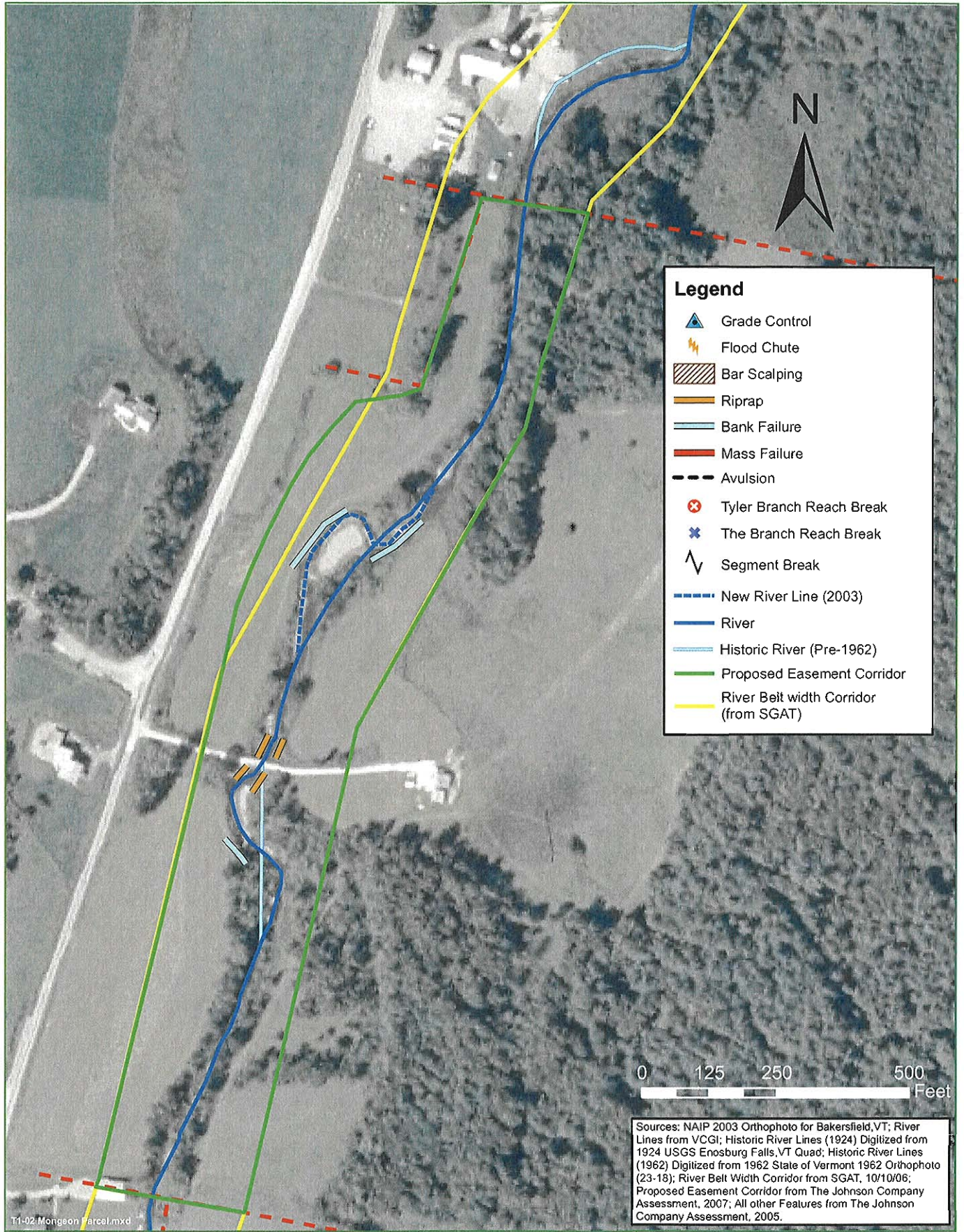


Figure 1: Mongeon Parcel (T1-02)  
Corridor/Restrains Map

**THE JOHNSON COMPANY, INC.**  
Environmental Sciences and Engineering

100 STATE STREET MONTPELIER, VT 05602

DATE: 2/19/07  
DRAWN BY: MJR

PROJECT: 1-1470-6  
SCALE: 1" = 250'



Figure 2: T1-02 Mongeon Parcel

## **Reach M04 Tyler Branch Project**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: Tyler Branch Reach M04, from approximately the intersection of Route 108 and Tyler Branch Road downstream to first bridge

Landowners: James G. Welch, Gregory and Celeste Stebbins, and Marcel Parent

Project Alternatives: Bridge Replacement, Bridge Replacement with River Corridor Protection and CREP Buffer, River Corridor Protection with CREP Buffer, CREP Buffer only

### **Background**

The proposed project area is located in Reach M04 within the Tyler Branch Watershed. The Phase 2 assessment completed during the summer of 2005 resulted in segmentation of M04 into M04A and M04B due to planform and bed size differences. Both segments were characterized as having not departed from their Phase 1 reference stream type, C-gravel, though segment B was found to be a plane bed system rather than a riffle-pool. The dominant adjustment processes were found to be historic degradation and active widening and aggradation with several very large point bars observed in M04A. Historic straightening was also evident in segment B, though this likely occurred some time ago as the historic maps and aerial photos from 1953 and 1962 show the segment in approximately the same location as it is today (see Figure 1). Both reaches were moderately to highly incised (incision ratios of 1.4 and 1.8 for the two cross sections completed within the reach), having connection to floodplain only during the highest flow events. Segment B was found to be relatively stable despite the historic channel management and was dominated by rip-rap along the right bank. A farm bridge built at the location of a large bedrock grade control was noted in the middle of Segment B. The dominant land use was pasture and hay with relatively narrow buffers of 5 to 25 feet dominating the Segment. Segment A was more sinuous with larger buffers of 25 to 100 feet, with the exception of a hay field located near the downstream end of the segment where a large area of erosion is occurring. A large channel avulsion occurred here in 2002 and the old neck cutoff is still visible where the channel used to run along the valley wall (see upper left corner of Figure 1). The likely cause of this avulsion is a combination of the bridge located just downstream which is poorly aligned and a floodprone constriction, and the lack of adequate woody buffers along the stream bank to help prevent erosion.

The project area is dominated by agriculture, predominantly hay and pasture though some wooded areas were noted in M04A. Cows have access to some areas of the stream channel near the farm bridge in M04B. Areas of rip-rap dominated the right bank in M04B. Potential constraints within the reach include the network of hay fields and pasture which dominate the land use in the area, the bridge and Tyler Branch Road which

acts as a floodprone constriction at the downstream end of the reach, and the farm bridge and cattle crossing point located at the bedrock grade control in the middle of M04B.

The site was initially chosen based on field observations and data collected during the Phase 2 assessment to deal with the instability in M04A, re-establish a geomorphic equilibrium within the watershed, reduce conflicts between the river and adjacent landowners, and look for ways to enhance sediment and nutrient attenuation. Selected potential projects for this area would need to relieve the stressors which dominate the reach including the historic channel management (i.e. straightening, bank armoring, etc.), active aggradation and widening processes, the bridge at the downstream end of the reach which acts as a planform and floodprone constriction, and the reduced sediment and nutrient storage capacity.

Given the current geomorphic condition, list of stressors and adjustment processes which dominate the project area, and the overall project goals of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique for M04 appears to be replacement of the bridge combined with corridor protection to allow the expected channel evolution and enhanced floodplain connection proceed without conflicting with adjacent landowners. Enhancement of stream buffers and cattle exclusion would not move the system toward geomorphic equilibrium, though it would reduce the sediment and nutrient inputs within the reach, allow for bank stability once equilibrium channel dimensions are achieved, and improve wildlife habitat conditions. There are no head cuts, or berms which are contributing to the instability within the reach though replacing the bridge in M04A would be a valid restoration technique here. Stream bank stabilization, while limiting some sediment inputs into the system, would not be a permanent solution to the overall instability of the area and would likely fail in the future should the current stressors remain in place. Based on the information described above, the four alternatives considered reasonable for this project area are replacement of the bridge, replacement of the bridge combined with corridor protection and CREP buffering/cattle exclusion, protection of the river corridor combined with CREP buffer enhancement/cattle exclusion in some of the more stable areas, and CREP buffering/cattle exclusion alone.

### **Bridge Replacement**

The bridge replacement alternative involves replacing the existing town bridge located at the downstream end of M04 with a wider bridge which is more properly aligned with the natural meander pattern of the stream. Currently the structure is not a channel constriction, but is not wide enough to accommodate high flow events. In addition, the structure is skewed toward the roadway. Replacing the bridge would prevent the backup of water during high flow events and allow for more effective movement of sediment and debris through the system. The likely cause of the channel avulsion which occurred in 2002 is the constriction caused by the bridge. Figure 2 shows the location of the current structure and Reach M04A as it appeared in March 2006 during a fly over conducted by Vermont Rivers Management Program (RMP). The photo clearly shows how the bridge is currently undersized and mis-aligned.

### Overall Sediment/Nutrient Reduction and Attenuation

Simply replacing the bridge would not in and of itself enhance the overall sediment and nutrient retention potential of the reach, however it would help to restore the area to a less dynamic geomorphic condition, which in the long term would result in greater sediment storage. By removing the constriction, the sediment continuity and transport capacity of the river would be restored and channel evolution could proceed. Floodplain enhancement and re-development would occur, which would increase the sediment and nutrient retention in the project area. During the channel evolution and floodplain development process it would be expected that a short term increase in sediment and nutrient output would occur as the channel adjusts and some of the sediment currently stored behind the bridge is moved downstream through the system.

### Project Constraints

Potential constraints which will need to be addressed prior to final design and implementation of the bridge replacement are largely related to proper sizing and location of the new bridge. The location of the road will likely have to be moved to accommodate the new structure. Adjacent land use near the bridge is mainly hay and pasture, which may represent a constraint to the new location of the road and bridge. Potential landowner conflicts may also occur during channel adjustment following bridge replacement. A further constraint may be the downstream reach M03, which would receive a larger amount of sediment after the new bridge is in place.

### Additional Data Needed

Additional data needed prior to design include a more detailed assessment of the project area including Phase 3 geomorphic assessments of both reach M04A, and Reach M03 to more thoroughly document the current and predicted future adjustment processes. A detailed survey of the current bridge as well as detailed cross sections of the channel would be needed so that modeling could be conducted to accurately size the new structure. Further information should be obtained about the current structure such as when it was built, and if there is a future replacement date.

### Permitting Issues

Permitting issues which may apply to replacement of the bridge include Stream Alteration Permits, permits from the Army Corps of Engineers and Vermont Conditional Use Determination for potential wetland impacts.

### Cost and Feasibility

The relative cost for replacing the bridge will depend on the final design and size of the structure, but would likely be hundreds of thousands of dollars. Probably the most feasible way to accomplish the project would be to incorporate an adequate design into the planned routine replacement of the bridge, though this might not happen for decades. While the benefit of the project to the river system would be substantial, the cost would be large and more overall benefit may be accomplished through several smaller, less expensive projects which may result in a larger overall benefit.

#### Degree of Landowner Interest

None of the neighboring landowners have as of yet been contacted about the potential bridge replacement project. While the project would be quite large, it is likely that the amount of additional private land needed to implement it would be quite small.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the bridge replacement alternative will meet the RMP Project Criteria is shown in the Table below along with the other alternatives discussed for reach M04. As is shown in the table, the alternative does meet most of the RMP's criteria.

#### **Bridge Replacement with River Corridor Protection and Buffer Enhancement/Cattle Exclusion**

This alternative involves implementing the bridge replacement discussed above with the addition of corridor protection and buffer enhancement. Replacement of the bridge will remove the current constriction which is the major stressor impacting the reach. Replacing the bridge would prevent the backup of water during high flow events and allow for more effective movement of sediment and debris through the system. In addition to replacing the structure this alternative would protect the river corridor upstream of the bridge to limit potential landowner conflicts during the channel adjustments that would occur. The river corridor easement portion of the alternative involves eliminating channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention with the project area. As part of the easement the landowners would be paid an upfront payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. agricultural crop production) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between cropland and the stream bank. Part of the alternative would also involve fencing to limit the cows' access to the stream channel. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective.. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the current landowners is intended to compensate them for these anticipated losses. The potential

river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The 1953 and 1962 river lines shown on Figure 1 were drawn by overlaying the 1953 and 1962 maps with the 2003 aerial photo. The proposed corridor area for Reach M04 totals 77.1 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to a geomorphic equilibrium state. By removing the constriction, the sediment transport capacity of the river would be restored and channel evolution could proceed. Floodplain enhancement and re-development would occur, which would increase the sediment and nutrient retention in the project area. During the channel evolution and floodplain development process it would be expected that a short term increase in sediment and nutrient output would occur as the channel adjusts and some of the large amount of sediment currently stored behind the bridge is moved downstream through the system.

#### Project Constraints

As with the bridge replacement only alternative discussed above, the following potential constraints will need to be addressed prior to final design and implementation of the bridge replacement; proper sizing and location of the new bridge, relocation of portions of the road, reclamation of adjacent land to accommodate the new structure, potential landowner conflicts which may also occur during channel adjustment following the bridge replacement, and the downstream reach M03, which would receive a larger amount of sediment after the new bridge is in place. One additional constraint to adding the corridor protection/easement alternative is the willingness of landowners within the corridor (James Welch, Gregory Stebbins, and Marcel Parent) to take part in the easement process. The corridor is largely undeveloped, though there is a bridge and farm road in M04B which may represent a constraint to the project.

#### Additional Data Needed

In addition to the data needed for redesign of the bridge (a more detailed assessment of the project area including Phase 3 geomorphic assessments of both reach M04A, and reach M03, a detailed survey of the current bridge including detailed cross sections of the channel, and further information about the current structure such as when it was built, and if there is a future replacement date) a more precise delineation of the proposed corridor will have to be conducted after evaluation of the project constraints and negotiations with the affected landowners.

### Permitting Issues

Permitting issues for this alternative would be similar to those needed for the bridge replacement only alternative which includes Stream Alteration Permits, and permits from the Army Corps of Engineers and Vermont Conditional Use Determination for potential wetland impacts.

### Cost and Feasibility

The cost of combining bridge replacement with corridor protection would be slightly higher than solely replacing the bridge, though by adding the corridor protection the likelihood of success would be much greater. With the corridor protected, potential conflicts with adjacent landowners would be greatly diminished and the anticipated channel adjustments likely have a higher probability of success. By selling their channel management rights, the landowners would still be able to farm in the easement corridor on lands not eroded by the river, and they would potentially save the cost of bank stabilization measures which may or may not have prevented erosion of their land. Given the high cost of replacing the bridge, the added cost of protecting the river corridor would not significantly increase the budget for the project.

### Degree of Landowner Interest

None of the neighboring landowners have been directly contacted about the potential project. Initial contact letters were sent out in the fall of 2006 to inform potential landowners that the area was being studied. Mr. Welch was present at a public meeting in the spring of 2006 when the results of the Tyler Branch Geomorphic Assessment were presented and indicated some interest in participating in remediation projects.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the bridge replacement/corridor protection/easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for reach M04. As is shown in the table, the alternative does meet most of the RMP's criteria.

### **River Corridor Protection and Easement with Buffer Enhancement/Cattle Exclusion**

This alternative involves implementing the river corridor easement alternative described above without replacement of the bridge in M04A. In exchange for financial compensation the landowners would agree to sell channel management rights within the easement area allowing the river evolution process to proceed. Given the presence of the bridge, which acts as a constriction, complete geomorphic equilibrium may never be reached; though by procuring the easement, potential landowner conflicts with the river may be alleviated. As part of the easement the landowners would be paid an upfront

payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. agricultural crop production) would be allowed to continue with a minimum floating buffer area (35) maintained between cropland and the stream bank. Part of the alternative would also involve fencing to limit the cows' access to the stream channel in M04B. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective.. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowners is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The 1953 and 1962 river lines shown on Figure 1 were drawn by overlaying the 1953 and 1962 maps with the 2003 aerial photo. The proposed corridor area for Reach M04 totals 77.1 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to more equilibrated state. With the bridge still in place, the sediment regime of the lower reach would remain highly depositional and may actually retain more sediment, for periods of time, than if the bridge were removed and the system restored to its reference condition. As in the past, the aggradation eventually leads to channel avulsions, moving downstream much of the sediment that had been stored. With this enhanced floodplain connection the sediment and nutrient retention potential in upper portion of the reach would be enhanced.

#### Project Constraints

The most significant potential constraint to the corridor protection/easement alternative is the willingness of landowners within the corridor (James Welch, Gregory Stebbins, and Marcel Parent) to take part in the easement process. The corridor is largely undeveloped, though there is a bridge and farm road in M04B which may represent a constraint to the project.

#### Additional Data Needed

A more precise delineation of the proposed corridor after evaluation of the project constraints and negotiations with the affected landowners would be needed prior to initiating the project. The level of financial compensation for the affected landowners would need to be determined. In addition, discussions with Mr. Stebbins would be needed to determine if relocation of the farm road in M04B might be feasible to remove it from the corridor. However, the bridge, located in M04B, is built on a naturally

occurring bedrock grade which is typically the ideal location from a geomorphic compatibility standpoint.

#### Permitting Issues

No Permitting issues are anticipated for this alternative.

#### Cost and Feasibility

The cost of implementing the corridor protection alternative would be significantly less expensive than the alternatives which include bridge replacement. The total corridor area in M04 is 77.1 acres. Landowners would be paid on a per acre basis to relinquish their channel management rights. By relinquishing their channel management rights, the landowners would not only be compensated by VT RMP, they would still be able to farm in the easement corridor on lands not eroded by the river, and they would also potentially save the cost of bank stabilization measures which they may have utilized in the future in an attempt to prevent erosion. The project would be feasible given sufficient landowner interest in it.

#### Degree of Landowner Interest

None of the neighboring landowners have been directly contacted about the potential project. Initial contact letters were sent out in the fall of 2006 to inform potential landowners that the area was being studied and telephone messages were left with Mr. Welch and Mr. Stebbins in an attempt to discuss these different restoration alternatives with them. As of the date of this report, none of these messages have been returned. Mr. Welch was present at a public meeting in the spring of 2006 when the results of the Tyler Branch Geomorphic Assessment were presented and indicated some interest in participating in remediation projects.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the corridor protection/easement alternative will meet the RMP Project Criteria is shown in the Table below along with the other alternatives discussed for reach M04. As is shown in the table, the alternative does meet most of the RMP's criteria.

#### **Buffer Enhancement/Cattle Exclusion Only**

The buffer enhancement alternative is presented as a relatively inexpensive way to improve wildlife habitat, and enhance nutrient retention and storage in Reach M04. This alternative would do little toward moving the stream toward geomorphic equilibrium, though if a woody buffer could be established it may help to stabilize streambanks and reduce erosion. Limiting the cows' access to the stream would also reduce nutrient

inputs and help stabilize stream banks. Currently, most of segment M04A is bordered by an adequate woody buffer averaging 25 to 100 feet in width with the exception of the eroding bank in the hay field near the downstream bridge. Planting of a buffer in this area would not be recommended until the stream becomes more stable or the streambank is stabilized to prevent further erosion and loss of any planted trees and shrubs. M04B does have adequate buffer widths averaging 25 to 50 feet along most of the left bank, but the right bank has several areas with little to no buffer, particularly near the farm bridge in the middle of the segment. This area would be the main focus of the buffer enhancement, which would likely involve planting of a 35 to 50 foot buffer through the assistance of CREP and US Fish and Wildlife. Part of the project would also involve some fencing near the bridge to limit the cows' access to the stream. The approximate area of coverage for the buffer area is shown on Figure 1. A 35 foot wide buffer in this area would encompass approximately 0.8 acres. A 50 foot buffer in this area would be approximately 1.1 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

The CREP buffer alternative would provide some nutrient retention associated with the prevention of animal manure, and runoff entering the stream. This alternative would do very little toward achieving geomorphic dynamic equilibrium conditions.

#### Project Constraints

The only potential constraint associated with this alternative is associated with the landowners' willingness to participate in the CREP program and relinquish a portion of their pastureland in exchange for the financial compensation offered through CREP. The bridge already in place represents an ideal place for the cows to cross as it is easier on their feet, and allows for safer stream crossing during high flow events.

#### Additional Data Needed

No additional data are needed prior to implementation of the buffer/cattle exclusion alternative other than to determine the cost of the project, locate funding sources (primarily CREP and US Fish and Wildlife), and delineate a more precise buffer area and fencing scheme for the project. Likely one or two site visits between Ben Gabos and the landowners is all that would be needed to accomplish this.

#### Permitting Issues

There are no permitting issues to deal with for the buffer alternative. There will be some contracts and other paperwork associated with the CREP and other programs which may share some of the cost of the project.

### Cost and Feasibility

The cost for the project would be relatively inexpensive and limited to the ~\$160/acre/year that CREP would pay plus the cost of fencing to exclude cows from the stream which could also be covered through the CREP program with assistance from US Fish and Wildlife. Feasibility would not be an issue so long as the landowners were willing to sign up for the program.

### Degree of Landowner Interest

None of the neighboring landowners have been contacted directly about the potential project. Initial contact letters were sent out in the fall of 2006 to inform potential landowners that the area was being studied and telephone messages were left with Mr. Welch and Mr. Stebbins in an attempt to discuss these different restoration alternatives with them. As of the date of this report, none of these messages have been returned. Mr. Welch was present at a public meeting in the spring of 2006 when the results of the Tyler Branch Geomorphic Assessment were presented and indicated some interest in participating in remediation projects.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer alternatives will meet the River's Management Project Criteria is shown in the Table below along with the corridor easement alternative discussed above. As shown in the table, the buffer alternative would result in some level of nutrient reduction and attenuation, though would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, town and State Transportation Departments, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

<b>Rivers Management Project Review Criteria Table for Reaches M04</b>				
<b>Rivers Management Project Criteria</b>	<b>Bridge Replacement</b>	<b>Bridge Replacement with Corridor Protection</b>	<b>Corridor Protection with Buffer Enhancement</b>	<b>Buffer Enhancement</b>
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Yes	Yes, though with the bridge still in place the system will remain unstable	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Yes	Yes	None
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	None	None	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	Will contribute to restoration of equilibrium conditions in other reaches	Will contribute to restoration of equilibrium conditions in other reaches	Will contribute to restoration of equilibrium conditions in other reaches	Will not contribute to restoration of equilibrium conditions
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes	Yes, but moderated as described above

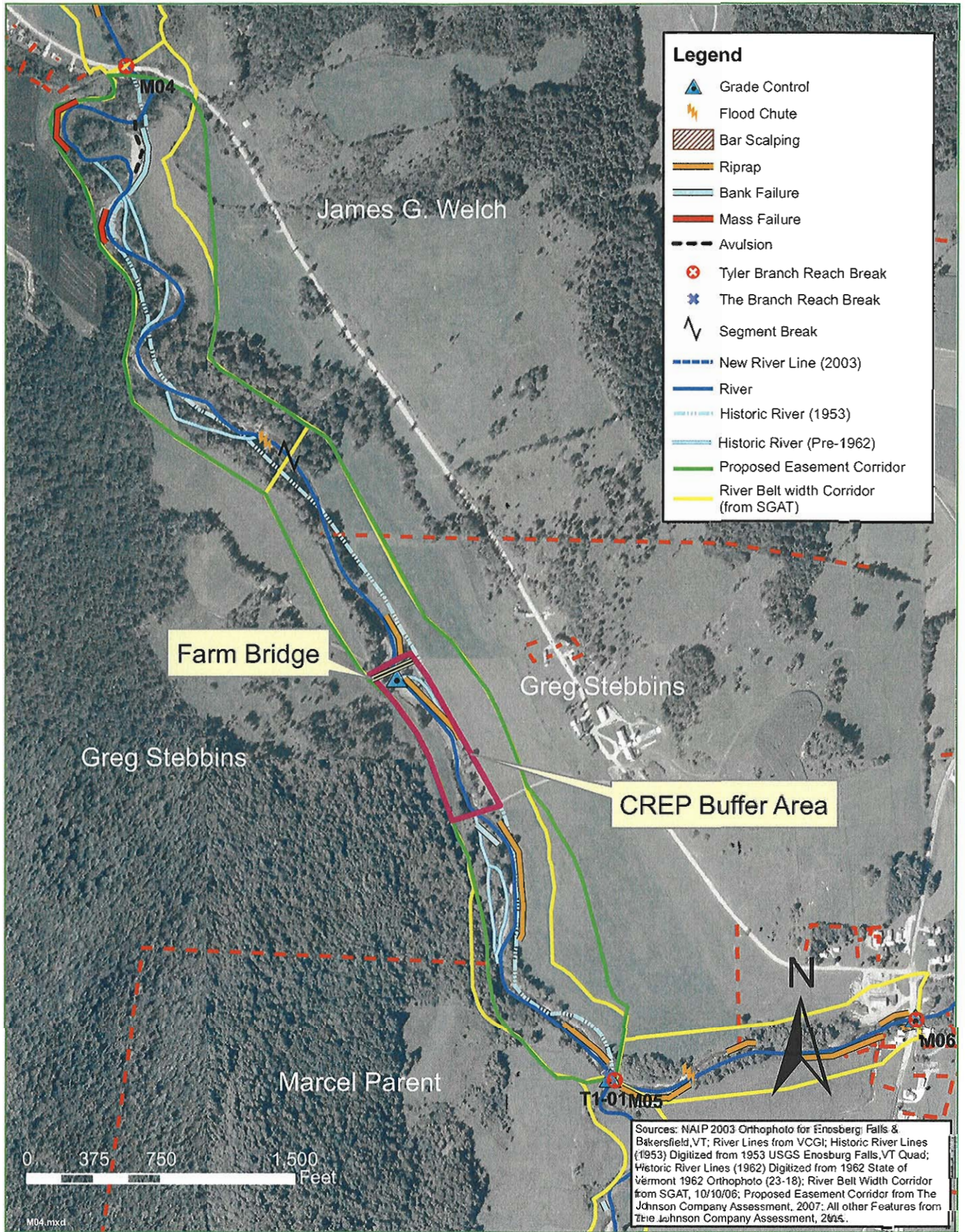


Figure 1: Tyler Branch (M04) Corridor/Restraints Map

**THE JOHNSON COMPANY, INC.**

*Environmental Sciences and Engineering*

100 STATE STREET

MONTPELIER, VT 05602

DATE: 2/20/07

PROJECT: 1-1470-6

DRAWN BY: MJR

SCALE: 1" = 750'

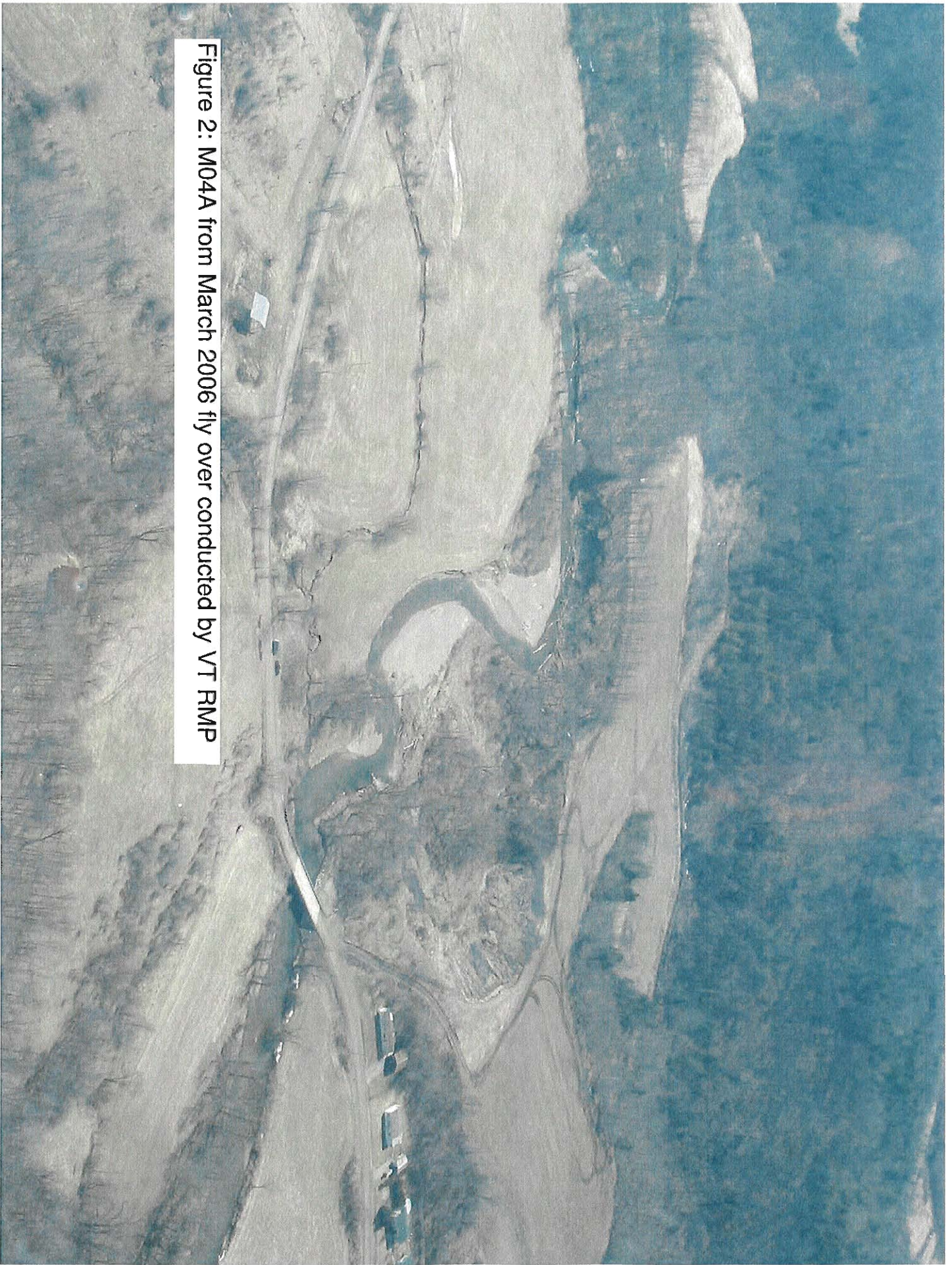


Figure 2: M04A from March 2006 fly over conducted by VT RMP

## **Reach M07 Tyler Branch Project**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability and floodplain access.**

Project Location: M07 from intersection of Tyler Branch Road and Grange Hall Road upstream to just below large bedrock gorge

Landowners: Andrew and Sally Bobkowicz and A. Domrowski and S. Sweeney on left bank and Alan and Susan Vaillancourt on right bank

Project Alternatives: Berm Removal, Berm Removal with River Corridor Protection and Buffer Enhancement, River Corridor Protection with Buffer Enhancement, Buffer Enhancement only

### **Background**

The proposed project area is Reach M07 which is located between two bedrock gorges (M06 and M08). The Phase 2 assessment completed during the summer of 2005 indicated that the dominant stream type for the project area was C-gravel, riffle-pool, which is consistent with the reference type as indicated in the Phase 1 assessment. The dominant adjustment process was found to be aggradation, widening, and planform adjustments, with several large gravel bars and steep riffles noted throughout the reach. Based on the data collected during the Phase 2 assessment this reach is moderately incised (incision ratios of 1.5 and 1.6 for the two cross sections completed in the reach) and does have some connection to the floodplain during very high flow events. Due to its position between the two bedrock constrictions, Reach M07 is likely a highly dynamic reach which would naturally undergo significant planform adjustments similar to an alluvial fan. Recent berming was evident along a small portion of the right bank, where trees and debris were piled along the streambank. A large amount of relatively new rip-rap was also observed along both the right and left banks. Much of the riparian buffer along the right bank has been removed in the past 10 years and converted from forest to hay field. There is also evidence that significant planform adjustments are likely to occur in the future based on the river centerline positions shown on Figure 1 which were created by overlaying historic topographic and aerial photos from 1953 and 1962 with the existing Phase 1 and 2 river center lines. The project area is shown on Figure 1.

The project area is dominated by agriculture, predominantly hay fields with large areas of rip-rap on both the right and left banks as shown on Figure 1. Potential constraints within the project area include the relatively new rip-rap, the hay fields which dominate the land use in the area, the berm located mid-reach, Tyler Branch Road which is located in the belt width corridor at the upstream and downstream ends of the reach, and the residential property located in the upstream end of the reach.

The site was chosen due to the channel instability observed, as an opportunity to look for other ways for landowners to have a sustainable relationship with the river, and to re-

establish geomorphic equilibrium and enhance sediment and nutrient attenuation assets in a strategic location in the watershed between two bedrock gorges. Any selected potential projects for this area would need to relieve the stressors which dominate it including the recent berming, channel management (i.e. bar scalping, bank armoring, etc.), relatively high bed load, and lack of stream bank buffers in some areas.

Given the current geomorphic condition, list of stressors and adjustment processes which dominate the project area, and the overall project goals of achieving stream geomorphic equilibrium and enhancing sediment and nutrient attenuation, the most promising restoration technique for this area appears to removal of the berm combined with corridor protection and buffer enhancement to allow the expected channel evolution to proceed and enhance floodplain connection without conflicting with adjacent landowners. Berm removal without implementation of corridor protection could also re-establish the sediment and nutrient attenuation potential for the reach. Implementation of corridor protection and buffer enhancement without removal of the berm would also work toward reestablishment of geomorphic equilibrium and floodplain enhancement. Enhancement of stream buffers by themselves would not move the system toward geomorphic equilibrium, though they would reduce the sediment and nutrient inputs within the reach and improve wildlife habitat conditions. There are no other structures within the reach which need to be replaced or removed. Stream bank stabilization, while limiting some sediment inputs into the system, would not be a permanent solution to the overall instability of the area and would likely fail in the future should the current stressors remain in place. Based on the information described above, the four alternatives considered reasonable for this project area are removal of the berm, removal of the berm combined with corridor protection and enhanced buffering, protection of the river corridor combined with buffer enhancement, and buffering alone.

### **Berm Removal**

The berm replacement alternative involves removing the berm currently in place in the upstream end of the reach. Removing the berm would allow for enhanced sediment and nutrient storage capacity by reconnecting the stream to its historic floodplain. Removing the berm might also prevent excessive downstream bank erosion by allowing flooding during high flow events. The current location of the berm is shown of Figure 1 and is approximately 300 feet long and 3 feet high. The berm is constructed of logs, branches, and other debris which should be relatively easy to remove with heavy equipment.

### Overall Sediment/Nutrient Reduction and Attenuation

Removing the berm would enhance the overall sediment and nutrient retention potential of the reach by reconnecting the river to its historic floodplain. Though the reach moderately incised, sediment and nutrients would be stored in the floodplain during flow events higher than bankfull. This alternative may also limit sediment production from within the reach by alleviating some of the downstream bank erosion attributable to the increased stream power below the berm.

### Project Constraints

Potential constraints which will need to be addressed prior to removal of the berm are largely related to landowner negotiations. The berm was likely constructed to prevent flooding in the adjacent field, and the landowner may be reluctant to remove it.

### Additional Data Needed

No additional data would be needed prior to implementing the alternative other than procuring landowner participation and finding a suitable place for disposal of the berm material.

### Permitting Issues

There are no anticipated permitting issues associated with removal of the berm.

### Cost and Feasibility

The costs for the alternative would be relatively low, likely a few thousand dollars to hire a contractor to perform the work. If landowner participation can be obtained the project is very feasible, however it may be more feasible to combine the berm removal with corridor protection as is described below to provide some financial incentives for the landowner.

### Degree of Landowner Interest

The affected landowner has not been directly contacted about the potential project. An Initial contact letter was sent out in the fall of 2006 to inform the potentially affected landowner that the area was being studied. Attempts were made to reach Mr. Vaillancourt by telephone in December 2006, however as of yet no direct contact has been made with him.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the berm removal alternative will meet the Rivers Management Project (RMP) Criteria is shown in the Table below along with the other alternatives discussed for reach M07. As is shown in the table, the alternative does meet most of the RMP's criteria.

### **Berm Removal with River Corridor Protection and Buffer Enhancement**

This alternative involves implementing the berm removal discussed above with the addition of corridor protection and buffer enhancement. Removal of the berm will remove the current constriction and allow partial floodplain access to be restored within the reach. The reach is still moderately incised, so adding river corridor protection would allow expected channel adjustments to occur (most notably planform adjustments and

floodplain redevelopment) and move the system toward geomorphic equilibrium. The river corridor easement portion of the alternative involves eliminating channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention with the project area. Based on the Phase 2 Assessment results it is expected the widening and planform adjustments will occur in the future as the stream re-establishes floodplain. Given the inherently dynamic nature of M07, due to the bedrock constrictions located immediately upstream and downstream, the corridor easement would also reduce future conflicts between the landowners and the river. In exchange for financial compensation the landowners would agree not to conduct channel management practices within the easement area allowing the river evolution process to proceed. As part of the project, each affected landowner would be paid an upfront payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. agriculture) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between cropland and the stream bank. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowners is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The river lines shown on Figure 1 were drawn by overlaying the 1953, 1962 and 2003 topographic maps and aerial photos. The proposed corridor area for the project area totals 23.2 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to a geomorphic equilibrium state. Due to the bedrock gorges located immediately downstream and upstream reach M07 is inherently dynamic and contains a large amount of sediment. By removing the berm, the sediment depositional capacity of the river would be enhanced and channel evolution could proceed. Meander and floodplain enhancement and re-development would occur, which would increase the sediment and nutrient retention in the project area. During the channel evolution and floodplain development process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts.

#### Project Constraints

As with the berm removal alternative discussed above, the largest potential constraint to this project alternative is procuring each affected landowners' involvement. Other constraints include the relatively new rip-rap which has been placed in large areas of the reach in the last 10 years, the hay fields which dominate the land use in the area, the berm

located mid-reach, the bar scalping observed in 2005 which may still be happening, Tyler Branch Road which is located in the belt width corridor at the upstream and downstream ends of the reach, and the residential property located in the upstream end of the reach. The proposed corridor easement area shown on Figure 1 has been modified from the belt width corridor to exclude the road and residential property which will have to be maintained in their current position.

#### Additional Data Needed

A more precise delineation of the proposed corridor will be needed after evaluation of the project constraints and negotiations with the affected landowners prior to implementation of the alternative.

#### Permitting Issues

There are no anticipated permits associated with implementation of this alternative.

#### Cost and Feasibility

The cost of combining berm removal with corridor protection would be considerably higher than solely removing the berm, though by adding the corridor protection the likelihood of success would be much greater. With the corridor protected, potential conflicts with adjacent landowners would be greatly diminished and the anticipated channel adjustments likely have a higher probability of success. By selling their channel management rights, the landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river, they would save the cost of bank stabilization measures which they may have implemented, and may or may not have prevented erosion of their land. Feasibility of the project would depend on availability of sufficient funding sources as well as willingness of the affected landowners to participate in the project.

#### Degree of Landowner Interest

None of the affected landowners have as of yet been directly contacted about the potential project. An Initial contact letter was sent out in the fall of 2006 to inform all of the potentially affected landowners that the area was being studied.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the alternative will meet the RMP Project Criteria is shown in the Table below along with the other alternatives discussed for this area. As is shown in the table, the alternative does meet most of the RMP's criteria.

## **River Corridor Protection and Easement with Buffer Enhancement**

This alternative involves implementing the river corridor easement alternative described above without removal of the berm located in the project area. This involves eliminating channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance the sediment and nutrient retention with the project area. Based on the Phase 2 Assessment results, it is expected the widening and planform adjustments will occur in the future as the stream re-establishes floodplain connection. Given the inherently dynamic nature of M07 due to the bedrock constrictions located immediately upstream and downstream, and the continued presence of the berm, the corridor easement would also minimize future conflicts between the landowners and the river. As part of the project, each landowner would be paid an upfront payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. agriculture) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between cropland and the stream bank. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective. It is anticipated that over time, as the channel evolution process continues, portions of some fields may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowners is intended to compensate them for these anticipated losses. The potential river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT, which has been modified based on visual observations, and historic topographic maps (from 1953) and aerial photos (from 1962). The river lines shown on Figure 1 were drawn by overlaying the 1953, 1962 and 2003 topographic maps and aerial photos. The proposed corridor area for the project area totals 23.2 acres.

### Overall Sediment/Nutrient Reduction and Attenuation

In the long term, this alternative would provide additional sediment and nutrient retention once the channel has adjusted to a more equilibrated state and enhanced floodplain connection has been established. Over time floodplain connection would be enhanced as the channel continues to widen and develop a more natural meander pattern. The continued presence of the berm would somewhat limit the floodplain development potential within the upstream portion of the corridor, and therefore reduce the overall sediment and nutrient attenuation potential for this alternative.

### Project Constraints

As with the other alternatives discussed above, the largest potential constraint to this project alternative is procuring the potentially affected landowners involvement. Other constraints include the continued presence of the berm, the relatively new rip-rap which has been placed in large areas of the reach in the last 10 years, the hay fields which

dominate the land use in the area, the berm located mid-reach, the bar scalping observed in 2005 which may still be happening, Tyler Branch Road which is located in the belt width corridor at the upstream and downstream ends of the reach, and the residential property located in the upstream end of the reach. The proposed corridor easement area shown on Figure 1 has been modified from the belt width corridor to exclude the road and residential property which will have to be maintained in their current position.

#### Additional Data Needed

A more precise delineation of the proposed corridor will be needed after evaluation of the project constraints and negotiations with the affected landowners prior to implementation of the alternative.

#### Permitting Issues

There are no anticipated permits associated with implementation of this alternative.

#### Cost and Feasibility

The cost of implementing corridor protection would be slightly lower than combining corridor protection with berm removal. With the corridor protected, potential conflicts with adjacent landowners would be greatly diminished and the anticipated channel adjustments likely have a higher probability of success. By selling their channel management rights, the landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river, and they would save the cost of future bank stabilization measures which may or may not have prevented erosion of their land. Feasibility of the project would depend on availability of sufficient funding sources as well as willingness of the affected landowners to participate in the project.

#### Degree of Landowner Interest

None of the affected landowners have as of yet been directly contacted about the potential project. An Initial contact letter was sent out in the fall of 2006 to inform all of the potentially affected landowners that the area was being studied.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for this area. As is shown in the table, the alternative does meet most of the RMP's criteria.

#### **Buffer Alternative**

The potential buffer alternative would involve implantation of a 35 to 50 foot wide buffer between the existing hayfields and the stream channel. This buffer could be implemented as part of the Conservation Reserve Enhancement Program (CREP). As is visible on

Figure 1, some portions of the Reach currently have buffers ranging from 25 to 50 feet wide, but a majority of the right bank and small portion of the left bank have virtually no buffers. These areas are where the planting of buffers would be targeted. The approximate acreage for the 35 foot buffer alternative is nearly 3 acres, while the 50 foot buffer is approximately 4 acres. Through the CREP program the buffer could be either a forested buffer, grass filter strip or a combination of the two and could be enrolled for either 15 or 30 years. Compensation would be approximately \$160 per acre per year as all of the land is currently used for hay production. The buffer would do little to nothing toward moving the system toward geomorphic equilibrium conditions, but would provide some sediment and nutrient retention within the reach and once established enhance bank stability and reduce erosion. Given the inherent instability within the reach, there is a high likelihood that portions of the buffer area may be lost to erosion. Large portions of the reach have been rip-rapped in the recent past which will offer resistance to erosion for a limited period of time.

#### Overall Sediment/Nutrient Reduction and Attenuation

The proposed CREP alternative would provide some level of nutrient reduction and attenuation with the wider buffer providing the greatest benefit. The benefit for these alternatives is lower than that for the berm removal/corridor easement alternatives, and would do little toward achieving geomorphic dynamic equilibrium conditions.

#### Project Constraints

The largest constraint associated with the CREP buffer alternative is the current ongoing instability within the project area which may threaten vegetation planted in the buffer area if continued channel migration occurs. The large areas of rip-rap in the reach would provide some bank stability. The landowners' willingness to participate in the program may also be a constraint.

#### Additional Data Needed

No additional data are needed prior to implementation of the alternative other than a final delineation of the area to be included and the details of the CREP contract including the level of compensation and duration of the agreement.

#### Permitting Issues

There are no permitting issues to deal with for the buffer alternatives. There will be some contracts and other paperwork associated with CREP which will need to be worked out between NRCS and the landowners.

#### Cost and Feasibility

The cost for the buffer would be approximately \$160 per acre per year based on the type of crop grown on the land within the last 10 years (hay), and the soil type. The total area

for the 35 foot wide buffer is approximately 3 acres while the wider 50 foot buffer is approximately 4 acres. The only other cost associated with the alternative would be the purchase and planting of the trees and shrubs or grass within the buffer which would also be covered through CREP. The alternative would be relatively simple to implement once it is decided if it is the preferred alternative.

#### Degree of Landowner Interest

None of the affected landowners have been directly contacted about the potential project. An Initial contact letter was sent out in the fall of 2006 to inform all of the potentially affected landowners that the area was being studied.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer alternatives will meet the RMP Project Criteria is shown in the Table below along with the berm removal/corridor easement alternatives discussed above. As shown in the table, the buffer alternative would result in some level of sediment and nutrient reduction and attenuation, though would not contribute to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

#### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

<b>Rivers Management Project Review Criteria Table for Reaches M04</b>				
<b>Rivers Management Project Criteria</b>	<b>Berm Removal</b>	<b>Berm Removal with Corridor Protection and Buffers</b>	<b>Corridor Protection with Buffers</b>	<b>Buffer Enhancement</b>
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Yes	Yes, though with the berm still in place the system will remain unstable	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Yes	Yes	No alteration of existing sediment regime
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	None	None	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will contribute to restoration of equilibrium conditions in other reaches</b>	<b>Will not contribute to restoration of equilibrium conditions</b>
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes	Yes, but moderated as described above

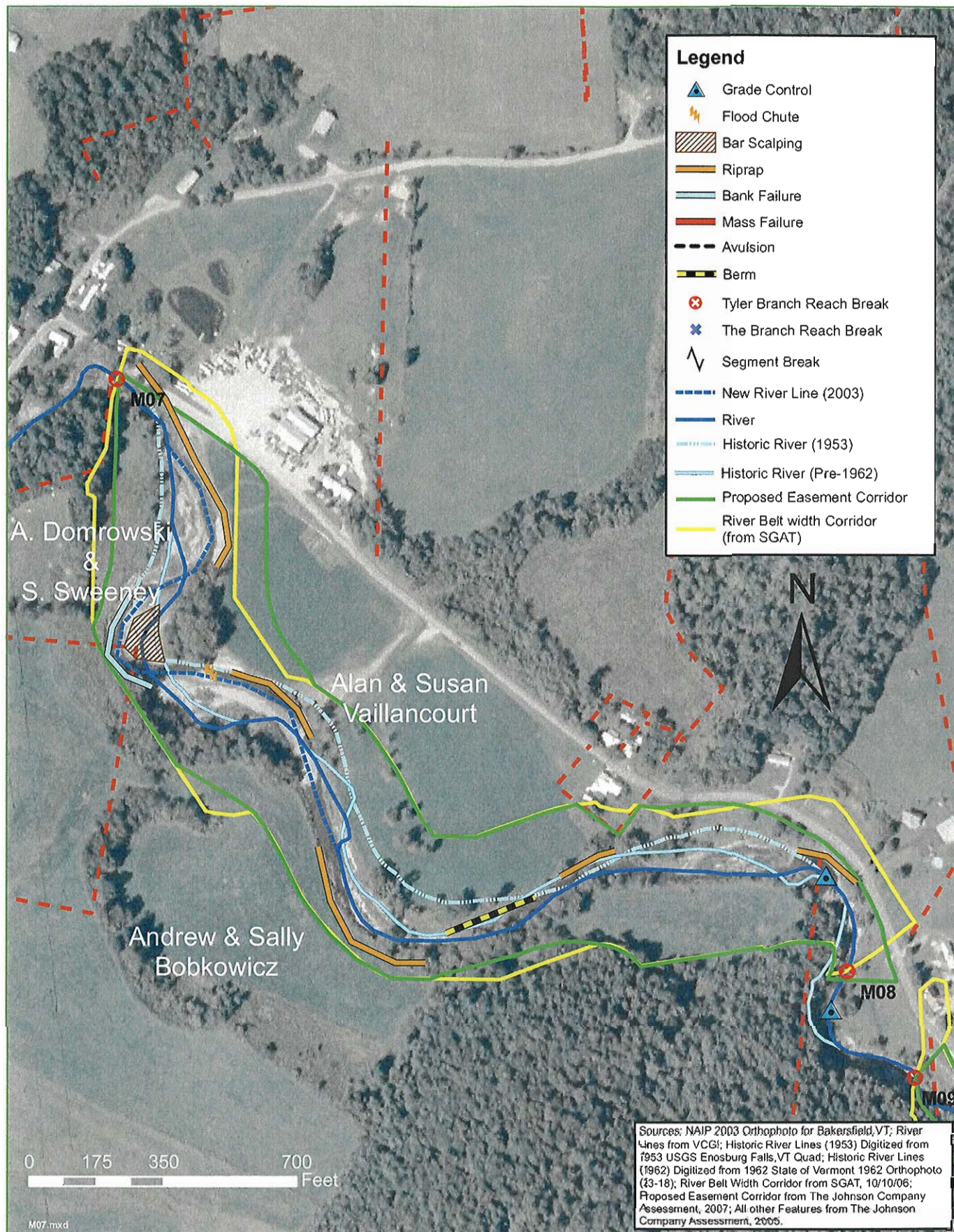


Figure 1: Tyler Branch (M07) Corridor/Restraints Map

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Environmental Sciences and Engineering

100 STATE STREET

MONTPELIER, VT 05602

DATE: 2/20/07

PROJECT: 1-1470-6

DRAWN BY: MJR

SCALE: 1" = 350'

## **Reach M09 Tyler Branch Project**

**Project Goal: Sediment/nutrient storage and attenuation, re-establish geomorphic stability.**

Project Location: Tyler Branch – Reach M09

Landowners: Patrick Vaillancourt and Frances Vaillancourt

Project Alternatives: River Corridor Protection and Buffer Enhancement, Buffer Enhancement/Cattle Exclusion, Combination River Corridor Protection and Buffer Enhancement with Cattle Exclusion

### **Background**

The proposed project area is located in Reach M09 within the Tyler Branch Watershed and extends from near the intersection of Tyler Branch Road and Ovitt Road downstream to the large bedrock gorge approximately ½ mile downstream. The Phase 2 assessment completed during the summer of 2005 indicated the dominant stream type to be C-gravel, riffle-pool, which is consistent with the reference type indicated in the Phase 1 assessment. The dominant adjustment processes were found to be historic minor degradation and minor active aggradation and widening. The reach was moderately to highly incised (incision ratios of 1.1 and 1.8 for the two cross sections completed) and does have some connection to the floodplain during high flow events. The reach was found to be in Evolution Stage III (widening). There is also evidence that historic straightening may have occurred based on the low meander width ratio of 3. The historic river lines shown on Figure 1 from 1953 and 1962 do not show significant changes in the past 50 years. There is a farm bridge located in the middle of the reach along with a stream ford which are used to access fields across the river. Cows have access to the entire river corridor, and evidence of bar scapling was observed on a large point bar located near the downstream end of the reach.

The project area is dominated by agriculture, predominantly corn, hay and pasture. Potential constraints within the project area include the farm bridge and stream ford located mid-reach, the network of agricultural fields and pasture which dominate the land use in the area, the active bar scapling observed in the reach, Tyler Branch Road which encroaches upon the river corridor at the upstream and downstream ends of the reach, and the relatively narrow valley.

The site was initially chosen based on field observations during the Phase 2 assessment as an opportunity to look for ways to limit nutrient inputs into the river by excluding cattle, and enhancing buffer establishment. The geomorphic data also indicates that the area may provide an opportunity to re-establish geomorphic equilibrium and enhance sediment attenuation in a strategic location immediately upstream of a large bedrock constriction. Given the current geomorphic condition, list of stressors which dominate the project area, and the overall project goals of achieving stream geomorphic

equilibrium and enhancing sediment and nutrient attenuation the most promising restoration technique for this reach appears to be protection of the river corridor and buffer enhancement to allow the expected channel evolution to progress, reestablish a more natural meander pattern and enhanced floodplain connection and increased sediment and nutrient attenuation. Enhancement of stream buffers and cattle exclusion would not necessarily help to move the system toward geomorphic equilibrium, though they would reduce the sediment and nutrient inputs, particularly considering the large amount of agriculture within the reach, and would be relatively easy and inexpensive to implement. There are no head cuts, berms, or other structures which are contributing to the instability within the reaches (the farm bridge located in the reach represents a minor floodprone constriction though replacing it would not significantly improve the geomorphic condition of the stream), so arresting head cuts, removing berms and/or structures are not valid restoration techniques here. There are currently only a few small areas of bank erosion located within the reaches. Stabilizing them would not contribute to the restoration of geomorphic equilibrium conditions and would not provide a significant amount of nutrient retention, so this is not a recommended restoration technique for the area. Based on the information described above, the three alternatives considered reasonable for this project area are protecting the river corridor in conjunction with buffer enhancement, enhancing stream bank buffers and implementing cattle exclusion measures, or a combination of river corridor protection and stream bank buffer/cattle exclusion.

### **Corridor Easement Alternative with Buffer Enhancement**

The river corridor easement Alternative involves curtailing and/or limiting channel management activities within the river corridor in order to allow the river to move toward geomorphic equilibrium and enhance sediment and nutrient retention within the project area. As described above, this portion of the Tyler Branch has been managed in the past. As part of this alternative, the landowners would be paid an upfront payment in order to relinquish their current channel management rights in a deeded easement. Current land use within the corridor (i.e. hay and/or pasture) would be allowed to continue with a minimum floating buffer area (35 feet) maintained between the ag-land and the stream bank to limit excess nutrient inputs. If, during the channel evolution process, the stream channel begins to move within the corridor, channel management would be the right of the easement holder and would only occur in consultation with the RMP in a manner consistent with the river equilibrium objective. It is anticipated that over time, as the channel evolution process continues, some land may be lost as the stream channel re-establishes a more natural meander pattern and floodplain connection. The financial compensation provided to the landowners is intended to compensate them for these anticipated losses. The proposed river corridor easement area is shown on the attached Figure 1. The corridor shown is the belt width corridor calculated using SGAT which has been slightly modified to take into account on the ground observations, the historic river line from the 1962 aerial photo, the 1953 topographic map, and the human infrastructure within the reach. The total area for the proposed easement in M09 is approximately 24.9 acres.

### Overall Sediment/Nutrient Reduction and Attenuation

The river corridor easement option would provide a great deal of long term sediment and nutrient attenuation through the natural evolution of the river to a more stable form. Sediment and nutrients would be stored in the channel and on the floodplain as the river naturally progresses toward its historic depositional sediment regime located upstream of the naturally occurring bedrock constriction. This process would be gradual, as it may take years for the river to regain a more natural meander pattern and floodplain connection. During this process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts and some level of soil erosion occurs. This passive floodplain and meander redevelopment would act to restore the area to its historic role as a depositional reach and would, in the long term, result in much greater sediment storage capacity.

### Project Constraints

Potential constraints which will need to be addressed prior to final design of the corridor easement are mainly related to landowner negotiations and human infrastructure located within the historic river corridor. The river corridor shown on Figure 1 represents a significant portion of the relatively narrow valley where suitable agricultural land is at a premium. During channel evolution some of this useable land may become unusable as the stream begins to meander through the corridor. While the easement would compensate the landowners for these potential losses, they and may not be willing to give up portions of land despite the potential compensation. Currently, a large portion of the corridor is used for pasture, some of which will have to be relinquished to implement the floating buffer along the stream. Other issues which need to be considered include the bridge and animal crossings and stream fords located in the middle of the reach. Some of these crossings will need to be maintained to allow access to pasture and cropland located on the eastern side of the stream. The historic bar scalping which has been occurring near the farm bridge may also have to be addressed prior to implementation of the easement.

### Additional Data Needed

The main pieces of additional data needed prior to implementation of the corridor easement are a final delineation of the river corridor after further evaluation of the constraints and negotiations with the landowners. Another question that needs to be answered is whether or not the landowners may be willing to relocate the stream fords and/or animal crossings currently used to access fields on the other side of the river should channel evolution threaten these areas.

### Permitting Issues

One permitting issue which may apply to the corridor easement alternative is the potential need for a stream alteration permit depending on the type and magnitude of activity required should relocation of the bridge and/or stream fords become necessary.

### Cost and Feasibility

The relative cost of the alternative will depend on the final size of the corridor included in the easement and the payment terms (i.e. \$/acre) which will have to be worked out between RMP, the easement holder, and the landowners. A relatively large upfront payment would be paid to the landowners in exchange for relinquishment of their channel management rights to compensate them for the anticipated loss of some amount of land during channel evolution. The landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river, they would be compensated for potential lost production value, and would benefit by not incurring the cost of future channel management techniques (rip-rap, fill, etc.) that may have otherwise been used. The benefit from the easement would be sediment and nutrient attenuation within the project area, a more stable relationship between the landowners and the river, and hopefully less conflicts between upstream and downstream landowners and the river as the project moves the system toward a more stable state. The feasibility of the project depends solely on the willingness of the landowners to relinquish some or all of their channel management rights in exchange for financial compensation.

### Degree of Landowner Interest

An initial landowner contact letter was sent out to landowners within the project area in the fall of 2006 to let them know the area was being studied. Attempts were also made to reach Mr. Vaillancourt by phone, however, as of the date of this report, no response has been received.

### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the corridor easement alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for M09. As is shown in the table, the corridor easement alternative does meet all six of the RMP's criteria.

### **CREP Buffer/Cattle Exclusion Alternative**

The potential Conservation Reserve Enhancement Program (CREP) buffer/cattle exclusion alternative is shown on Figure 2. Currently, nearly the entire stream channel is accessible by cows and the streambanks lack adequate woody vegetation. No major areas of erosion were noted along this area, so by excluding the cows, and planting buffers the nutrient inputs from this area would be greatly reduced and wildlife habitat greatly improved. Currently, the cows cross the road and proceed down a farm road to the large

gravel bar shown on Figure 2. They then proceed along the stream channel to access pasture in the upper portion of M09. The proposed fencing scheme eliminates the cows' access to the stream channel with the exception of a proposed stream crossing to allow access to pasture on both sides of the stream. A minimum 35 foot wide buffer would be maintained along both sides of the stream over the entire reach with the exception of the cattle crossing and the downstream portion of the reach from the existing cattle crossing to the large gravel bar which would need to be maintained as a road to allow equipment access to the fields. The total land area converted to buffer space as part of this alternative is approximately 3.5 acres.

#### Overall Sediment/Nutrient Reduction and Attenuation

The CREP/cattle exclusion alternative would provide a relatively large amount of nutrient retention associated with the prevention of animal feed, manure, and runoff entering the stream. This alternative would do nothing toward achieving geomorphic dynamic equilibrium conditions.

#### Project Constraints

The largest foreseeable constraint for this alternative is the willingness of the landowners to eliminate the 3.5 acres of pasture needed in exchange for compensation through CREP. Some of the hay field located near the road would also be needed to move the cows to the pasture without entering the stream. Fencing in the hayfield would not be eligible for CREP funding as it is too far away from the stream.

#### Additional Data Needed

No additional data are needed prior to implementation of the buffer/cattle exclusion alternative other than to determine the cost of the project, locate funding sources, and secure landowner participation.

#### Permitting Issues

There are no permitting issues to deal with for the buffer/cattle exclusion alternative other than a potential stream alteration permit associated with the cattle crossing. There will be some contracts and other paperwork associated with the CREP and other programs which may share some of the cost of the project.

#### Cost and Feasibility

The cost for the project would be relatively inexpensive given the level of benefit for the watershed. The main cost associated with the project would be the purchase and installation of the fencing and gates required, likely to be a few thousand dollars. The 3.5 acres of buffer would be eligible under CREP for reimbursement as marginal pastureland at a rate of approximately \$160/acre/year. It is anticipated that CREP and the US Fish and Wildlife Service would be able to pay for a significant portion of the project

including most of the fencing and buffer planting cost. The fencing associated with the alleyway located along the road would probably not be eligible for CREP, however EQIP and/or other related programs may defray some of the cost.

#### Degree of Landowner Interest

An initial landowner contact letter was sent out to landowners within the project area in the fall of 2006 to let them know the area was being studied. Attempts were also made to reach Mr. Vaillancourt by phone; however, as of the date of this report, no response has been received.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which the CREP buffer/cattle exclusion alternatives will meet the River's Management Project Criteria is shown in the Table below along with the corridor easement alternative discussed above. As shown in the table, the buffer alternative would result in some level of sediment and nutrient reduction and attenuation, though would not contribute significantly to the overall watershed goal of restoring geomorphic stability and equilibrium conditions.

#### **River Corridor Easement and CREP/Cattle Exclusion Combination**

A third potential alternative for the Site would be to combine the corridor easement and the CREP buffer/cattle exclusion alternatives. This project would involve implementing the buffer/cattle exclusion to eliminate cows' access to the stream channel in conjunction with the corridor easement which would provide even greater sediment and nutrient attenuation than either of the alternatives as it would combine elements of both. There would be no conflicts between the two as there would be some required buffers as part of the corridor alternative were it to proceed on its own.

#### Overall Sediment/Nutrient Reduction and Attenuation

This option would provide the maximum level of long term sediment and nutrient attenuation through the natural evolution of the river to a more stable form and reduction of nutrient inputs through exclusion of cattle from the stream channel. Sediment and nutrients would be stored in the channel and on the floodplain as the river naturally progresses toward its historic depositional sediment regime located upstream of the naturally occurring bedrock constriction. This process would be gradual, as it may take years for the river to regain a more natural meander pattern and floodplain connection. During this process it would be expected that a short term increase in sediment and nutrient output may occur as the channel adjusts and some level of soil erosion occurs. This passive floodplain and meander redevelopment would act to restore the area to its historic role as a depositional reach and would, in the long term, result in much greater sediment storage capacity.

## Project Constraints

Potential constraints which will need to be addressed prior to final design of the alternative are mainly related to landowner negotiations and human infrastructure located within the historic river corridor. The river corridor shown on Figure 1 represents a significant portion of the relatively narrow valley where suitable agricultural land is at a premium. During channel evolution some of this useable land may become unusable as the stream begins to meander through the corridor. While the easement would compensate the landowners for these potential losses, they may not be able to afford to give up portions of land despite the potential compensation. Currently, a large portion of the corridor is used for pasture, some of which will have to be relinquished to implement the floating buffer along the stream. In addition, a portion of the hayfield outside of the river corridor will need to be converted to an alleyway to keep the cows out of the stream. Other issues which need to be considered included the bridge and proposed animal crossing located in the middle of the reach. These will need to be maintained to allow access to pasture and cropland located on the eastern side of the stream. The historic bar scalping which has been occurring near the farm bridge may also have to be addressed prior to implementation of the easement.

## Additional Data Needed

The main pieces of additional data needed prior to implementation of the corridor easement is a final delineation of the river corridor and buffer and fencing schemes after further evaluation of the constraints and negotiations with the landowners.

## Permitting Issues

One permitting issue which may apply to the corridor easement alternative is the potential need for a stream alteration permit depending on the type and magnitude of activity required should relocation of the bridge and/or stream fords become necessary.

## Cost and Feasibility

The relative cost of the alternative will depend on the final size of the corridor included in the easement and the payment terms (i.e. \$/acre) which will have to be worked out between RMP, the easement holder, and the landowners. In addition, a few thousand dollars will also be required to purchase and install fencing for the cattle exclusion portion of the alternative. A relatively large upfront payment would be paid to the landowners in exchange for relinquishment of their channel management rights to compensate them for the anticipated loss of some amount of land during channel evolution. The landowners would be allowed to continue farming in the easement corridor on lands not eroded by the river, they would be compensated for potential lost production value, and would benefit by not incurring the cost of future channel management techniques (rip-rap, fill, etc.) that they may have otherwise used. The benefit from the easement would be sediment and nutrient attenuation within the project area, a more stable relationship between the landowners and the river, and hopefully less

conflicts between upstream and downstream landowners and the river as the project moves the system toward a more stable state.

#### Degree of Landowner Interest

An initial landowner contact letter was sent out to landowners within the project area in the fall of 2006 to let them know the area was being studied. Attempts were also made to reach Mr. Vaillancourt by phone, however, as of the date of this report, no response has been received.

#### Degree to which Project Meets RMP's Project Review Criteria

The degree to which this alternative will meet the River's Management Project Criteria is shown in the Table below along with the other alternatives discussed for M09. As is shown in the table, this alternative does meet all six of the RMP's criteria.

#### **Partnering Agencies**

In order to implement any of the alternatives discussed above partnerships between the State of Vermont Rivers Management Program, the Vermont Department of Agriculture, the United States Department of Agriculture, the United States Department of Fish and Wildlife, as well as various other consultant and non-profit groups such as the Missisquoi River Basin Association will be critical.

**Rivers Management Project Review Criteria Table for Reaches T1-03/T1-05**

Rivers Management Project Criteria	Corridor Easement Alternative with Buffer Enhancement	Corridor Easement/CREP Buffer and Cattle Exclusion Alternatives Combined	CREP Buffer/Cattle Exclusion Alternative
Will the project move the stream toward or help sustain fluvial geomorphic dynamic equilibrium conditions?	Yes	Yes	No
Will the project result in an overall reduction of sediment/nutrient production and an increase in sediment/nutrient storage in the watershed?	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes, in the long term. A short term increase in sediment may occur during channel adjustment	Yes
Will the anticipated alteration of the sediment regime (if any) be sustainable when examined in a long term temporal sense?	Yes	Yes	Maintenance and extension of the existing transport regime in what would be a sediment deposition reach may not be sustainable.
If the project is completed, what is the likelihood that it may fail because of ongoing or anticipated reach-associated channel adjustments?	None	Possible	Possible
Will the project lead or contribute to, or be inconsistent with maintenance or restoration of equilibrium conditions in upstream or downstream reaches?	Will contribute to restoration of equilibrium conditions in other reaches	Will contribute to restoration of equilibrium conditions in other reaches	Will not contribute to restoration of equilibrium conditions
Are the anticipated project outcomes consistent with aquatic and riparian habitat enhancement, flood and fluvial erosion hazard mitigation and avoidance, water quality protection and restoration, and state and local socio-economic and ecological sustainability objectives?	Yes	Yes	Yes, but moderated as described above

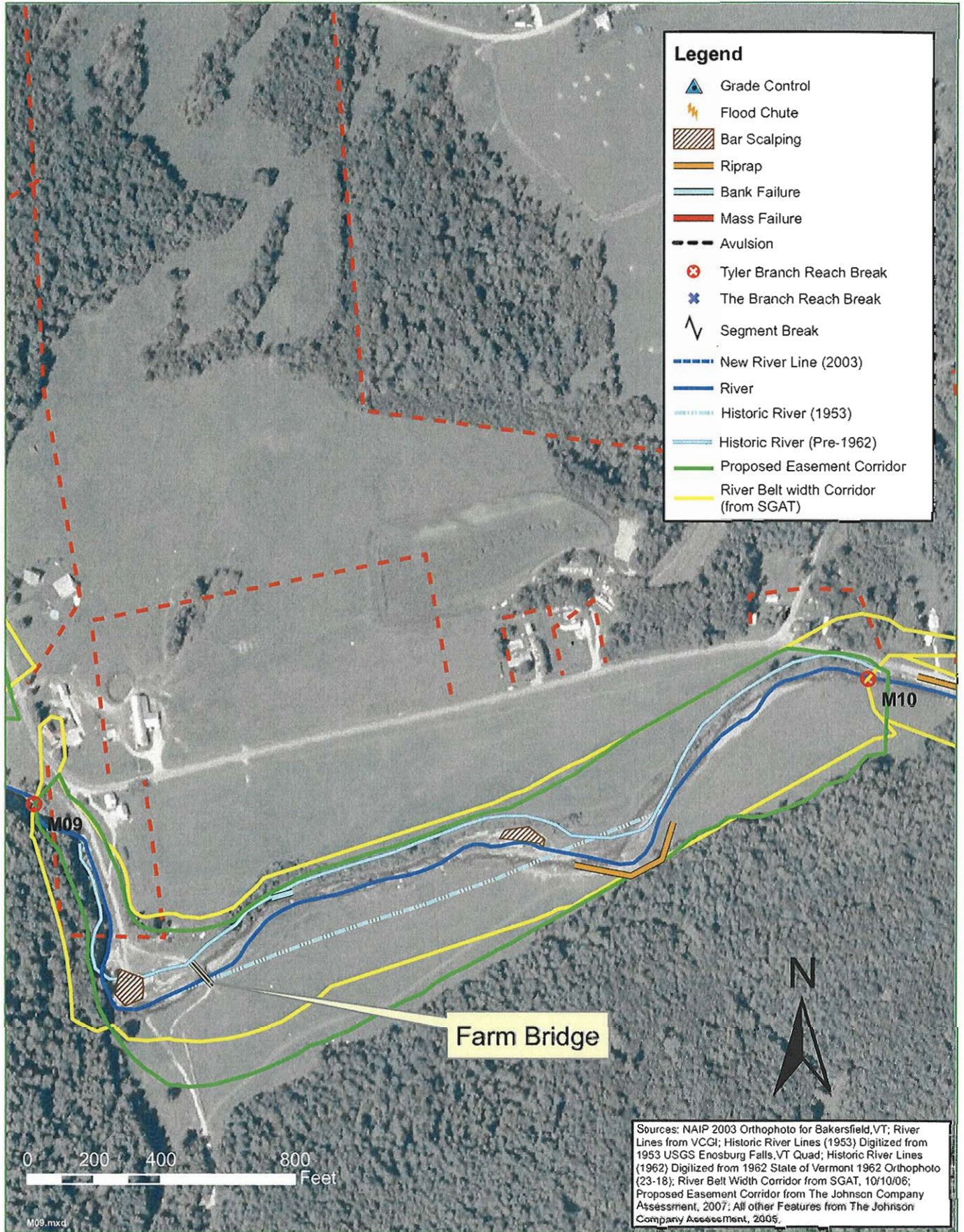


Figure 1: Tyler Branch (M09) Corridor/Restrains Map

**THE JOHNSON COMPANY, INC.**

*Environmental Sciences and Engineering*

100 STATE STREET

MONTPELIER, VT 05602

DATE: 2/21/07

PROJECT: 1-1470-6

DRAWN BY: MJR

SCALE: 1" = 400'

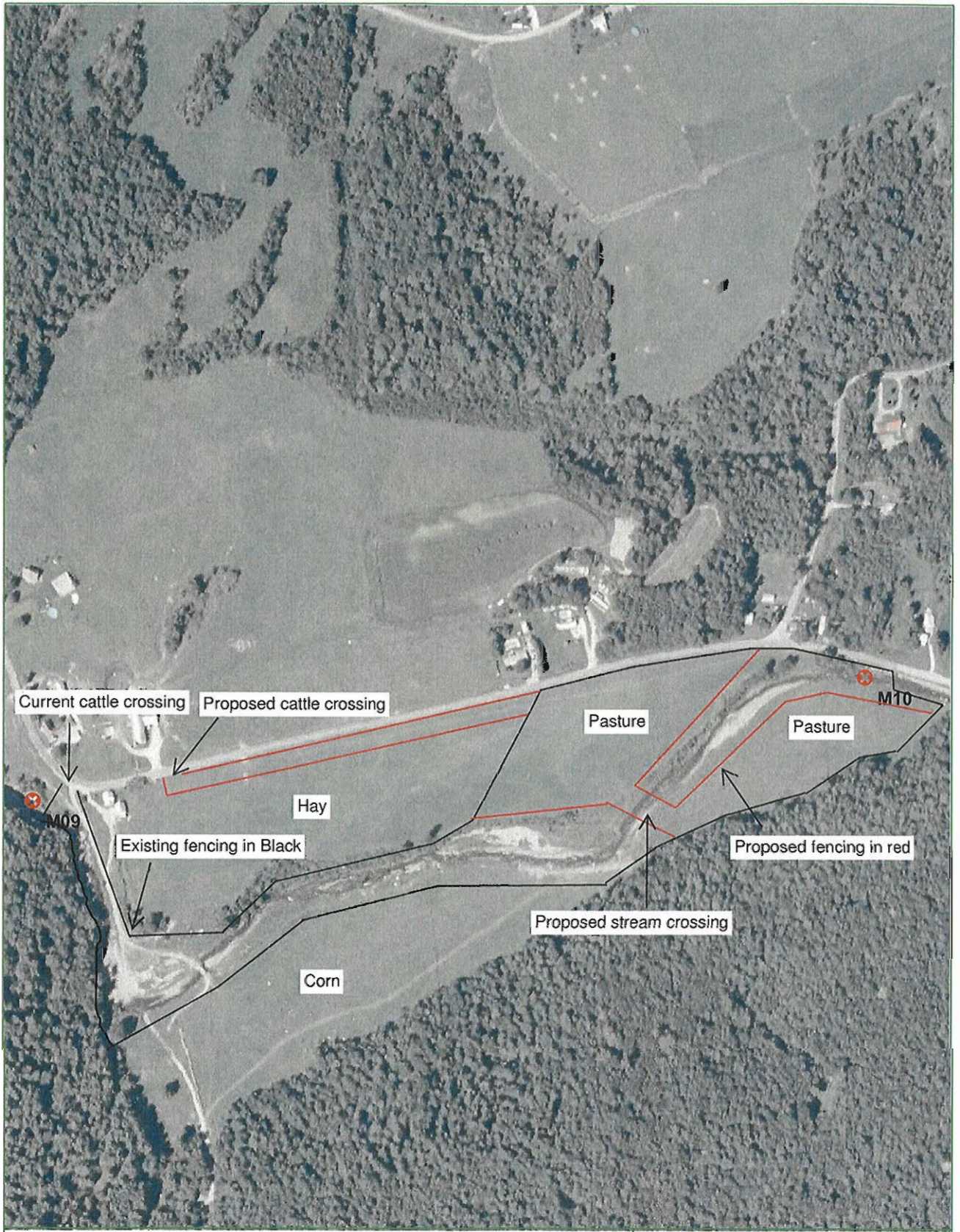


Figure 2: Proposed Cattle Exclusion M09

**THE JOHNSON COMPANY, INC.**

*Environmental Sciences and Engineering*

100 STATE STREET

MONTPELIER, VT 05602

DATE: 2/21/07

PROJECT: 1-1470-6

DRAWN BY: AWR

SCALE: 1" = 400'

**APPENDIX 2**

**LANDOWNER CONTACT INFORMATION**

**Tyler Branch Watershed  
Potential Project Area Landowner Information**

Reach	Parcel	Landowner	Mailing Address	Telephone	Contact record
M01/M02	Unknown	Harness	753 Davis Road, Enosburg Falls, VT 05450	933-4093	Johnson Company (JCO) met with Steve on 11/8/06. He is interested in possibly seeding over cornfield along Tyler Branch Road. He has been in contact with Ben Gabos of NRCS. He was not interested in any sort of corridor easement as he wants to be able to manage channel. He has already rip-raped eroding bank downstream. JCO and Ben Gabos met with Steve on January 4, 2007 to present potential CREP alternatives.
T1-03/T1-05	WE4756	Hull	4756 West Enosburg Road, Enosburg Falls, VT 05450	933-2557	JCO met with Warren on 11/8/06. We looked at barnyard in T1-03. Based on layout of barn, proximity to stream, need to use stream culvert for cow crossing - no immediate projects seem feasible here. Barnyard in T1-05 could be enhanced using fencing to create buffer strip between feeding area and stream. Warren would be willing to consider this option. JCO and Ben Gabos met with Warren on Feb. 9, 2007 to finalize fencing scheme in T1-05. Ben to meet w/Warren in spring to discuss other CREP opportunities.
T1-02	WE2968	Sweet	2968 West Enosburg Road, Enosburg Falls, VT 05450	933-4941	JCO and Ben Gabos met with Margaret on Jan. 4, 2007 to discuss possible options (CREP, corridor easement). Margaret was open to both ideas but need to work out rental terms with Terry Magrnan who uses fields.
T1-02	WE3725	Mongeon	307 Main Street, Bakersfield, VT 05441	827-3773 524-5543 ex 101	Letter sent November 2006, phone messages in November 2006, and January 2007. Mark sold property in Feb. 2007, current owner unknown
M04	TB0499	Welch	248 Sugarbush Farm Road, Colchester, VT 05446	933-4908 893-0324	Letter sent November 2006, phone messages in November and December 2006
M04	TB1288	Stebbins	9437 Route 105 Enosburg Falls, VT 05450	933-4975	Letter sent November 2006, phone messages in November and December 2006
M04	WE2618	Parent	2623 West Enosburg Road Enosburg Falls, VT 05450	933-2289	Letter sent November 2006, left message with Marcel's wife on December 15, 2006. Site visit by Ben Gabos and Staci Pomeroy in fall of 2006 regarding potential CREP and/or corridor projects. Marcel is not interested in participating in any government programs.
M07	WE2703	Bobkowitz	PO Box 562 Enosburg Falls, VT 05450	933-5322	Letter sent November 2006
M07	TB2035	Vaillancourt	2035 Tyler Branch Road, Enosburg Falls, VT 05450	933-4741	Letter sent November 2006, phone message December 2006
M07	WE2499	Sweeney	PO Box 1133 Enosburg Falls VT 05450	933-9020	Letter sent November 2006
M09	TB2443	Vaillancourt	2443 Tyler Branch Road, Enosburg Falls, VT 05450	933-4733	Letter sent November 2006, phone message December 2006