Fitzgerald Environmental Associates, LLC.

Applied Watershed Science & Ecology

Alder Brook Watershed Phase I and II
Stream Geomorphic Assessment Report

December 29, 2006

Prepared for:

Essex Waterways Association
Essex, Vermont

Funding for this work was provided by:

Vermont Department of Environmental Conservation
River Management Program
Waterbury, Vermont

316 River Road · Colchester · Vermont · 05446
Tel/Fax. 802·861·7599 · fitzgeraldenvironmental@gmail.com

TABLE OF CONTENTS:

1.0 Executive Summary

This report summarizes Phase I and II stream geomorphic assessment data collected by Fitzgerald Environmental Associates, LLC (FEA) for the Alder Brook watershed in Essex, Vermont. The watershed has a drainage area of 10.4 square miles and represents approximately 30% of the entire Town area, making it an important planning unit within the Town. Urbanization in the Alder Brook watershed has increased during the past 10 years, and urban land now covers approximately 10% of the watershed area. Although ANR's monitoring of the Alder Brook biotic community during the past 10 years indicates a waterway in good to fair condition, recent observations of the physical stability of the channel below Route 15 suggest that the channel is experiencing rapid adjustment. The goal of this analysis is to better understand the current physical state of Alder Brook in the context of historic impacts and current development pressures, through the identification of watershed scale and reach scale stressors.

In order to understand the current physical changes occurring in the watershed, an analysis of the historic impacts to the Alder Brook watershed was conducted. This analysis revealed that the main stem of Alder Brook in the Essex Town center once flowed (naturally) into the Browns River to the north. A man-made diversion for milling purposes, and later a flood in 1830 permanently diverted the channel into its present-day location through the steep sand ravines to the Winooski River. This diversion had an extreme effect on the physical stability of the lower watershed, and on the amount of sediment delivered to the Winooski River at the confluence. Historical aerial photographs from the 1930's indicate that the stream corridor was still recovering from this drastic change over 100 years later.

Today, 175 years after this human induced watershed impact, there are signs that areas of the stream corridor below Route 15 have since recovered. Despite this recovery, changes in land use in the lower watershed since the 1960's combined with the recent construction of Route 289 (Circ) have introduced new sources of stressors to this sensitive area. The field observations conducted during the Phase II geomorphic assessment indicate that the combination of steep, highly erodible terrain and uncontrolled stormwater discharges from residential areas have dramatically increased the delivery of sediment to the channel. In addition, berm encroachment on the floodplain and sediment delivered to the channel from the Circ construction have caused areas of sediment accumulation that are migrating through the channel network as sediment "slugs". These areas of increased sedimentation are causing lateral adjustments in the channel, which are in turn degrading in-stream habitat conditions.

Alder Brook corridor conditions above Essex Center reveal a different set of stressors related to historic impacts from agriculture, including channel straightening and removal of buffer vegetation. Large areas of land once used for agriculture in this part of the watershed have since redeveloped forest cover. Where

agricultural land uses are still found, impacts include limited buffer vegetation and grazing cattle along the stream channel. However, there has been an overall recovery of floodplain connectivity since these historic agricultural impacts, which has led to a recovery of channel stability and physical habitat across many of the middle and upper reaches.

A discussion of restoration project opportunities specific to each reach of the watershed has been provided in Section 5 of this report. In addition, general recommendations for restoration strategies (with a focus on the lower watershed zone) at larger scales within the watershed have been addressed. These include strategies that could form the basis for town level planning and zoning to address the sediment regime stressors affecting channel equilibrium conditions in the lower reaches. Recommendations for future monitoring of geomorphic stability and biotic habitat in the Alder Brook watershed are also included in this report. Summarized, these recommendations include the following needs:

1. Assess and prioritize the impacts of gullies in Reaches M05 and M06 below Essex Center for future remediation efforts similar to those currently being implemented on Fern Hollow Road.
2. Address the need for stormwater runoff control for discharges to gullies in reaches M05 and M06 and develop a plan for long-term implementation of infiltration structures.
3. Assessment of tributaries that appear to be delivering large amounts of sediment to the main stem (thereby degrading biotic habitat) in Reaches M02, M03, and M05.
4. Develop a watershed-wide stream corridor protection strategy for reaches susceptible to future encroachment, whereby a belt width of six times the channel width is used as a basis for the corridor.
5. Continued monitoring of the channel below the stormwater discharges from the Clover Road neighborhood where no runoff control structures were noted.
6. Restoration of natural, woody vegetation along specific areas of stream bank to lower summer stream temperatures and increase beneficial organic inputs to the channel.
7. Prioritize areas in Reaches M12 and M14 for keeping grazing cattle away from stream channel using fencing.

2.0 Introduction and Project Overview

The Essex Waterways Association (EWA) is a community group that formed in 2005 under the direction of Dr. Suzanne Levine, a UVM professor of Aquatic Ecology and an Essex resident. The mission of EWA is to work towards protecting the waterways in the town through watershed assessments and community outreach, and the group has identified three watersheds within the Essex town limits that will be the focus of various sampling efforts. These watersheds are Indian Brook, Sunderland Brook, and Alder Brook. Both Indian and Sunderland Brooks are included on the EPA 303d list as impaired waterways due to "stormwater runoff". The Vermont Agency of Natural Resources (ANR) is currently involved in a process of developing clean-up plans (known as Total Maximum Daily Loads) to address biological impairment in these streams. However, comparatively less is known about the physical and biotic health of the Alder Brook watershed. FEA was retained by EWA in April 2005 to conduct Phase I and II stream geomorphic assessments for the Alder Brook watershed.

The Alder Brook watershed (see maps in Appendix 1) is a small tributary of the Winooski River, located almost entirely within the Town of Essex. Approximately 30% of the Town land area is drained by the Alder Brook watershed, with another 50% drained by Indian and Sunderland Brooks and the Browns River, thus making the Alder Brook watershed an important ecological planning unit within the Town. The watershed encompasses an area of 10.4 square miles, with 11.6 miles of stream channel from headwaters to mouth. The steep headwaters of Alder Brook are found in mostly unaltered, forested terrain north of Rollin Irish Road in Jericho. In the middle section of the watershed, Alder Brook becomes a low gradient channel winding through a mix of agricultural, forested, and residential land uses before entering the village of Essex Center. From the village down to the outlet, Alder Brook becomes much steeper as its valley cuts sharply through geologic sand features before reaching the Winooski River valley.

The overall land cover of the watershed contains a mix of agricultural, residential and commercial (urban), and forested lands (Table 1). A review of historic aerial photos reveals that the land cover has undergone significant recovery of forest since the early 1900's, especially in the middle and upper sections of the watershed.

Table 1. Alder Brook Watershed Land Use†			
Open*	**Forest**	**Urban**	**Water/Other**
49.6%	39.7%	10.5%	0.2%

† 2002 LandSAT imagery from UVM's Spatial Analysis Lab
* Includes agricultural land and urban lawns

Because of economic growth in Chittenden County and the desirability of the Essex community for residential and commercial development, urban land use has begun to occupy a larger share of the watershed land cover in the past decade. Analysis of 2002 imagery shows that urban land use now occupies over 10 percent of the land cover, approaching a level that is typically associated with decline in water quality and biotic integrity (CWP, 2003). Biotic sampling (of fish and macroinvertebrates) conducted within the past 5 years in Alder Brook show a condition of good to fair (VTDEC, 2005). However, observations of the habitat conditions in the channel taken during this sampling suggest that upstream sedimentation may be adversely affecting the biota of the lower watershed. Further sampling of macroinvertebrates was conducted by ANR in fall 2006 and results of the sampling will be available sometime in spring 2007.

Given the above mentioned concerns about the Alder Brook watershed, the goal of this project is to better understand the state of the physical health of Alder Brook in the context of development pressures in the watershed. The collection of stream geomorphic assessment data will aid in determining the watershed scale and reach scale stressors on the health of Alder Brook. Phase I (remotely sensed) and Phase II (field observations) geomorphic assessment data have been collected and analyzed for 15 reaches of the main stem of the brook, and are summarized in Section 5 of this report.

3.0 Watershed Background

3.1 Geologic Background

The Alder Brook watershed lies in the Champlain Valley and its surficial geology and soils have been shaped by three dominant processes of the landscape since the last period of glaciation: 1) Retreat of the Laurentide Ice Sheet; 2) Presence of Lake Vermont/Champlain Sea; 3) Deposition from the Winooski River. Each of these historic geologic processes help describe the current distribution of soil characteristics found throughout the watershed today.

As the Laurentide Ice Sheet retreated from Vermont approximately 14,000 years ago, it left behind a “tongue” of ice extending through the lower elevations of the Champlain Valley. This retreat (melting faster than moving southward), and the southward movement that proceeded it, left a barren landscape with glacial till soils. During the retreat of the glaciers, a large freshwater lake formed as the meltwater draining to the north was blocked by the remaining “tongue” of ice in the northern Champlain Valley. This lake, which later became brackish, persisted for approximately 4,000 years at an elevation of 620 feet above sea level (Wright, 2003).

The presence of this lake had a profound effect on the soils that are found in the Alder Brook watershed, especially in the lower section below the Route 15 crossing. During this historic period of Lake Vermont, the surface elevation of the water extended north in the Alder Brook watershed near Bowman's Corner in Jericho. Due to the quiescent waters of the lake, large amounts of fine and coarse sediment settled in these areas, leaving behind the silty and sandy soils found throughout the watershed today. The only section of the watershed that was not greatly affected by the presence of Lake Vermont was the upper headwaters of Alder Brook above Rollin Irish Road, where till soils are dominant. The surficial geology of the remaining lower part of the watershed is dominated by a mix of sands and coarse gravels associated with deposition in the Lake. In the lower section of the watershed below Route 15 this is most evident, where the soils are nearly 100% coarse sand. This area represents an ancient delta of the Winooski River where sands were deposited when the elevation of the lake was approximately 600 feet.

Table 2 provides a summary of the riparian corridor soil properties and valley side slopes at the reach scale. Note that in the lower part of the watershed (Reaches M01 through M07), the erodibility of the soils is very high and the side slopes of the valley are very steep. This combination of characteristics provides for the erosive and dynamic conditions that are observed in the lower reaches (discussed more in section 5). In the upper part of the watershed (Reaches M08 through M13), the stream corridor is found in a flat valley with a combination of alluvial deposits and glacial lake deposits characterized by fine silts and sands.

Table 2. Alder Brook Geology and Soils Summary

	Geologic Materials			Soil Properties				Valley Side Slopes	
Reach ID	Dominant	%	Sub-Dominant	Hydrologic Group	%	Erodibility	%	Left	Right
M01	Alluvial	83	Glacial Lake	C	78	Slight	16	Flat	Steep
M02	Ice-Contact	55	Glacial Lake	B	89	Very Severe	99	Very Steep	Very Steep
M03	Ice-Contact	100	NA	B	86	Very Severe	99	Very Steep	Steep
M04	Ice-Contact	100	NA	B	100	Very Severe	88	Very Steep	Very Steep
M05	Ice-Contact	95	Glacial Lake	B	100	Moderate	29	Steep	Steep
M06	Ice-Contact	59	Glacial Lake	B	100	Severe	56	Steep	Very Steep
M07	Glacial Lake	96	Ice-Contact	D	71	Very Severe	96	Very Steep	Very Steep
M08	Alluvial	73	Glacial Lake	C	74	Slight	4	Flat	Flat
M09	Alluvial	71	Glacial Lake	C	71	Moderate	26	Hilly	Hilly
M10	Alluvial	75	Glacial Lake	C	78	Slight	20	Flat	Flat
M11	Alluvial	80	Glacial Lake	C	87	Slight	3	Flat	Hilly
M12	Alluvial	81	Glacial Lake	C	81	Slight	13	Flat	Flat
M13	Alluvial	67	Glacial Lake	C	73	Slight	4	Flat	Flat
M14	Till	73	Alluvial	D	64	Severe	73	Steep	Steep
M15	Till	98	Ice-Contact	D	85	Very Severe	99	Steep	Steep

3.2 Watershed Zones and Reach Delineation

The same historic geologic events described above that shaped the soil characteristics along the channel network of Alder Brook also created the changes in topography and slope in the watershed that are observed today. These changes in topography, slope, and soils were the basis for the reach delineation that was carried out in the Phase I remote sensing analysis of watershed. Below is a discussion of the macro-scale watershed zones that have been delineated and described in this report, and Table 3 provides a summary of Phase I generated statistics for all reaches in the Alder Brook watershed.

Table 3. Alder Brook Phase I Reference Reach Summary Statistics

Reach ID	Drainage Area (mi^2)	Valley Width (ft)	Valley Type	Channel Width (ft)	Channel Slope (%)	Sinuosity	Reference Stream Type	Channel Bedform
M01	10.4	340	Broad	36.8	0.6	1.4	C	Riffle-Pool
M02	10.4	137	Narrow	32.0	0.7	1.0	C	Riffle-Pool
M03	10.1	157	Narrow	36.2	1.0	1.1	C	Riffle-Pool
M04	9.0	158	Narrow	34.4	0.9	1.2	C	Riffle-Pool
M05	8.8	125	Semi-Confined	34.0	0.8	1.4	C	Riffle-Pool
M06	8.3	192	Narrow	33.3	0.7	1.3	C	Riffle-Pool
M07	7.9	190	Narrow	32.5	3.7	1.1	B	Step-Pool
M08	7.9	443	Very Broad	32.4	0.1	1.5	E	Dune-Ripple
M09	6.4	306	Very Broad	29.7	0.2	1.2	C	Riffle-Pool
M10	6.0	449	Very Broad	18.0	0.1	1.4	E	Dune-Ripple
M11	5.1	462	Very Broad	16.0	0.1	1.5	E	Dune-Ripple
M12	3.6	318	Very Broad	23.1	0.1	1.3	E	Dune-Ripple
M13	2.8	391	Very Broad	9.0	0.3	1.4	E	Dune-Ripple
M14	0.8	60	Narrow	15.0	2.9	1.1	B	Plane Bed
M15	0.3	20	Semi-Confined	7.7	3.8	1.1	B	Step-Pool

In the lower zone of the watershed, confining valley characteristics dominate the stream corridor where the channel has historically formed deep ravines through the sand delta deposits. For these reaches (M01 through M07), the average slope of the channel is 1.2%, and cobble and gravel bottomed channels with riffle-pool bedform are found (Montgomery and Buffington, 1997). In this zone, the average width of the valley is approximately 200 feet, resulting in stream geometry associated with B and C type channels (Rosgen, 1994). Further detailed descriptions of the reaches found in this watershed zone, and the associated Phase I and II observations, are found in Section 5 of this report. Maps depicting reach delineations and watershed boundaries are found in Appendix 1.

In the middle watershed zone, found above the Route 15 crossing in the flat alluvial valley along Towers and Chapin Roads, the valley setting and geologic characteristics are dramatically different. For these reaches (M08 through M13), the average slope of the channel is 0.2% and sinuous, sand bottomed channels with dune-ripple bedform prevail. In this zone of the watershed, the valley is much wider, resulting in stream geometry associated with E type channels. One reach (M12) was not assessed during the Phase II field surveys due to lack of property access. Further detailed descriptions of the reaches found in this watershed zone, and the associated Phase I and II observations, are found in Section 5 of this report. Maps depicting reach delineations and watershed boundaries are found in Appendix 1.

In the upper headwaters zone of the watershed, found above Rollin Irish Road in Jericho, the stream valley and corridor characteristics change again for the final two reaches of the watershed (M14 and M15). The average channel slope of these two headwaters reaches is 3.3% and small, cobble and gravel bottomed channels are found. The average width of the narrow valley in this zone of the watershed is 60 feet, resulting in stream geometry associated with A and B type channels with plane bedform. Further detailed descriptions of the reaches found in this watershed zone, and the associated Phase I and II observations, are found in Section 5 of this report. Maps depicting reach delineations and watershed boundaries are found in Appendix 1.

3.3 Land Use History

The Alder Brook watershed, like much of the state of Vermont, was largely devoid of forest vegetation in the middle part of the 1800's. This watershed-scale impact, along with the direct impacts to the channel associated with clearing and farming (e.g., straightening), left scars that are still healing today. In the absence of historic aerial photographs that predate 1937, only anecdotal information from historical records can be used to piece together the story of the watershed and its land use. Nevertheless, historic aerial photos taken in 1937 provide a basis for using time-lapse analysis to understand the extent of the forest clearing and subsequent recovery in the 1900's as the economy shifted away from the traditional pastoral land uses. These photos also aid in understanding the extent of channel straightening that occurred in the middle watershed zone, and the degree to which the natural sinuosity of the channel has recovered.

Provided below is a series of aerial photographs with discussion that helps illustrate the changes in land cover that have occurred since the 1930's in the watershed. The historic photos were taken in 1937 during the Soil Conservation Service (SCS) inventory of the state, while the current aerial photography was flown in 1999 as part of Vermont State Government's modern-day inventory.

Figure 1. SCS 1937 Aerial Photograph of Lower Reaches (M01 & M02)

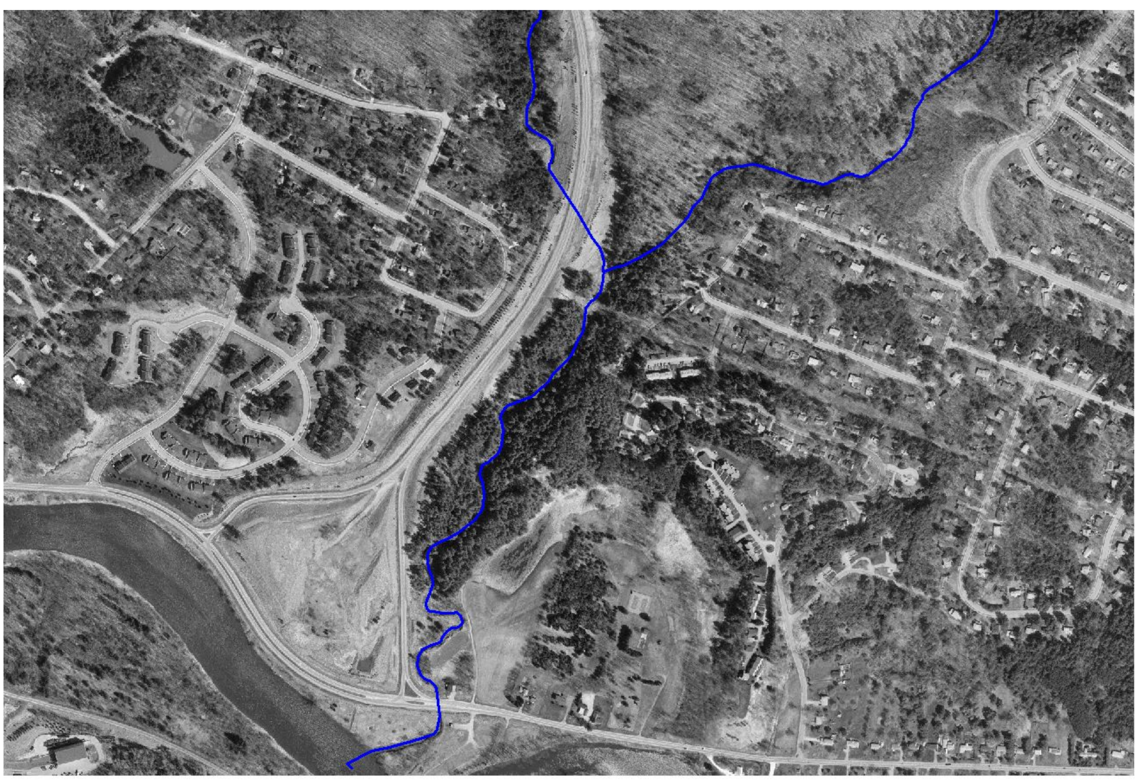


Figure 2. 1999 Aerial Photograph of Lower Reaches (M01 & M02)

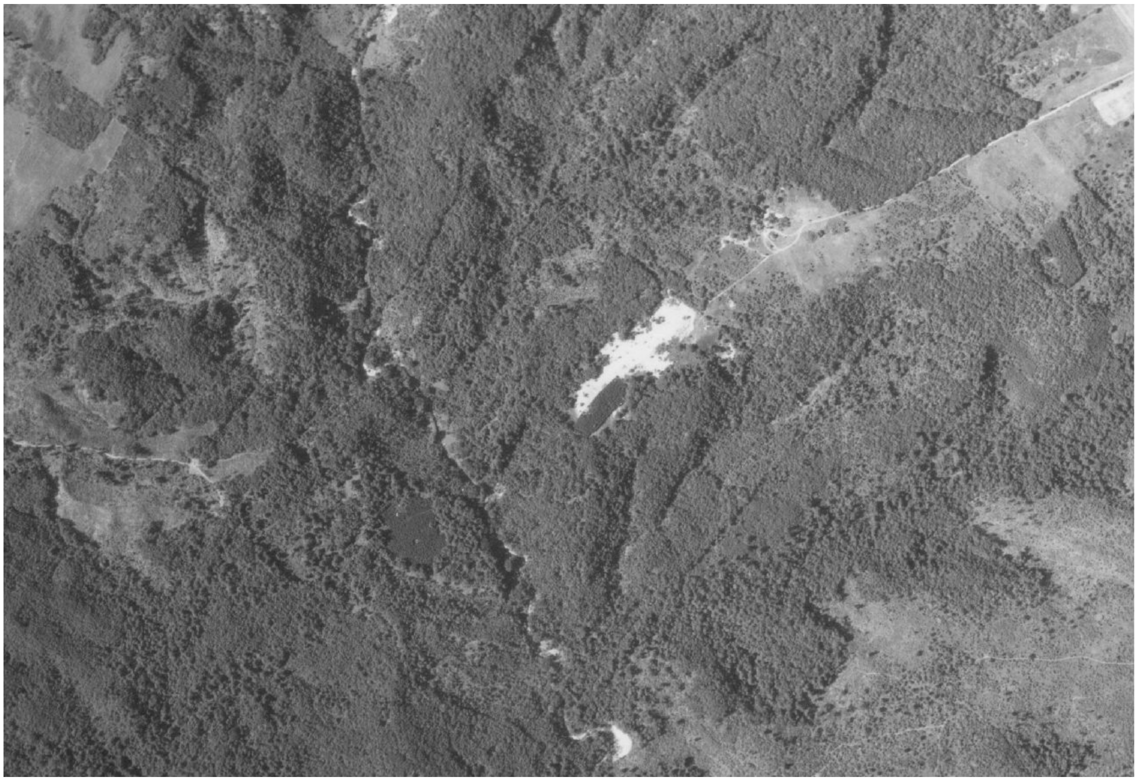


Figure 3. SCS 1937 Aerial Photograph of Lower Reaches (M03 & M04)

Figure 4. 1999 Aerial Photograph of Lower Reaches (M03 & M04)

Figures 1 through 4 depict Reaches M01 through M04 of the lower watershed zone. Note that the change in land cover in these reaches of the watershed is different from that in the area immediately below Essex Center (see Figures 5 and 6). In this lower zone, a large percentage of the recovering forest has been converted to residential areas, and the construction of Route 289 has directly encroached upon the stream channel corridor. Detailed review of the channel location over the 60 year period reveals that it has changed little since the 1930's, suggesting that the watershed scale impacts to the channel from the initial clearing in the 1800's had been ameliorated over time.

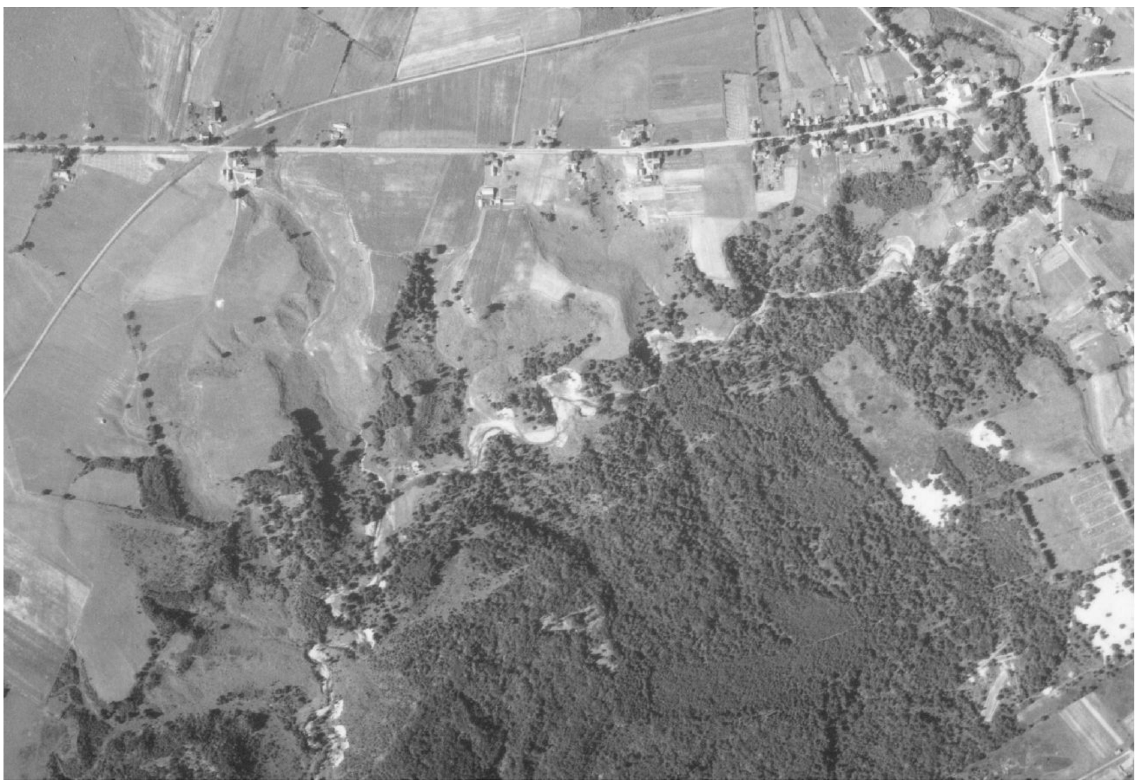


Figure 5. 1937 SCS Aerial Photograph of Lower Reaches (M05 & M06)

Figure 6. 1999 Aerial Photograph of Lower Reaches (M05 & M06)

Figure 7. 1937 SCS Aerial Photograph of Middle Reaches (M07 & M08)

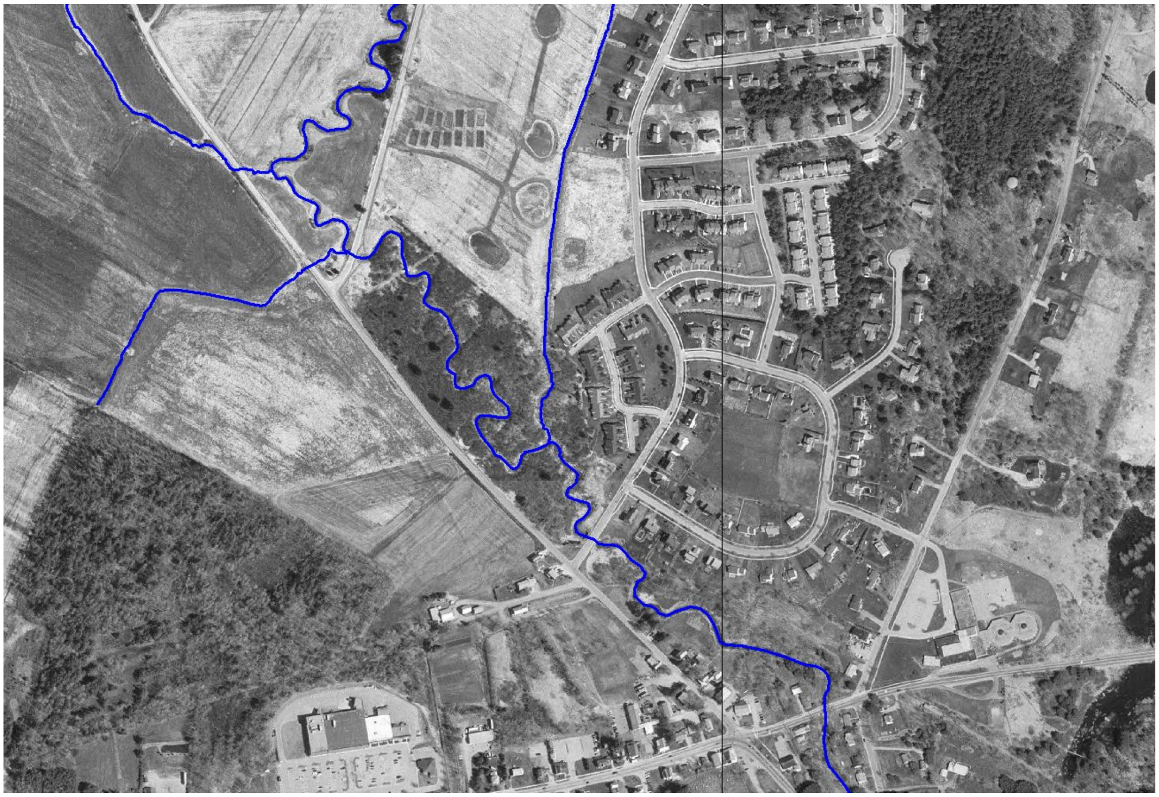


Figure 8. 1999 Aerial Photograph of Middle Reaches (M07 & M08)

Figures 5 and 6 depict the uppermost reaches of the lower watershed zone (M05 and M06). The land cover surrounding the stream corridor in this area has undergone marked recovery from its denuded state in the 1930's. Much of the current forest cover is still in the initial stages of recover, as noted in the dominance of softwoods (white pine). However, large areas of residential development to the north and south of the stream corridor, and in the vicinity of Essex Center, have converted forest cover to dispersed areas of impervious cover (e.g., roadways and rooftops). This current day conversion is partly driving the watershed-scale impacts to water quality that were observed in the lower watershed zone during the Phase II field assessments. The effect of this impact will be described in great detail in Section 5 of this report.

Similarly, Figures 7 and 8 illustrate some areas of forest recovery above Essex Center, however large areas of once pervious farmland to the northwest of the stream corridor have been replaced by residential land use. These areas discharge stormwater runoff to the channel below Clover Road, and appear to be adversely affecting water quality and channel stability in downstream reaches. Also noteworthy in Figures 7 and 8 is the similarity of channel location and sinuosity over the 60 year time period, despite the historic clearing along the stream corridor. This similarity suggests that the recovery of the landscape from agricultural impacts did not drastically change the sediment and hydrologic regimes of Alder Brook during this time period.

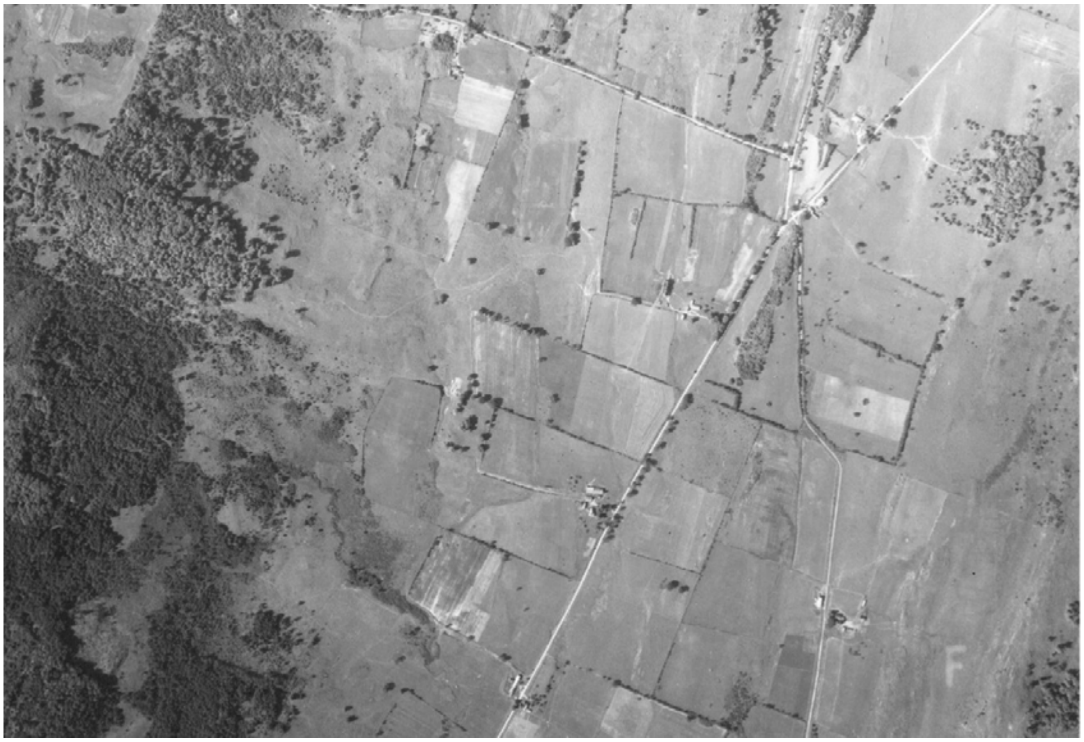


Figure 9. 1937 SCS Aerial Photograph of Upper Reaches (M13 & M14)

Figure 10. 1999 Aerial Photograph of Upper Reaches (M13 & M14)

Figure 9 and 10 illustrate the large-scale recovery of the forest landscape in the headwaters reaches. This area of the watershed, which has flat and rolling terrain with silty-clay soils suitable for agriculture, was nearly 100% cleared in the 1800s. It has since recovered to approximately 60% forest cover, with the remaining land use being mostly pasture and hayfields for dairy farms.

3.4 Flood History

Some of the larger rivers in Chittenden County, such as the Winooski and Browns, have detailed historical accounts of flooding and channel avulsions, due to the fact that their large size has caused significant property damage. On the other hand, Alder Brook is a waterway of much smaller scale than these rivers, and the same detailed accounts do not exist. However, one account published on a historical website describes a flood of 1830 in the Town of Essex that apparently caused the Alder Brook channel to change course:

> *'In 1804 Mr. PELTON leased of David MORGAN the right to flow land on Alder Brook, and built a saw-mill on the bank west of Lysander WOODWORTH's. This brook, so called from the immense grove of alders on its bank, was then a very small stream, quite shallow, emptying in Brown's River, in the northeast part of the town. Mr. PELTON diverted this brook from its natural course, carrying the water in a flume to a reservoir dam a few miles below the present gulf cross-way. In this saw-mill some of the lumber used in building the meeting-house was prepared. At this time there was no gulf, but in the great freshet of 1830 the brook became a mighty power, swept off bridges, dams and mills, cut for itself a new channel well toward a hundred feet below the original bed and forced its way over all opposing obstacles until it mingled its waters with the Winooski, many miles away, in an entirely opposite direction from its original mouth. This was one of the most destructive calamities the town ever witnessed, and from which the "Center" never recovered.'* (Roots Web, 2006)

Historical survey maps (see Figure 11) from the time period prior to the freshet of 1830 depict the flow of Alder Brook from Essex Center in two directions: both into the Browns River *and* into the steep ravine towards the Winooski River. It is likely that the diversion flume that carried water to the reservoir and mill below is depicted in blue in this survey, since this survey was conducted prior to the flood that permanently diverted the channel into its present-day location. It seems likely that the manipulation of the channel to divert water away from the Browns River also led to the complete diversion (during the flood) of the channel to the present location. However, it should be noted that the original channel location was separated from the current ravine by only a small elevation gradient, perhaps less than 10 feet. Without topographical surveys of the Essex Center prior to the diversion and flood of the early 1830's, it is impossible to know whether or not the original channel ever accessed this ravine naturally during flood events, or if the ravine had been at least partially formed prior to the 1830 flood.

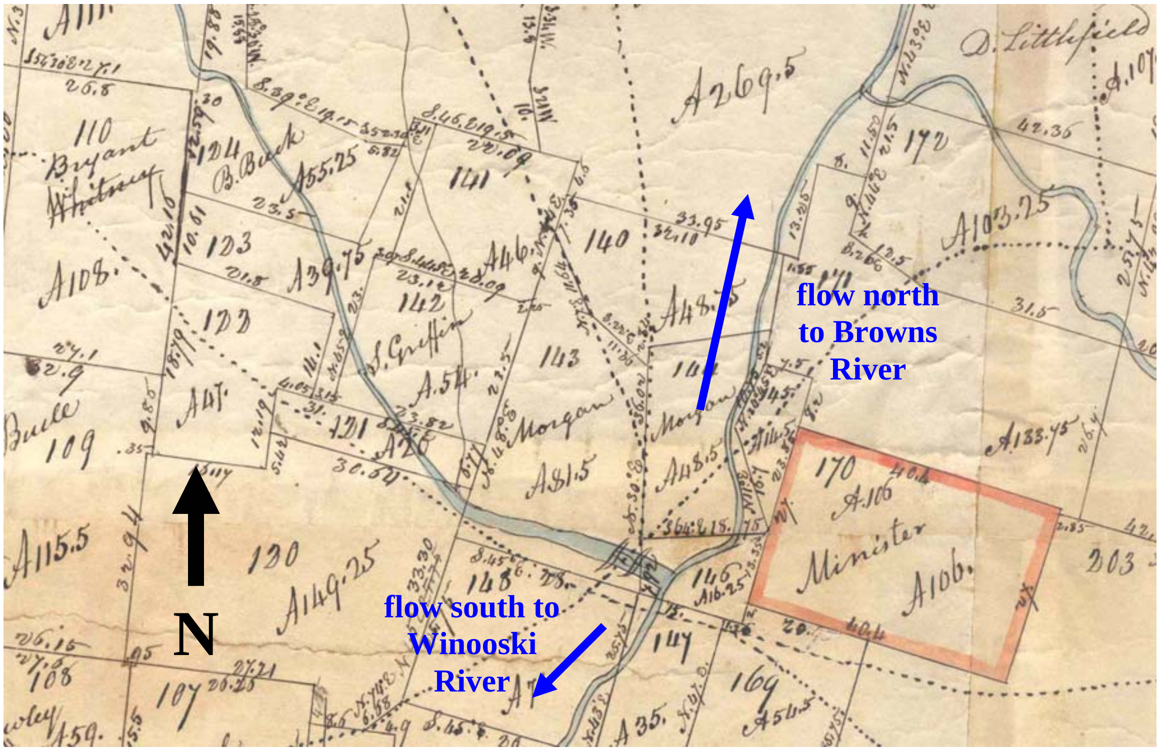


Figure 11. Johnson Survey (ca. 1815) of Essex Center

In addition, a review of the 1999 aerial photograph with topographic contours overlain (see Figure 12) reveals the old channel location to the Browns River. This channel can be clearly seen to the north where it nears the Browns River, and the topography indicates where the channel once turned from the east to the north outside of Essex Center. This old channel, although overgrown by vegetation, can be observed in the field today. The channel continues to maintain mostly stagnant surface waters (likely fed by groundwater inputs) and has been colonized by beavers over the years. Further discussion of the diversion and flood are found below in Section 3.5.

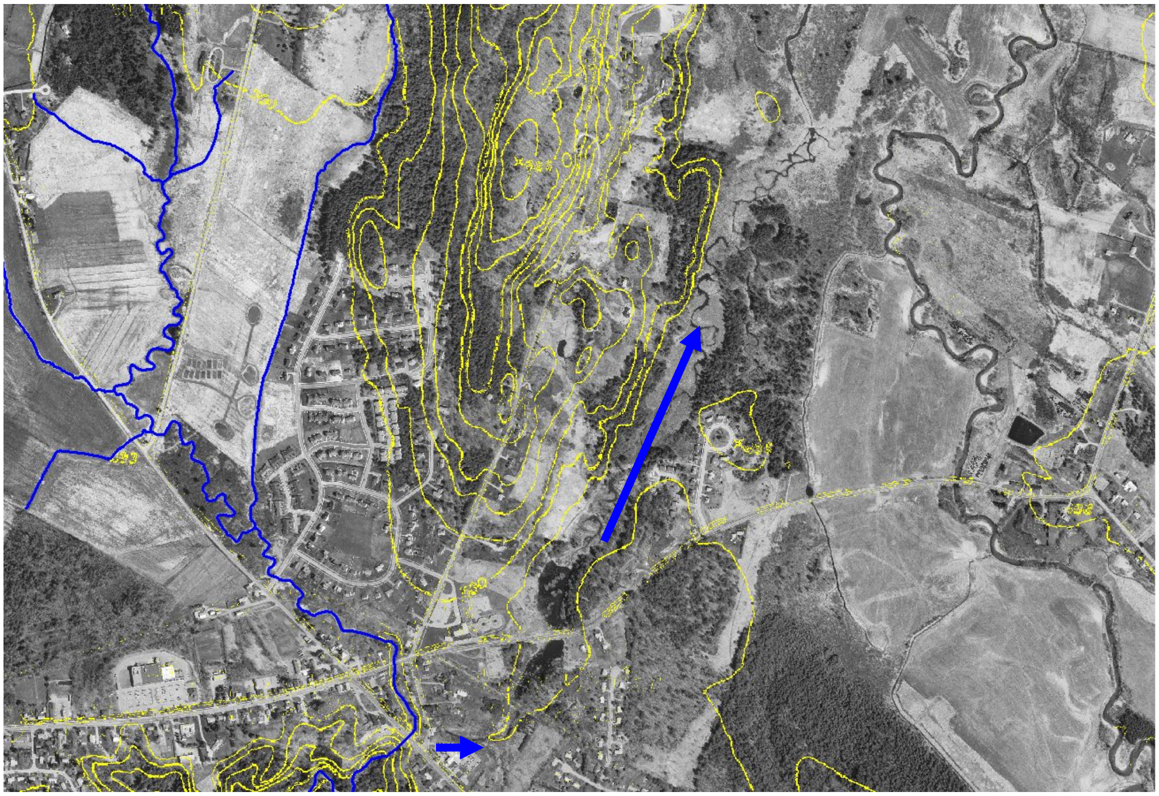


Figure 12. 1999 Aerial Photograph Depicting Abandoned Channel to Browns River

3.5 Channel and Floodplain Management History

The impact of the flume diversion and subsequent flood of 1830 was certainly the greatest historic channel management impact of man on the Alder Brook watershed. The watershed, which once encompassed an area of approximately 8 square miles, increased in drainage area to 10.5 square miles at the current day mouth to the Winooski River; an increase of 32%. It is perhaps impossible to know to what degree the ravines emptying into the Winooski River existed prior to the flood of 1830, since no topographic surveys from this time are available. It is likely, however, that a small watercourse did exist in this area, since the drainage area of 2.5 square miles was sufficient for the development of a small stream.

Whether or not any natural sand ravines in the lower part of the watershed existed prior to 1830 is an important consideration with respect to the age of the channel evolution and change. However, even if there was a small stream and ravine in the lower watershed, it is clear that the full diversion of Alder Brook towards the Winooski River had an extreme effect on channel development and sediment generation. Figures 5 and 6 depict the area of Alder Brook below the town center in 1937 and 1999. In the 1937 photograph many mass failures (seen as white reflectance of the exposed sandy soils) can be seen along this stretch of the stream. Numerous areas of incised channel and adjacent failing slopes indicate that the stream corridor, and the sandy slopes surrounding it, were still recovering from the channel diversion of 1830 (it is also possible that the great flood of 1927 had some effect of further destabilizing the channel). The 1999 photograph contrasts with the 1937, as natural revegetation of the riparian corridor can be seen, as well as a stabilization of many of the mass failures along the corridor.

The diversion also had important implications for the long-term health of the Browns and Winooski Rivers. This diversion reduced the Alder Brook drainage area to the Browns River by 8 square miles, effectively altering the sediment and hydrologic regimes of that river downstream of Essex Center. The addition of 8 square miles of drainage area to the Winooski River likely had a significant impact on the river ecosystem, especially with the amount of fine sediment (sands) that was delivered from the ravine cutting.

Historic photography from 1937 of the middle and upper part of the watershed above Route 15 also indicates that significant channel straightening occurred in areas that were heavily cleared for agriculture. Portions of the channel in reaches M09 through M14 were straightened, probably in the late 1800's or early 1900's. Figure 13 depicts a section of the channel in Reach M10 upstream of the Col. Page Road crossing. In some of the reaches in this zone of the watershed, the channel has undergone little planform change since the 1930's (M09 and M10), whereas other reaches have migrated considerably. The effect of historic straightening and its consequences for the sediment regimes is discussed in further detail in Section 5 of this report.

Figure 13. 1937 Aerial Photograph of Channel Straightening in Reach M10

4.0 Methods

4.1 Phase I and II Geomorphic Assessment Methodology

The data collection process for remotely sensed data (Phase I) and direct field observations (Phase II) followed ANR's Stream Geomorphic Assessment (SGA) Protocols (VTANR, 2006). All metadata for sources of data used during the Phase I analysis are found on ANR's Database Management System (DMS) website (https://anrnode.anr.state.vt.us/ssl/sga/security/frmlogin.cfm). Land Cover data from UVM's Spatial Analysis Lab was used to develop the land use data used in Tables 1 and 5. Some additional sources of historical maps and information have been used and noted throughout the report. Much of the historical information is available through UVM's Bailey-Howe Library on the ground floor in the Special Collections Room.

Some additional data have been included from my MSc. thesis research (Fitzgerald et al., 2006) in order to compare the geomorphic conditions of Alder Brook with other small streams in Chittenden County. The data from this research are currently unpublished but have been cited in the references and are available by contacting me directly. These data will likely be published by April of 2007.

4.2 QA/QC Summary

Included in Appendix 2 is a summary of the Quality Assurance-Quality Control (QA/QC) conducted on the Phase I and II data. This summary highlights any changes in data collection or possible data discrepancies for sections in the database. This summary is useful mostly for those who are reviewing details of the data and links between the Phase I and II datasets. All general questions about data collection methods can be answered by referencing ANR's SGA Protocols (VTDEC, 2006).

5.0 Results

The following section presents the results of the Phase I and II SGA data for Alder Brook. Section 5.1 summarizes watershed scale stressors on the physical stability and habitat conditions of the brook and discusses broad approaches to addressing these stressors. Section 5.2 summarizes reach scale stressors and, for applicable reaches, includes project identification information specific to the reach. Reach scale data from the Phase II observations are provided as summary sheets in Appendix 3. Reaches for which no Phase II data were collected (not assessed in field) have no summary sheets included. Reach summary statistics and channel geometry data are found respectively in Appendices 4 and 5. Plots of channel cross sections are found in Appendix 6.

5.1 Watershed Scale Stressors

The division of the Alder Brook watershed into three different zones (as described in Section 3.2) allows for a logical approach to addressing the hydrologic and sediment regime stressors at the watershed scale. Discussion of these stressors is organized below for the lower, middle, and upper zones of the watershed. Many of the tables found in this section contain information relevant to each of the watershed zones, and are referenced throughout.

5.1.1 Lower Watershed Zone: Reaches M01 – M06

The lower watershed zone stream corridor, found below the Route 15 crossing, is characterized by steep valley side slopes and highly erodible sandy soils. The historic diversion of Alder Brook at the Route 15 crossing, as discussed in Section 3.5, has shaped the form and features of this watershed zone. The combination of a new severely increased hydrologic regime (excess water) and the inherently erodible parent material caused extreme historic incision and failing slopes along the stream corridor (see Figure 5). Some of these failing slopes have remained unstable over time, and were observed during the field assessments. However, the stream corridor and the channel features within it have shown remarkable recovery over the 175 years since the water diversion. ANR's biomonitoring results from the 1990's for this watershed zone indicate biotic communities in good condition (see Appendix 8). Channel geometry data indicate that some reaches in this watershed zone have reestablished equilibrium conditions where rapid reforestation occurred in the absence of urban development through the 1900's (see Appendix 5).

Current day stressors to the hydrologic and sediment regimes are caused largely by: 1) the residential development outside of the corridor on the upper sand flats; 2) floodplain encroachment and straightening from the Circ. Many of these residential neighborhoods were constructed in the 1960's and 1970's and lacked the stormwater controls mandated by current state regulations. As a result, stormwater runoff increased both the amount of discharge to the main stem during channel forming flow events, as well as the amount of fine and coarse sediment delivery through gullying. The watershed-level impacts to both regimes, with a focus on the current-day stressors, are discussed separately below.

Hydrologic Regime

Despite ongoing adjustments in the channel network below Route 15 due to the historic diversion, there are some signs that the immediate channel boundary conditions have regained quasi-equilibrium conditions since 1830. This is most evident in Reaches M01 and M02, where bankfull channel width is close to the predicted width from the Regional Hydraulic Geometry

Curves (VTDEC, 2001). Current day impacts, both from stormwater discharges and corridor encroachment have begun to cause additional adjustments along the channel network. Mapping of stormwater discharges by Essex Town indicates that over 20 significant stormwater outfalls are found below Route 15. Many of these discharges predate rigorous regulation of stormwater runoff, and are adversely affecting the hydrologic regime. Urbanization along the stream corridor and in the upslope sand flats has increased significantly since the construction of the Circ Highway. This has caused both floodplain encroachment and filling, and increased runoff volume. Table 4 summarizes the degree of upslope urbanization and other land use types draining to the lower reaches. As noted previously, the percentage of urban land use is near or above 10% for many of the lower reaches; a level that has been associated with decline of biotic integrity in other small watersheds in Chittenden County (Fitzgerald et al., 2006).

Table 4. Upslope Watershed Land Use and Corridor Encroachments

Reach ID	Upslope Watershed Land Use				Corridor Encroachment (ft)		
	Open	Forest	Urban	Water/Other	Berm	Road	Total
M01	49.6%	39.7%	10.5%	0.2%	302	--	302
M02	49.5%	39.8%	10.4%	0.2%	64	301	365
M03	50.1%	39.6%	10.0%	0.2%	1090	237	1327
M04	53.4%	38.1%	8.2%	0.3%	535	327	862
M05	54.2%	37.4%	8.1%	0.3%	487	162	649
M06	54.9%	37.7%	7.2%	0.3%	--	--	--
M07	56.0%	37.5%	6.2%	0.3%	551	791	1342
M08	56.2%	37.6%	5.9%	0.3%	376	117	493
M09	53.6%	42.0%	4.0%	0.4%	142	--	142
M10	51.6%	44.2%	3.8%	0.4%	--	--	--
M11	44.9%	51.5%	3.1%	0.5%	--	--	--
M12	43.1%	53.2%	3.1%	0.6%	--	--	--
M13	34.2%	63.0%	2.1%	0.8%	--	--	--
M14	45.5%	52.7%	1.5%	0.4%	447	0	447
M15	21.4%	77.2%	0.7%	0.7%	--	--	--

-- Indicates value of 0

Sediment Regime

The altered sediment regime in the lower watershed zone is causing severe adjustments in many reaches due to: 1) the inherent erodibility of the watershed and corridor soils; 2) uncontrolled stormwater discharges; 3) floodplain encroachment. Uncontrolled stormwater discharges originating from residential areas, such as Fern Hollow Road, have created deep gullies that continue to transport exorbitant amounts of coarse and fine sands to the main channel. An attempt to quantify the amount of sediment delivered to the main channel from the Fern Hollow Gully (see Figure 22 on page 31 for location) is included in Table 5. Measurements collected by

Suzanne Levine and other EWA volunteers for 43 cross-sections along the length of the gully provide a basis for estimating the amount of sediment exported to Alder Brook.

Table 5. Fern Hollow Gully Sediment Delivery					
Gully Length (ft)	**Average Width (ft)**	**Average Depth (ft)**	**Volume Sediment (ft^3)**	**Dumptruck Loads of Sediment***	**Loads Per Year Since 1970****
1,600	21.8	6.8	235,723	582	16

* based on truck with 15 cubic yard capacity
** total load averaged over 36 years

These data indicate that the gully has exported over 235,000 cubic feet of sediment to the downstream channel since the road and man-made drainage system were installed in 1970 (approximate year based on Essex town records). To put this into perspective using lay terms, this equates to 582 dumptruck loads of sediment. Without knowing the temporal scale at which the gully incised, a calculation for average loading per year indicates that the equivalent of 16 dumptruck loads per year has be delivered to Alder Brook since the initiation of the gully. There is little doubt that the impact from this gully, along with that of other similar gullies observed in this watershed zone, have contributed to the severe lateral channel adjustments and degradation of biotic habitat. In addition, a field survey of ephemeral drainages nearby the Fern Hollow gully that do not receive concentrated stormwater discharge show no signs of incision or gully development. This comparison supports the idea that the gully was initiated independently from any tributary rejuvenation caused by the diversion of 1830 and subsequent incision in the main stem of Alder Brook; the real cause of this impact is from inadequate stormwater management on extremely sensitive soils.

Phase II observations confirm that the gullying and other sedimentation impacts associated with the Circ Highway have affected the bed stability and habitat conditions of the channel. Table 6 summarizes the frequency of sedimentation features found across all reaches of the watershed. The greatest three reach values found in each category (of features per stream mile) have been highlighted in this table to indicate the spatial scale of these adjustments. Note that eight of the total nine sedimentation indicator values are found below Route 15. The degree to which this sedimentation is having deleterious effects on channel stability and physical habitat conditions is described in further detail in the reach scale results in Section 5.2 of this report.

Table 6. Reach Sedimentation Indicators							
Reach of Segment	Stream Miles	# Debris Jams (DJ)	DJ per mile	# Bar Features (BF*)	BF* per mile	# Mass Failures (MF)	MF per mile
M01	0.31	1	3	14	45	--	--
M02	0.44	8	18	20	46	7	16
M03-A	0.47	7	15	25	53	5	11
M03-B	0.32	3	9	10	32	5	16
M04	0.47	12	25	19	40	5	11
M05	0.50	13	26	17	34	8	16
M06	0.87	20	23	32	37	11	13
M07	0.36	3	8	3	8	--	--
M08-A	0.27	--	--	--	--	--	--
M08-C	0.68	5	7	8	12	--	--
M09-A	0.13	2	16	6	48	1	8
M09-C	0.55	7	13	11	20	--	--
M10	0.98	3	3	16	16	--	--
M11	0.97	9	9	8	8	--	--
M13-B	0.33	1	3	6	18	--	--
M14-B	0.56	--	--	2	4	1	2
M15	1.39	3	2	2	1	1	1

-- Indicates value of 0
* Includes all vegetated and unvegetated islands and bars

5.1.2 Middle Watershed Zone: Reaches M07 – M13

The middle watershed zone, found above the location of the historic diversion at Route 15, is affected by a different set of watershed stressors related largely to past agricultural land uses. With the exception of high gradient Reach M07, many of the reaches in this watershed zone are low gradient, sinuous channels flanked by hay fields and pasture. This zone is mostly unaffected by urbanization, except where residential neighborhoods have been developed close to the town center on Clover Road (Reach M08). Impacts from historic channel straightening are still observable today, however the lack of corridor encroachment and berming has allowed for recovery of channel planform in many reaches. Table 7 summarizes the direct impacts to the channel boundary conditions for reaches across the watershed. Note that four out of the seven reaches in this watershed zone currently have greater than 10% of their channel length straightened. Historic straightening has led to incision and increased sediment transport capacity in some reaches, which may also be contributing to fine sediment loading in downstream reaches. Many of the legacy impacts from straightening are found only in specific areas of reaches, and will be discussed in further detail in reach-scale descriptions and project identification in Section 5.2.

Table 7. Direct Channel Impacts										
Reach	Bridges - Culverts				Bank Armoring			Channel Straightening		
ID	Number	Length	Percent	Impact	Length	Percent	Impact	Length	Percent	Impact
M01	1	107	6.5%	Low	171	5.2%	N.S.	247	15.0%	Low
M02	--	--	--	N.S.	38	0.8%	N.S.	--	--	--
M03	1	545	13.1%	Low	313	3.8%	N.S.	390	9.4%	Low
M04	--	--	--	N.S.	193	3.8%	N.S.	267	10.6%	Low
M05	1	255	9.6%	Low	325	6.1%	N.S.	--	--	--
M06	--	--	--	--	--	--	--	--	--	--
M07	2	135	7.1%	Low	365	9.5%	N.S.	657	34.3%	High
M08	2	78	1.1%	Low	116	0.8%	N.S.	245	3.4%	Low
M09	--	--	--	N.S.	253	2.8%	N.S.	711	16.0%	Low
M10	1	21	0.4%	Low	78	0.8%	N.S.	892	17.2%	Low
M11	--	--	--	N.S.	36	0.4%	N.S.	--	--	--
M12	--	--	--	--	--	--	--	--	--	--
M13	1	17	0.6%	Low	77	1.3%	N.S.	352	12.1%	Low
M14	2	75	1.5%	Low	81	0.8%	N.S.	1483	30.3%	High
M15	1	67	0.9%	Low	160	1.1%	N.S.	329	4.5%	Low

-- Indicates value of 0
N.S. not significant

5.1.3 Upper Watershed Zone: Reaches M14 & M15

The headwaters zone of the Alder Brook watershed is also impacted by agricultural land uses and straightening, but has seen vast recovery of forest since the mid 1900's. This recovery of forest, both in the larger watershed and the stream corridor, has allowed for recovery of many features important to headwaters channels, such as shading and leaf litter inputs (Allan, 1995). Nevertheless, legacy impacts to the channel boundary conditions continue to affect reach M14. Note in Table 7 that approximately 30% of the channel length of this reach is straightened. Indeed, the lower segment of this reach is deeply incised and through pastureland and continues to generate and transport sediment to downstream Reach M13. Detailed discussions of the channel conditions and possible restoration strategies are discussed below in Section 5.2.

5.2 Reach Scale Stressors

The following is a technical summary of the Phase I and II observations used to document key geomorphic processes and adjustments occurring in the Alder Brook watershed at the reach scale. Within this summary is a discussion of reaches in the context of potential projects that could protect, sustain, or restore fluvial geomorphic equilibrium conditions, through the implementation of either passive or active stream corridor management strategies. Reach scale data referenced throughout the discussion are summarized in Appendices 3, 4, 5 and 6.

5.2.1 Reach M01

Reach Description:

This reach is located from the mouth at the Winooski River up to a change in buffer vegetation from open to forested cover. It is found in the historic floodplain of the Winooski River, which has been used heavily for agriculture for centuries. The reach has a length of 1651 feet and an overall channel slope of 0.6%. Observations of natural valley and slope characteristics suggest that the reference channel conditions are C-type with riffle-pool bedform; this channel form was observed during the field assessment. Channel cross sectional geometry suggests that this reach has already gone through a channel evolution process of incision and widening, from which it is currently recovering. Observations of abandoned terraces on the west side of the middle of the reach (where historic straightening had occurred) confirm a classification of stage IV of channel evolution. As the channel continues to adjust laterally to accommodate the excess sediment generated from Stage II and III of channel evolution (see Figure 14), additional erosion, deposition and debris jams will likely persist for years to come; this may adversely affect the habitat conditions and the biotic community it supports. Current geomorphic stability (RGA) and habitat (RHA) scores reflect a reach in fair condition that is still undergoing adjustments due to historic straightening, the historic water diversion, and current impacts from encroachment of the adjacent Circ Highway.

Figure 14. Channel Cross Section for Reach M01

Project Identification:

Although this reach has undergone recent encroachment form the Circ Highway, the equilibrium conditions appear to be recovering from the severe adjustments associated with the diversion of 1830. Due to the berming associated with the encroachment along the Circ Highway on-ramp (see map in Appendix 1), and the River Road crossing immediately below, there is little opportunity for restoration of greater floodplain connectivity in the lower section of this reach. There may be, however, opportunity to reestablish natural buffer vegetation along the middle portion of the reach (east bank) where recovery potential (due to Stage IV of channel evolution) is much higher. This would need to involve cooperation from the adjacent landowner whose farm fields abut the stream bank. Given the current stage of channel evolution in this reach, any restoration strategies should seek to avoid active management approaches in favor of cost-effective strategies to restore shading and input of organic materials for improvement of biotic habitat.

5.2.2 Reach M02

Reach Description:

This reach extends from the start of the softwood vegetation up to the downstream end of the first culvert crossing under the Circ Highway. At this break in slope Alder Brook leaves the historic floodplain of the Winooski River and enters a confined valley setting with steep, sandy side slopes that are characteristic of the lower zone of the watershed. The reach has an overall length of 2304 feet, with an average channel slope of 0.7%. Natural stream corridor characteristics indicate that this reach would be dominated by C-type geometry and riffle-pool bedform with a mix of planebed features in the more confined areas. RGA and RHA scores reflect the good stability and habitat conditions that dominate the reach, however certain areas of the reach are undergoing significant lateral adjustments due to severe aggradation.

Figure 15. Severe Aggradation in Reach M02

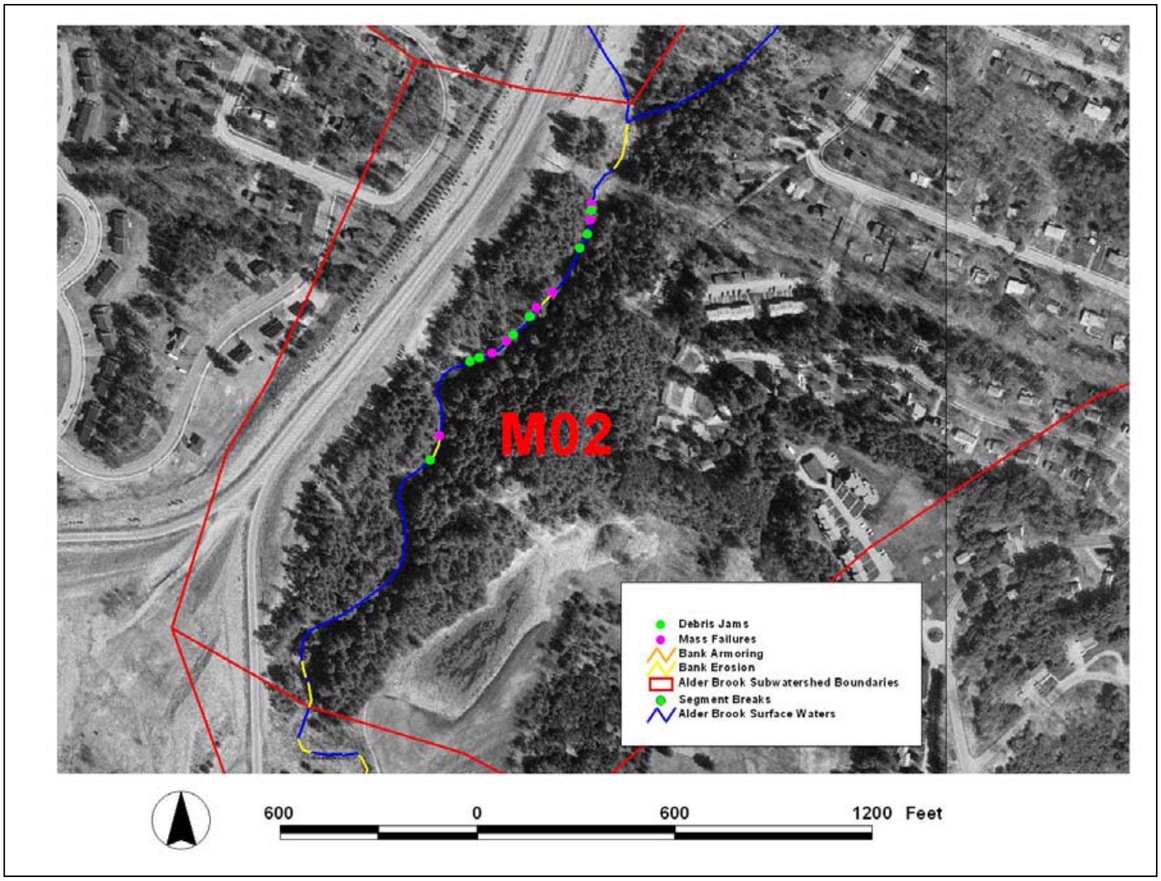


Figure 16. Spatial Scale of Sedimentation Features in Reach M02

This aggradation is leading to an abundance of bar features, debris jams, and mass failures (see Figures 15 and 16). Two cross sectional measurements were taken in this reach (see Appendix 6), and one had a much larger than expected bankfull width (55 feet); reflecting the resulting widening in this upstream section. The reach has therefore been assessed at Stage IIb of channel evolution. Compared with all other reaches in the watershed, the frequency of sedimentation indicators for M02 was among the highest (see Table 7). This aggradation is likely due to more recent impacts associated with the construction of the Circ Highway. At the downstream end of the first Circ Highway culvert crossing (reach break with M03) there are multiple threads to the channel and large bar features, indicating that large amounts of sediment were likely generated during the road construction and installation of the box culvert.

Project Identification:

There are no significant restoration project opportunities in this reach, due to the confined valley setting and the need for these adjustment processes to continue to occur and be resolved naturally over time. However, the tributary entering the upper reach from the northeast should be explored (and ideally assessed) in the future, as some gullying was noted during the field assessments. This impact, occurring independently of the culvert and road installation impacts, could also be contributing to aggradation and channel adjustments downstream.

5.2.3 Reach M03

Reach Description:

This reach extends from the upstream end of the first Circ Highway culvert up to the M04 reach break where a tributary enters from the northeast. The reach length is 4171 feet and the overall channel slope is 1.0%. M03 has been broken into 2 segments because of a change in channel dimensions and bedform. The lowermost segment, M03-A, has a slightly higher channel slope than Segment B, resulting in a B-type stream dominated by plane bedform. This reach has been assessed as having good geomorphic stability and habitat conditions. Although it likely went though a long period of instability after the diversion of 1830, it has reestablished a new equilibrium condition and has thus been classified in Stage I of channel evolution. The high number of depositional features noted for this segment in Table 7 are largely found in the upper section, where a "slug" of sediment associated with the Circ Highway construction and berming is migrating downstream (see Figure 17).

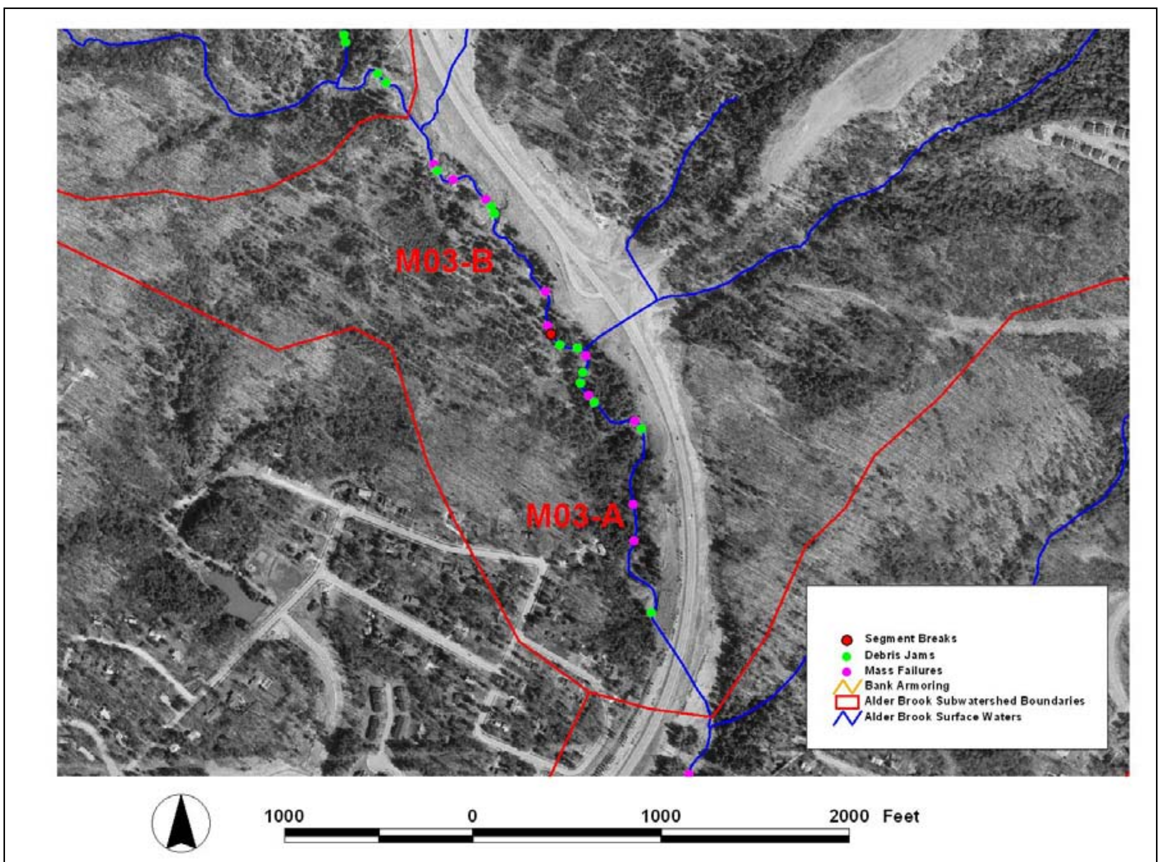


Figure 17. Spatial Scale of Channel Features in Reach M03

Segment B is found from the berm encroachment for the Circ "jughandle" up to the M04 reach break. This segment has a lesser channel slope, resulting in a C-type channel with riffle-pool bedform. This segment has been significantly impacted by direct sedimentation from road construction and berm encroachment. There are 2 sections of channel that have been straightened, representing approximately 10% of the entire reach length. The area with the greatest amount of aggradation and lateral adjustment in M03-B is the upper section closest to the reach break. Here the impacts to channel bed stability and planform can be easily observed in the field (can be seen from the Circ above; see Figure 18). Due to the degree of aggradation and widening observed in this segment, channel evolution has been assessed at Stage IIb, and fair geomorphic stability and habitat conditions have been noted.

Figure 18. Reach M03 as observed from the Circ Highway

Project Identification:

Similar to reach M02, there are no significant restoration project opportunities in this reach due to the confined valley setting and the fact that the adjustment processes associated with the sediment slugs will continue unabated over time with or without active restoration strategies. However, there are a number of depositional features concentrated around the tributary mouth entering the middle reach from the northeast which suggest that this tributary deserves investigation. In the future this tributary should be assessed to determine whether it is having a significant effect on the aggradation observed in the upper part of Segment A.

5.2.4 Reach M04

Reach Description:

This reach begins immediately upstream of a section of the channel straightened during the Circ Highway construction, and extends up to the downstream end of the second culvert at the reach break with M05. The channel length of this reach is 2507 feet with an overall slope of 0.9%, resulting in a C-type stream with riffle-pool bedform. As in downstream Reaches M02 and M03, a slug of sediment associated with the road construction is currently migrating downstream through the middle section of the reach. This is seen in Figure 19 where the abundance of debris jams and mass failures are causing lateral adjustments and widening. This was likely caused by the Circ road construction and the channel straightening that followed, which changed the sediment processes of the upper section of the reach from a depositional zone to a transport zone. The channel cross section measurements indicate an increase in width of over 10 feet from expected width derived from regional regressions (see Appendix 5). This aggradation and widening resulted in the reach being assessed as Stage IIb of channel evolution with fair geomorphic stability and habitat conditions. There is currently some beaver activity in the middle section of the reach.

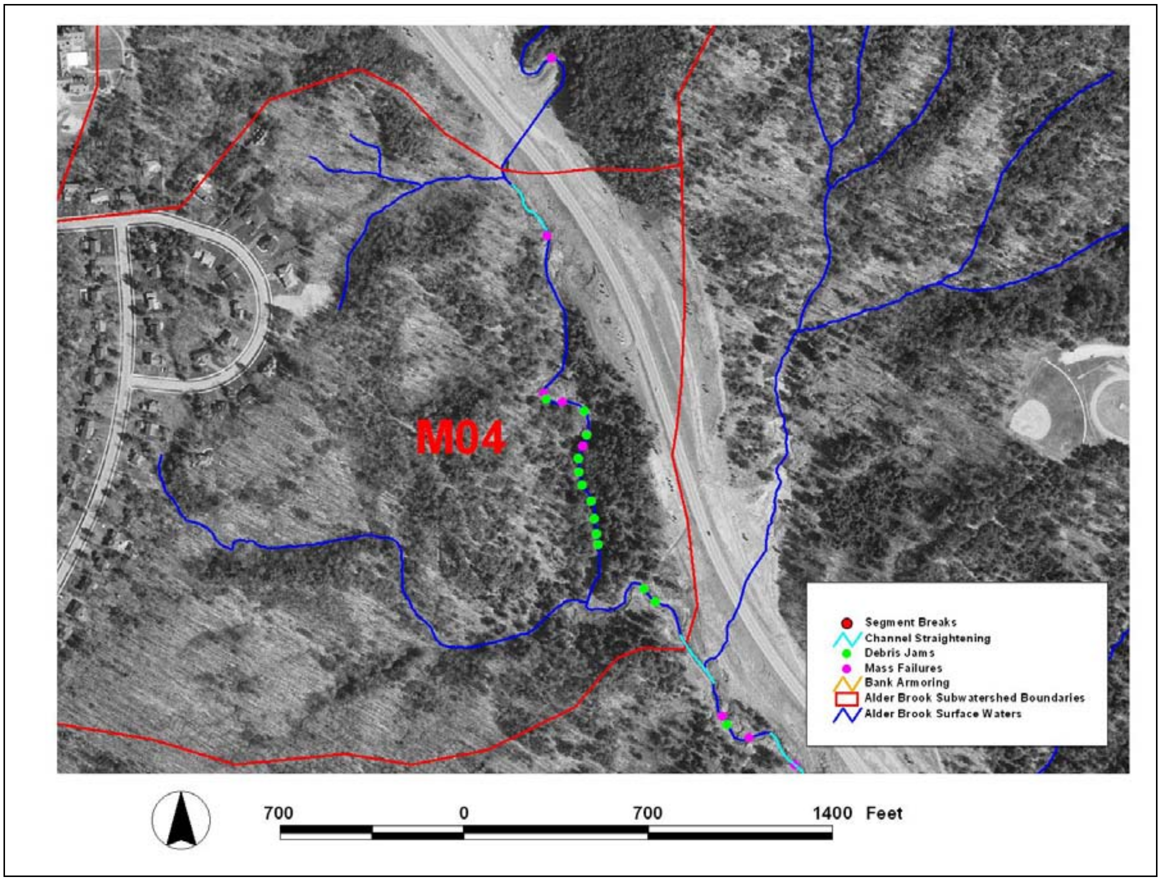


Figure 19. Spatial Scale of Channel Features in Reach M04

Project Identification:

The aggradation and widening in the middle and lower portion of the reach, caused by the Circ Highway construction and channel straightening, will likely continue to affect the lower section of the reach, and eventually Reach M03, for years to come. However, due to the narrow confinement of the valley, few if any floodplain restoration opportunities exist in the vicinity of the berming and road encroachment in the upper reach. There are some failing slopes along the berming that should be monitored over time (see Figure 20), as these slopes are continuing to contribute large amounts of sediment to the channel and causing widening downstream. If the bank failures continue, an active approach to stabilizing them may be necessary in the future.

Figure 20. Bank Failure Along Circ Berm in Reach M04

Figure 21. Gully in Reach M06

5.2.5 Reaches M05 and M06

Reach Description:

These two reaches have been grouped together for description because of their similarity in channel form and adjustment processes. They are found from the upper Circ culvert up to the Route 15 crossing in an area with little to no disturbance in the stream corridor. Both reaches are found within semi-confined to narrow valley settings with slopes ranging between 0.7 and 0.8%. C-type channel geometry with riffle-pool bedform dominates, and both reaches have been assessed in Stage IIb of channel evolution because of the observed aggradation and widening. Ratings of fair were assigned to the geomorphic stability and habitat conditions due mainly to impacts from aggradation and widening.

Figure 22 depicts the number and location of sedimentation features along the channel network. Note that (as described for downstream reaches) there is a pattern of oscillation between areas of high aggradation and lateral adjustment and areas of little lateral adjustment. There are a number of gullies (Figure 21) that were observed in both reaches that are deeply incised and are delivering significant amounts of sediment to the main channel, causing severe lateral adjustment below *and* immediately above the gully confluence. Although the incision in the lower potions of these gullies may be relics of rejuvenated tributaries from the historic incision associated with the diversion of 1830, many are being heavily impacted and aggravated by urban runoff today. The Fern Hollow Road gully is one such example, and the effect of the sediment delivered to the main channel (quantified in Table 5) can be observed in the mainstem as the sediment slug continues to migrate downstream, as seen in Figure 22.

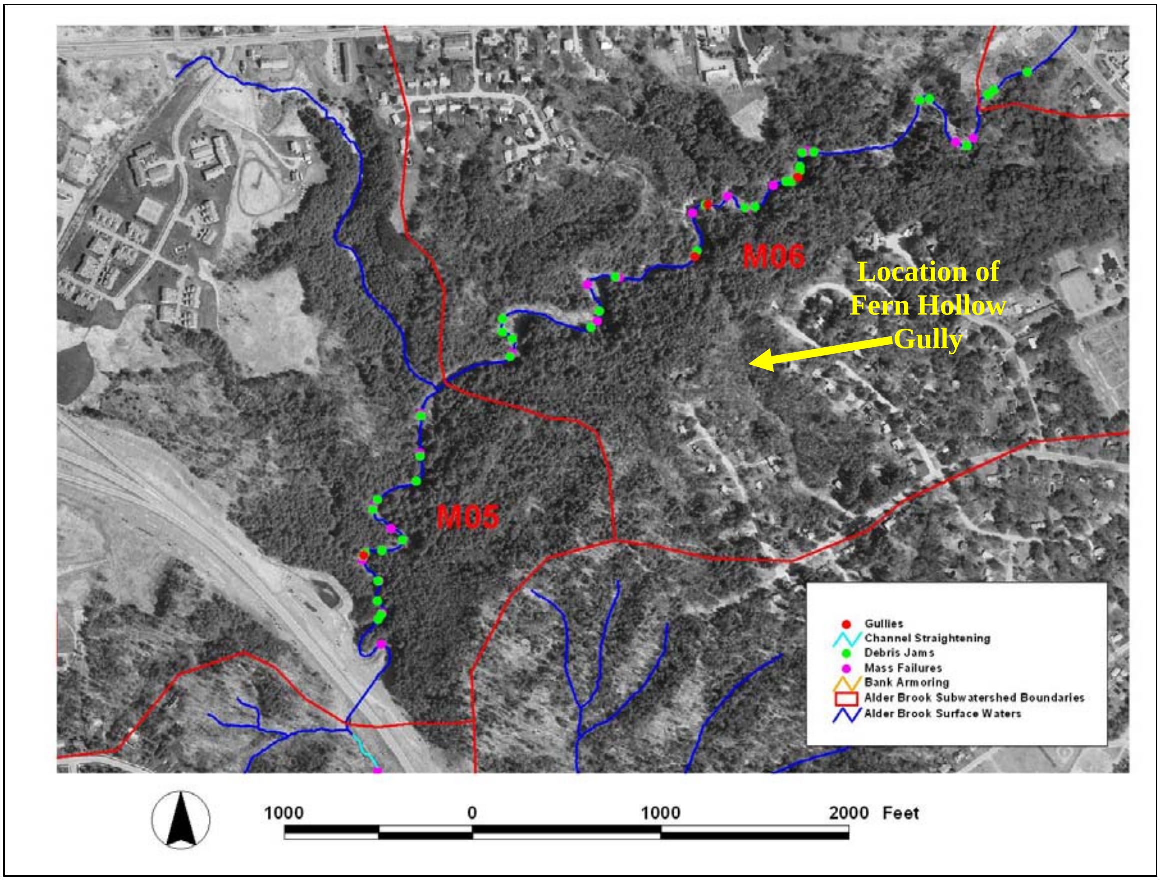


Figure 22. Spatial Scale of Sedimentation Features in Reaches M05 and M06

Project Identification:

Reaches M05 and M06 may present the greatest opportunity for active restoration of any of the reaches in the watershed; although these opportunities are found outside of the stream corridor and would need to be addressed using a watershed management and hydrologic approach. Currently, the deeply incised gully at the Fern Hollow Road outfall is being addressed by ANR and VYCC using manual labor and a NRCS/SCS check dam approach (Riley, 1998). A similar approach is recommended in an additional three gullies as depicted by the red dots (representing gully confluence with main channel) in Figure 22. Restabilization of these four gullies will reduce loading of coarse sand to the channel in the short term, however long-term resolution of the problem will require a stormwater management approach to control the runoff entering the head of each gully. Given the soil characteristics found in this part of the watershed (abundance of sand), there are likely many opportunities to control stormwater runoff using infiltration designs on the flat sand terraces where the residential and commercial development exists. Only by addressing the source of the gullying (discharge points) will the sediment delivery from these sources be controlled in the long term, as the check dams currently being used are not designed to withstand less frequent rainfall events of higher magnitude and energy. They will likely fail without upslope runoff control.

In addition to the above described restoration projects, future assessment of the tributary entering M05 from the northwest is recommended. The sediment delivered to the main channel from this tributary warrants investigation as a large degree of lateral adjustment was observed below the confluence.

5.2.6 Reach M07

Reach Description:
This reach is found from just below the Route 15 crossing to approximately 500 feet above Route 128. The confined valley setting is a result of historic straightening and berming that occurred along the channel after the 1830 flood and diversion. Greater than 30% of the reach has been straightened, which increased the channel slope (3.7%), making this a sediment transport reach in a quasi-equilibrium state (Stage V) of channel evolution (see Figure 23). Also noteworthy is a small amount of channel braiding found below the Route 15 culvert. This area of channel adjustment represents the most upstream extent of the severe channel incision and recovery from the 1830 diversion. Here the steep armored slope descending from the Route 15 culvert continues to control the grade of the historic downstream adjustments.

Due to the stream type departure noted for this reach (change from B to F) and the unnaturally confined setting, geomorphic stability has been assessed as poor, however fair habitat conditions were noted. The rating of poor for stability reflects the straightening and unnatural confinement that makes this reach susceptible to frequent bed movement due to limited floodplain access. Current conditions in Stage V are relatively stable and are supporting a biotic community in fair condition (see Appendix 8). No project identification discussion has been included for this reach, since its human caused confinement precludes significant restoration.

Figure 23. Cross Section for Reach M07

5.2.7 Reach M08

Reach Description:

Reach M08 begins approximately 500 feet upstream of the Route 128 crossing and extends upstream to the north along Chapin Road to the confluence of two small tributaries entering from the west and east. This reach has a length of 7187 feet with an overall slope of 0.1%, resulting in a very low gradient E-type channel with dune-ripple and plane bedform. A diverse substrate, including some gravel and many macrophytes were present throughout the reach (see Figure 24), however a stream type departure has been noted for Segments A and C where plane bedform dominated over the reference dune-ripple bedform. The reach was segmented in the field because of the abundance of beaver activity found just upstream from Clover Road up to the crossing at Chapin Road. Due to the low gradient nature of the channel, and the overall absence of significant woody vegetation in the buffer, few sedimentation features (bars, debris jams, and mass failures) were noted. Comparison of the 1937 and 1999 aerial photography indicates that the stream planform has changed little over this time period, and straightening was limited (3.4%) along the reach. Fair conditions for geomorphic stability and physical habitat were noted.

Figure 24. Cross Section for Reach M08

Project Identification:

Overall there is good floodplain connectivity within M08, however there may be some buffer revegetation opportunities in the lower section of the reach from the lower reach break up to Clover Road. In this stretch, there are residential encroachments that have precluded the reestablishment of woody vegetation on the west bank. Efforts to reduce the encroachment of lawns in this zone and reestablish woody vegetation would increase shading, helping to lower summer temperatures in the water as it moves into downstream Reach M07, where the biotic communities are likely more sensitive. In addition, no stormwater controls were observed in the large residential neighborhood to the northeast of the channel on Clover Road. There is evidence below the outfalls originating from this area that peak flows are causing instability in the channel (e.g., scour), and it is recommended that this area be monitored further in the future.

5.2.8 Reach M09

Reach Description:

Reach M09 has an overall length of 4435 feet, ending at Col. Page Road to the north. This reach has an overall slope of 0.2%, but the channel gradient is variable and was the basis for creating three segments. Segments A and B are both low gradient E-type streams with planebed features and a mix of gravel and sand substrate. RGA and RHA scores noted for segment A are identical to those calculated for downstream segment M08-C due to the similarity of these segments. Beaver dams were observed in

Segment B and therefore the reach was not assessed for RGA and RHA scores. Segment C has a slightly higher gradient than the overall reach gradient, and C-type geometry with riffle-pool bedform has been noted in the field summary sheets. Significant channel straightening and bank armoring were noted in the upper section of this segment, which is leading to some minor changes in planform. Since there is good floodplain connectivity and buffer integrity in this reach, it is not likely that efforts to restore natural channel sinuosity would improve sediment attenuation or habitat conditions. Therefore, no project areas have been identified.

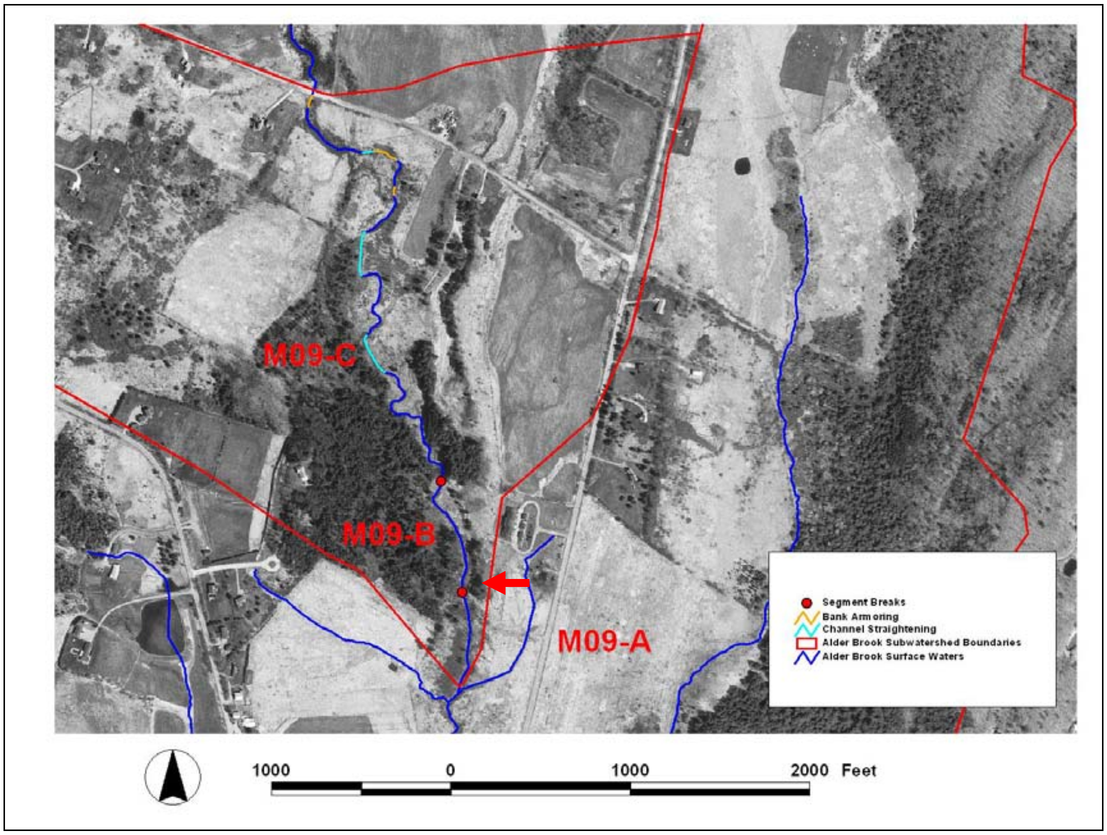


Figure 25. Direct Channel Impact Mapping for Reach M09

5.2.9 Reaches M10 and M11

Reach Description:

Reaches M10 and M11 have been grouped together for description because of their similarity of channel form and processes. Both reaches have very low gradient, sinuous channels with E-type channel geometry. Reach M10 begins at Col. Page road and extends 5172 feet to a break in the unvegetated buffer where softwoods are found in the corridor. Reach M11 extends 4999 feet from this buffer break up to the Earl Farm pasture. Due to the historic straightening and armoring in the lower section of Reach M10, a stream type departure has been noted where the bedform and substrate have changed from reference sand conditions to cobble and gravel bottom with plane bedform. These areas of bedform change are found largely in the lower portion of the reach where armoring was present (see Figure 26). With the exception of this change from reference conditions, good physical stability and habitat conditions were noted for these reaches (reference RHA score for M11). A review of historic aerial photography, as well as the presence of abandoned terraces suggests there has been a process of channel change and restabilization over time. Channel Evolution Stage V has been noted for both reaches. Since there is good floodplain connectivity and buffer integrity in both reaches, it is not likely that restoration efforts would improve sediment attenuation or habitat conditions. Therefore, no project areas have been identified.

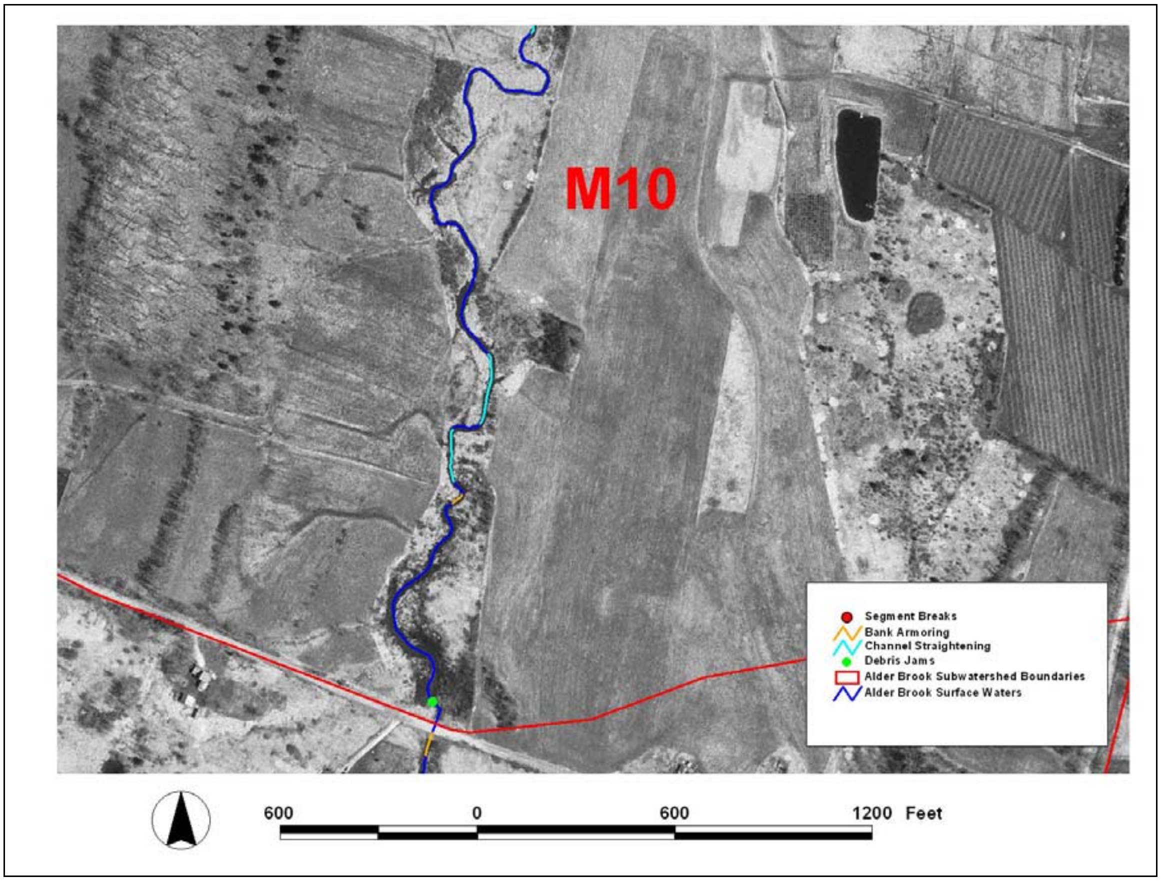


Figure 25. Direct Channel Impact Mapping in Lower Reach M10

5.2.10 Reach M13

Reach Description:

Reach M13 begins approximately 1000 feet above the Old Stage Road crossing and extends 2909 feet up to the confluence with a tributary entering from the west. This reach has a channel slope of 0.3%, resulting in a low gradient channel with E-type geometry. Within reach M13, only Segment B was assessed due to limited property access. Observations from Segment B suggest that the historic straightening (see Figure 26) has resulted in a bedform and substrate departure from reference conditions, whereby the increase in energy gradient has caused a coarsening of the bed and a loss of channel undulation normally observed in sinuous channels in this setting. Nevertheless, the channel has recovered significantly from the historic impacts and is currently in Stage IV of channel evolution with good physical stability and habitat conditions. Due to the floodplain connectivity and buffer integrity found in this reach, it is not likely that restoration efforts would improve sediment attenuation or habitat conditions. Therefore, no project areas have been identified.

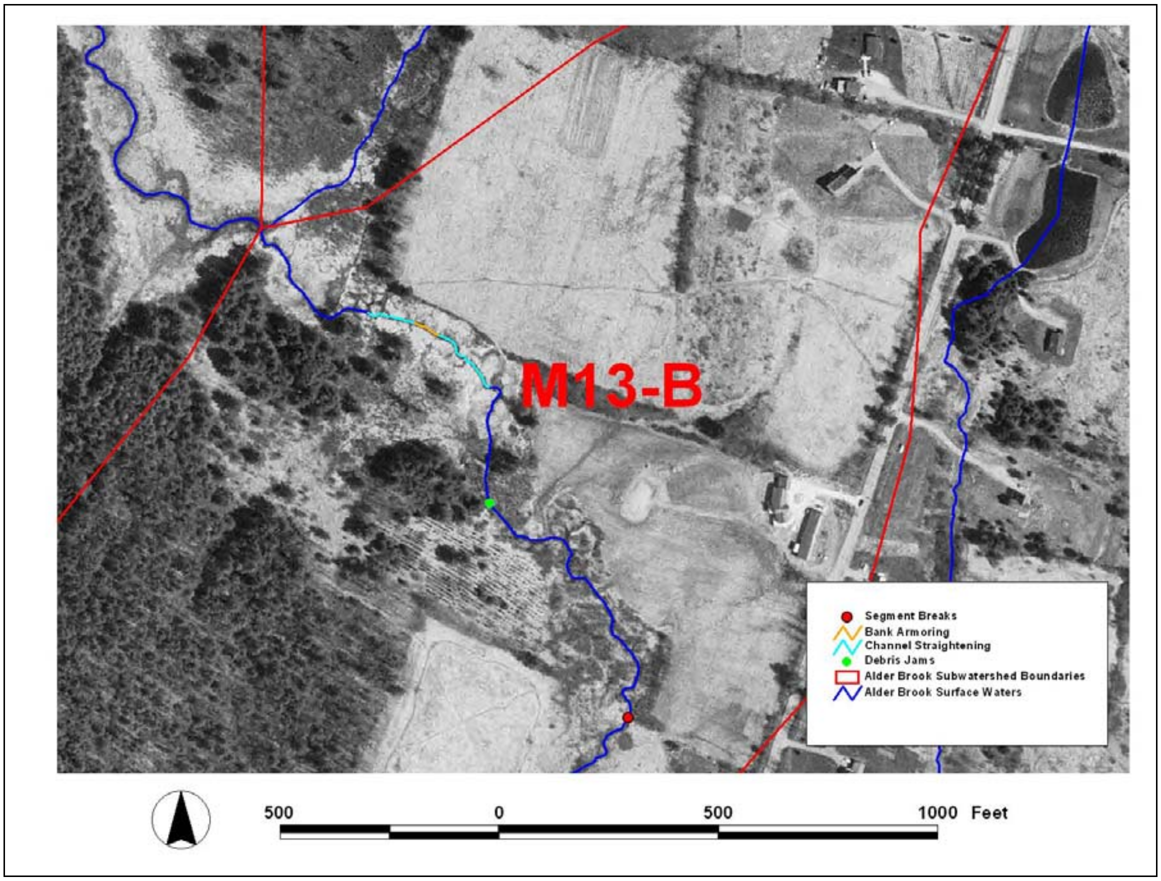


Figure 26. Direct Channel Impact Mapping in Segment M13-B

5.2.11 Reach M14

Reach Description:

Reach M14 begins at the confluence with the large tributary entering from the west and extends approximately 5000 feet up to the crossing at Rollin Irish Road. The reach has an overall channel slope of 2.9%, with a cobble-bottomed substrate and B-type channel geometry. Due to limited property access, the reach was broken into two segments and only the upper segment (B) was assessed. Significant channel straightening was evident in both segments (observed from afar in segment A) and is depicted in Figure 27. This historic straightening has caused some incision in areas of the segment that was not noted in the channel cross-section measurements. The channel stability and habitat conditions of Segment B have been assessed as fair. In addition, active pastureland in Segment A and lower Segment B is causing significant instability in the channel.

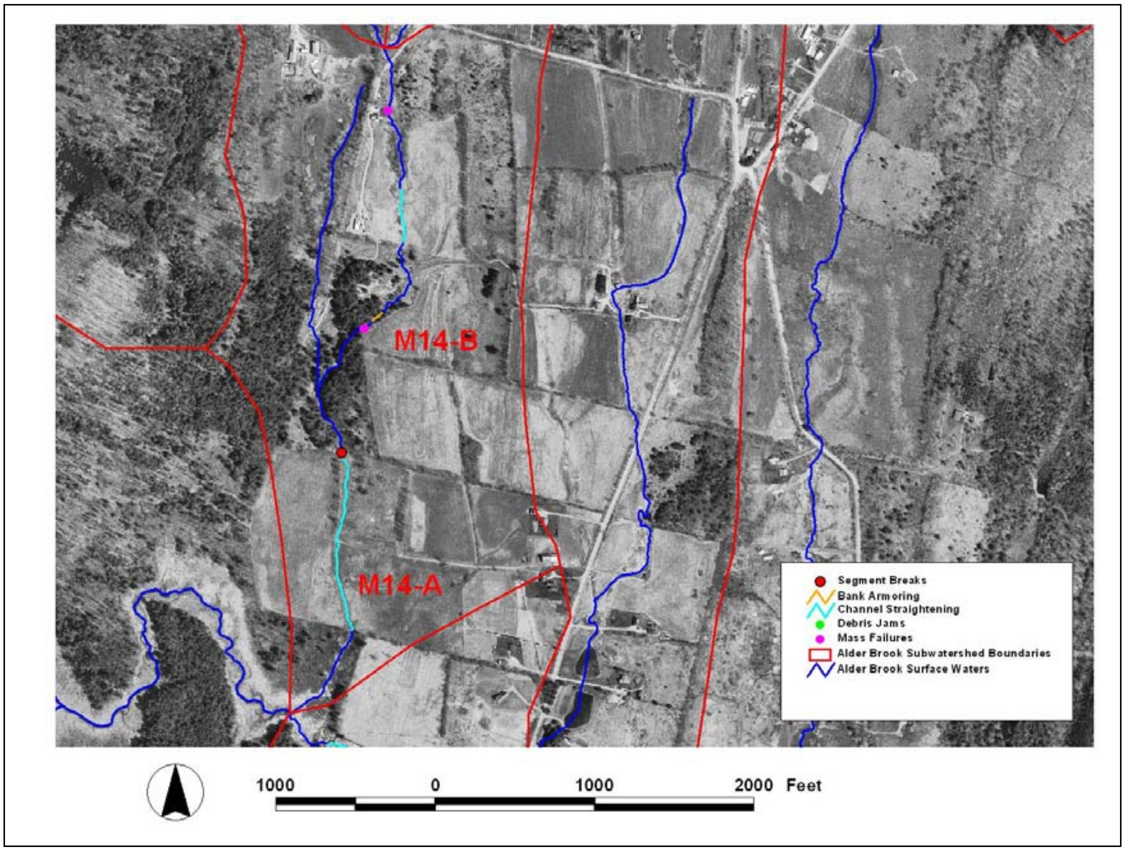


Figure 27. Direct Channel Impact Mapping in Reach M14

Project Identification:

The channel instability caused by grazing in Segments A and B is generating sediment that is transported and deposited in a lower gradient, buffered section of Segment A. This area presents an opportunity for fencing out the cattle to reduce channel instability and nutrient inputs. However, it should be recognized that the habitat conditions in this ephemeral channel (dry conditions were observed in August) may not be greatly improved given its small size and marginal capacity to support an aquatic community.

5.2.12 Reach M15

Reach Description:

Headwaters Reach M15 begins at the Rollin Irish Road crossing and extends approximately 7000 feet through a forested area before reaching the source of Alder Brook: a beaver pond at 900 feet elevation. The overall gradient of this reach is 3.8%, resulting in a cobble-bottomed channel with B-type geometry (see Figure 28). A small amount of historic straightening was observed in the lower part of the reach, but does not appear to have adversely affected the overall stability of the channel. Therefore, geomorphic stability and habitat conditions have been assessed as good with a Channel Evolution Stage of I. No project areas have been identified for this reach.

Figure 28. Channel Cross Section for Reach M15

6.0 Conclusions

The watershed and reach scale stressors described above indicate that the lower zone of the watershed is experiencing the greatest degree of channel adjustment and decline in physical habitat. While the historic diversion of 1830 is partly responsible for on-going adjustments observed today, the deleterious effects of recent residential and commercial development and floodplain encroachment in this zone of the watershed is clearly evident. Without steps to address the watershed level stressors affecting the channel corridor, habitat conditions will continue to decline and may not support the reference biotic community in the near future. To summarize the reach-level project identifications provided in Section 5.2, the following steps are recommended to initiate restoration efforts and future monitoring in the lower watershed zone:

1. Assess and prioritize the impacts of gullies in Reaches M05 and M06 below Essex Center for future remediation efforts similar to those currently being implemented on Fern Hollow Road.
2. Address the need for stormwater runoff control for discharges to gullies in reaches M05 and M06 and develop a plan for long-term implementation of infiltration structures.
3. Develop a stream corridor protection strategy for reaches susceptible to future encroachment, whereby a belt width of six times the channel width is used as a basis for the corridor. Reaches M01, M03, M04, M05 and M06 are high priority reaches for corridor protection.
4. Assessment of tributaries that appear to be delivering large amounts of sediment to the main stem in reaches M02, M03, and M05.

In the middle and upper zones of the watershed, there are fewer opportunities for restoration. These watershed zones generally have good floodplain connectivity, and in many cases have forest vegetation that is regenerating within the corridor. Some small-scale, passive restoration strategies and monitoring have been addressed in the reach summaries in section 5.2 and are summarized below:

1. Develop a stream corridor protection strategy for reaches susceptible to future encroachment, whereby a belt width of six times the channel width is used as a basis for the corridor. Reaches M08, M09 and M12 are high priority reaches for corridor protection.
2. Continued monitoring of the stormwater discharges from the Clover Road neighborhood where no runoff control structures were noted.
3. Restoration of natural, woody vegetation along specific areas of stream bank to lower summer stream temperatures and increase organic inputs to the channel (e.g., large woody debris).
4. Prioritize areas in reaches M12 and M14 for keeping grazing cattle away from stream channel with fencing.

7.0 Literature Cited

Allan, J. D. (1995) Stream Ecology: Structure and Function of Running Waters, Kluwer Academic Publishers, Boston, MA.

CWP - Center for Watershed Protection. (2003). Impacts of impervious cover on aquatic systems. *Watershed Protection Research Monograph* (1), Chapter 3, 39-49

Fitzgerald, E.P., Bowden, W.B. & Foley, J. (2006). Linking Urban Land Use to Stream Geomorphology and Biotic Integrity in the Lake Champlain Basin. In *Proceedings of the 2006 Meeting of the North American Benthological Society*. Anchorage, AK

Montgomery, D. R., & Buffington, J. M. (1997). Channel-reach morphology in mountain drainage basins. *Geological Society of America Bulletin*. 109(5), 596-611.

Riley, A.L. (1998). Restoring Streams in Cities. Island Press. Washington, D.C.

Root's Web. (2006). http://www.rootsweb.com/~vermont/ChittendenEssex.html

Rosgen, D. L. (1994). A classification of natural rivers. *Catena*, 22(3), 169 - 199.

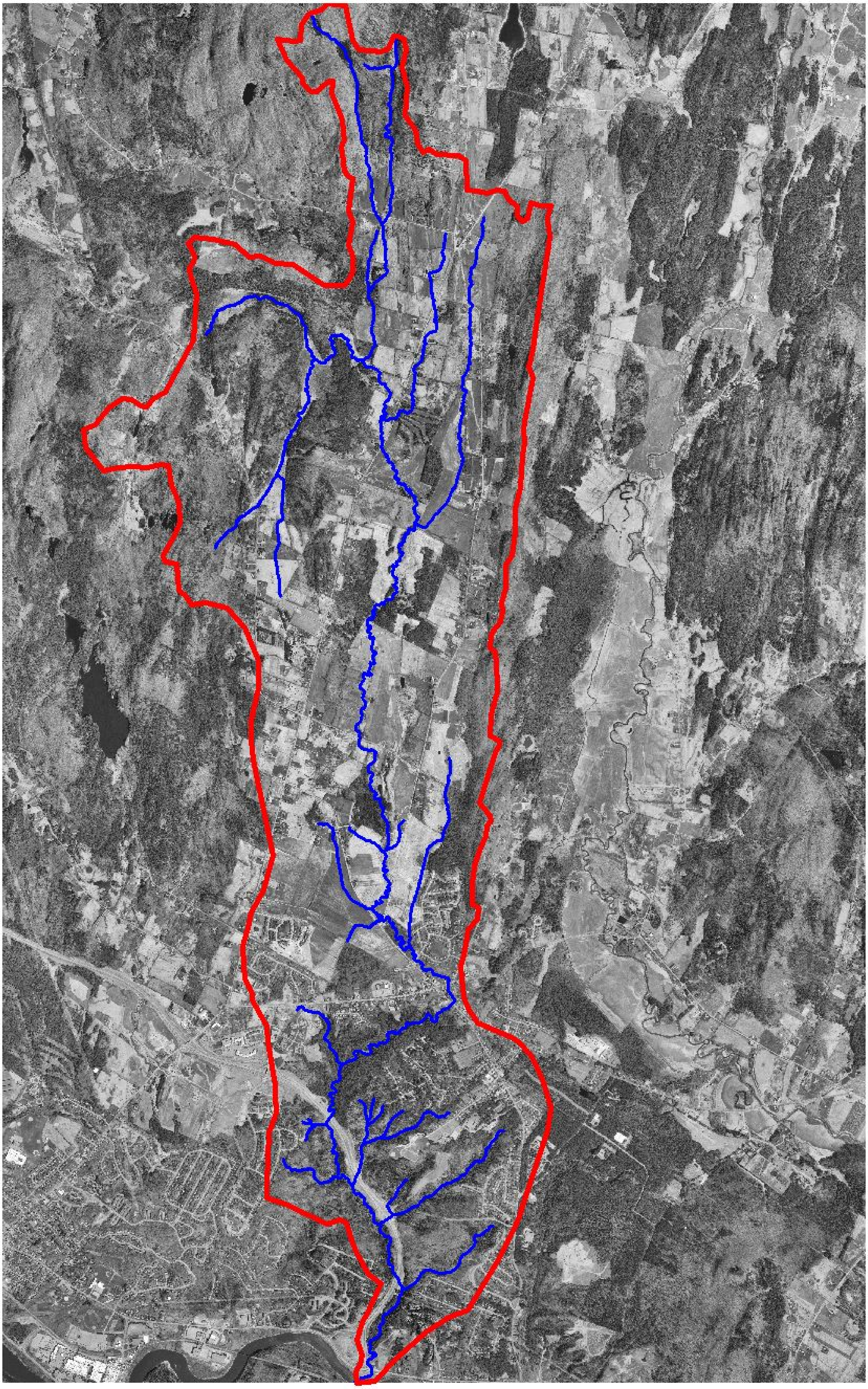
VTDEC - Vermont Department of Environmental Conservation (2001) Vermont Regional Hydraulic Geometry Curves

VTDEC - Vermont Department of Environmental Conservation. (2005). Results of Biomonitoring on Alder Brook, Essex, Vermont

VTDEC - Vermont Department of Environmental Conservation. (2006). Stream Geomorphic Assessment Handbook - Phase 1 & 2 Protocols. VTANR. April 2006

Wright, S. (2003). Glacial Geology of the Burlington and Colchester 7.5 minute Quadrangles. Vermont Geological Survey. Waterbury, VT

Appendix 1 – Subwatershed & Reach Maps

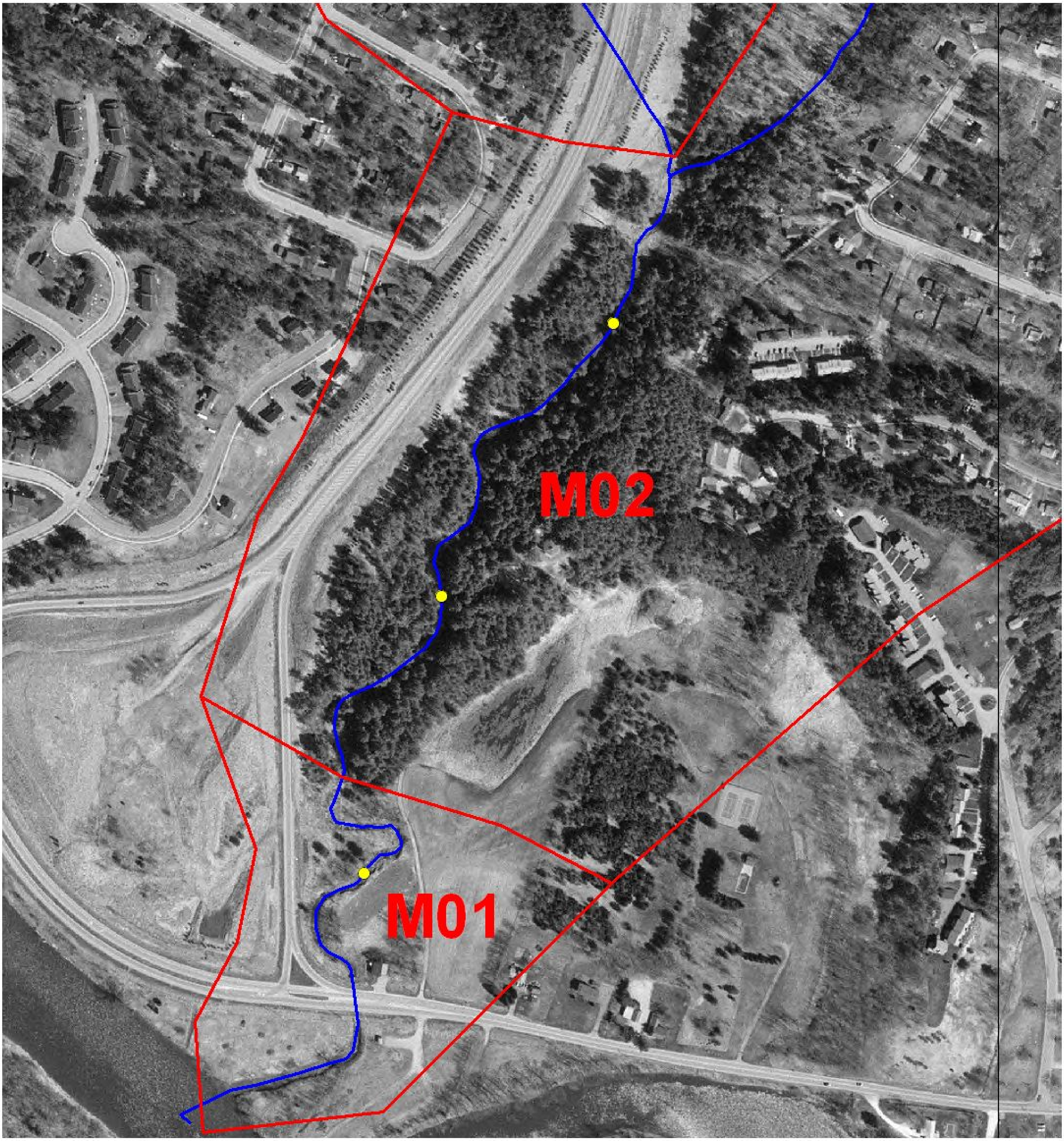


Alder Brook SGA Overall Watershed Map

6000 0 6000 Feet

Alder Brook Watershed Boundary

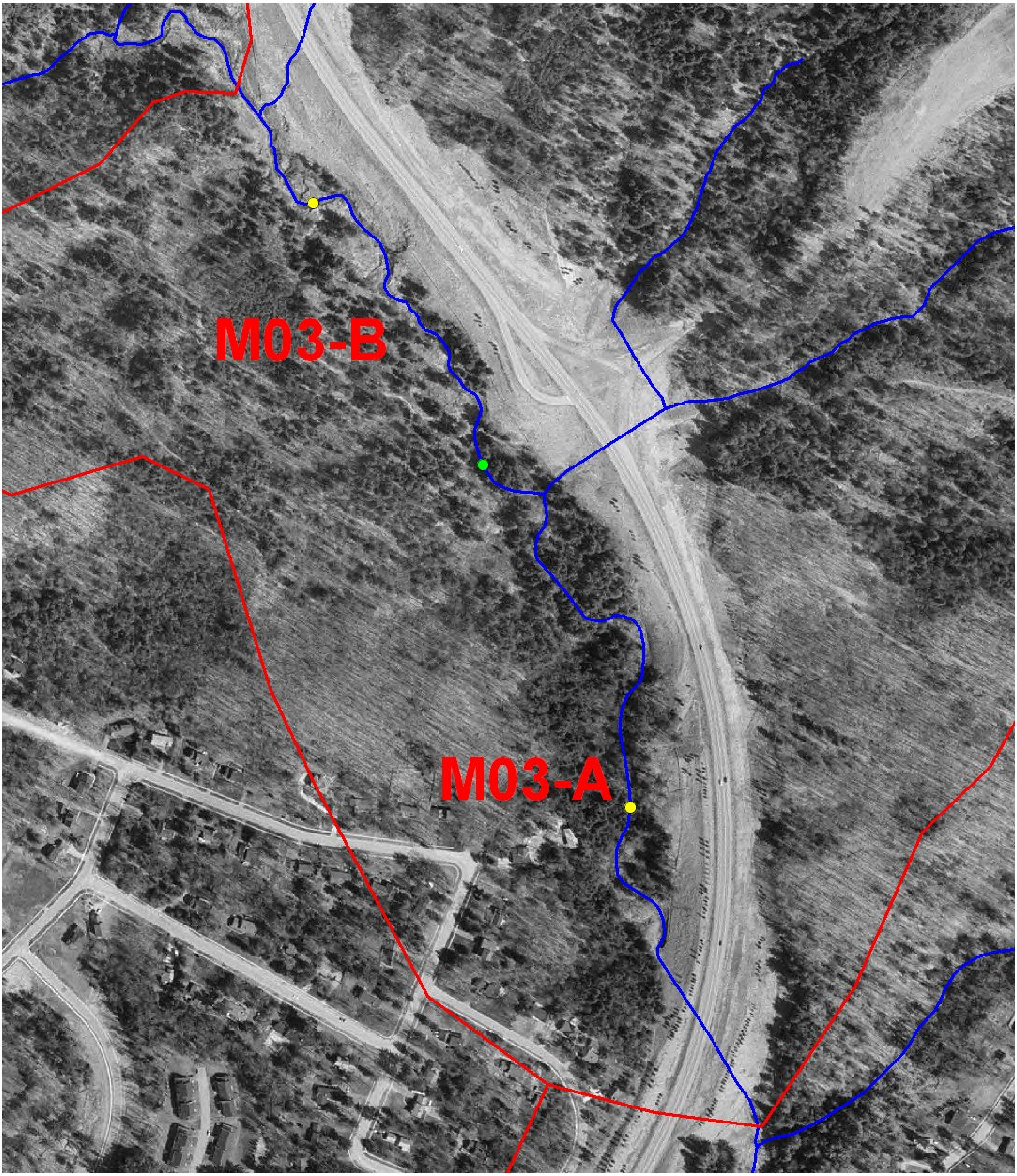
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M01 & M02

600 0 600 Feet

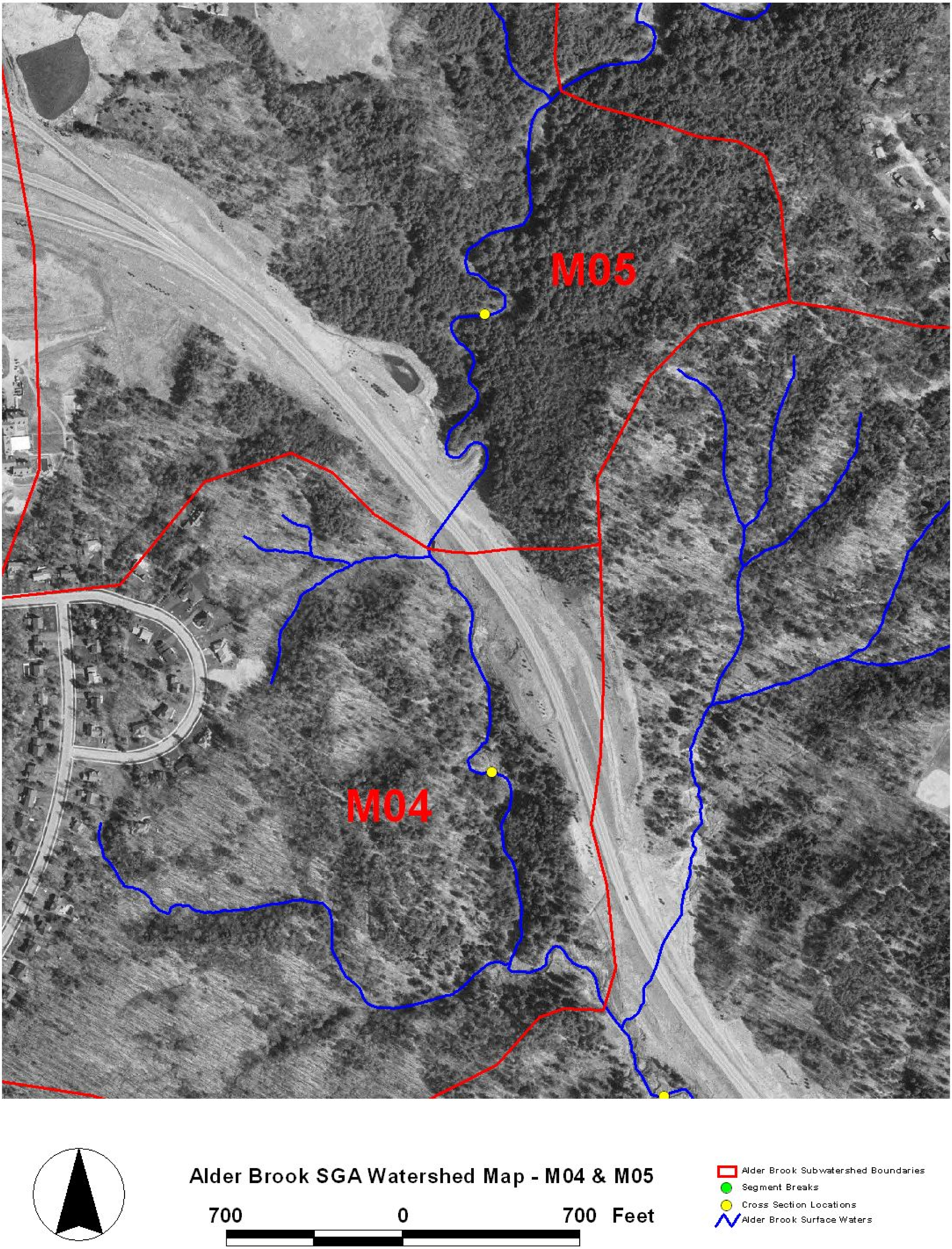
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters

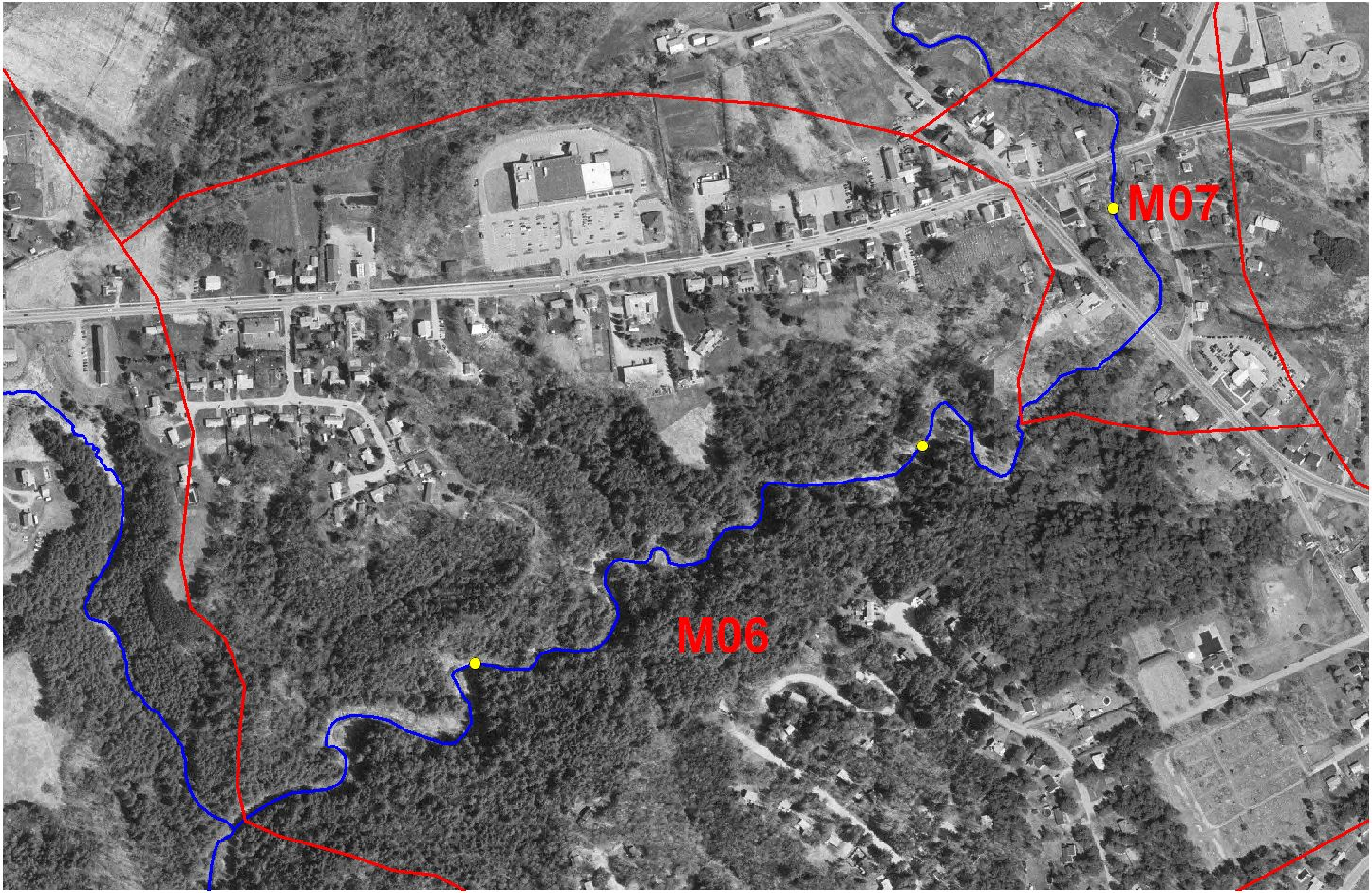


Alder Brook SGA Watershed Map - M03-A & M03-B

600 0 600 Feet

Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters

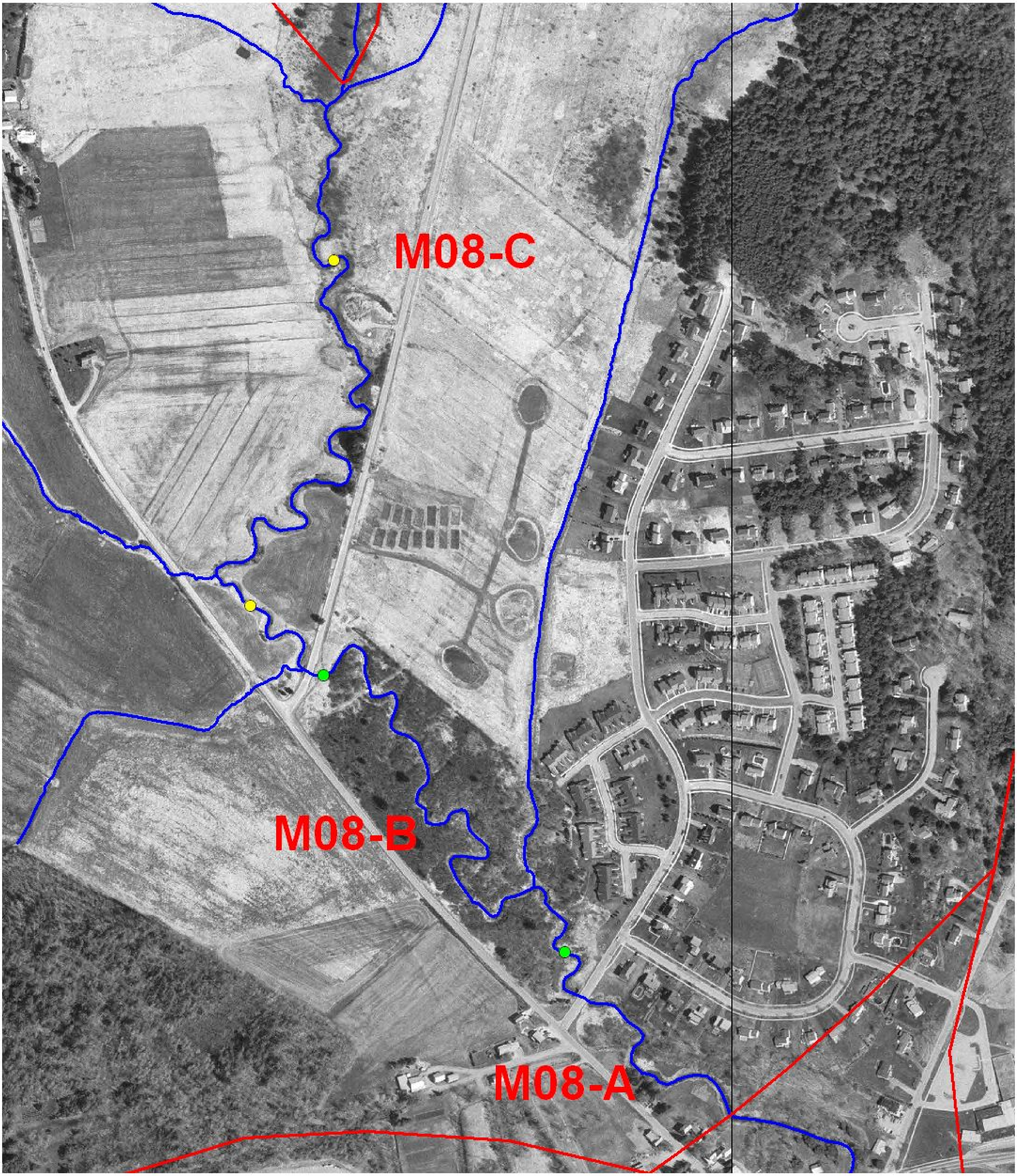

M05
M04
Alder Brook SGA Watershed Map - M04 & M05
700
0
700 Feet
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M06 & M07

800 0 800 1600 Feet

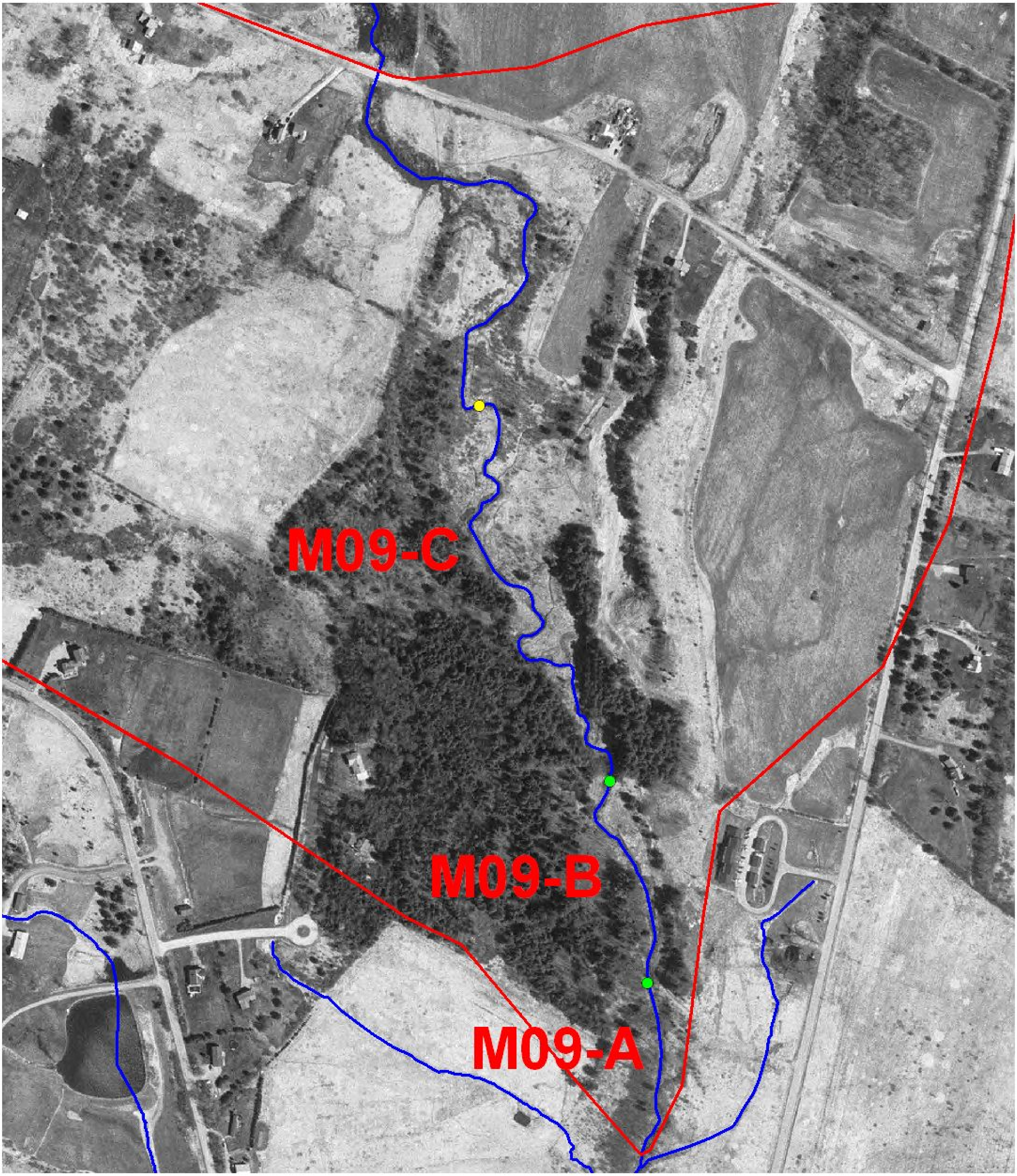
- Alder Brook Subwatershed Boundaries
- Segment Breaks
- Cross Section Locations
- Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M08

700 0 700 Feet

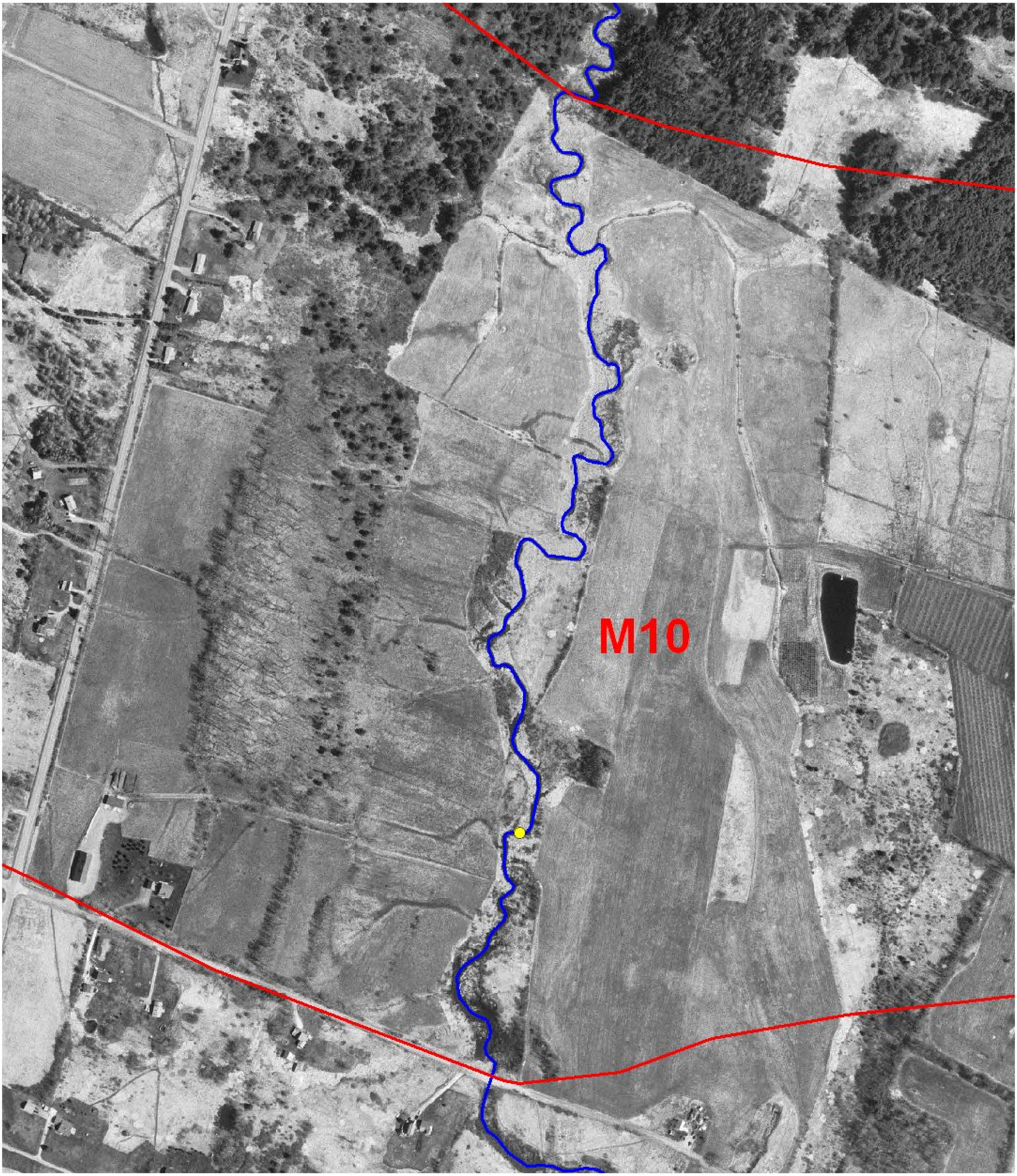
- Alder Brook Subwatershed Boundaries
- Segment Breaks
- Cross Section Locations
- Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M09

600 0 600 Feet

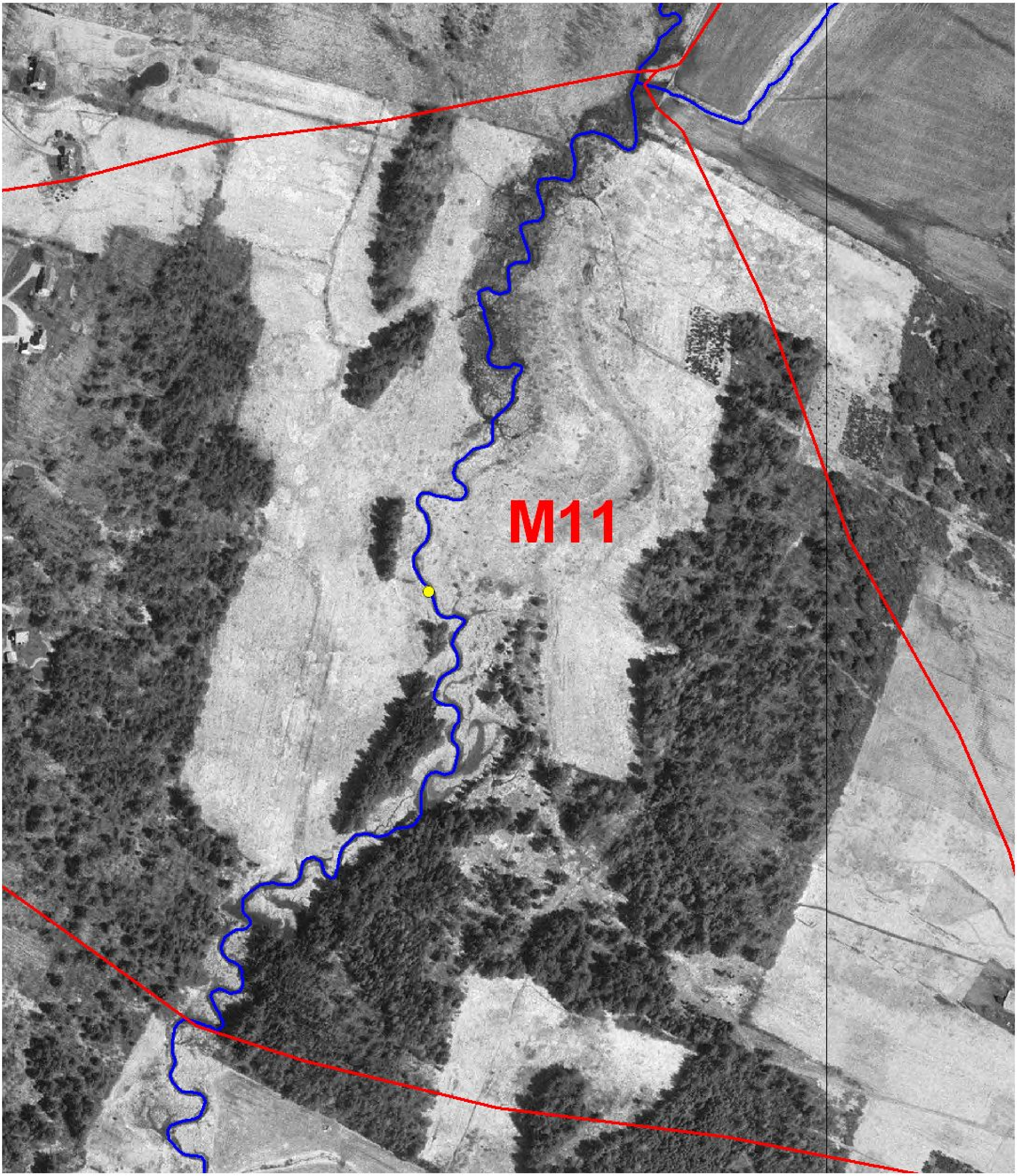
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M10

700 0 700 Feet

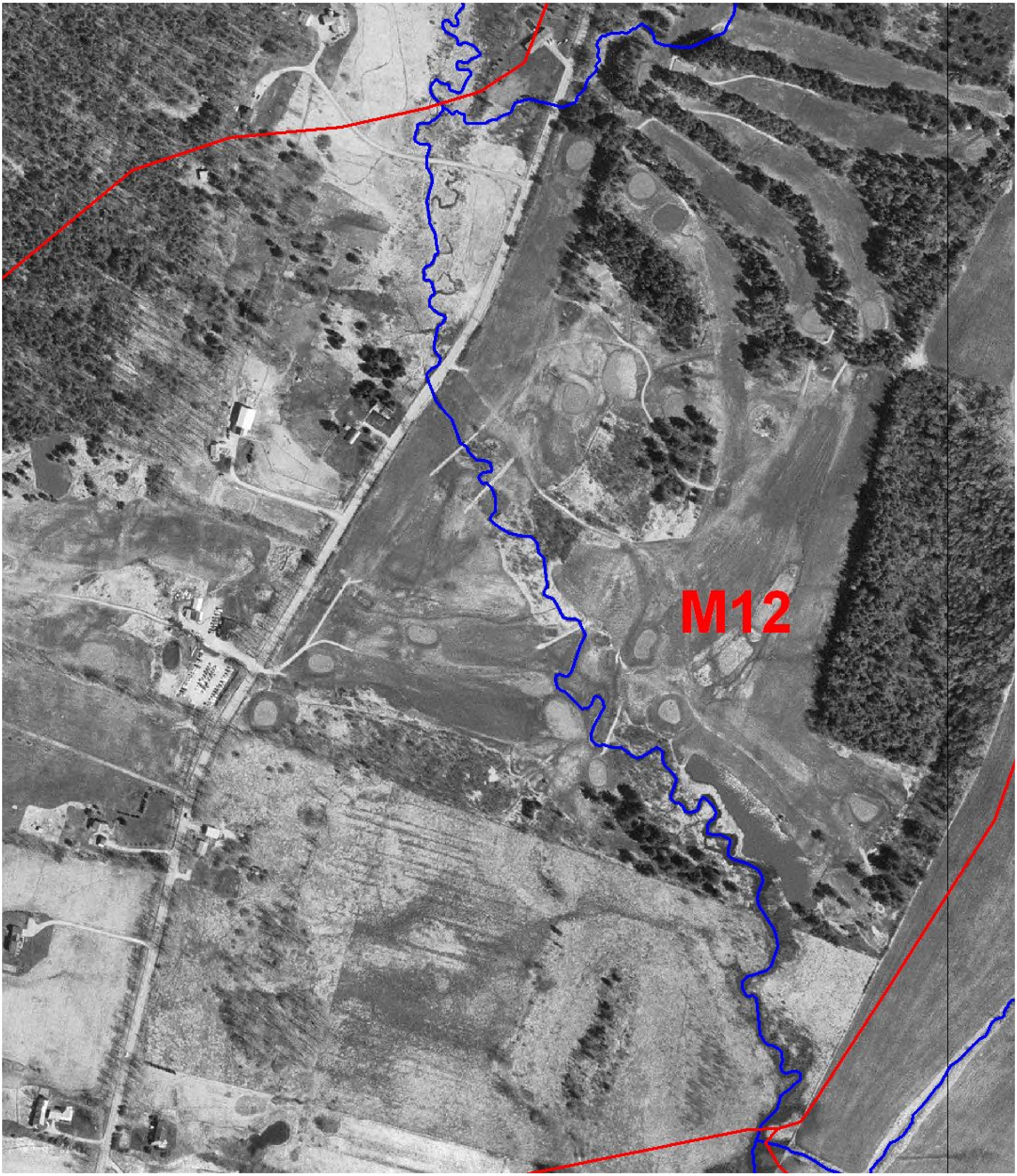
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M11

600 0 600 Feet

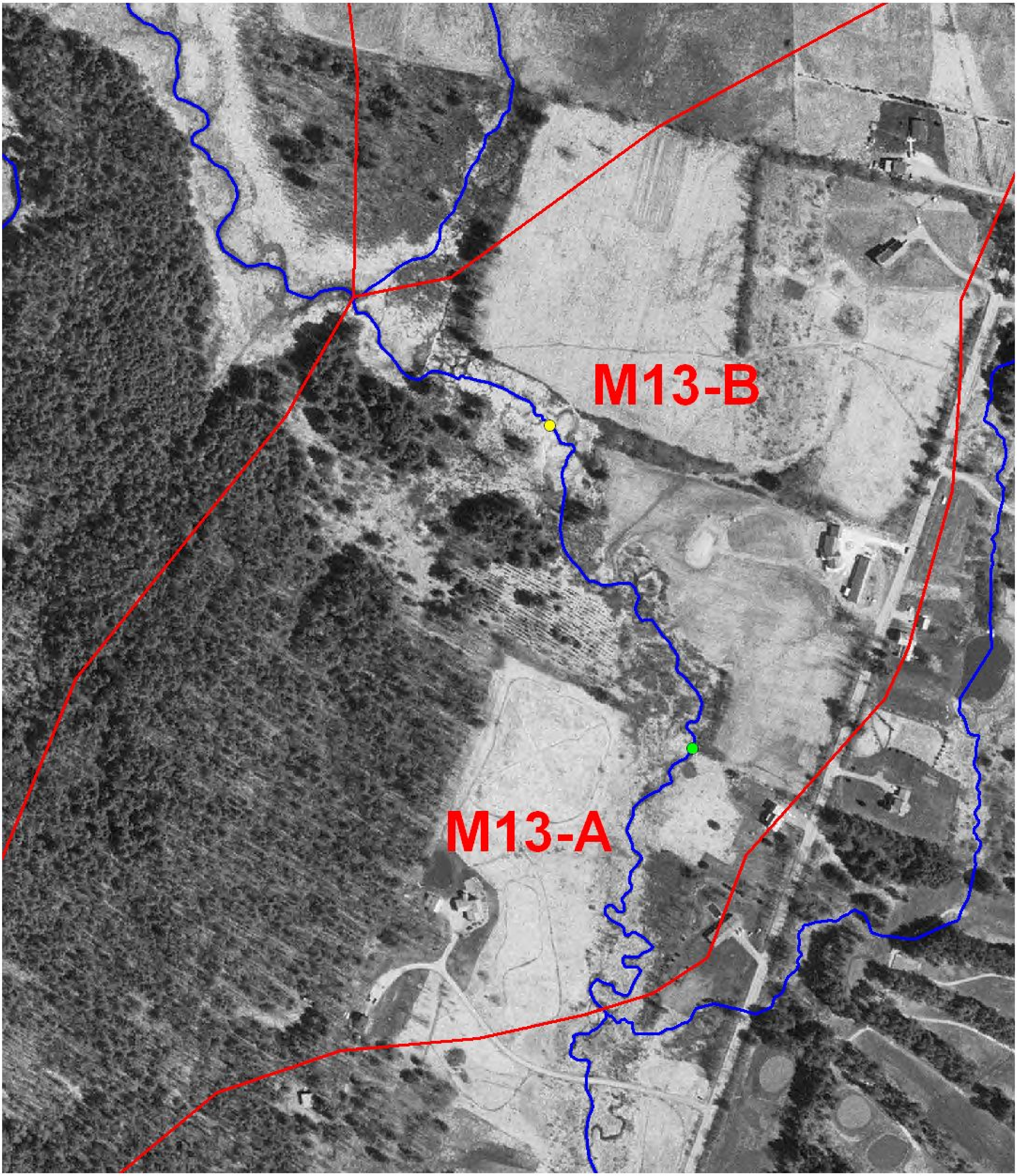
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M12

600 0 600 Feet

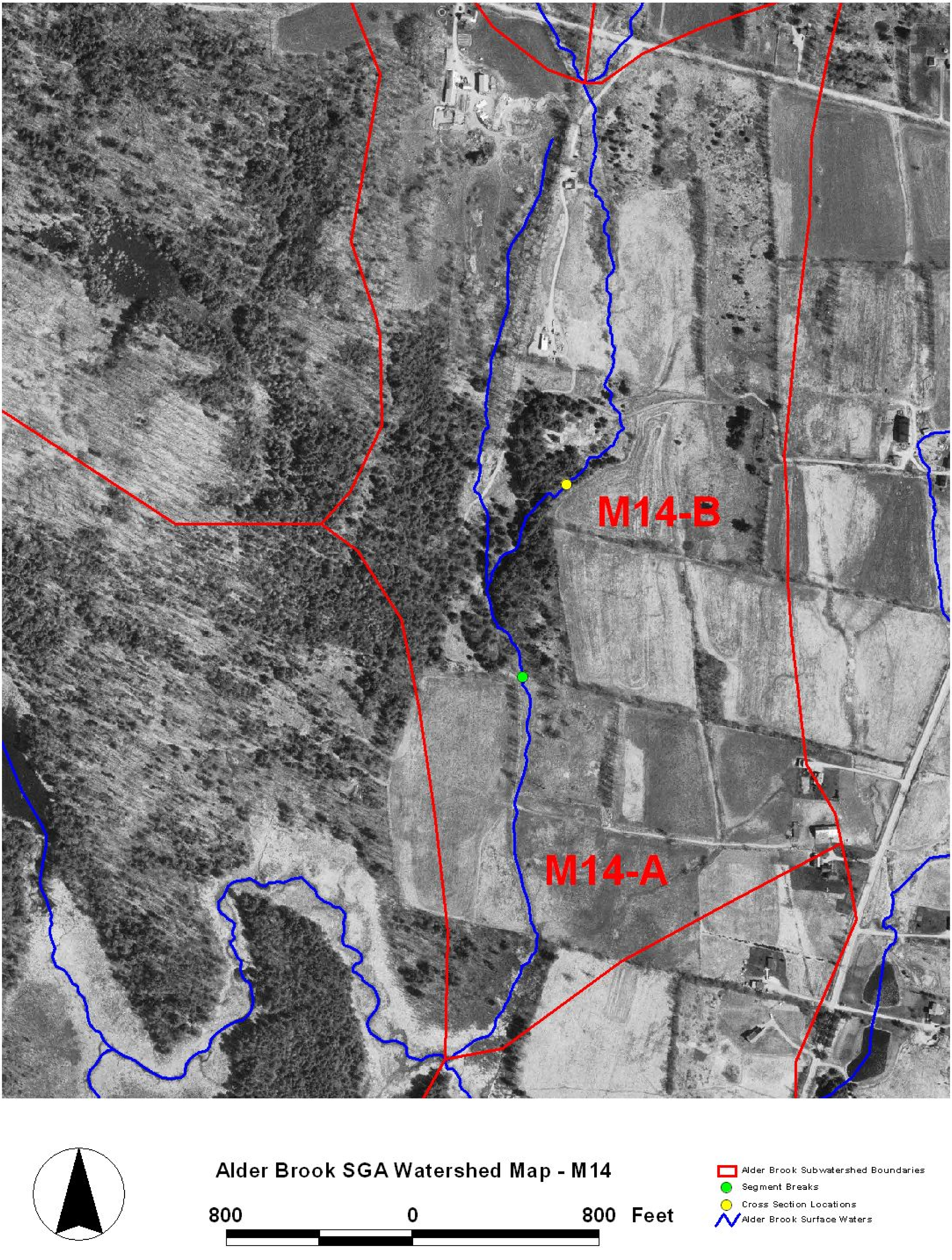
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters

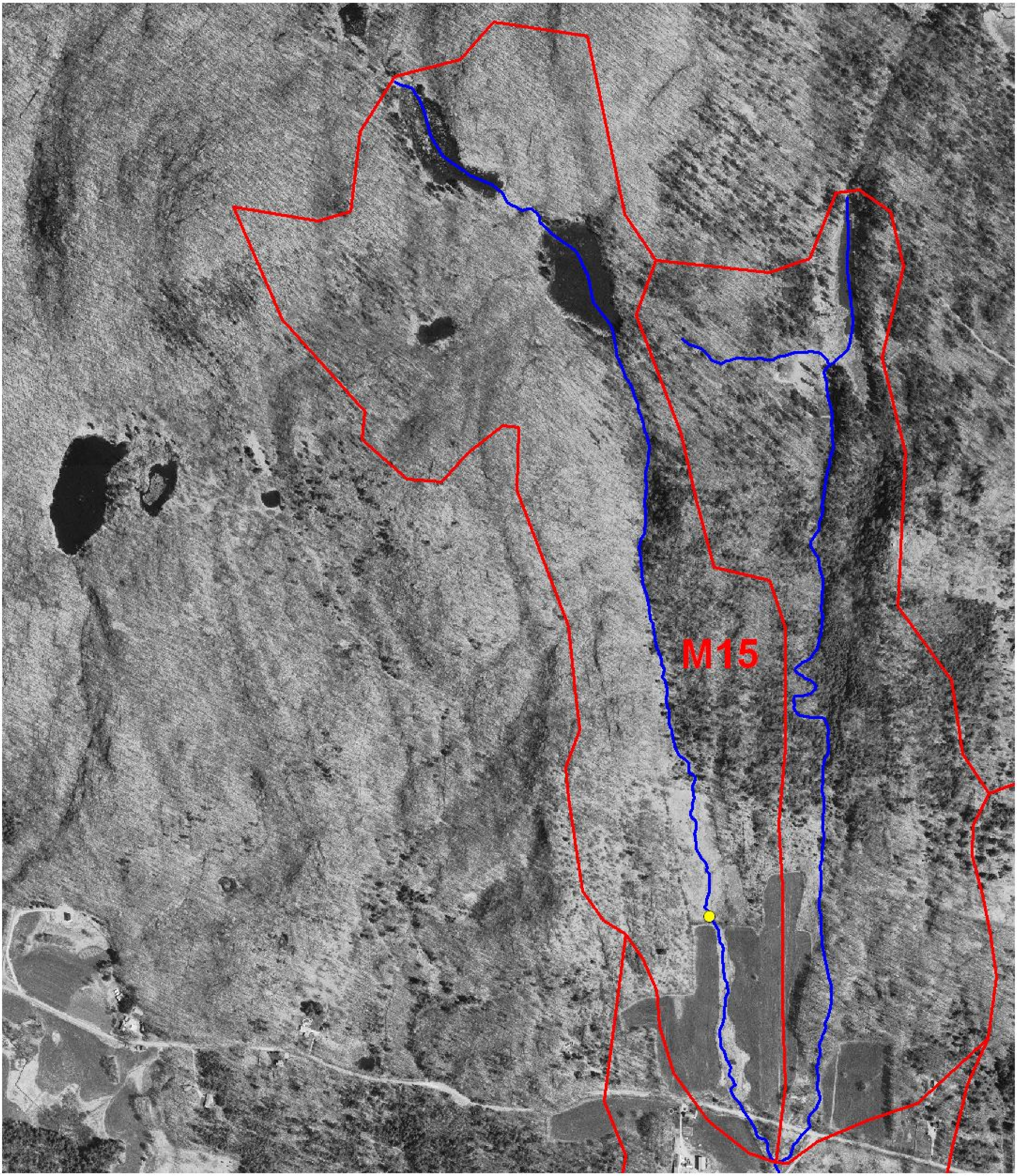


Alder Brook SGA Watershed Map - M13

500 0 500 Feet

Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters


M14-B
M14-A
Alder Brook SGA Watershed Map - M14
800
0
800
Feet
Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters



Alder Brook SGA Watershed Map - M15

1000 0 1000 Feet

Alder Brook Subwatershed Boundaries
Segment Breaks
Cross Section Locations
Alder Brook Surface Waters

Appendix 2

Phase II Notes and Updates to Phase I Data:
General updates are reviewed below for each DMS Phase II step to which noteworthy revisions were made to the Alder Brook dataset, after the initial QA/QC from DEC staff. Common parameter themes across reaches are summarized with **reach names in bold text**. References to Phase I data are summarized and discussed in red text.

- *Step 1 - Valley and Floodplain Corridor:*
  - Adjacent Terrace or Hillside (1.4)
    - Phase II side-slopes have been reviewed and have been updated in the Phase I database.
  - Valley Features (1.5)
    - Where better estimated or measured values were taken for valley width in Phase II surveys, Phase I data has been updated. Otherwise, Phase I valley width has been used and entered in Phase II database.
  - Grade Controls (1.6)
    - Phase II grade controls have been reviewed and considered per the guidance in the most recent SGA protocols (2006) where culverts are not considered grade controls. All culverts and crossings have been removed from the Grade Control database.
    - Despite the abundance of beaver dams in some reaches and their ability to control stream grade on a short-term basis, these features have not been considered as grade controls in the database.
- *Step 2 - Stream Channel:*
  - Stream Channel (2.1 – 2.9)
    - Efforts were made to get 1 to 2 cross-sections per reach; 2 for the longer reaches. Sometimes representative cross-sections selected for DMS data entry disagrees with stream type or adjustment type, or suggests a higher/lower degradation adjustment than that observed.
      1. Reaches with more than one cross-section that have average incision ratios **lower** than the one reported incision ratio include: **M06**
      2. Reaches with more than one cross-section that have average incision ratios **higher** than the one reported incision ratio include: **M08-A and M08-C**
  - Riffle Data (2.10 – 2.11)
    - Riffle data has not been collected for “dune-ripple” or “plane” bedforms. All observed riffle/pool spacings have been included for “riffle-pool” and “step-pool” bedforms.
  - Substrate Data (2.12 – 2.13)
    - Percent Detritus has been estimated and tends to be higher on lower gradient reaches (E-types). Note that this data is more qualitative than quantitative.
    - For “Dune-Ripple” bedforms, average largest particles on both the bed and bar are sand, which often appear as “0” values in the DMS.
  - Stream Type (2.14)
    - In heterogeneous reaches, dominant bedform has been selected even though reach may contain multiple bedforms throughout (e.g., B3 step-pool may also have significant portions of plane bedform). Those reaches with altered bedform from reference conditions are listed below:
      1. Plane bed reaches that were likely riffle-pool include: **M02**
      2. Plane bed reaches that were likely step-pool include: **M07**
      3. Plane bed reaches that were likely dune-ripple include: **M08-A, M08-C, M13-B**
    - Determination of stream type may be based on data from more than one cross-section measurement.
    - Please refer to all cross section data to confirm chosen stream type. Reference condition stream types have been updated in the Phase I database where a type different from Phase I estimate was observed in the field.
- *Step 3 - Riparian Banks, Buffers, and Corridors:*
  - Stream Banks (3.1)

- Observed bank erosion values in many cases represent best possible estimations of length for each bank. For reaches with higher percentages in particular, estimated values are likely more qualitative than quantitative.
- Phase II bank erosion data have been FIT'ed and are therefore included in the Phase I database.

- Stream Buffer (3.2)
  - Phase II buffer width and vegetation data have been reviewed and have been updated in the Phase I database.
- Stream Corridor (3.3)
  - Phase II corridor land use data have been reviewed but have **NOT** been updated in the Phase I database. Therefore, database user should refer to Phase II for accurate data.

- *Step 4 – Flow and Flow Modifiers:*
  - Springs, Seeps, & Tributaries (4.1)
    - In addition to seeps and springs, tributaries of any size were considered to provide water storage capacity at the reach scale during the Phase II assessments. GIS mapping using orthophotography and VHD layers were also used to determine the abundance of tributaries for each reach.
  - Adjacent Wetlands/GW Inputs; Impoundments/Flow Regs; Constrictions (4.2, 4.5, 4.7, 4.8)
    - Phase II inputs for above-described data have been reviewed and have been updated in the Phase I database.
  - Flow Regulating Impoundments (4.5 & 4.7)
    - In the Alder Brook watershed there are no on-stream impoundements.
  - Stormwater Inputs (4.6)
    - Stormwater inputs include those outfalls discharging directly to the channel, as well as those ditches and other features conveying concentrated runoff directly to channel. Man-made drainage mapping was used in field during Phase II assessments to locate potential stormwater inputs not found directly on the channel.
- *Step 5 – Channel Bed and Planform Changes:*
  - Bar Types (5.1)
    - Phase II bar type and abundance data have been reviewed and have been updated in the Phase I database.
  - Planform Changes (5.2 – 5.3)
    - Present-day alterations to the hydrologic and sediment regimes in the Alder Bk. watershed are caused primarily by: 1) urban runoff, and 2) beaver modifications to channel and floodplain. It is often difficult to tease apart the relative impacts of each of these factors during Phase II assessments when both are present in a reach or segment. Noteworthy planform changes relative to each impact are listed below:
      1. Reaches where significant alterations to planform can be associated with **beaver activity** include the following reaches: **M04, M08-B, M09-C**
      2. Reaches where significant alterations to planform are resulting from **urban runoff** and/or **floodplain encroachment** include the following reaches: **M01, M02, M03-B, M04, M05, M06 & M07**
  - Channel Alterations (5.5)
    - Phase II channel alteration data have been FIT'ed and are therefore included in the Phase I database.
- *Step 6 – RHA:*
  - Bank Stability (6.8)
    - Bank stability measurements reflect estimated bank erosion values entered in step 3.1. In some cases RHA scores for bank stability may appear slightly higher or lower than the expected ranges/values entered in step 3.1. Best judgment was used in these cases when evaluating bank stability from a habitat perspective.
  - Overall Rating (6.11)
    - Confidence in integrity of overall RHA scores is high for Alder Brook.

- Overall habitat assessment in E-type channels is difficult due to general lack of quality habitat associated with these sand-bottomed reaches. Another confounding variable which makes assessment of habitat in low-gradient E-type channels difficult is the influence of beaver activity. Reaches with lower RHA scores due to beaver influence included: **M04-A & M09-C**

- *Step 7 – RGA:*
  - Channel Degradation (7.1)
    - Incision values and entrenchment ratios were reviewed for ALL reach cross-section measurements in order to determine scores in 7.1 (row 2) and 7.3 (row 3). Certain reaches may appear to have RGA scores for these rows which do not agree with reported DMS cross section geometry, in which case database user should refer to additional cross-sections. Reaches where this is the case include: **M14-B**
  - Channel Widening (7.3)
    - As the channel evolution stage that follows aggradation, channel widening is an important adjustment process occurring in many of the impacted high-gradient (B & C type channels) reaches in the lower part of Alder Brook. Channel widths have been compared with hydraulic geometry curves developed for Chittenden County in order to make adjustments to scores in 7.3 (row 1). For this parameter, width to depth ratio is not always adequate at capturing the degree of widening. Also, certain reaches may appear to have RGA scores for these rows which do not agree with reported DMS cross section geometry, in which case the database user should refer to additional cross sections.
  - Overall Rating (7.6)
    - Confidence in integrity of overall RGA scores is high for Alder Brook.
    - As discussed above in the RHA section, overall geomorphic stability is often difficult to assess in low-gradient, E-type channels affected by beaver activity.

Appendix 3 – Phase II Reach Data

Project: Alder Brook
Phase 2 Segment Summary November 19, 2006 FIT: **Yes**

Stream: **Alder Brook** Reach # **M01** Segment: **0** Completion Date: **July 31, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, CMB** Why Not assessed: Rain: **Yes**

Segment Length (ft): **1,651** Segment Location: **At Jct. of Rt. 289 and River Rod (Rt. 117) park at gravel pull off on Winooski River side of**

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	302	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	340
Width Determination	Estimated
Confinement Type	Broad
Rock Gorge?	No

Human-caused changed valley width? **No**

Notes:

Historic channel straightening is evident above the road crossing along the adjacent field. There is a significant amount of incision as well as aggradation occurring throughout the reach, suggesting stage III to IV of CEM. A review of historic impacts (aerial photos) reveals historic and current impacts from straightening, and redevelopment of sinuosity.

Despite lower w:d ratio, channel is C type. However, any further incision and entrnchment could lead to a G-type channel.

Large amounts of armoring have been placed at the outlet of the culvert under River Road

Step 2. Stream Channel

2.1 Bankfull Width	33
2.2 Max Depth (ft)	4.75
2.3 Mean Depth (ft)	2.97
2.4 Floodprone Width (ft)	325
2.5 Aband. Floodpln	6.45
2.6 Width/Depth Ratio	11.11
2.7 Entrenchment Ratio	9.85
2.8 Incision Ratio	1.36
2.9 Sinuosity	Moderate
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	70

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	5 %
Coarse Gravel	47 %
Fine Gravel	13 %
Sand	35 %

Silt/Clay Present? **Yes**

Detritus **5** %

Large Woody **8**

2.13 Average Largest Particle on

Bed	6.0	inches
Bar	3.0	inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

2.15 Reference Stream Type
(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	152	238
Erosion Height (ft)	5.00	2.50
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	171	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	1-25	26-50
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	5-25	5-25
Sub-dominant	26-50	26-50

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Crop	Commercial
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	Some
4.3 Flow Status	Moderate
4.4 # of Debris Jams	1
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
6	4	3
Diagonal	**Delta**	**Island**
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	Yes
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	**Alder Brook**		**Phase 2 Reach Summary**	page 2 of 2	November 19, 2006
Stream:	**Alder Brook**	Reach #	**M01**	Segment: **0**	Completion Date: **July 31, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF, CMB**		Rain: **Yes**
Segment Length (ft):	**1,651**	Segment Location:	**At Jct. of Rt. 289 and River Rod (Rt. 117) park at gravel pull off on Winooski River side**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	17.0	Yes	No	Yes	Yes

Problem Deposition Below,Alignment

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**Yes**
7.2 Channel Aggradation	**9**	**None**	**No**
7.3 Widening Channel	**12**		**No**
7.4 Change in Planform	**10**		**No**
Total Score	**42**		
Geomorphic Rating	**0.525**		

Channel Evolution Model **F**
Channel Evolution Stage **IV**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	8
6.5 Channel Flow Status	14
6.6 Channel Alteration	7
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 7 Right: 6
6.9 Bank Vegetation Protection	Left: 6 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 2 Right: 2
Total Score	111
Habitat Rating	0.555

Habitat Stream Condition **Fair**

Narrative:

Aggradation and planform changes are evident, as well as some incision (see results for cross section). Observations of historic impacts and current conditions suggest stage IV to V of channel evolution for F model.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006

FIT: **Yes**

Stream: **Alder Brook** | Reach # **M02** | Segment: **0** | Completion Date: **July 31, 2006**

Organization: **Essex Waterways Association** | Observers: **EPF, CMB** | Why Not assessed: | Rain: **Yes**

Segment Length (ft): **2,304** | Segment Location: **From break in conifer buffer (and slope) along Rt. 289 up to first box culvert under Rt. 289**

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	64	0
Roads	301	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side

	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Silt/Clay	Silt/Clay

1.5 Valley Features

Valley Width (ft)	137
Width Determination	Measured
Confinement Type	Narrowly
Rock Gorge?	No

Human-caused changed valley width? **No**

Notes:

Many planform changes as a result of aggradation and abundant debris jams. No apparent straightening due to tight valley and steep side slopes.

Despite low entrenchment value and low w:d, this reach is a C-type. In lower section of reach where physical adjustments are not as severe, slope is slightly higher and plane bedform dominates (which is assumed to be reference bedform). In upper section of reach, slope is slightly less and riffle-pool bedorm is likely reference. Segmentation was not deeded necessary b/c of the overall homogeneity of the entire reach.

Step 2. Stream Channel

2.1 Bankfull Width	32
2.2 Max Depth (ft)	3.50
2.3 Mean Depth (ft)	2.73
2.4 Floodprone Width (ft)	85
2.5 Aband. Floodpln	3.50
2.6 Width/Depth Ratio	11.72
2.7 Entrenchment Ratio	2.66
2.8 Incision Ratio	1.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	150

2.12 Substrate Composition

Bedrock	0	%
Boulder	6	%
Cobble	21	%
Coarse Gravel	38	%
Fine Gravel	22	%
Sand	13	%

Silt/Clay Present? **Yes**

Detritus **3** %

Large Woody **27**

2.13 Average Largest Particle on

Bed	20.0	inches
Bar	2.5	inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	228	144
Erosion Height (ft)	4.00	3.67
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	38	0

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Herbaceous	Herbaceous

Bank Canopy	Left	Right
Canopy %	76-100	76-100

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	51-100

Buffer Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Commercial	Commercial

	Amount	Mean Height
Mass Failures	Multiple	17.00
Gullies	Multiple	7.50

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Some
4.3 Flow Status	Low
4.4 # of Debris Jams	8
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	1
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	4	9
Diagonal	**Delta**	**Island**
2	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	1

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
2	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	**Alder Brook**		**Phase 2 Reach Summary**	page 2 of 2	November 19, 2006
Stream:	**Alder Brook**	Reach #	**M02**	Segment: **0**	Completion Date: **July 31, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF, CMB**		Rain: **Yes**
Segment Length (ft):	**2,304**	Segment Location:	**From break in conifer buffer (and slope) along Rt. 289 up to first box culvert under Rt.**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	20.0	Yes	No	Yes	Yes
Problem	Scour Below				
Bedrock	50.0	Yes	No	No	Yes
Problem	Deposition Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**14**	**None**	**No**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**13**		**No**
7.4 Change in Planform	**14**		**No**
Total Score	**54**		
Geomorphic Rating	**0.675**		

Channel Evolution Model **D**
Channel Evolution Stage **IIb**
Geomorphic Condition **Good**
Stream Sensitivity **Moderate**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	8
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	8
6.5 Channel Flow Status	9
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	17
6.8 Bank Stability	Left: 7 Right: 7
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 9
Total Score	135
Habitat Rating	0.675

Habitat Stream Condition **Good**

Narrative:

Lower section of reach stable w/ few historic or current impacts. However, upper section of reach undergoing sign. aggrad. due to impacts from recent Rt. 289 construction.

Project:	Alder Brook	**Phase 2 Segment Summary**	page 1 of 2	November 19, 2006	FIT: **Yes**
Stream:	**Alder Brook**	Reach # **M03**	Segment: **A**	Completion Date:	**August 1, 2006**
Organization:	**Essex Waterways Association**	Observers: **EPF, SNL**	Why Not assessed:		Rain: **Yes**

Segment Length (ft): **2,500** Segment Location: **From first box culvert under Rt. 289 up to the turnaround. Access by parking at the**

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**434**	**0**
Roads	**237**	**0**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**0**	**0**

1.4 Adjacent Side	Left	Right
Hillside Slope	**Very Steep**	**Steep**
Continuous w/	**Sometimes**	**Sometimes**
W/in 1 Bankfill	**Always**	**Always**
Texture	**Silt/Clay**	**Silt/Clay**

1.5 Valley Features

Valley Width (ft)	**157**
Width Determination	**Measured**
Confinement Type	**Semi-confined**
Rock Gorge?	**No**
Human-caused changed valley width?	**No**

Notes:

There is a short section of the lower segment where straightening had occurred for the culvert installation.

The areas where aggradation and large bar features were found are near or downstream of debris jams in the upper section of segment - which are also causing mass failures.

Slope of this segment is higher than segment B. This segment has not seen significant historic impacts and is relatively unimpacted by Rt. 289 construction. It is a stable (stage I) plane bed reach, especially in the lower section approx. 500 feet above road crossing.

Step 2. Stream Channel

2.1 Bankfull Width	**42**
2.2 Max Depth (ft)	**3.60**
2.3 Mean Depth (ft)	**2.63**
2.4 Floodprone Width (ft)	**70**
2.5 Aband. Floodpln	**3.60**
2.6 Width/Depth Ratio	**15.97**
2.7 Entrenchment Ratio	**1.67**
2.8 Incision Ratio	**1.00**
2.9 Sinuosity	**Low**
2.10 Riffles Type	**Not**
2.11 Riffle/Step Spacing (ft)	**N/A**

2.12 Substrate Composition

Bedrock	**0**	%
Boulder	**15**	%
Cobble	**49**	%
Coarse Gravel	**10**	%
Fine Gravel	**17**	%
Sand	**9**	%

Silt/Clay Present?	**Yes**	
Detritus	**2**	%
# Large Woody	**34**	

2.13 Average Largest Particle on

Bed	**12.0**	**inches**
Bar	**4.0**	**inches**

2.14 Stream Type

Stream Type:	**B**
Bed Material:	**Cobble**
Subclass Slope:	**None**
Bed Form:	**Plane Bed**

2.15 Reference Stream Type (if different from Phase 1)

B **3** **Non Plane Bed**

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	**Silt/Clay**	**Silt/Clay**
Consistency	**Cohesive**	**Cohesive**
Lower		
Material Type	**Gravel**	**Gravel**
Consistency	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft)	**134**	**179**
Erosion Height (ft)	**3.00**	**4.67**
Revetmt. Type	**Rip-Rap**	**None**
Revetmt. Length (ft)	**259**	**0**

Near Bank Veg. Type	Left	Right
Dominant	**Coniferous**	**Coniferous**
Sub-dominant	**Deciduous**	**Deciduous**

Bank Canopy	Left	Right
Canopy %	**76-100**	**76-100**
Mid-Channel Canopy	**Closed**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**>100**
Sub-dominant	**26-50**	**None**

Buffer Veg. Type	Left	Right
Dominant	**Coniferous**	**Coniferous**
Sub-dominant	**Herbaceous**	**Deciduous**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Forest**
Sub-dominant	**Commercial**	**None**

	Amount	Mean Height
Mass Failures	**Multiple**	**15.00**
Gullies	**One**	**10.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	**Abundant**
4.2 Adjacent Wetlands	**Some**
4.3 Flow Status	**Moderate**
4.4 # of Debris Jams	**7**
4.5 Impoundments	**None**
Impoundmt. Location	
4.6 # of Stormwater Inputs	**3**
4.7 Upstream Flow	**None**
4.9 # of Beaver Dams	**0**
Affected Length (ft)	**0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
6	**10**	**6**
Diagonal	Delta	Island
2	**1**	**0**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	**0**	**0**	**0**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	**0**	**No**

5.4 Stream Ford or Animal	**No**
5.5 Straightening	**No**
5.5 Dredging	**None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	**Alder Brook**	**Phase 2 Reach Summary**	page 2 of 2		November 19, 2006
Stream:	**Alder Brook**	Reach # **M03**	Segment: **A**	Completion Date:	**August 1, 2006**
Organization:	**Essex Waterways Association**	Observers: **EPF, SNL**		Rain:	**Yes**
Segment Length (ft):	**2,500**	Segment Location: **From first box culvert under Rt. 289 up to the turnaround. Access by parking at the**			

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	20.0	Yes	No	Yes	Yes

Problem Deposition Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Plane Bed**

	Score	STD	Historic
7.1 Channel Degradation	**14**	**None**	**No**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**13**		**No**
7.4 Change in Planform	**14**		**No**
Total Score	**54**		
Geomorphic Rating	**0.675**		

Channel Evolution Model **F**
Channel Evolution Stage **I**
Geomorphic Condition **Good**
Stream Sensitivity **Moderate**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	11
6.4 Sediment Deposition	10
6.5 Channel Flow Status	12
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 8 Right: 8
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 9
Total Score	134
Habitat Rating	0.67

Habitat Stream Condition **Good**

Narrative:
Stable plane bed reach with some aggradation noted around mass failures.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006

FIT: **Yes**

Stream: **Alder Brook** Reach # **M03** Segment: **B** Completion Date: **August 1, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Why Not assessed: Rain: **Yes**

Segment Length (ft): **1,671** Segment Location: **From Rt. 289 turnaround up to tributary entering from east. Access from Rt. 289 tunraround**

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	656	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Silt/Clay	Silt/Clay

1.5 Valley Features

Valley Width (ft) **157**

Width Determination **Measured**

Confinement Type **Narrow**

Rock Gorge? **No**

Human-caused changed valley width? **No**

Notes:

Straightening along Rt. 289 where construction and berming had encroached on the stream corridor. ATV crossing noted as stream ford and will be located in FIT.

This segment has a much lower slope than A, and has been much more impacted by Rt 289 construction and berming. Aggradation and widening, as noted in channel geometry, are main adjustment processes. Riffle-pool bedorm is still pervaisve throughout, however plane bedform is also common and will likely replace the reference bedform.

Step 2. Stream Channel

2.1 Bankfull Width	50
2.2 Max Depth (ft)	4.65
2.3 Mean Depth (ft)	2.50
2.4 Floodprone Width (ft)	150
2.5 Aband. Floodpln	4.65
2.6 Width/Depth Ratio	20.00
2.7 Entrenchment Ratio	3.00
2.8 Incision Ratio	1.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	175

2.12 Substrate Composition

Bedrock	0	%
Boulder	0	%
Cobble	27	%
Coarse Gravel	36	%
Fine Gravel	16	%
Sand	21	%

Silt/Clay Present? **Yes**

Detritus **4** %

Large Woody **10**

2.13 Average Largest Particle on

Bed	8.0	inches
Bar	3.0	inches

2.14 Stream Type

Stream Type: **C**

Bed Material: **Gravel**

Subclass Slope: **None**

Bed Form: **Riffle-Pool**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	52	97
Erosion Height (ft)	5.00	6.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	54	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Shrubs/Saplin
Sub-dominant	Shrubs/Saplin	Deciduous

Bank Canopy	Left	Right
Canopy %	1-25	26-50

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	>100
Sub-dominant	5-25	None

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Mixed Trees

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Commercial	Forest

	Amount	Mean Height
Mass Failures	Multiple	20.80
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Moderate
4.4 # of Debris Jams	3
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	2
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	3	6
Diagonal	**Delta**	**Island**
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
2	0	No

5.4 Stream Ford or Animal	Yes
5.5 Straightening	Yes
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: Alder Brook	Phase 2 Reach Summary		November 19, 2006
Stream: **Alder Brook**	Reach # **M03**	Segment: **B**	Completion Date: **August 1, 2006**
Organization: **Essex Waterways Association**	Observers: **EPF, SNL**		Rain: **Yes**
Segment Length (ft): **1,671**	Segment Location: **From Rt. 289 turnaround up to tributary entering from east. Access from Rt. 289**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**12**	**None**	**No**
7.2 Channel Aggradation	**10**	**None**	**No**
7.3 Widening Channel	**11**		**No**
7.4 Change in Planform	**9**		**No**
Total Score	**42**		
Geomorphic Rating	**0.525**		

Channel Evolution Model **D**
Channel Evolution Stage **IId**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	8
6.2 Embeddedness	7
6.3 Velocity/Depth Patterns	6
6.4 Sediment Deposition	4
6.5 Channel Flow Status	7
6.6 Channel Alteration	6
6.7 Frequency of Riffles/Steps	13
6.8 Bank Stability	Left: 8 Right: 8
6.9 Bank Vegetation Protection	Left: 6 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 9
Total Score	94
Habitat Rating	0.47

Habitat Stream Condition **Fair**

Narrative:

Aggradation and planform changes, especially along sections affected by Rt. 289 berming and construction.

Project:	Alder Brook		**Phase 2 Segment Summary**	page 1 of 2	November 19, 2006	FIT:	Yes
Stream:	**Alder Brook**	Reach #	M04	Segment: 0	Completion Date:	**August 2, 2006**	
Organization:	**Essex Waterways Association**	Observers:	**EPF, SNL**	Why Not assessed:		Rain:	**Yes**
Segment Length (ft):	**2,507**	Segment Location:	**From bend of main stem into conifer woods off Rt. 289 up to 2nd box culvert crossing of Rt.**				

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**535**	**0**
Roads	**327**	**0**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**0**	**0**

1.4 Adjacent Side	Left	Right
Hillside Slope	**Very Steep**	**Steep**
Continuous w/	**Sometimes**	**Sometimes**
W/in 1 Bankfill	**Sometimes**	**Sometimes**
Texture	**Silt/Clay**	**Silt/Clay**

1.5 Valley Features

Valley Width (ft)	**158**
Width Determination	**Measured**
Confinement Type	**Semi-confined**
Rock Gorge?	**No**
Human-caused changed valley width?	**No**

Notes:

Some straightening around Rt. 289 at inlet to box culvert. Many mass failures throughout reach, especially in upper section of reach where impacts from road/berm are most obvious.

Widening apparent in channel dimensions and in bar features in vicinity of berm.

Step 2. Stream Channel

2.1 Bankfull Width	**44**
2.2 Max Depth (ft)	**4.25**
2.3 Mean Depth (ft)	**2.49**
2.4 Floodprone Width (ft)	**170**
2.5 Aband. Floodpln	**4.25**
2.6 Width/Depth Ratio	**17.47**
2.7 Entrenchment Ratio	**3.91**
2.8 Incision Ratio	**1.00**
2.9 Sinuosity	**Moderate**
2.10 Riffles Type	**Sedimented**
2.11 Riffle/Step Spacing (ft)	**200**

2.12 Substrate Composition

Bedrock	**0**	%
Boulder	**0**	%
Cobble	**28**	%
Coarse Gravel	**34**	%
Fine Gravel	**13**	%
Sand	**25**	%

Silt/Clay Present?	**Yes**	
Detritus	**4**	%
# Large Woody	**23**	

2.13 Average Largest Particle on

Bed	**6.0**	**inches**
Bar	**3.0**	**inches**

2.14 Stream Type

Stream Type:	**C**
Bed Material:	**Gravel**
Subclass Slope:	**None**
Bed Form:	**Riffle-Pool**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	**Silt/Clay**	**Silt/Clay**
Consistency	**Cohesive**	**Cohesive**
Lower		
Material Type	**Mix**	**Mix**
Consistency	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft)	**170**	**0**
Erosion Height (ft)	**2.00**	**0.00**
Revetmt. Type	**Rip-Rap**	**Rip-Rap**
Revetmt. Length (ft)	**119**	**74**

Near Bank Veg. Type	Left	Right
Dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
Sub-dominant	**Coniferous**	**Coniferous**

Bank Canopy	Left	Right
Canopy %	**51-75**	**51-75**
Mid-Channel Canopy	**Closed**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**>100**
Sub-dominant	**5-25**	**None**

Buffer Veg. Type	Left	Right
Dominant	**Coniferous**	**Coniferous**
Sub-dominant	**Shrubs/Saplin**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Forest**
Sub-dominant	**Commercial**	**None**

	Amount	Mean Height
Mass Failures	**Multiple**	**12.80**
Gullies	**One**	**20.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	**Abundant**
4.2 Adjacent Wetlands	**Some**
4.3 Flow Status	**Moderate**
4.4 # of Debris Jams	**12**
4.5 Impoundments	**None**
Impoundmt. Location	
4.6 # of Stormwater Inputs	**1**
4.7 Upstream Flow	**None**
4.9 # of Beaver Dams	**2**
Affected Length (ft)	**400**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
6	**5**	**6**
Diagonal	Delta	Island
2	**0**	**0**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	**0**	**0**	**1**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
3	**0**	**No**

5.4 Stream Ford or Animal	**No**
5.5 Straightening	**Yes**
5.5 Dredging	**None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Stream: **Alder Brook** Reach # **M04** Segment: **0** Completion Date: **August 2, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Rain: **Yes**

Segment Length (ft): **2,507** Segment Location: **From bend of main stem into conifer woods off Rt. 289 up to 2nd box culvert crossing**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	20.0	Yes	No	Yes	Yes

Problem Deposition Below

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**No**
7.2 Channel Aggradation	**10**	**None**	**No**
7.3 Widening Channel	**11**		**No**
7.4 Change in Planform	**8**		**No**
Total Score	**40**		
Geomorphic Rating	**0.5**		

Channel Evolution Model **D**

Channel Evolution Stage **IIc**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	9
6.2 Embeddedness	7
6.3 Velocity/Depth Patterns	7
6.4 Sediment Deposition	6
6.5 Channel Flow Status	6
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 6 Right: 8
6.9 Bank Vegetation Protection	Left: 5 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 6
Total Score	95
Habitat Rating	0.475

Habitat Stream Condition **Fair**

Narrative:

High degree of aggradation and changes in planform from gullies entering in reach and reaches above.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006

FIT: **Yes**

Stream: **Alder Brook** Reach # **M05** Segment: **0** Completion Date: **August 2, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Why Not assessed: Rain: **Yes**

Segment Length (ft): **2,658** Segment Location: **From 2nd box culvert under Rt. 289 up to tributary entering from north. Access from end of**

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	487	0
Roads	162	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Silt/Clay	Silt/Clay

1.5 Valley Features

Valley Width (ft) **125**

Width Determination **Measured**

Confinement Type **Semi-confined**

Rock Gorge? **No**

Human-caused changed valley width? **No**

Notes:

Berming and armoring of channel in vicinity of Rt. 289. Valley tightens significantly above road crossing. Aggradation and widening are dominant processes in reach.

Step 2. Stream Channel

2.1 Bankfull Width	34
2.2 Max Depth (ft)	3.20
2.3 Mean Depth (ft)	2.30
2.4 Floodprone Width (ft)	94
2.5 Aband. Floodpln	3.20
2.6 Width/Depth Ratio	14.78
2.7 Entrenchment Ratio	2.76
2.8 Incision Ratio	1.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	120

2.12 Substrate Composition

Bedrock	0 %
Boulder	11 %
Cobble	47 %
Coarse Gravel	21 %
Fine Gravel	15 %
Sand	6 %

Silt/Clay Present? **Yes**

Detritus **2** %

Large Woody **42**

2.13 Average Largest Particle on

Bed **11.0** **inches**

Bar **4.0** **inches**

2.14 Stream Type

Stream Type: **C**

Bed Material: **Cobble**

Subclass Slope: **None**

Bed Form: **Riffle-Pool**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	78	213
Erosion Height (ft)	3.00	2.25
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	148	176

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Herbaceous	Herbaceous

Bank Canopy	Left	Right
Canopy %	51-75	51-75

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	5-25

Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	None	Commercial

	Amount	Mean Height
Mass Failures	Multiple	20.25
Gullies	One	12.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Moderate
4.4 # of Debris Jams	13
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	1
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	8	4
Diagonal	**Delta**	**Island**
2	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	1

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
2	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: **Alder Brook**	**Phase 2 Reach Summary**		November 19, 2006
Stream: **Alder Brook**	Reach # **M05**	Segment: **0**	Completion Date: **August 2, 2006**
Organization: **Essex Waterways Association**	Observers: **EPF, SNL**		Rain: **Yes**
Segment Length (ft): **2,658**	Segment Location: **From 2nd box culvert under Rt. 289 up to tributary entering from north. Access from**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	20.0	Yes	No	Yes	Yes

Problem Deposition Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**12**	**None**	**No**
7.2 Channel Aggradation	**9**	**None**	**No**
7.3 Widening Channel	**10**		**No**
7.4 Change in Planform	**9**		**No**
Total Score	**40**		
Geomorphic Rating	**0.5**		

Channel Evolution Model **D**

Channel Evolution Stage **IIb**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	10
6.4 Sediment Deposition	8
6.5 Channel Flow Status	10
6.6 Channel Alteration	13
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 4 Right: 5
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8
Total Score	122
Habitat Rating	0.61

Habitat Stream Condition **Fair**

Narrative:

Areas of significant aggradation, widening and changes in planform.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006

FIT: **Yes**

Stream: **Alder Brook** Reach # **M06** Segment: **0** Completion Date: **August 3, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Why Not assessed: Rain: **Yes**

Segment Length (ft): **4,609** Segment Location: **From where small trib enters from north at M05/M06 reach break up to sharp bend and mass**

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Silt/Clay	Silt/Clay

1.5 Valley Features

- Valley Width (ft) **192**
- Width Determination **Measured**
- Confinement Type **Semi-confined**
- Rock Gorge? **No**

Human-caused changed valley width? **No**

Notes:

No significant straightening observed, but multiple ATV crossings throughout entire reach. These have been noted as "fords" and will be entered w/ FIT.

Many mass failures, abundant bar features indicate aggradation and widening. Numerous gullies enter reach from surrounding neighborhoods which carry with them large sediment loads. Despite intact buffer conditions, reach is in fair conditions in stage IIb of channel evolution.

Step 2. Stream Channel

2.1 Bankfull Width	48
2.2 Max Depth (ft)	3.50
2.3 Mean Depth (ft)	2.34
2.4 Floodprone Width (ft)	135
2.5 Aband. Floodpln	3.70
2.6 Width/Depth Ratio	20.51
2.7 Entrenchment Ratio	2.81
2.8 Incision Ratio	1.06
2.9 Sinuosity	High
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	225

2.12 Substrate Composition

Bedrock	0	%
Boulder	0	%
Cobble	51	%
Coarse Gravel	28	%
Fine Gravel	12	%
Sand	9	%

Silt/Clay Present? **Yes**

Detritus **3** %

Large Woody **57**

2.13 Average Largest Particle on

Bed	9.0	inches
Bar	3.5	inches

2.14 Stream Type

- Stream Type: **C**
- Bed Material: **Cobble**
- Subclass Slope: **None**
- Bed Form: **Riffle-Pool**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	57	192
Erosion Height (ft)	3.00	4.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Herbaceous
Sub-dominant	Coniferous	Herbaceous

Bank Canopy	Left	Right
Canopy %	51-75	51-75

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	None

Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	None	None

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	None	None

	Amount	Mean Height
Mass Failures	Multiple	25.64
Gullies	Multiple	8.67

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	20
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	1
Affected Length (ft)	500

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
9	6	10
Diagonal	**Delta**	**Island**
2	2	3

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	1

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal	Yes
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Stream: **Alder Brook** Reach # **M06** Segment: **0** Completion Date: **August 3, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Rain: **Yes**

Segment Length (ft): **4,609** Segment Location: **From where small trib enters from north at M05/M06 reach break up to sharp bend**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**12**	**None**	**No**
7.2 Channel Aggradation	**8**	**None**	**No**
7.3 Widening Channel	**9**		**No**
7.4 Change in Planform	**10**		**No**
Total Score	**39**		
Geomorphic Rating	**0.4875**		

Channel Evolution Model **D**

Channel Evolution Stage **IIb**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	8
6.3 Velocity/Depth Patterns	9
6.4 Sediment Deposition	6
6.5 Channel Flow Status	7
6.6 Channel Alteration	16
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 4 Right: 5
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 9
Total Score	119
Habitat Rating	0.595

Habitat Stream Condition **Fair**

Narrative:

As in many of the downstream reaches, significant aggradation and widening occurring throughout reach. This leads to many debris jams and changes in planform.

Phase 2 Segment Summary

November 19, 2006

Project:	**Alder Brook**			FIT:	**Yes**
Stream:	**Alder Brook**	Reach #	**M07**	Segment:	**0**
Completion Date:	**August 3, 2006**				
Organization:	**Essex Waterways Association**	Observers:	**EPF, SNL**	Why Not assessed:	
Rain:	**Yes**				
Segment Length (ft):	**1,914**	Segment Location:	**From approx. 800 feet below Rt. 15 crossing to just above Rt. 128 crossing. Access from**		

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**0**	**551**
Roads	**0**	**791**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**512**	**863**

1.4 Adjacent Side	Left	Right
Hillside Slope	**Very Steep**	**Very Steep**
Continuous w/	**Sometimes**	**Sometimes**
W/in 1 Bankfill	**Always**	**Always**
Texture	**Mixed**	**Mixed**

1.5 Valley Features

Valley Width (ft)	**60**
Width Determination	**Measured**
Confinement Type	**Narrowly**
Rock Gorge?	**No**

Human-caused changed valley width? **Yes**

Notes:

Straightening in between Rt. 15 and Rt. 128 road crossings. Appears to be bermed (historically) through this section. Reach is relatively stable, with exception of some bank erosion, and has been assessed at stage V of channel evolution, which relfects the state of quasi-equilibrium.

Significant deposition has been noted where a significant break in slope occurs at M07/M06 reach break. Here the channel has potential to braid and split. One very large mass failure is found just below this split channel in M06.

Step 2. Stream Channel

2.1 Bankfull Width	**35**
2.2 Max Depth (ft)	**4.05**
2.3 Mean Depth (ft)	**2.68**
2.4 Floodprone Width (ft)	**41**
2.5 Aband. Floodpln	**4.05**
2.6 Width/Depth Ratio	**13.06**
2.7 Entrenchment Ratio	**1.16**
2.8 Incision Ratio	**1.00**
2.9 Sinuosity	**Low**
2.10 Riffles Type	**Not**
2.11 Riffle/Step Spacing (ft)	**0**

2.12 Substrate Composition

Bedrock	**1**	%
Boulder	**32**	%
Cobble	**60**	%
Coarse Gravel	**6**	%
Fine Gravel	**1**	%
Sand	**0**	%

Silt/Clay Present?	**No**	
Detritus	**1**	%
# Large Woody	**18**	

2.13 Average Largest Particle on

Bed	**30.0**	**inches**
Bar	**14.0**	**inches**

2.14 Stream Type

Stream Type:	**F**
Bed Material:	**Cobble**
Subclass Slope:	**b**
Bed Form:	**Plane Bed**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	**Boulder/Cobbl**	**Boulder/Cobbl**
Consistency	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type	**Mix**	**Mix**
Consistency	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft)	**0**	**125**
Erosion Height (ft)	**0.00**	**8.00**
Revetmt. Type	**Rip-Rap**	**Rip-Rap**
Revetmt. Length (ft)	**180**	**185**

Near Bank Veg. Type	Left	Right
Dominant	**Deciduous**	**Deciduous**
Sub-dominant	**Shrubs/Saplin**	**Shrubs/Saplin**

Bank Canopy	Left	Right
Canopy %	**76-100**	**76-100**
Mid-Channel Canopy	**Closed**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**5-25**	**5-25**
Sub-dominant	**51-100**	**51-100**

Buffer Veg. Type	Left	Right
Dominant	**None**	**None**
Sub-dominant	**Mixed Trees**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Residential**	**Residential**
Sub-dominant	**Forest**	**None**

	Amount	Mean Height
Mass Failures	**None**	**0.00**
Gullies	**None**	**0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	**Abundant**
4.2 Adjacent Wetlands	**Abundant**
4.3 Flow Status	**Moderate**
4.4 # of Debris Jams	**3**
4.5 Impoundments	**None**
Impoundmt. Location	
4.6 # of Stormwater Inputs	**6**
4.7 Upstream Flow	**None**
4.9 # of Beaver Dams	**0**
Affected Length (ft)	**0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	**0**	**1**
Diagonal	Delta	Island
0	**0**	**1**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	**0**	**0**	**1**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	**0**	**No**

5.4 Stream Ford or Animal	**No**
5.5 Straightening	**Yes**
5.5 Dredging	**None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Stream: **Alder Brook** Reach # **M07** Segment: **0** Completion Date: **August 3, 2006**

Organization: **Essex Waterways Association** Observers: **EPF, SNL** Rain: **Yes**

Segment Length (ft): **1,914** Segment Location: **From approx. 800 feet below Rt. 15 crossing to just above Rt. 128 crossing. Access**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	12.0	Yes	No	Yes	Yes
Problem	Scour Above,Scour Below				
Instream	16.0	Yes	No	Yes	Yes
Problem	Scour Below,Alignment				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**5**	**B to F**	**Yes**
7.2 Channel Aggradation	**11**		**No**
7.3 Widening Channel	**7**		**Yes**
7.4 Change in Planform	**6**		**Yes**
Total Score	**29**		
Geomorphic Rating	**0.3625**		

Channel Evolution Model **F**

Channel Evolution Stage **V**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	5
6.4 Sediment Deposition	12
6.5 Channel Flow Status	15
6.6 Channel Alteration	3
6.7 Frequency of Riffles/Steps	5
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 2 Right: 2
Total Score	86
Habitat Rating	0.43

Habitat Stream Condition **Fair**

Narrative:

Channel is now relatively stable and in a state of quasi-equilibrium, however some failing slopes are noted along upper straightened section. Entrenched channel has therefore been assessed at stage V of CEM due to low probab. of further adjustment.

Phase 2 Segment Summary

November 19, 2006 — FIT: Yes

Project:	Alder Brook				
Stream:	Alder Brook	Reach #	M08	Segment: A	Completion Date: August 4, 2006
Organization:	Essex Waterways Association	Observers:	EPF, LEP, KP	Why Not assessed:	Rain: Yes
Segment Length (ft):	1,437	Segment Location:	Segment spilt below beaver ponding in Segment B. All data for steps 2, 6 & 7 for this		

Step 1. Valley and Floodplain

1.1 Segmentation **Other Reason**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	256	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	300	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	443
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused changed valley width? **No**

Notes:

Old , non-functioning stream crossing (not counted as stream ford) with abutments still intact in lower section of reach - now constrict channel and cause scour above and below.

Data entered in step 2 is from channel geometry from segment C - which was confirmed for this segment too. RHA and RGA scores have not been entered, but can be referenced for segment C.

Little buffer through this section, with numerous residential encroachments as noted in FIT data.

Step 2. Stream Channel

2.1 Bankfull Width	27
2.2 Max Depth (ft)	5.90
2.3 Mean Depth (ft)	2.71
2.4 Floodprone Width (ft)	250
2.5 Aband. Floodpln	7.15
2.6 Width/Depth Ratio	9.78
2.7 Entrenchment Ratio	9.43
2.8 Incision Ratio	1.21
2.9 Sinuosity	High
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	2 %
Fine Gravel	6 %
Sand	92 %

Silt/Clay Present?	Yes
Detritus	10 %
# Large Woody	75

2.13 Average Largest Particle on

Bed	N/A
Bar	N/A

2.14 Stream Type

Stream Type:	E
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Plane Bed

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	39	0
Erosion Height (ft)	4.00	0.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	46	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	0	0
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	5-25	5-25
Sub-dominant	51-100	51-100

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Residential
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	0
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	2
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0
Diagonal	**Delta**	**Island**
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: **Alder Brook** | **Phase 2 Reach Summary** | | November 19, 2006

Stream: **Alder Brook** | Reach # **M08** | Segment: **A** | Completion Date: **August 4, 2006**

Organization: **Essex Waterways Association** | Observers: **EPF, LEP, KP** | Rain: **Yes**

Segment Length (ft): **1,437** | Segment Location: **Segment spilt below beaver ponding in Segment B. All data for steps 2, 6 & 7 for this**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	18.0	Yes	No	Yes	Yes
Problem	Scour Below				
Bridge	8.00	Yes	No	Yes	Yes
Problem	Scour Above,Scour Below				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**Yes**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**12**		**No**
7.4 Change in Planform	**10**		**Yes**
Total Score	**46**		
Geomorphic Rating	**0.575**		

Channel Evolution Model **F**

Channel Evolution Stage **V**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	10
6.2 Pool Substrate	14
6.3 Pool Variability	14
6.4 Sediment Deposition	11
6.5 Channel Flow Status	15
6.6 Channel Alteration	11
6.7 Channel Sinuosity	13
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 6 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 5
Total Score	123
Habitat Rating	0.615

Habitat Stream Condition **Fair**

Phase 2 Segment Summary

November 19, 2006

Project:	Alder Brook			FIT:	Yes
Stream:	Alder Brook	Reach #	M08	Segment:	B
Completion Date:	August 4, 2006				
Organization:	Essex Waterways Association	Observers:	EPF, LEP, KP	Why Not assessed:	Wetland/impounded
Rain:	Yes				
Segment Length (ft):	2,156	Segment Location:	From Clover Dr. up to Chapin Rd.		

Step 1. Valley and Floodplain

1.1 Segmentation

1.2 Alluvial Fan

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	191	0

1.4 Adjacent Side	Left	Right
Hillside Slope		
Continuous w/		
W/in 1 Bankfill		
Texture		

1.5 Valley Features

Valley Width (ft) **0**

Width Determination

Confinement Type

Rock Gorge?

Human-caused changed valley width?

Notes:

Step 2. Stream Channel

2.1 Bankfull Width	0
2.2 Max Depth (ft)	0.00
2.3 Mean Depth (ft)	0.00
2.4 Floodprone Width (ft)	0
2.5 Aband. Floodpln	0.00
2.6 Width/Depth Ratio	0.00
2.7 Entrenchment Ratio	0.00
2.8 Incision Ratio	0.00
2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Silt/Clay Present?

Detritus **0** %

Large Woody **0**

2.13 Average Largest Particle on

Bed **0.0**

Bar **0.0**

2.14 Stream Type

Stream Type:

Bed Material:

Subclass Slope:

Bed Form:

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope

Bank Texture	Left	Right
Upper		
Material Type		
Consistency		
Lower		
Material Type		
Consistency		

Bank Erosion	Left	Right
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant		
Sub-dominant		

Bank Canopy	Left	Right
Canopy %		
Mid-Channel Canopy		

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant		
Sub-dominant		

Buffer Veg. Type	Left	Right
Dominant		
Sub-dominant		

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant		
Sub-dominant		

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	
4.2 Adjacent Wetlands	
4.3 Flow Status	
4.4 # of Debris Jams	0
4.5 Impoundments	
Impoundmt. Location	
4.6 # of Stormwater Inputs	1
4.7 Upstream Flow	
4.9 # of Beaver Dams	4
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0
Diagonal	**Delta**	**Island**
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	

5.4 Stream Ford or Animal	Yes
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Phase 2 Segment Summary

November 19, 2006

Project: Alder Brook			FIT: Yes
Stream: Alder Brook	Reach # M08	Segment: C	Completion Date: August 4, 2006
Organization: Essex Waterways Association	Observers: EPF, LEP, KP	Why Not assessed:	Rain: Yes
Segment Length (ft): 3,594	Segment Location: From Chapin Road crossing up to confluence of 2 small tribs from east and west. Data for		

Step 1. Valley and Floodplain

1.1 Segmentation: **Other Reason**

1.2 Alluvial Fan: **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	120	0
Roads	117	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side

	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	443
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused changed valley width? **No**

Notes:

Historic straightening along Chapin Road where channel parallels road midway through segment. Other historic straighening also present above road, possibly from old farming impacts.

Due to historic agriculture impacts, channel assessed at stage V of channel evolution.

Step 2. Stream Channel

2.1 Bankfull Width	27
2.2 Max Depth (ft)	5.90
2.3 Mean Depth (ft)	2.71
2.4 Floodprone Width (ft)	200
2.5 Aband. Floodpln	7.15
2.6 Width/Depth Ratio	9.78
2.7 Entrenchment Ratio	7.55
2.8 Incision Ratio	1.21
2.9 Sinuosity	High
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	2 %
Fine Gravel	6 %
Sand	92 %

Silt/Clay Present?	Yes
Detritus	10 %
# Large Woody	75

2.13 Average Largest Particle on

Bed	N/A
Bar	N/A

2.14 Stream Type

Stream Type:	E
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Plane Bed

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	246	0
Erosion Height (ft)	3.20	0.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	70	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	0	0
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	51-100
Sub-dominant	5-25	5-25

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Hay	Hay

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	5
4.5 Impoundments	
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	2	4

Diagonal	Delta	Island
0	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	Yes
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Stream: **Alder Brook** Reach # **M08** Segment: **C** Completion Date: **August 4, 2006**
Organization: **Essex Waterways Association** Observers: **EPF, LEP, KP** Rain: **Yes**
Segment Length (ft): **3,594** Segment Location: **From Chapin Road crossing up to confluence of 2 small tribs from east and west. Data**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	13.0	Yes	No	Yes	Yes

Problem Deposition Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**Yes**
7.2 Channel Aggradation	**13**	**None**	**Yes**
7.3 Widening Channel	**12**		**Yes**
7.4 Change in Planform	**10**		**Yes**
Total Score	**46**		
Geomorphic Rating	**0.575**		

Channel Evolution Model **F**
Channel Evolution Stage **V**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	10
6.2 Pool Substrate	14
6.3 Pool Variability	14
6.4 Sediment Deposition	11
6.5 Channel Flow Status	15
6.6 Channel Alteration	11
6.7 Channel Sinuosity	13
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 6 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 5
Total Score	123
Habitat Rating	0.615

Habitat Stream Condition **Fair**

Narrative:

Somem widening around areas where historic impacts from straightening had occurred. Overall, channel relatively stable after historic adjustments.

Project: Alder Brook
Phase 2 Segment Summary
November 19, 2006 FIT: Yes

Stream: Alder Brook Reach # M09 Segment: A Completion Date: August 9, 2006

Organization: Essex Waterways Association Observers: EPF, KD, KP Why Not assessed: Rain: Yes

Segment Length (ft): 665 Segment Location: Segment spilt below beaver ponding in Segment B. All data for steps 2, 6 & 7 for this

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

- Valley Width (ft) **306**
- Width Determination **Estimated**
- Confinement Type **Very Broad**
- Rock Gorge? **No**

Human-caused changed valley width? **No**

Notes:

No evidence of historic straightening in this segment. Channel geometry and habitat conditions are identical to those recorded in M08-C (as confirmed by measurements within segment), and can be used for this segment.

Data for RGA and RHA for this segment should also reference values entered for M08 -C, as channel and buffer conditions were very similar.

Step 2. Stream Channel

2.1 Bankfull Width	0
2.2 Max Depth (ft)	0.00
2.3 Mean Depth (ft)	0.00
2.4 Floodprone Width (ft)	0
2.5 Aband. Floodpln	0.00
2.6 Width/Depth Ratio	0.00
2.7 Entrenchment Ratio	0.00
2.8 Incision Ratio	0.00
2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Silt/Clay Present?

Detritus 0 %

Large Woody 0

2.13 Average Largest Particle on

- Bed 0.0
- Bar 0.0

2.14 Stream Type

- Stream Type:
- Bed Material:
- Subclass Slope:
- Bed Form:

2.15 Reference Stream Type

(if different from Phase 1)

E 5 Non Dune-Ripple

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	91	39
Erosion Height (ft)	4.00	3.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

Bank Canopy	Left	Right
Canopy %	26-50	26-50

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	None

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Mixed Trees	Mixed Trees

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Forest	Forest

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Some
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	2
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	4
Diagonal	**Delta**	**Island**
0	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	No
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	**Alder Brook**		**Phase 2 Reach Summary**	page 2 of 2	November 19, 2006
Stream:	**Alder Brook**	Reach #	**M09**	Segment: **A**	Completion Date: **August 9, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF, KD, KP**		Rain: **Yes**
Segment Length (ft):	**665**	Segment Location:	**Segment spilt below beaver ponding in Segment B. All data for steps 2, 6 & 7 for this**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**Yes**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**12**		**No**
7.4 Change in Planform	**10**		**Yes**
Total Score	**46**		
Geomorphic Rating	**0.575**		

Channel Evolution Model **F**
Channel Evolution Stage **V**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	10
6.2 Pool Substrate	14
6.3 Pool Variability	14
6.4 Sediment Deposition	11
6.5 Channel Flow Status	15
6.6 Channel Alteration	11
6.7 Channel Sinuosity	13
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 6 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 5
Total Score	123
Habitat Rating	0.615

Habitat Stream Condition **Fair**

Project: Alder Brook	**Phase 2 Segment Summary**	November 19, 2006	FIT: **Yes**
Stream: **Alder Brook**	Reach # **M09**	Segment: **B**	Completion Date: **August 9, 2006**
Organization: **Essex Waterways Association**	Observers: **EPF, KD, KP**	Why Not assessed: **Wetland/impounded**	Rain: **Yes**
Segment Length (ft): **887**	Segment Location: **Beaver impacted area behind condominiums off of Chapin Rd. Access from pull-off on west**		

Step 1. Valley and Floodplain

1.1 Segmentation

1.2 Alluvial Fan

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**0**	**0**
Roads	**0**	**0**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**0**	**0**

1.4 Adjacent Side	Left	Right
Hillside Slope		
Continuous w/		
W/in 1 Bankfill		
Texture		

1.5 Valley Features

Valley Width (ft) **0**

Width Determination

Confinement Type

Rock Gorge?

Human-caused changed valley width?

Notes:

Step 2. Stream Channel

2.1 Bankfull Width	**0**
2.2 Max Depth (ft)	**0.00**
2.3 Mean Depth (ft)	**0.00**
2.4 Floodprone Width (ft)	**0**
2.5 Aband. Floodpln	**0.00**
2.6 Width/Depth Ratio	**0.00**
2.7 Entrenchment Ratio	**0.00**
2.8 Incision Ratio	**0.00**
2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	**0**

2.12 Substrate Composition

Silt/Clay Present?

Detritus **0** %

Large Woody **0**

2.13 Average Largest Particle on

Bed **0.0**

Bar **0.0**

2.14 Stream Type

Stream Type:

Bed Material:

Subclass Slope:

Bed Form:

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope

Bank Texture	Left	Right
Upper		
Material Type		
Consistency		
Lower		
Material Type		
Consistency		

Bank Erosion	Left	Right
Erosion Length (ft)	**34**	**0**
Erosion Height (ft)	**3.00**	**0.00**
Revetmt. Type	**None**	**None**
Revetmt. Length (ft)	**0**	**0**

Near Bank Veg. Type	Left	Right
Dominant		
Sub-dominant		

Bank Canopy	Left	Right
Canopy %		
Mid-Channel Canopy		

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant		
Sub-dominant		

Buffer Veg. Type	Left	Right
Dominant		
Sub-dominant		

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant		
Sub-dominant		

	Amount	Mean Height
Mass Failures	**One**	**6.00**
Gullies	**None**	**0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps

4.2 Adjacent Wetlands

4.3 Flow Status

4.4 # of Debris Jams **0**

4.5 Impoundments

Impoundmt. Location

4.6 # of Stormwater Inputs **0**

4.7 Upstream Flow

4.9 # of Beaver Dams **4**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	**0**	**0**

Diagonal	Delta	Island
0	**0**	**0**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	**0**	**0**	**0**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	**0**	

5.4 Stream Ford or Animal **No**

5.5 Straightening **No**

5.5 Dredging **None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: Alder Brook		**Phase 2 Segment Summary**	page 1 of 2	November 19, 2006	FIT: **Yes**
Stream: **Alder Brook**	Reach # **M09**		Segment: **C**	Completion Date:	**August 9, 2006**
Organization: **Essex Waterways Association**	Observers: **EPF, KD, KP**		Why Not assessed:		Rain: **Yes**
Segment Length (ft): **2,883**	Segment Location:	**From bend to east just above beaver meadow up to crossing at Col Page Rd. Access from**			

Step 1. Valley and Floodplain

1.1 Segmentation **Other Reason**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**142**	**0**
Roads	**0**	**0**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**0**	**0**

1.4 Adjacent Side	Left	Right
Hillside Slope	**Hilly**	**Hilly**
Continuous w/	**Never**	**Never**
W/in 1 Bankfill	**Sometimes**	**Never**
Texture	**Not Evalua**	**Silt/Clay**

1.5 Valley Features

Valley Width (ft)	**306**
Width Determination	**Measured**
Confinement Type	**Very Broad**
Rock Gorge?	**No**

Human-caused changed valley width? **No**

Notes:

Many of the planform changes and steep riffles noted are due to old beaver dams. Despite low gradient of reach, channel substrate dominated by gravel and cobble.

Some lower gradient sections of this reach had channel dimensions suggesting E-type geometry, however a majority of reach was C -type.

Step 2. Stream Channel

2.1 Bankfull Width	**28**
2.2 Max Depth (ft)	**1.90**
2.3 Mean Depth (ft)	**1.25**
2.4 Floodprone Width (ft)	**250**
2.5 Aband. Floodpln	**1.90**
2.6 Width/Depth Ratio	**22.00**
2.7 Entrenchment Ratio	**9.09**
2.8 Incision Ratio	**1.00**
2.9 Sinuosity	**Moderate**
2.10 Riffles Type	**Sedimented**
2.11 Riffle/Step Spacing (ft)	**70**

2.12 Substrate Composition

Bedrock	**0**	%
Boulder	**1**	%
Cobble	**27**	%
Coarse Gravel	**38**	%
Fine Gravel	**20**	%
Sand	**14**	%

Silt/Clay Present?	**Yes**	
Detritus	**10**	%
# Large Woody	**60**	

2.13 Average Largest Particle on

Bed	**3.5**	**inches**
Bar	**1.8**	**inches**

2.14 Stream Type

Stream Type:	**C**
Bed Material:	**Gravel**
Subclass Slope:	**None**
Bed Form:	**Riffle-Pool**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	**Mix**	**Mix**
Consistency	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type	**Silt/Clay**	**Silt/Clay**
Consistency	**Cohesive**	**Cohesive**

Bank Erosion	Left	Right
Erosion Length (ft)	**320**	**228**
Erosion Height (ft)	**2.50**	**2.75**
Revetmt. Type	**Rip-Rap**	**Rip-Rap**
Revetmt. Length (ft)	**180**	**72**

Near Bank Veg. Type	Left	Right
Dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
Sub-dominant	**Herbaceous**	**Herbaceous**

Bank Canopy	Left	Right
Canopy %	**1-25**	**1-25**
Mid-Channel Canopy	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**>100**
Sub-dominant	**26-50**	**26-50**

Buffer Veg. Type	Left	Right
Dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
Sub-dominant	**Mixed Trees**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
Sub-dominant	**Forest**	**Forest**

	Amount	Mean Height
Mass Failures	**None**	**0.00**
Gullies	**None**	**0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	**Some**
4.2 Adjacent Wetlands	**Abundant**
4.3 Flow Status	**Low**
4.4 # of Debris Jams	**7**
4.5 Impoundments	**None**
Impoundmt. Location	
4.6 # of Stormwater Inputs	**0**
4.7 Upstream Flow	**None**
4.9 # of Beaver Dams	**2**
Affected Length (ft)	**0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	**4**	**5**
Diagonal	**Delta**	**Island**
2	**0**	**0**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	**0**	**0**	**1**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	**0**	**No**

5.4 Stream Ford or Animal	**No**
5.5 Straightening	**Yes**
5.5 Dredging	**None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	Alder Brook	Phase 2 Reach Summary			November 19, 2006
Stream:	**Alder Brook**	Reach #	**M09**	Segment: **C**	Completion Date: **August 9, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF, KD, KP**		Rain: **Yes**
Segment Length (ft):	**2,883**	Segment Location:	**From bend to east just above beaver meadow up to crossing at Col Page Rd. Access**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	14.0	Yes	No	Yes	Yes

Problem Scour Below,Alignment

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**13**	**None**	**Yes**
7.2 Channel Aggradation	**11**	**None**	**No**
7.3 Widening Channel	**14**		**No**
7.4 Change in Planform	**11**		**No**
Total Score	**49**		
Geomorphic Rating	**0.6125**		

Channel Evolution Model **D**
Channel Evolution Stage **IIc**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Pool Substrate	14
6.3 Pool Variability	13
6.4 Sediment Deposition	10
6.5 Channel Flow Status	17
6.6 Channel Alteration	10
6.7 Channel Sinuosity	8
6.8 Bank Stability	Left: 6 Right: 8
6.9 Bank Vegetation Protection	Left: 8 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8
Total Score	133
Habitat Rating	0.665

Habitat Stream Condition **Good**

Narrative:

Significant aggradation may be mostly due to beaver impacts, and resulting changes to the sediment regime. Aggradation and planform changes are most dominant processes throughout.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006 FIT: Yes

Stream: Alder Brook | Reach # M10 | Segment: 0 | Completion Date: August 11, 2006

Organization: Essex Waterways Association | Observers: EPF | Why Not assessed: | Rain: Yes

Segment Length (ft): 5,172 | Segment Location: From Col Page Road crossing up to break in hay/forested buffer and start of beaver dams.

Step 1. Valley and Floodplain

1.1 Segmentation None

1.2 Alluvial Fan No

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	250
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused changed valley width? No

Notes:

Much of the reach is dominated by clay/silt substrate, with only about 30% dominated by cobble and gravel (as seen in pebble count). However, channel geometry was uniform throughout, and is clearly an E-type with little bed feautes (mostly plane).

Straightening and some armoring present aong old hay fields, as noted in FIT. Stage V of channel evolution due to historic impacts.

Step 2. Stream Channel

2.1 Bankfull Width	18
2.2 Max Depth (ft)	2.85
2.3 Mean Depth (ft)	1.90
2.4 Floodprone Width (ft)	210
2.5 Aband. Floodpln	2.85
2.6 Width/Depth Ratio	9.47
2.7 Entrenchment Ratio	11.67
2.8 Incision Ratio	1.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0	%
Boulder	9	%
Cobble	62	%
Coarse Gravel	6	%
Fine Gravel	5	%
Sand	18	%

Silt/Clay Present? Yes

Detritus 15 %

Large Woody 29

2.13 Average Largest Particle on

Bed	8.0	inches
Bar	3.0	inches

2.14 Stream Type

Stream Type:	E
Bed Material:	Cobble
Subclass Slope:	None
Bed Form:	Plane Bed

2.15 Reference Stream Type (if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope Steep

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	124	344
Erosion Height (ft)	2.50	2.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	39	39

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	0	0

Mid-Channel Canopy Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	51-100
Sub-dominant	26-50	26-50

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Hay	Hay

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	3
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
9	3	4
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	Yes
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	**Alder Brook**	**Phase 2 Reach Summary**			November 19, 2006
Stream:	**Alder Brook**	Reach #	**M10**	Segment: **0**	Completion Date: **August 11, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF**		Rain: **Yes**
Segment Length (ft):	**5,172**	Segment Location:	**From Col Page Road crossing up to break in hay/forested buffer and start of beaver**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	7.00	Yes	No	Yes	Yes

Problem Deposition Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**13**	**None**	**Yes**
7.2 Channel Aggradation	**14**	**None**	**Yes**
7.3 Widening Channel	**15**		**Yes**
7.4 Change in Planform	**11**		**Yes**
Total Score	**53**		
Geomorphic Rating	**0.6625**		

Channel Evolution Model **F**
Channel Evolution Stage **V**
Geomorphic Condition **Good**
Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Pool Substrate	12
6.3 Pool Variability	10
6.4 Sediment Deposition	13
6.5 Channel Flow Status	16
6.6 Channel Alteration	10
6.7 Channel Sinuosity	13
6.8 Bank Stability	Left: 7 Right: 8
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8
Total Score	136
Habitat Rating	0.68

Habitat Stream Condition **Good**

Narrative:

Relatively stable reach with good floodplain connection, despite the evidence of historic straightening. Slight incision noted in some of the straightened sections, but not severe.

Project: Alder Brook **Phase 2 Segment Summary** November 19, 2006 **FIT: Yes**

Stream: **Alder Brook** Reach # **M11** Segment: **0** Completion Date: **August 11, 2006**

Organization: **Essex Waterways Association** Observers: **EPF** Why Not assessed: Rain: **Yes**

Segment Length (ft): **5,127** Segment Location: **From beaver dams to south up to barbed-wire fence at pasture break at Earle farm. Access**

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft) **462**

Width Determination **Measured**

Confinement Type **Very Broad**

Rock Gorge? **No**

Human-caused changed valley width? **No**

Notes:

Overall physical condition of stream is good, with much diversity of habitat. Many fish observed along hetergenous clay substrate.

Some evidence of old revetments in upper 1/3 of reach, but no clear evidence of historic straightening. Since no signs of impacts to channel boundary conditions can be observed in 1930's photos, channel evolution assumed to be at stage I despite the historic watershed impacts associated with agriculture

Step 2. Stream Channel

2.1 Bankfull Width	16
2.2 Max Depth (ft)	2.85
2.3 Mean Depth (ft)	1.89
2.4 Floodprone Width (ft)	450
2.5 Aband. Floodpln	2.85
2.6 Width/Depth Ratio	8.20
2.7 Entrenchment Ratio	29.03
2.8 Incision Ratio	1.00
2.9 Sinuosity	High
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	3 %
Fine Gravel	8 %
Sand	89 %

Silt/Clay Present? **Yes**

Detritus **20** %

Large Woody **18**

2.13 Average Largest Particle on

Bed **N/A**

Bar **N/A**

2.14 Stream Type

Stream Type: **E**

Bed Material: **Sand**

Subclass Slope: **None**

Bed Form: **Dune-Ripple**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	77	205
Erosion Height (ft)	2.00	2.75
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	36

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	1-25	1-25

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	51-100

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Coniferous	Coniferous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Forest	Forest

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	9
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	1
Affected Length (ft)	600

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	2	4
Diagonal	**Delta**	**Island**
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	No
5.5 Dredging	None

Note:

Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Stream: **Alder Brook** Reach # **M11** Segment: **0** Completion Date: **August 11, 2006**

Organization: **Essex Waterways Association** Observers: **EPF** Rain: **Yes**

Segment Length (ft): **5,127** Segment Location: **From beaver dams to south up to barbed-wire fence at pasture break at Earle farm.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**16**	**None**	**No**
7.2 Channel Aggradation	**16**	**None**	**No**
7.3 Widening Channel	**17**		**No**
7.4 Change in Planform	**16**		**No**
Total Score	**65**		
Geomorphic Rating	**0.8125**		

Channel Evolution Model **F**

Channel Evolution Stage **I**

Geomorphic Condition **Good**

Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	18
6.2 Pool Substrate	15
6.3 Pool Variability	18
6.4 Sediment Deposition	16
6.5 Channel Flow Status	18
6.6 Channel Alteration	18
6.7 Channel Sinuosity	18
6.8 Bank Stability	Left: 9 Right: 9
6.9 Bank Vegetation Protection	Left: 10 Right: 10
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 9
Total Score	176
Habitat Rating	0.88

Habitat Stream Condition **Referen**

Narrative:

Stream w/o significant human impacts, high sinuosity, and v. good floodplain connectivity. High scores for RGA and RHA reflect these conditions and the abundant fish observed throughout reach - suggesting high quality habitat.

Project: Alder Brook

Phase 2 Segment Summary

November 19, 2006 | FIT: Yes

Stream: **Alder Brook** | Reach # **M13** | Segment: **B** | Completion Date: **August 15, 2006**

Organization: **Essex Waterways Association** | Observers: **EPF, AV** | Why Not assessed: | Rain: **No**

Segment Length (ft): **1,745** | Segment Location: **Upper segment boundary is confluence with significant trib from west. Best accessed**

Step 1. Valley and Floodplain

1.1 Segmentation **Property Access**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	391
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused changed valley width? **No**

Notes:

Historic straightening and armoring in upper section of segment along large hay field to the north.

Old wooden bridge (falling apart) in lower segment is not having a large effect on channel adjustment, but is causing minor deposition and scour, as noted.

Despite low gradient of segment, roughly 1/2 of reach has gravel substrate and 1/2 sand. Channel evolution assessed at stage IV due to historic straightening and impacts, and the redevelopment of sinuosity in current channel. Reference conditions assumed to be sand be with dune-ripple bedform.

Step 2. Stream Channel

2.1 Bankfull Width	9
2.2 Max Depth (ft)	2.60
2.3 Mean Depth (ft)	1.70
2.4 Floodprone Width (ft)	155
2.5 Aband. Floodpln	2.90
2.6 Width/Depth Ratio	5.47
2.7 Entrenchment Ratio	16.67
2.8 Incision Ratio	1.12
2.9 Sinuosity	Moderate
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0 %
Boulder	7 %
Cobble	4 %
Coarse Gravel	39 %
Fine Gravel	31 %
Sand	19 %

Silt/Clay Present? **Yes**

Detritus **8** %

Large Woody **12**

2.13 Average Largest Particle on

Bed	N/A
Bar	N/A

2.14 Stream Type

Stream Type:	E
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Silt/Clay	Silt/Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	77

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	1-25	1-25

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	>100
Sub-dominant	26-50	None

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Hay	Forest

	Amount	Mean Height
Mass Failures	None	0.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Some
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Low
4.4 # of Debris Jams	1
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	4

Diagonal	Delta	Island
0	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	Yes
5.5 Straightening	Yes
5.5 Dredging	None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: **Alder Brook** | **Phase 2 Reach Summary** | November 19, 2006

Stream: **Alder Brook** | Reach # **M13** | Segment: **B** | Completion Date: **August 15, 2006**

Organization: **Essex Waterways Association** | Observers: **EPF, AV** | Rain: **No**

Segment Length (ft): **1,745** | Segment Location: **Upper segment boundary is confluence with significant trib from west. Best accessed**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	11.5	Yes	No	No	Yes

Problem Deposition Above,Scour Below

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	**14**	**None**	**Yes**
7.2 Channel Aggradation	**15**	**None**	**No**
7.3 Widening Channel	**16**		**No**
7.4 Change in Planform	**13**		**Yes**
Total Score	**58**		
Geomorphic Rating	**0.725**		

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Good**

Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	18
6.2 Pool Substrate	17
6.3 Pool Variability	17
6.4 Sediment Deposition	15
6.5 Channel Flow Status	18
6.6 Channel Alteration	10
6.7 Channel Sinuosity	10
6.8 Bank Stability	Left: 8 Right: 8
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 9
Total Score	155
Habitat Rating	0.775

Habitat Stream Condition **Good**

Narrative:

Some historic straighenting and degradation in upper segment, but overall physical condition of segment is good. Many fish observed throughout.

Phase 2 Segment Summary

Project: Alder Brook | FIT: Yes
Stream: Alder Brook | Reach # M14 | Segment: B | Completion Date: August 15, 2006
Organization: Essex Waterways Association | Observers: EPF, AV | Why Not assessed: | Rain: No
Segment Length (ft): 2,940 | Segment Location: From break in pasture at edge of conifers up to crossing under Rollin Irish Rd. Segment

Step 1. Valley and Floodplain

1.1 Segmentation: Property Access
1.2 Alluvial Fan: No

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	447	0
Roads	0	0
Railroads	0	0
Improved Paths	0	0
Development	0	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Silt/Clay	Silt/Clay

1.5 Valley Features
Valley Width (ft): 60
Width Determination: Measured
Confinement Type: Semi-confined
Rock Gorge?: No
Human-caused changed valley width? No

Notes:

Much of lower segment dominated by runs, most likely reflecting natural high gradient of valley/channel. Although incision not noted in cross-section, downcutting was observed in many sections of reach and stage II of channel evolution was chosen. Channel wider than predicited width due to headwaters, high-gradient stream (for which HG regression is not well suited).

Significant straightening in upper sectio of segment along old fields. Here the channel changes form significantly due to change in bank vegetation. Channel width reduces to 2 -3 feet and flow is limited. Section was not segmented further b/c channel form oscillated

Step 2. Stream Channel

2.1 Bankfull Width	15
2.2 Max Depth (ft)	1.90
2.3 Mean Depth (ft)	1.24
2.4 Floodprone Width (ft)	37
2.5 Aband. Floodpln	1.90
2.6 Width/Depth Ratio	12.10
2.7 Entrenchment Ratio	2.43
2.8 Incision Ratio	1.00
2.9 Sinuosity	Low
2.10 Riffles Type	Not
2.11 Riffle/Step Spacing (ft)	0

2.12 Substrate Composition

Bedrock	0 %
Boulder	11 %
Cobble	44 %
Coarse Gravel	24 %
Fine Gravel	12 %
Sand	9 %

Silt/Clay Present? Yes
Detritus 3 %
Large Woody 6

2.13 Average Largest Particle on
Bed 11.0 inches
Bar 4.0 inches

2.14 Stream Type
Stream Type: B
Bed Material: Cobble
Subclass Slope: None
Bed Form: Plane Bed

2.15 Reference Stream Type
(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks
Typical Bank Slope: Steep

Bank Texture	Left	Right
Upper		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	0	82
Erosion Height (ft)	0.00	4.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	81	0

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	51-75	51-75

Mid-Channel Canopy: Closed

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	51-100
Sub-dominant	26-50	26-50

Buffer Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Pasture	Pasture

	Amount	Mean Height
Mass Failures	Multiple	6.00
Gullies	None	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Some
4.2 Adjacent Wetlands	Some
4.3 Flow Status	Low
4.4 # of Debris Jams	0
4.5 Impoundments	None
Impoundmt. Location	
4.6 # of Stormwater Inputs	0
4.7 Upstream Flow	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	1
Diagonal	**Delta**	**Island**
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal: Yes
5.5 Straightening: Yes
5.5 Dredging: None

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project:	Alder Brook		**Phase 2 Reach Summary**	page 2 of 2	November 19, 2006
Stream:	**Alder Brook**	Reach #	**M14**	Segment: **B**	Completion Date: **August 15, 2006**
Organization:	**Essex Waterways Association**	Observers:	**EPF, AV**		Rain: **No**
Segment Length (ft):	**2,940**	Segment Location:	**From break in pasture at edge of conifers up to crossing under Rollin Irish Rd.**		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Instream	6.00	Yes	No	Yes	Yes
Problem	Deposition Above,Scour Above				
Instream	4.00	Yes	No	Yes	Yes
Problem	Scour Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Confined**

	Score	STD	Historic
7.1 Channel Degradation	**11**	**None**	**Yes**
7.2 Channel Aggradation	**12**	**None**	**No**
7.3 Widening Channel	**14**		**No**
7.4 Change in Planform	**10**		**Yes**
Total Score	**47**		
Geomorphic Rating	**0.5875**		

Channel Evolution Model **F**
Channel Evolution Stage **II**
Geomorphic Condition **Fair**
Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	10
6.4 Sediment Deposition	13
6.5 Channel Flow Status	11
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 7 Right: 7
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 6
Total Score	123
Habitat Rating	0.615

Habitat Stream Condition **Fair**

Narrative:

Some incision in straightened section not picked up in cross-sectional data. Channel evolution assessed at stage II due to observed incision.

Project:	Alder Brook	**Phase 2 Segment Summary**	page 1 of 2	November 19, 2006	FIT: **Yes**
Stream:	**Alder Brook**	Reach # **M15**	Segment: **0**	Completion Date:	**August 18, 2006**
Organization:	**Essex Waterways Association**	Observers: **EPF, WHF**	Why Not assessed:		Rain: **No**
Segment Length (ft):	**7,341**	Segment Location: **Headwaters reach accessed from Rollin Irish Rd to south.**			

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **No**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	**0**	**0**
Roads	**0**	**0**
Railroads	**0**	**0**
Improved Paths	**0**	**0**
Development	**0**	**0**

1.4 Adjacent Side

	Left	Right
Hillside Slope	**Steep**	**Steep**
Continuous w/	**Sometimes**	**Sometimes**
W/in 1 Bankfill	**Sometimes**	**Sometimes**
Texture	**Mixed**	**Mixed**

1.5 Valley Features

Valley Width (ft)	**60**
Width Determination	**Measured**
Confinement Type	**Narrowly**
Rock Gorge?	**No**

Human-caused changed valley width? **No**

Notes:

Channel dominated by planebed, transport characteristics with very few bar features. Channel wider than predicited width due to headwaters, high-gradient stream (for which HG regression is not well suited).

Some straightening through old farmed section along adjacent hay fields, as noted in FIT.

Step 2. Stream Channel

2.1 Bankfull Width	**10**
2.2 Max Depth (ft)	**0.65**
2.3 Mean Depth (ft)	**0.43**
2.4 Floodprone Width (ft)	**18**
2.5 Aband. Floodpln	**0.65**
2.6 Width/Depth Ratio	**23.26**
2.7 Entrenchment Ratio	**1.75**
2.8 Incision Ratio	**1.00**
2.9 Sinuosity	**Low**
2.10 Riffles Type	**Not**
2.11 Riffle/Step Spacing (ft)	**0**

2.12 Substrate Composition

Bedrock	**0**	%
Boulder	**6**	%
Cobble	**42**	%
Coarse Gravel	**25**	%
Fine Gravel	**15**	%
Sand	**12**	%

Silt/Clay Present? **Yes**

Detritus **15** %

Large Woody **8**

2.13 Average Largest Particle on

Bed	**6.0**	**inches**
Bar	**2.0**	**inches**

2.14 Stream Type

Stream Type:	**B**
Bed Material:	**Gravel**
Subclass Slope:	**None**
Bed Form:	**Plane Bed**

2.15 Reference Stream Type

(if different from Phase 1)

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	**Mix**	**Mix**
Consistency	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type	**Boulder/Cobbl**	**Boulder/Cobbl**
Consistency	**Non-cohesive**	**Non-cohesive**
Bank Erosion	Left	Right
Erosion Length (ft)	**0**	**0**
Erosion Height (ft)	**0.00**	**0.00**
Revetmt. Type	**None**	**Rip-Rap**
Revetmt. Length (ft)	**0**	**160**
Near Bank Veg. Type	Left	Right
Dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
Sub-dominant	**Herbaceous**	**Herbaceous**
Bank Canopy	Left	Right
Canopy %	**26-50**	**26-50**
Mid-Channel Canopy	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**>100**
Sub-dominant	**26-50**	**26-50**
Buffer Veg. Type	Left	Right
Dominant	**Mixed Trees**	**Mixed Trees**
Sub-dominant	**Shrubs/Saplin**	**Shrubs/Saplin**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Forest**
Sub-dominant	**Shrubs/Saplin**	**Shrubs/Saplin**
	Amount	Mean Height
Mass Failures	**One**	**5.00**
Gullies	**None**	**0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	**Abundant**
4.2 Adjacent Wetlands	**Abundant**
4.3 Flow Status	**Low**
4.4 # of Debris Jams	**3**
4.5 Impoundments	**None**
Impoundmt. Location	
4.6 # of Stormwater Inputs	**0**
4.7 Upstream Flow	**None**
4.9 # of Beaver Dams	**0**
Affected Length (ft)	**0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	**0**	**0**
Diagonal	Delta	Island
0	**0**	**2**

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	**0**	**0**	**0**

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	**0**	**No**

5.4 Stream Ford or Animal	**No**
5.5 Straightening	**Yes**
5.5 Dredging	**None**

Note:
Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - Steps 6 through 7.

Project: **Alder Brook** | **Phase 2 Reach Summary** | November 19, 2006

Stream: **Alder Brook** | Reach # **M15** | Segment: **0** | Completion Date: **August 18, 2006**

Organization: **Essex Waterways Association** | Observers: **EPF, WHF** | Rain: **No**

Segment Length (ft): **7,341** | Segment Location: **Headwaters reach accessed from Rollin Irish Rd to south.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water (ft)	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Plane Bed**

	Score	STD	Historic
7.1 Channel Degradation	**15**	**None**	**No**
7.2 Channel Aggradation	**16**	**None**	**No**
7.3 Widening Channel	**17**		**No**
7.4 Change in Planform	**13**		**Yes**
Total Score	**61**		
Geomorphic Rating	**0.7625**		

Channel Evolution Model **F**

Channel Evolution Stage **I**

Geomorphic Condition **Good**

Stream Sensitivity **Moderate**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	11
6.4 Sediment Deposition	15
6.5 Channel Flow Status	15
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 10 Right: 10
6.9 Bank Vegetation Protection	Left: 10 Right: 10
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8
Total Score	151
Habitat Rating	0.755

Habitat Stream Condition **Good**

Narrative:

Some historic changes in planform from straightening along adjacent hay fields in lower reach.

Appendix 4. Phase II Reach Summary Statistics															
Reach	Segment	Stream Type	Dominant Bed Material	Bedform	STD*	Reference Stream Type†	Reference Bed Material†	Reference Bedform†	RHA Score	RHA Condition	RGA Score	RGA Condition	Reach Sensitivity	CEM**	CEM** Stage
M01		C	Gravel	Riffle-Pool					0.56	Fair	0.53	Fair	Very High	F	IV
M02		C	Gravel	Plane Bed	Yes	C	Gravel	Riffle-Pool	0.68	Good	0.68	Good	Moderate	D	IIb
M03	A	B	Cobble	Plane Bed					0.67	Good	0.68	Good	Moderate	F	I
M03	B	C	Gravel	Riffle-Pool					0.47	Fair	0.53	Fair	Very High	D	IId
M04		C	Gravel	Riffle-Pool					0.48	Fair	0.50	Fair	Very High	D	IIc
M05		C	Cobble	Riffle-Pool					0.61	Fair	0.50	Fair	Very High	D	IIb
M06		C	Cobble	Riffle-Pool					0.60	Fair	0.49	Fair	Very High	D	IIb
M07		F	Cobble	Plane Bed	Yes	B	Cobble	Step-Pool	0.43	Fair	0.36	Fair	Very High	F	V
M08	A	E	Sand	Plane Bed	Yes	E	Sand	Dune-Ripple	0.62	Fair	0.58	Fair	Very High	F	V
M08	B	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
M08	C	E	Sand	Plane Bed	Yes	E	Sand	Dune-Ripple	0.62	Fair	0.58	Fair	Very High	F	V
M09	A	E	Sand	Plane Bed					0.62	Fair	0.58	Fair	Very High	F	V
M09	B	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
M09	C	C	Gravel	Riffle-Pool					0.67	Good	0.61	Fair	Very High	D	IIc
M10		E	Cobble	Plane Bed	Yes	E	Sand	Dune-Ripple	0.68	Good	0.66	Good	High	F	V
M11		E	Sand	Dune-Ripple					0.88	Reference	0.81	Good	High	F	I
M12		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
M13	A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
M13	B	E	Gravel	Plane Bed	Yes	E	Sand	Dune-Ripple	0.78	Good	0.73	Good	High	F	IV
M14	A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
M14	B	B	Cobble	Plane Bed					0.62	Fair	0.59	Fair	High	F	II
M15		B	Gravel	Step-Pool					0.76	Good	0.76	Good	Moderate	F	I

	RHA Score	RGA Score
Mean:	0.63	0.60
Max:	0.88	0.81
Min:	0.43	0.36

* STD = Stream Type Departure
** CEM = Channel Evolution Model
† = Assessed Reference Condition Prior to Stream Type Departure
NE = Not Evaluated

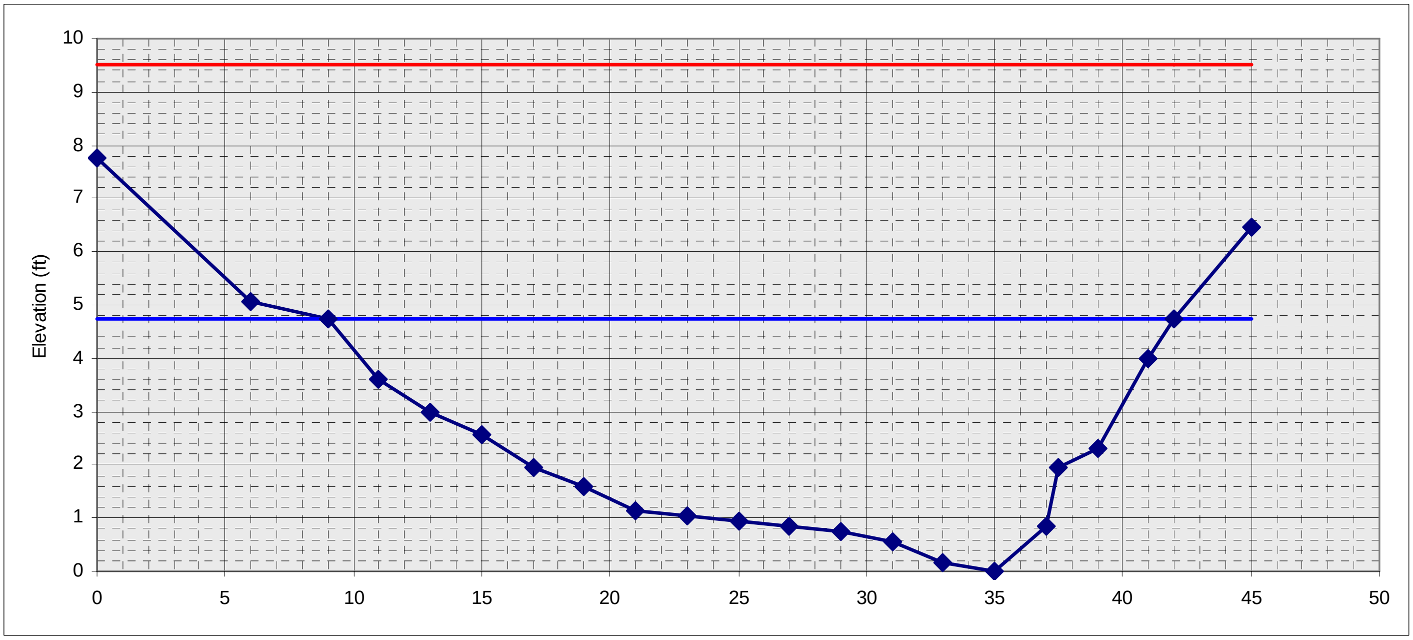
Appendix 5. Alder Brook Reach Geometry Data

		Phase 2 Stream Type					Phase 1 Data		Phase 2 Channel Data											
Reach	Seg-ment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Slope	Channel width	Bankfull width	Max. depth	Mean depth	Floodpr. width	Abandn FldPln	W/D Ratio	Entrench-ment	Incision Ratio	Stage Evol.	Evol. Model	RGA Cond.	RHA Cond.
M01	0	C	Gravel	Riffle-Pool	None	No	0.8	32.9	33.0	4.75	2.97	325.0	6.45	11.1	9.8	1.4	IV	F	Fair	Fair
M02	0	C	Gravel	Plane Bed	None	No	0.8	32.0	32.0	3.5	2.73	85.0	3.5	11.7	2.7	1.0	IIb	D	Good	Good
M03	A	B	Cobble	Plane Bed	None	Yes	1.0	32.3	42.0	3.6	2.63	70.0	3.6	16.0	1.7	1.0	I	F	Good	Good
M03	B	C	Gravel	Riffle-Pool	None	No	1.0	32.3	50.0	4.65	2.5	150.0	4.65	20.0	3.0	1.0	IId	D	Fair	Fair
M04	0	C	Gravel	Riffle-Pool	None	No	1.1	30.5	43.5	4.25	2.49	170.0	4.25	17.5	3.9	1.0	IIc	D	Fair	Fair
M05	0	C	Cobble	Riffle-Pool	None	No	1.1	30.1	34.0	3.2	2.3	94.0	3.2	14.8	2.8	1.0	IIb	D	Fair	Fair
M06	0	C	Cobble	Riffle-Pool	None	No	0.9	29.4	48.0	3.5	2.34	135.0	3.7	20.5	2.8	1.1	IIb	D	Fair	Fair
M07	0	F	Cobble	Plane Bed	b	No	3.9	28.6	35.0	4.05	2.68	40.5	4.05	13.1	1.2	1.0	V	F	Fair	Fair
M08	A	E	Sand	Plane Bed	None	No	0.1	28.5	26.5	5.9	2.71	250.0	7.15	9.8	9.4	1.2	V	F	Fair	Fair
M08	B					No	0.1	28.5												
M08	C	E	Sand	Plane Bed	None	No	0.1	28.5	26.5	5.9	2.71	200.0	7.15	9.8	7.5	1.2	V	F	Fair	Fair
M09	A					Yes	0.2	25.8									V	F	Fair	Fair
M09	B					No	0.2	25.8												
M09	C	C	Gravel	Riffle-Pool	None	No	0.2	25.8	27.5	1.9	1.25	250.0	1.9	22.0	9.1	1.0	IIc	D	Fair	Good
M10	0	E	Cobble	Plane Bed	None	No	0.1	18.0	18.0	2.85	1.9	210.0	2.85	9.5	11.7	1.0	V	F	Good	Good
M11	0	E	Sand	Dune-Ripple	None	No	0.2	16.0	15.5	2.85	1.89	450.0	2.85	8.2	29.0	1.0	I	F	Good	Reference
M12	0					No	0.2	19.4												
M13	A					No	0.4	9.0												
M13	B	E	Gravel	Plane Bed	None	No	0.4	9.0	9.3	2.6	1.7	155.0	2.9	5.5	16.7	1.1	IV	F	Good	Good
M14	A					No	3.0	15.0												
M14	B	B	Cobble	Plane Bed	None	No	3.0	15.0	15.0	1.9	1.24	36.5	1.9	12.1	2.4	1.0	II	F	Fair	Fair
M15	0	B	Gravel	Plane Bed	None	No	4.1	5.6	10.0	0.65	0.43	17.5	0.65	23.3	1.8	1.0	I	F	Good	Good

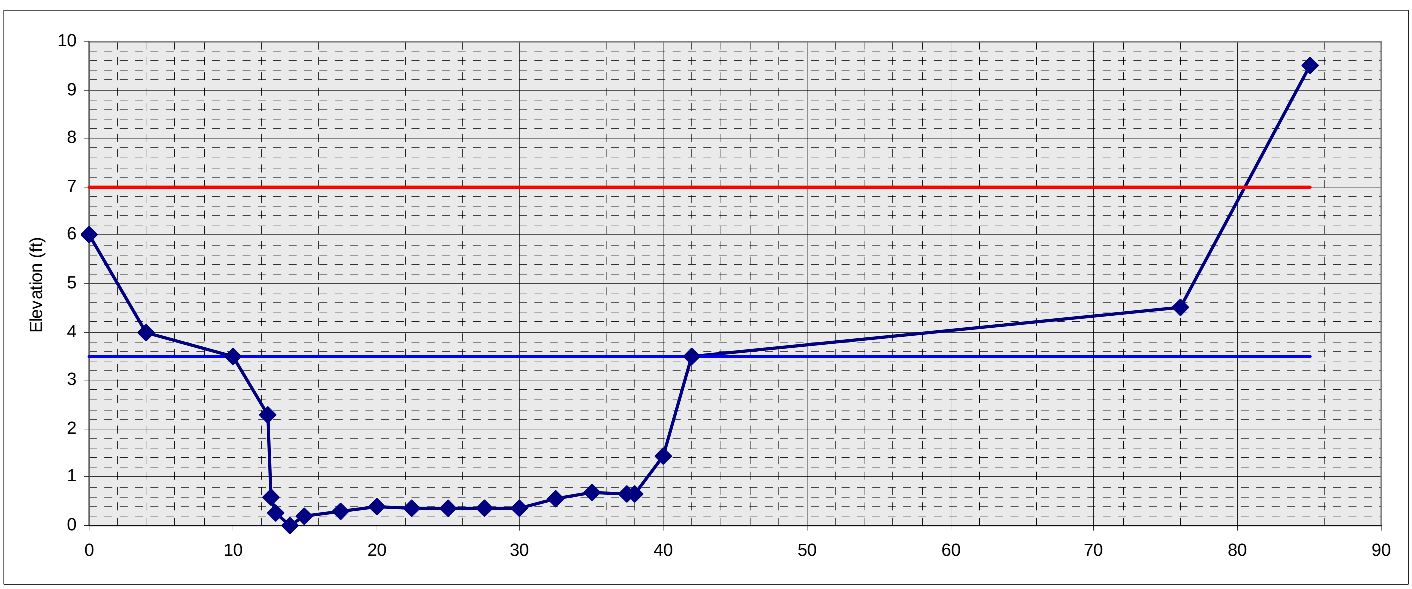
Appendix 6

Cross-sectional plots for Alder Brook reaches and segments are found below (all units in feet). The horizontal **blue line** represents the bankfull width and depth, and the **red line** represents the field-estimated floodprone depth and width (if visible on plot). Reaches/segments with multiple cross sections are denoted by X1, X2, etc.

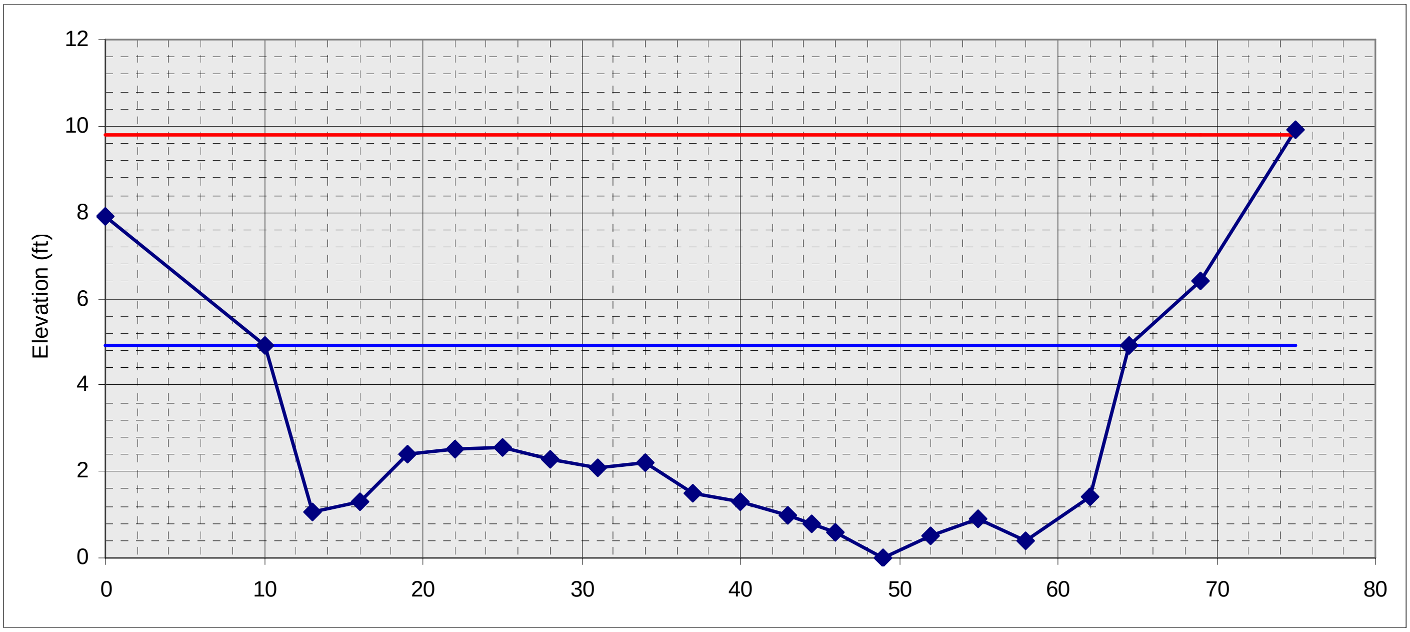
Reach M01



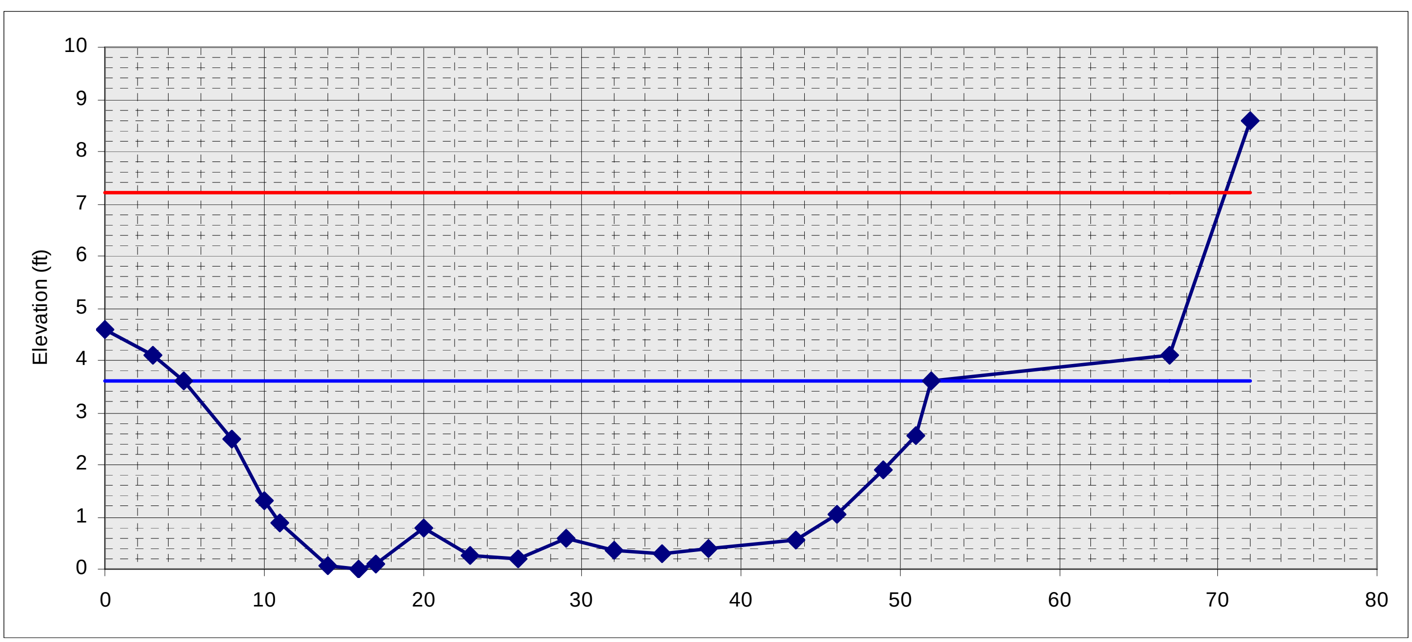
Reach M02 – X1



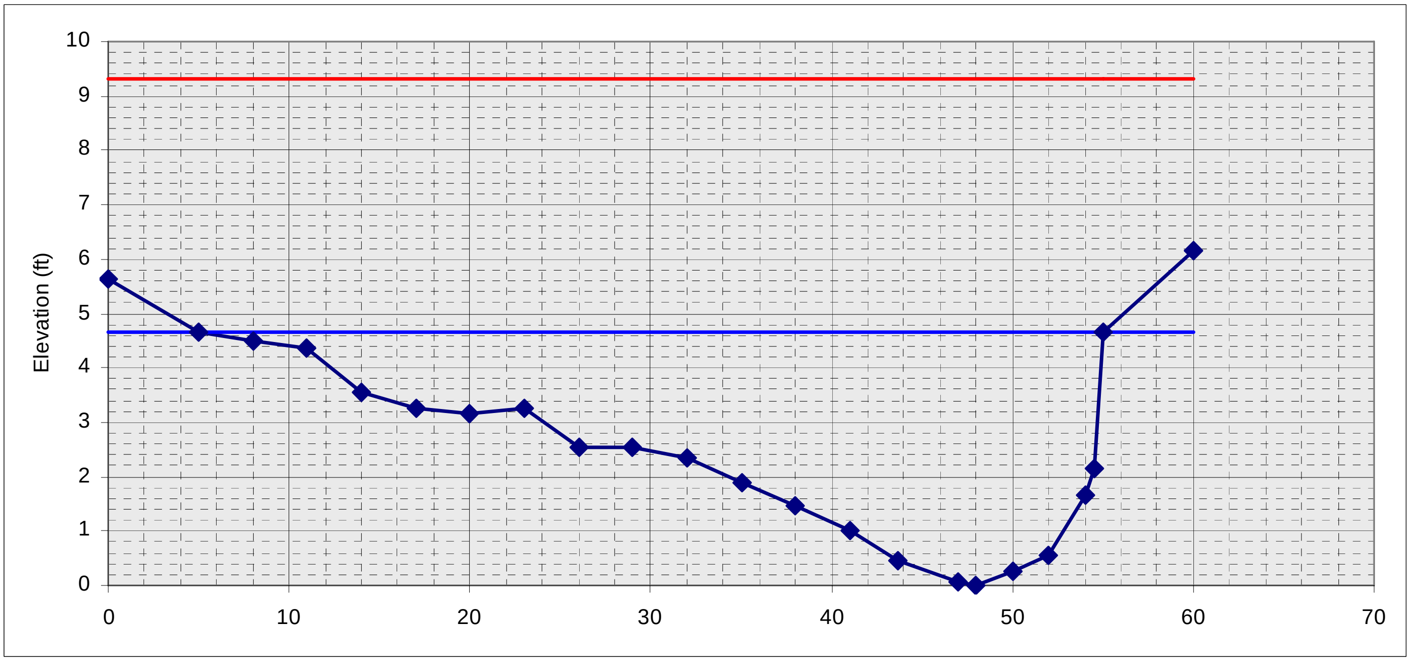
Reach M02 – X2



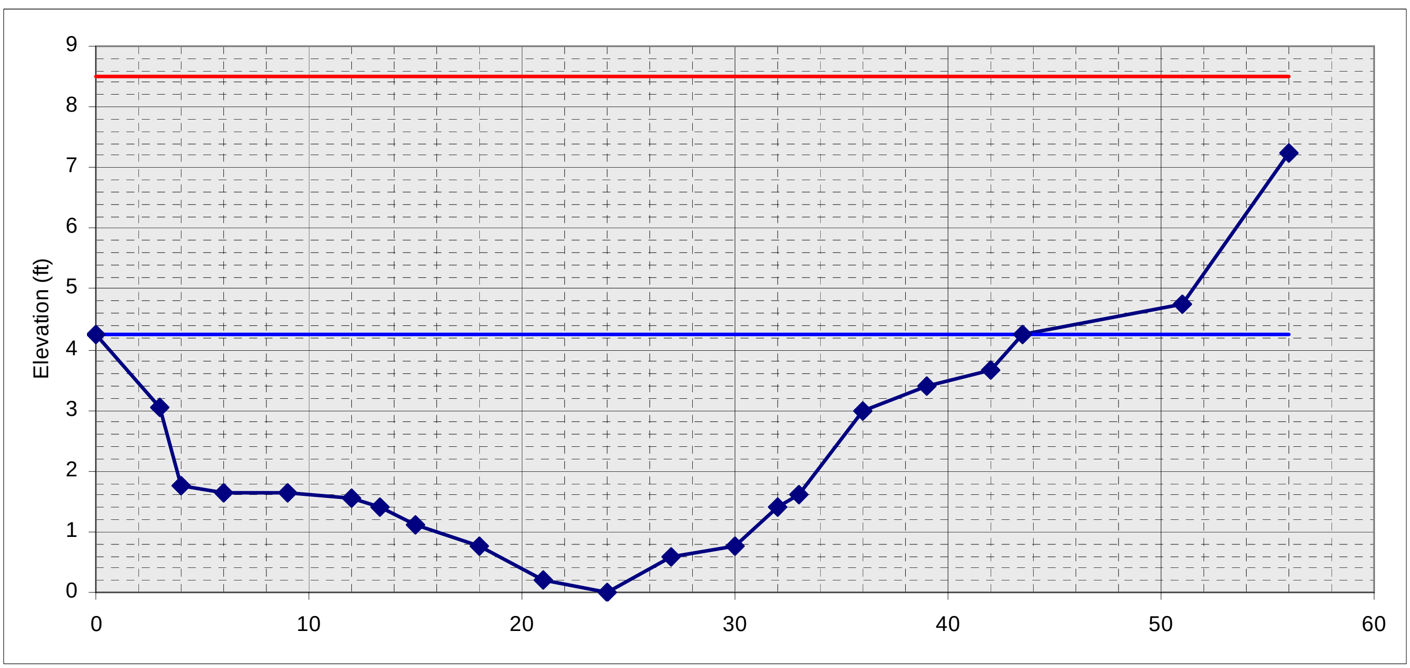
Segment M03-A



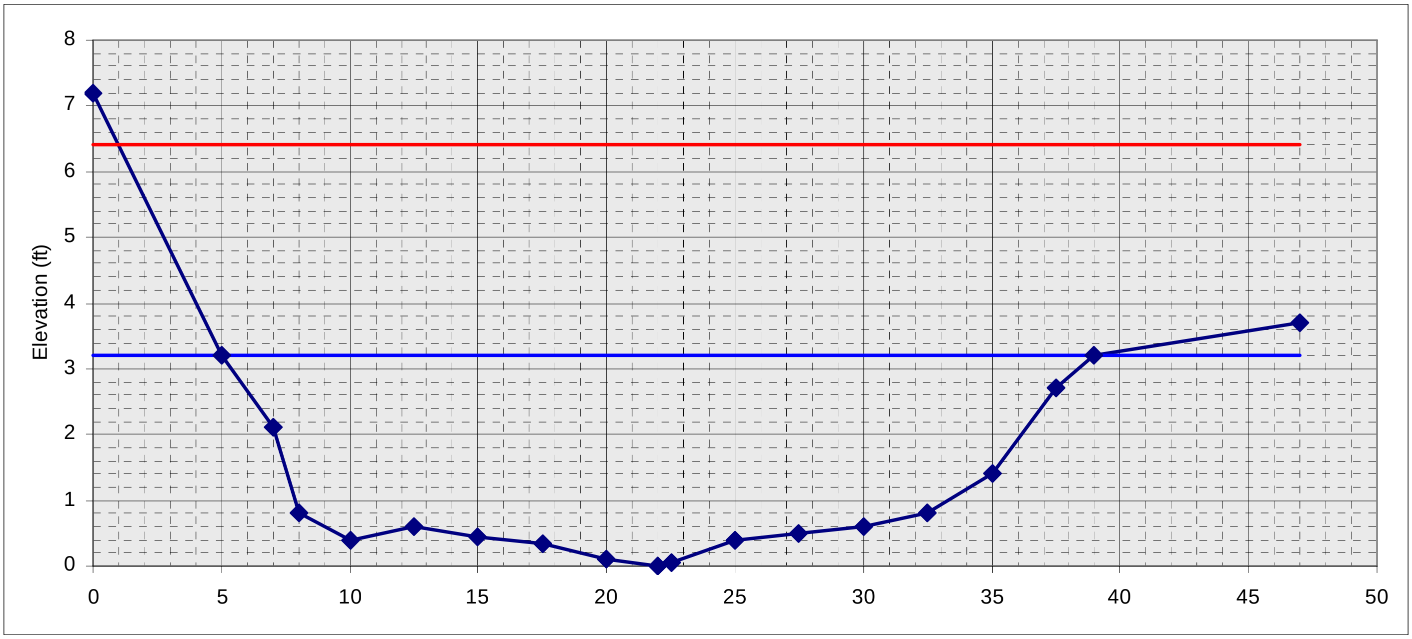
Segment M03-B



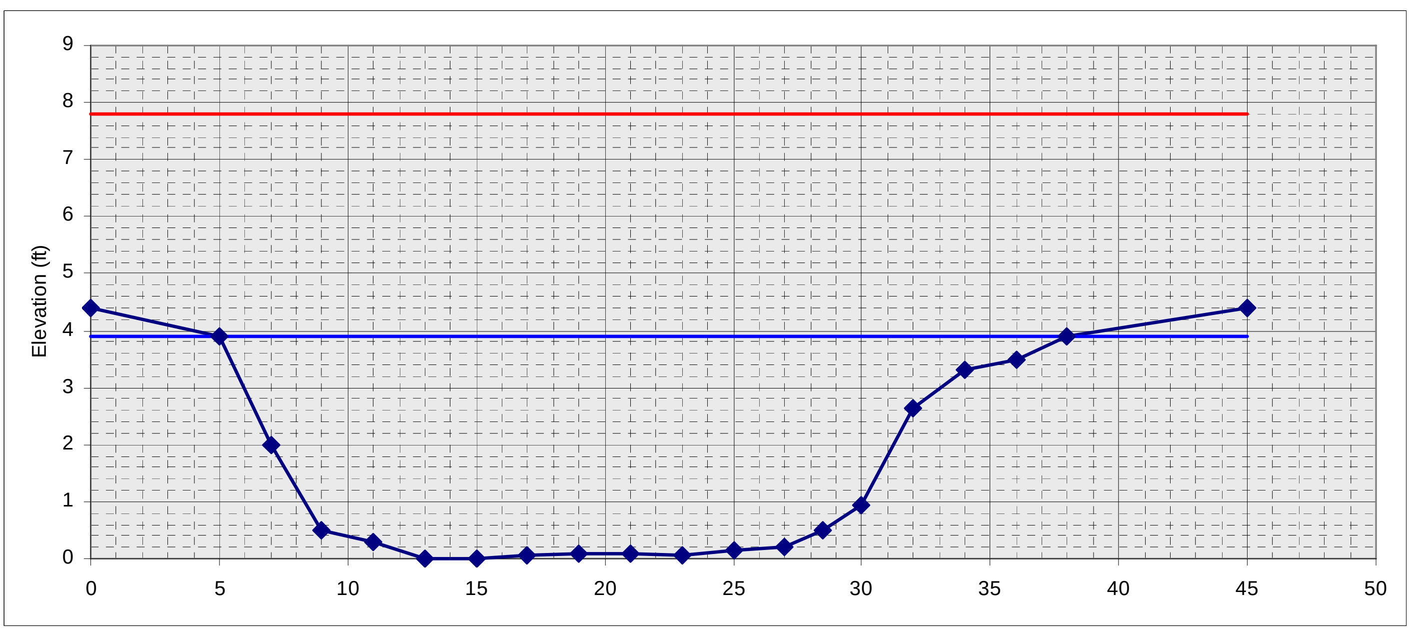
Reach M04



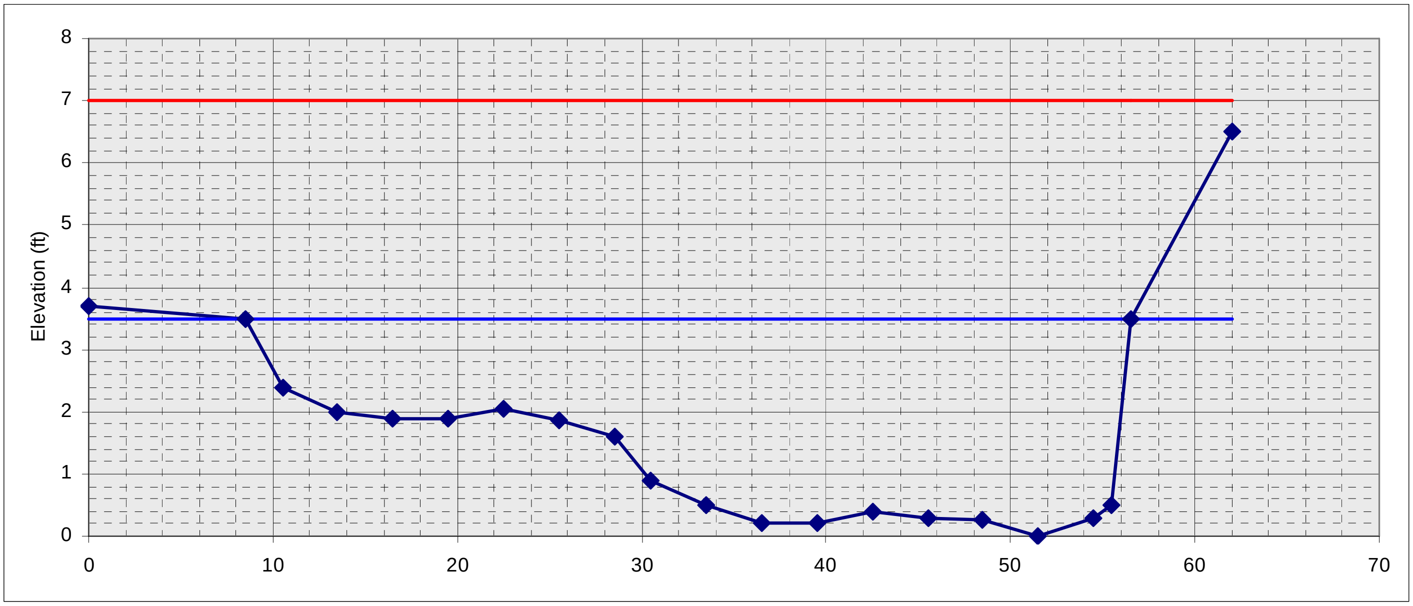
Reach M05



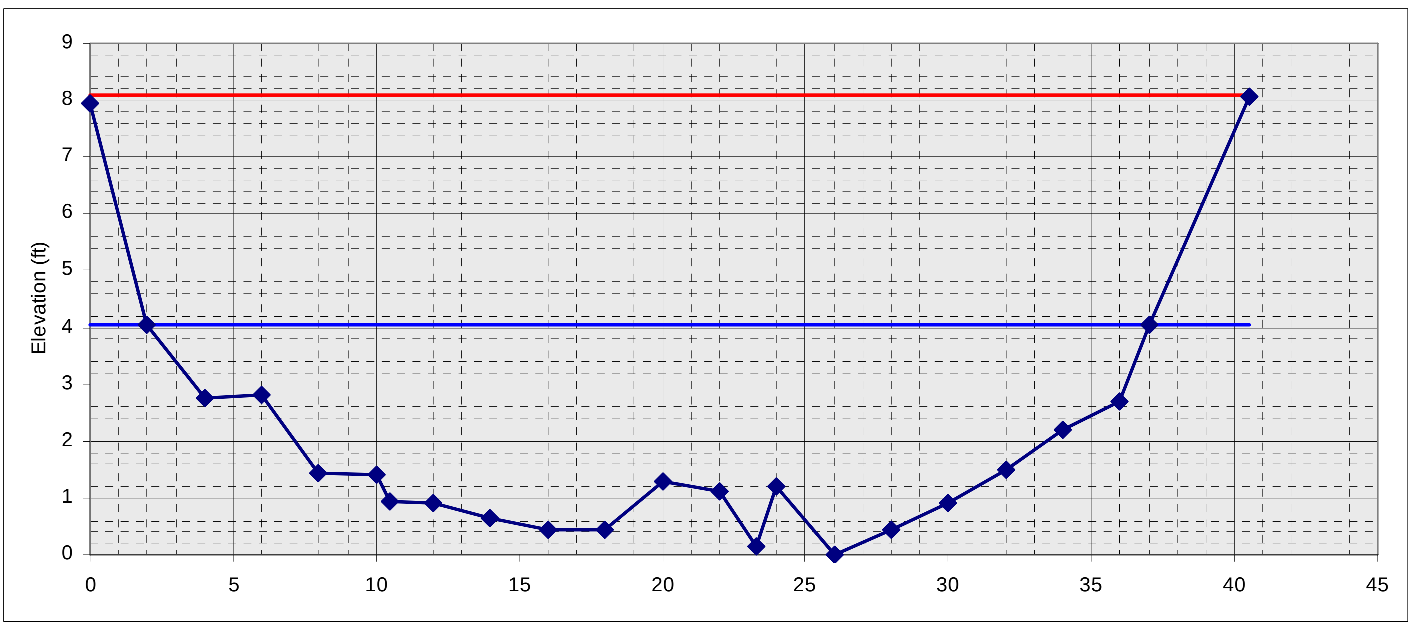
Reach M06 X1



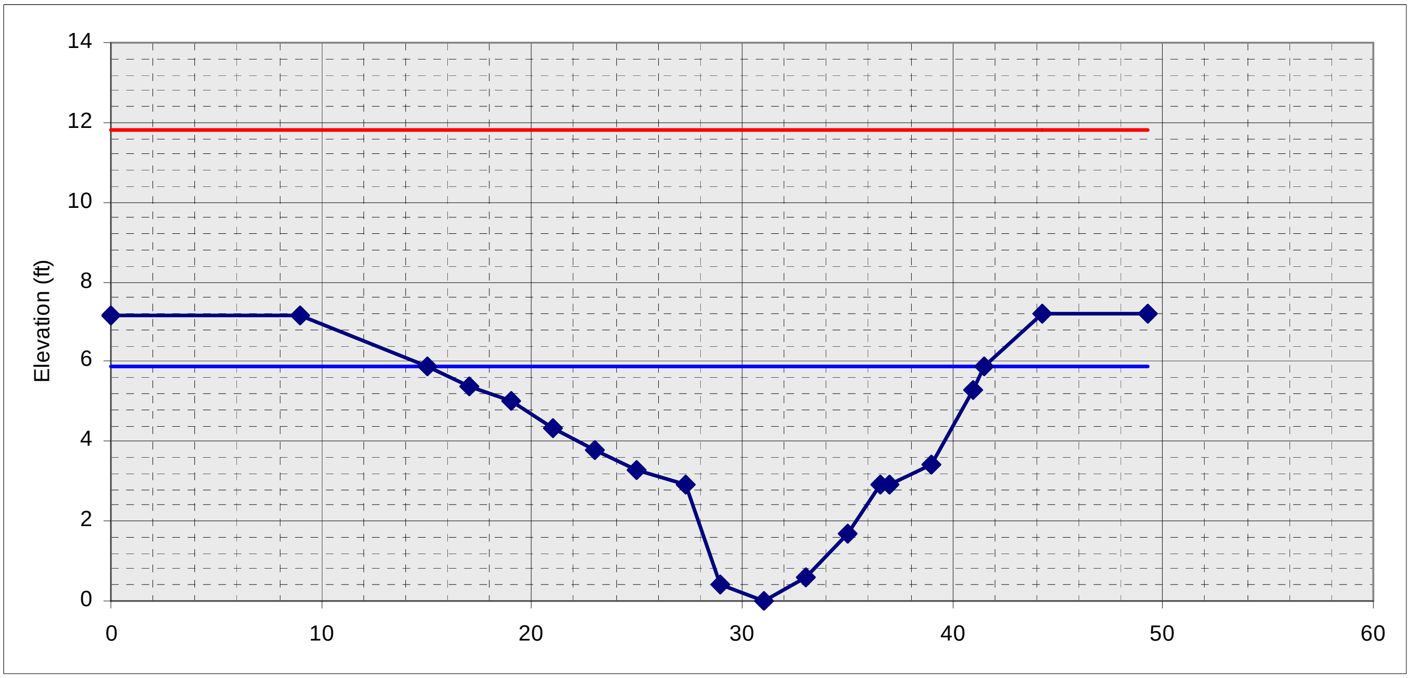
Reach M06 – X2



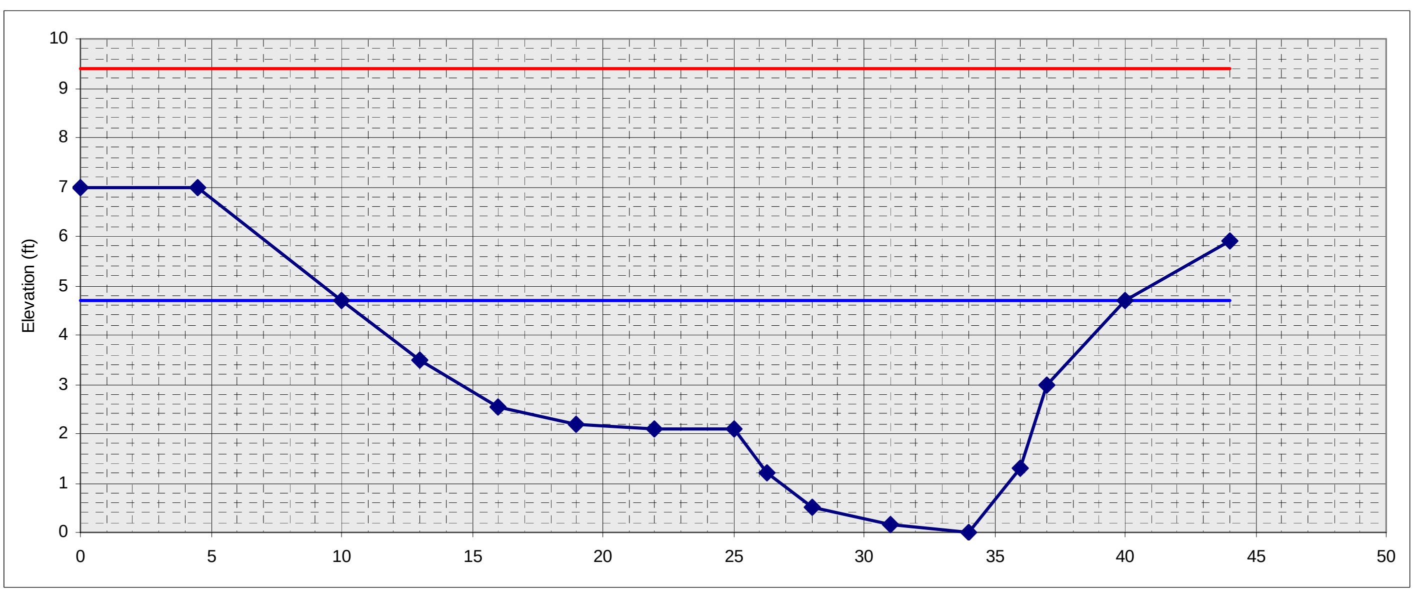
Reach M07



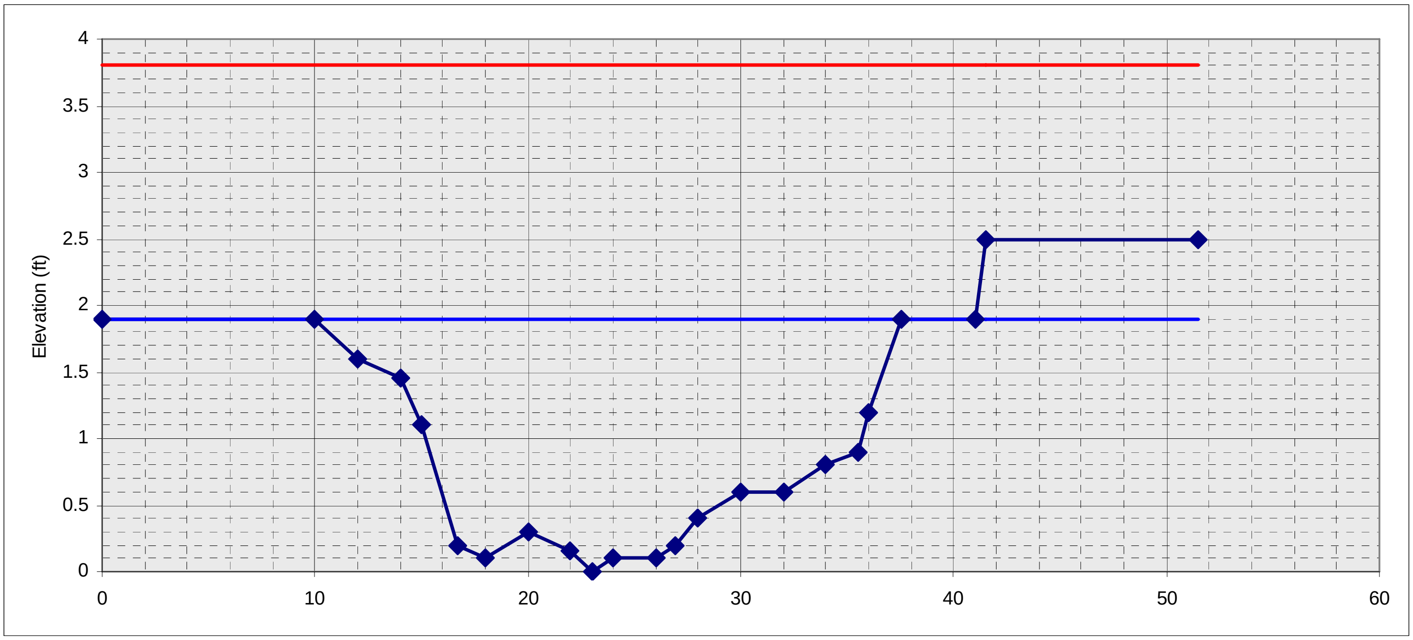
Segment M08-B – X1



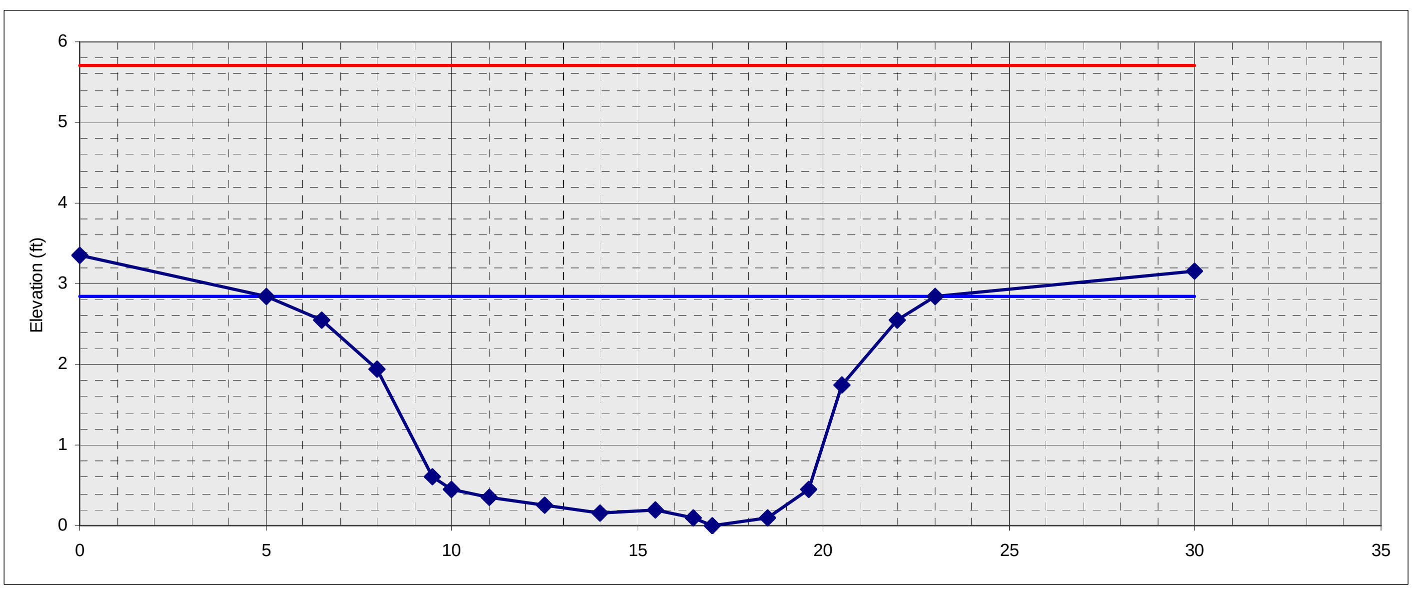
Segment M08-B – X2



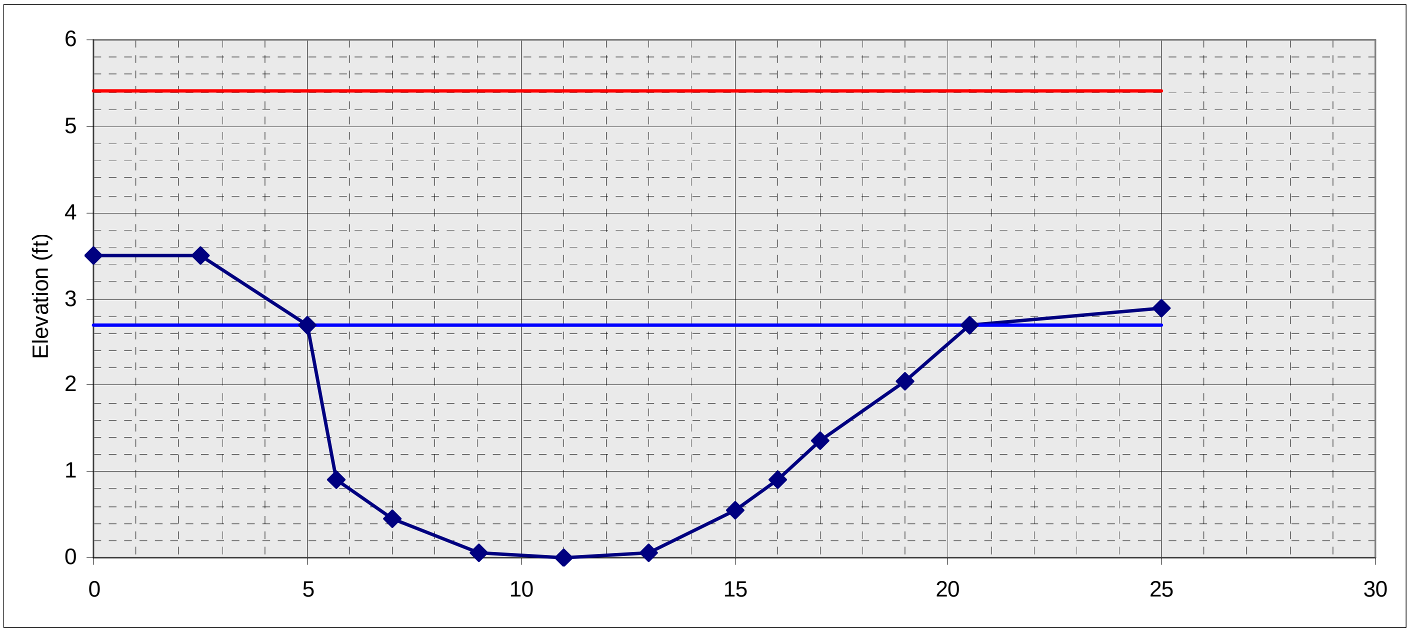
Segment M09-C



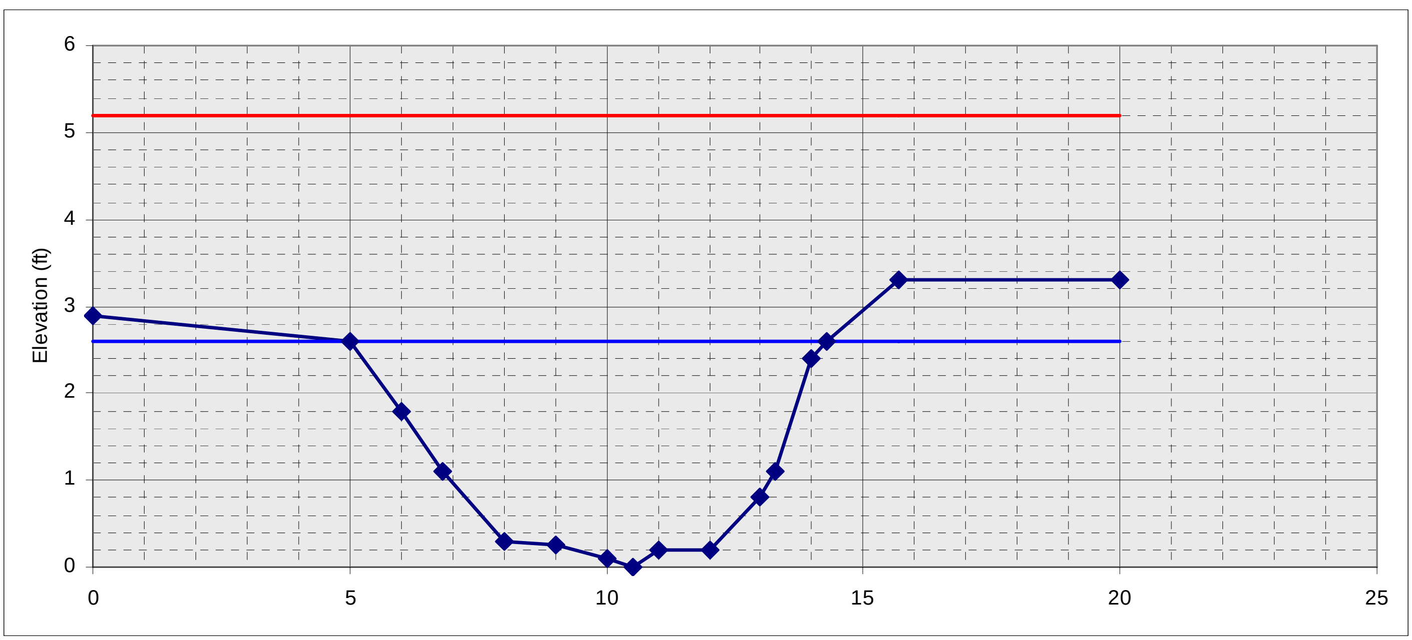
Reach M10



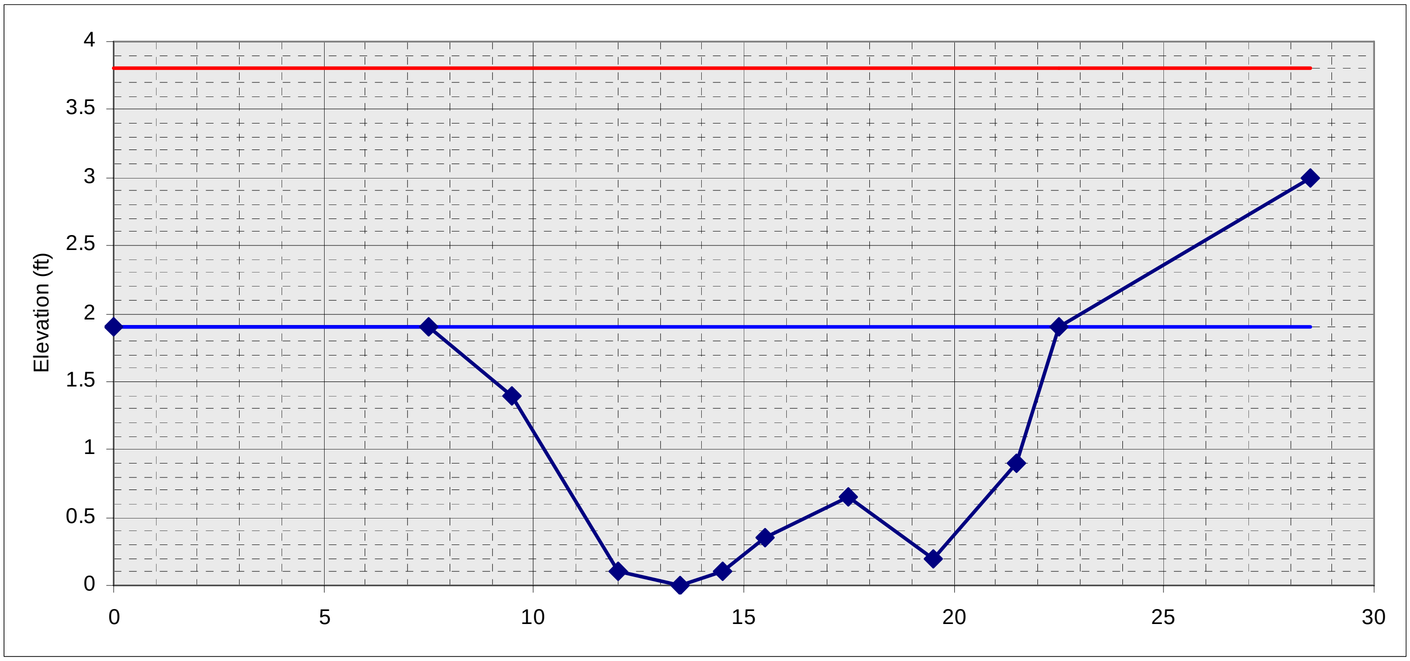
Reach M11



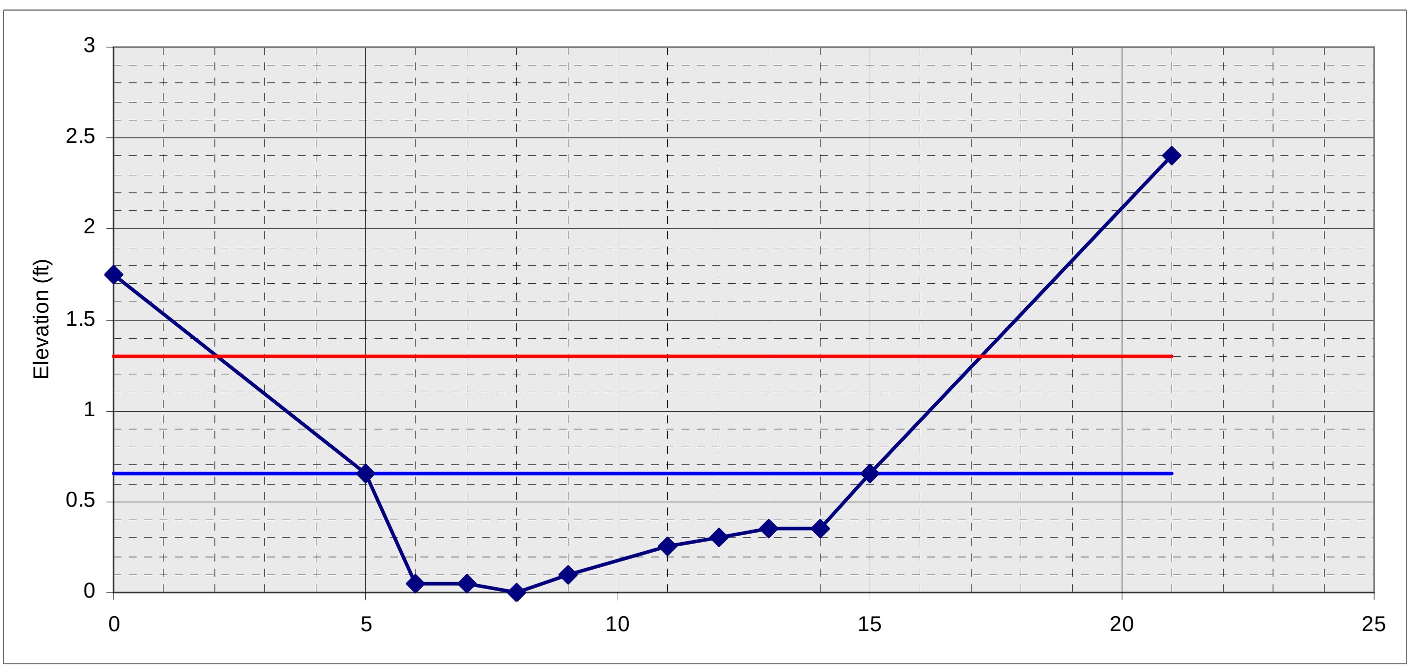
Segment M13-B



Segment M14-B



Reach M15



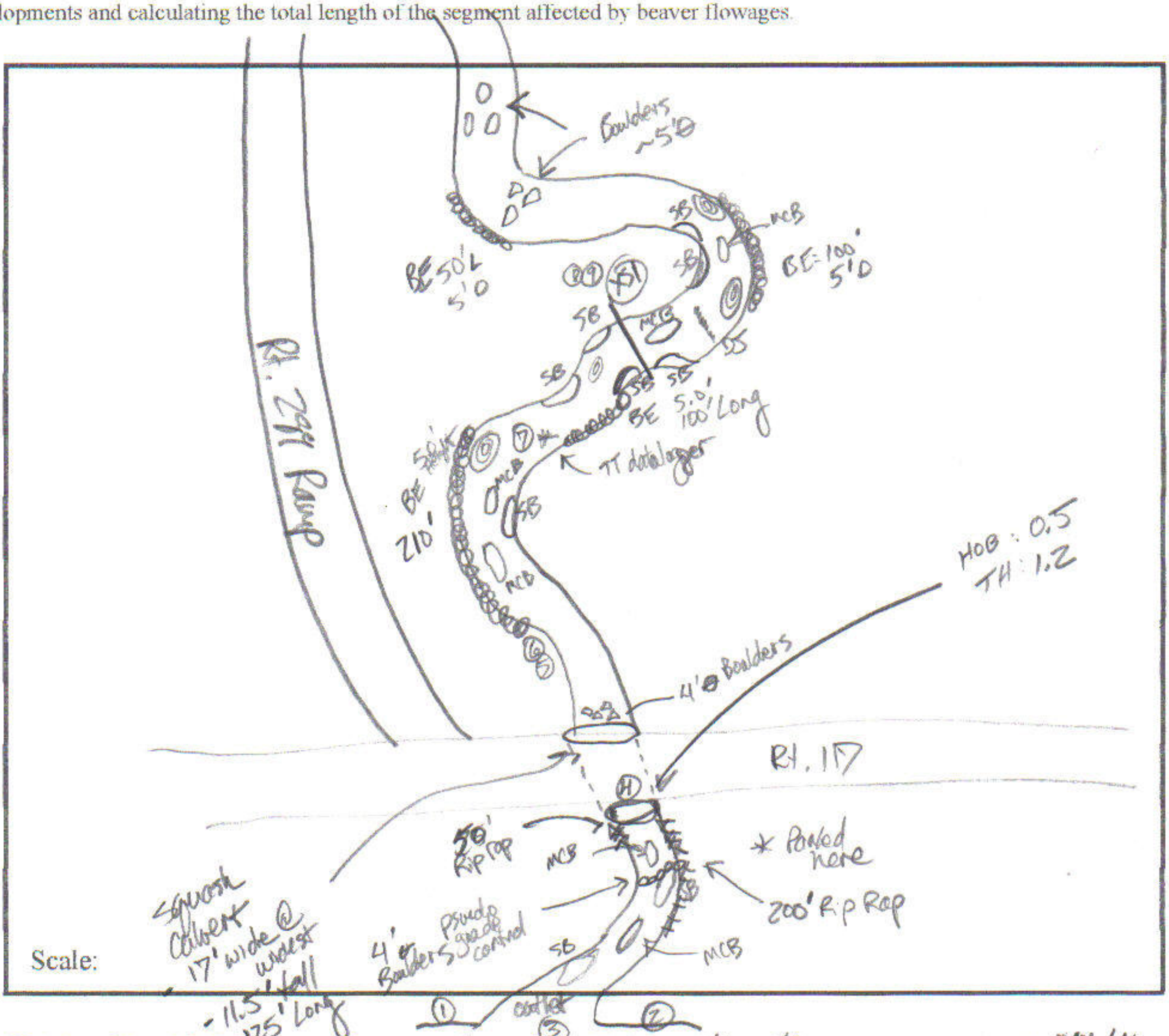
Appendix 7 – Reach Field Sketches

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 7/31/06
Observers: EPF + CMB
Organization /Agency: FEA + EWA

Segment or Site ID: M01
Town: Essex
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Winooski

Height of bankfull features above water surface (Ft.)

3.75' 4.0'

Selected BKF Height

LWD tally ~~||||~~ |||
Debris Jams /
Stormwater
Constrictions

(culverts, bridges, old footings, bedrock)

(#) = Photo #

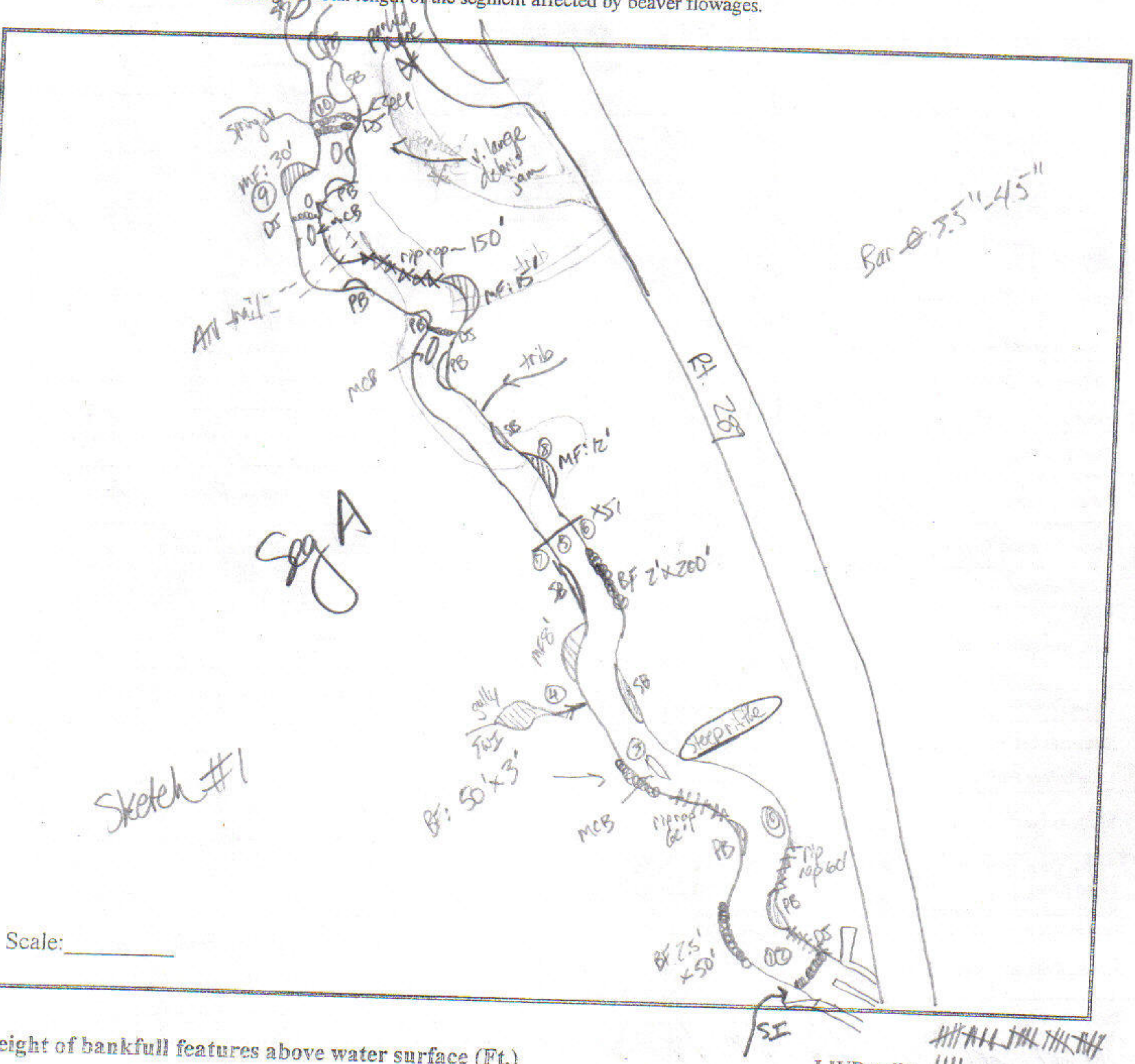
Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Location: West of Rt. 289

Observers: FPF + SNL
Organization /Agency: FEA + EWA

Segment or Site ID: M03-A
Date: 8/1/06
Town: Essex
Elevation: 300 bottom Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Scale: ______

Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally |||| ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~
Debris Jams
Stormwater
Constrictions
(culverts, bridges, old footings, bedrock

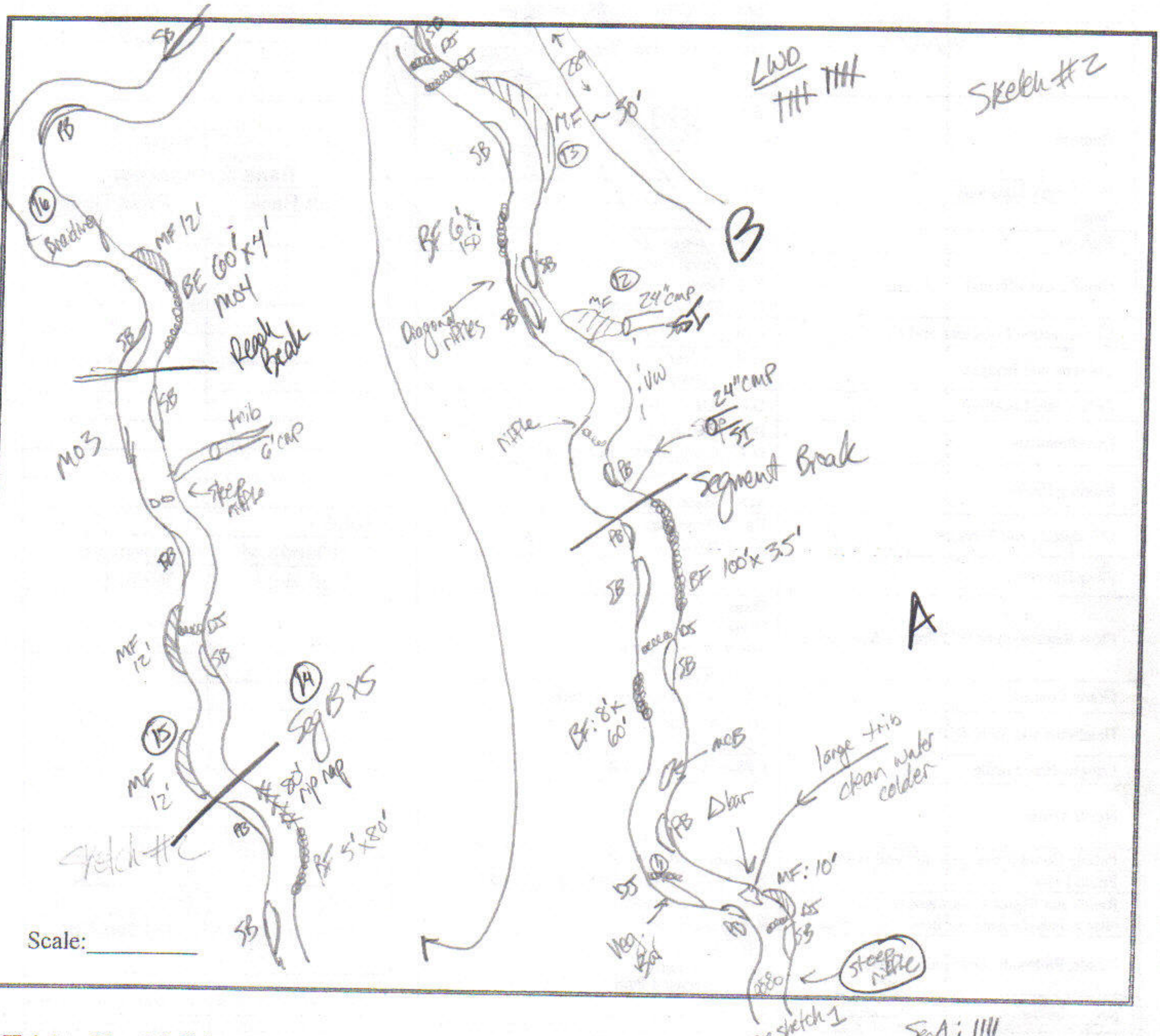
Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bh
Location:

Observers:
Organization /Agency:

Segment or Site ID: M03 A+B
Date:
Town:
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Scale:

Height of bankfull features above water surface (Ft.)

Selected BKF Height

Seg A: ||||
LWD tally
Debris Jams
Stormwater
Constrictions
(culverts, bridges, old footings, bedrock

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk

Date: 8/2/06

Observers: EAF + SNL

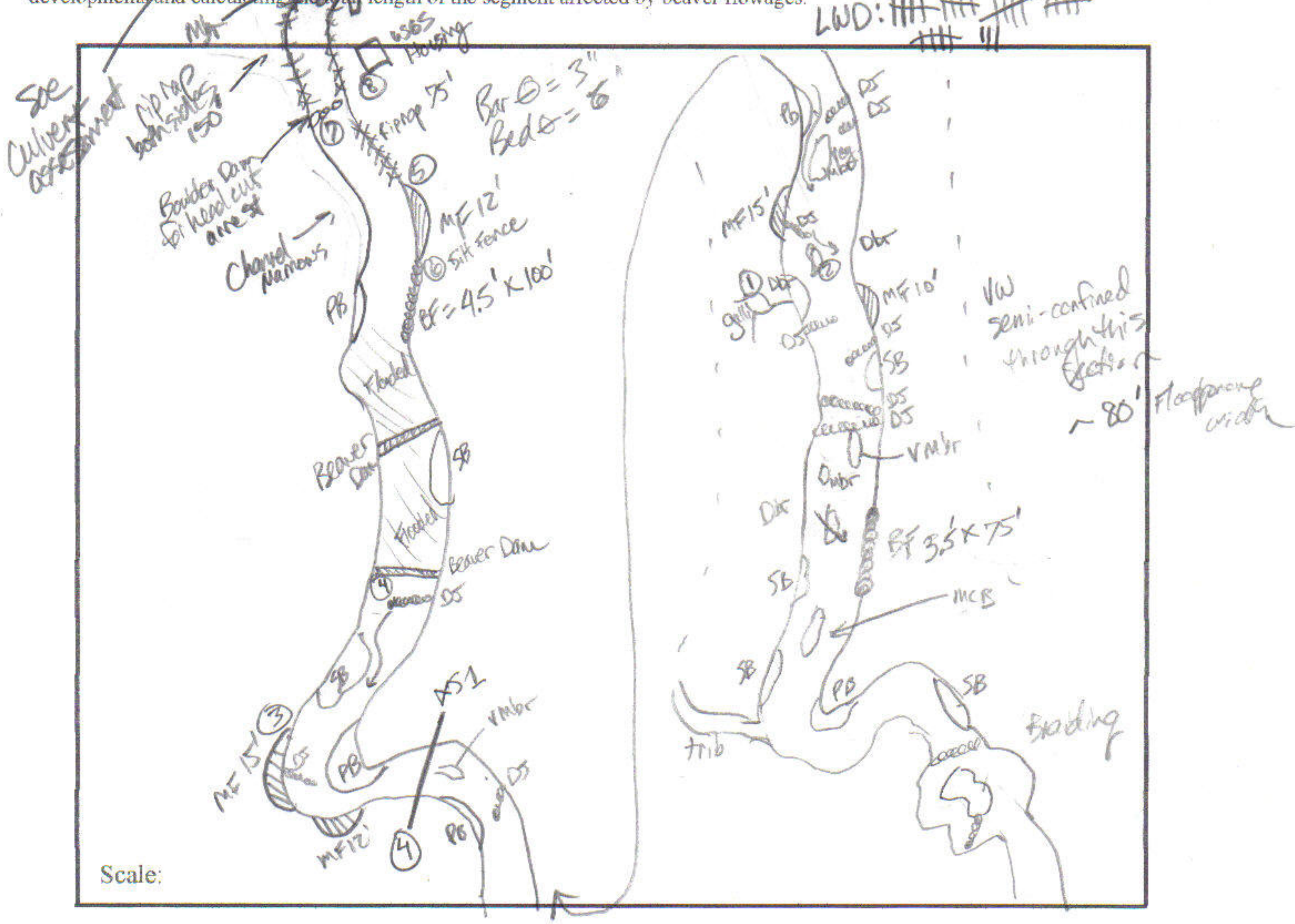
Organization /Agency: FEA + EWA

Segment or Site ID: M04

Town: Essex

Elevation: 350 (bottom) Ft.

Site Sketch - *see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.*



Height of bankfull features above water surface (Ft.)

2.6'

Selected BKF Height

LWD tally

Debris Jams

Stormwater

Constrictions

(culverts, bridges, old footings, bedrock)

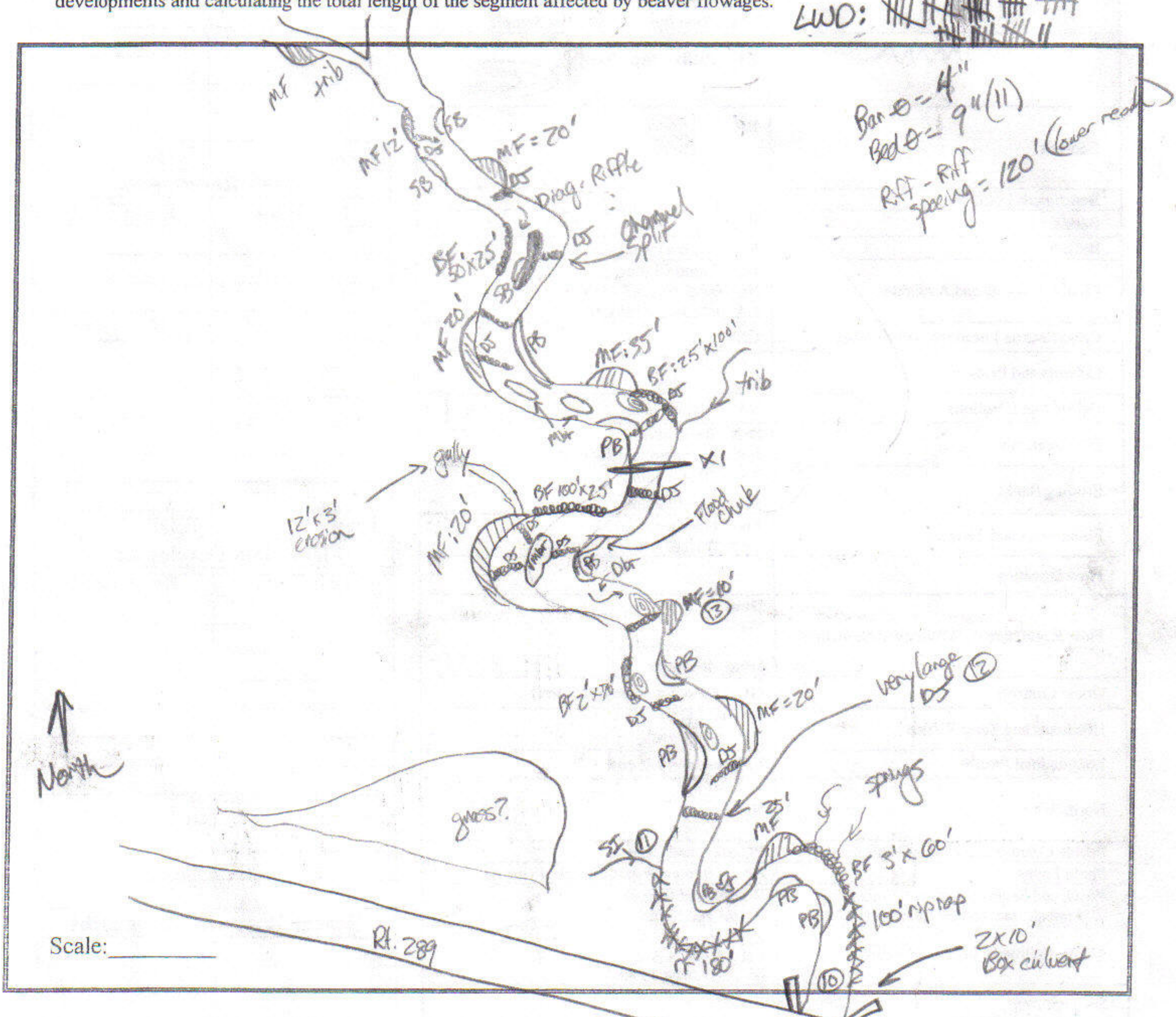
Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Location: Upper crossing of 289 to North

Observers: EPF + SNL
Organization /Agency: FEA + EWA

Segment or Site ID: M05
Date: 8/2/06
Town: Essex, VT
Elevation: 360 bottom Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

______ ______ ______ ______ ______ ______

______ ______ ______ ______ ______ ______

Selected BKF Height

LWD tally ________
Debris Jams ________
Stormwater ________
Constrictions ________
(culverts, bridges, old footings, bedrock

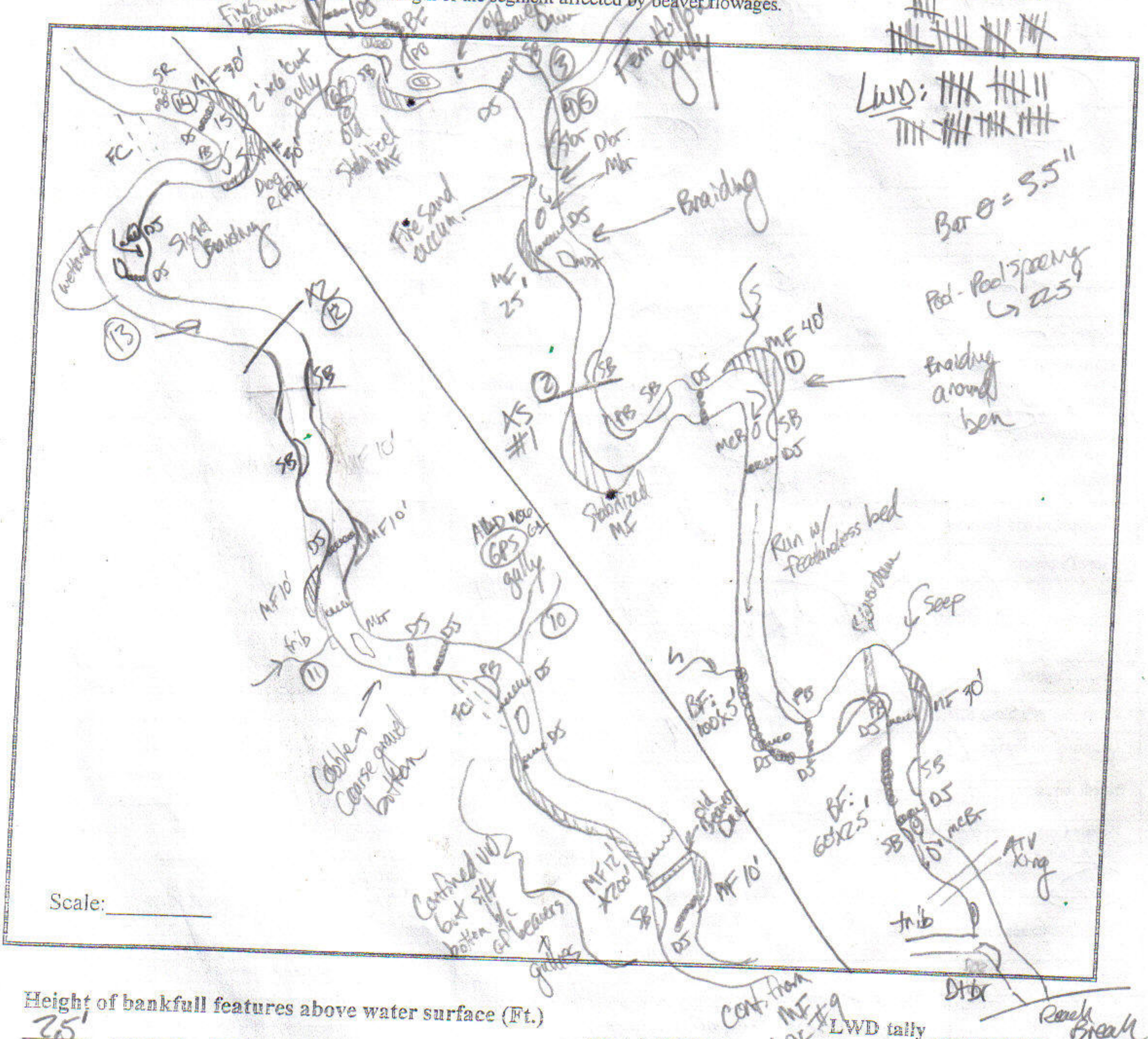
Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Location:

Segment or Site ID: M06
Date: 8/3/06
Town: Essex
Elevation: ______ Ft.

Observers: EPF & LEB
Organization /Agency: EVA & FRA

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Scale: ______

Height of bankfull features above water surface (Ft.)

2.5'

Selected BKF Height

LWD tally
Debris Jams
Stormwater
Constrictions
(culverts, bridges, old footings, bedrock

cont. from MF + pic #9

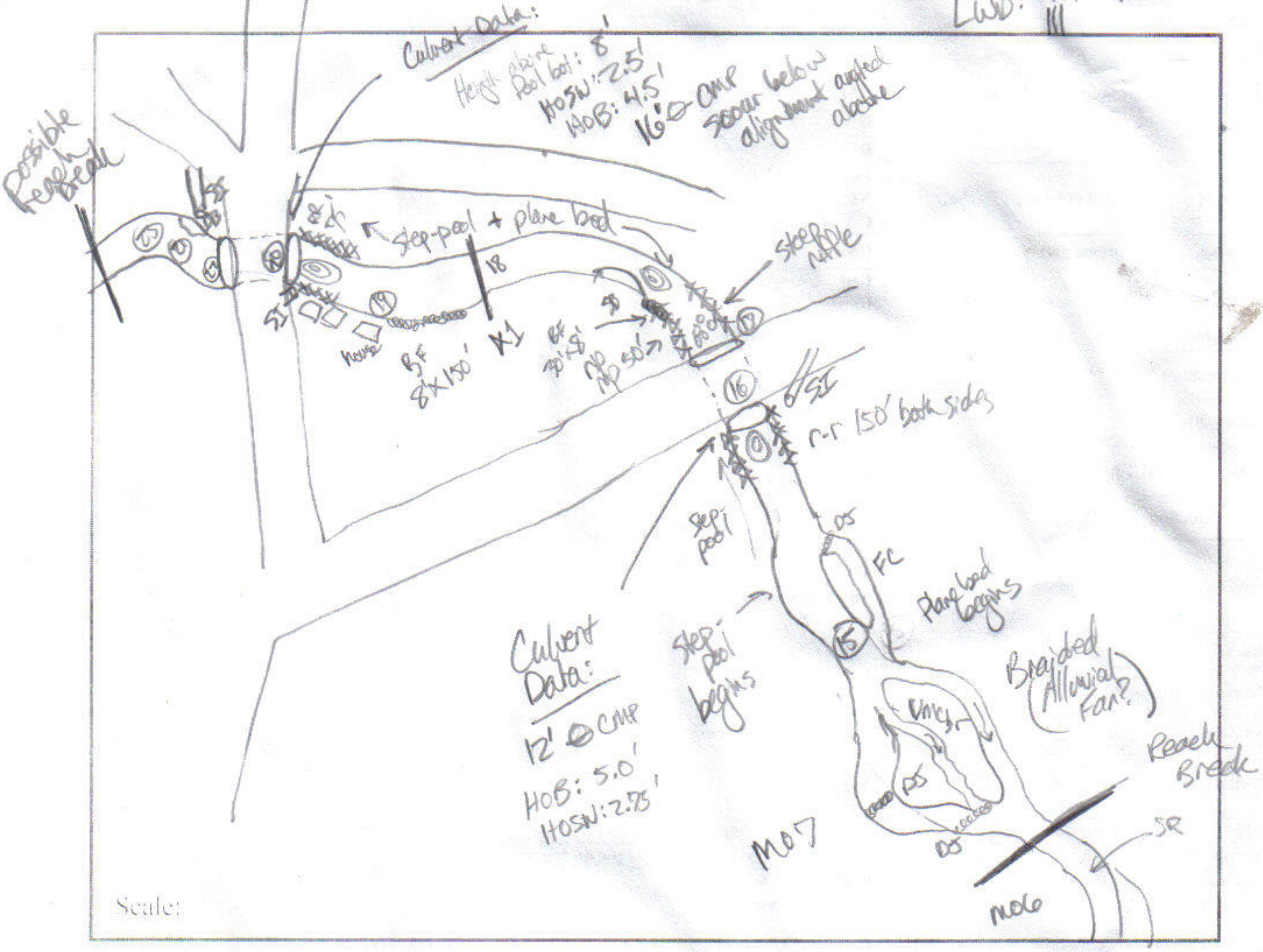
M05

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 8/3/06
Observers: EPF + LJB
Organization/Agency: FEA + EVA

Segment or Site ID: M07
Town: Essex
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally
Debris Jams
Stormwater
Constrictions

(culverts, bridges, old footings, bedrock)

(HD)

Sketch Form for Sites – Segments – Reaches

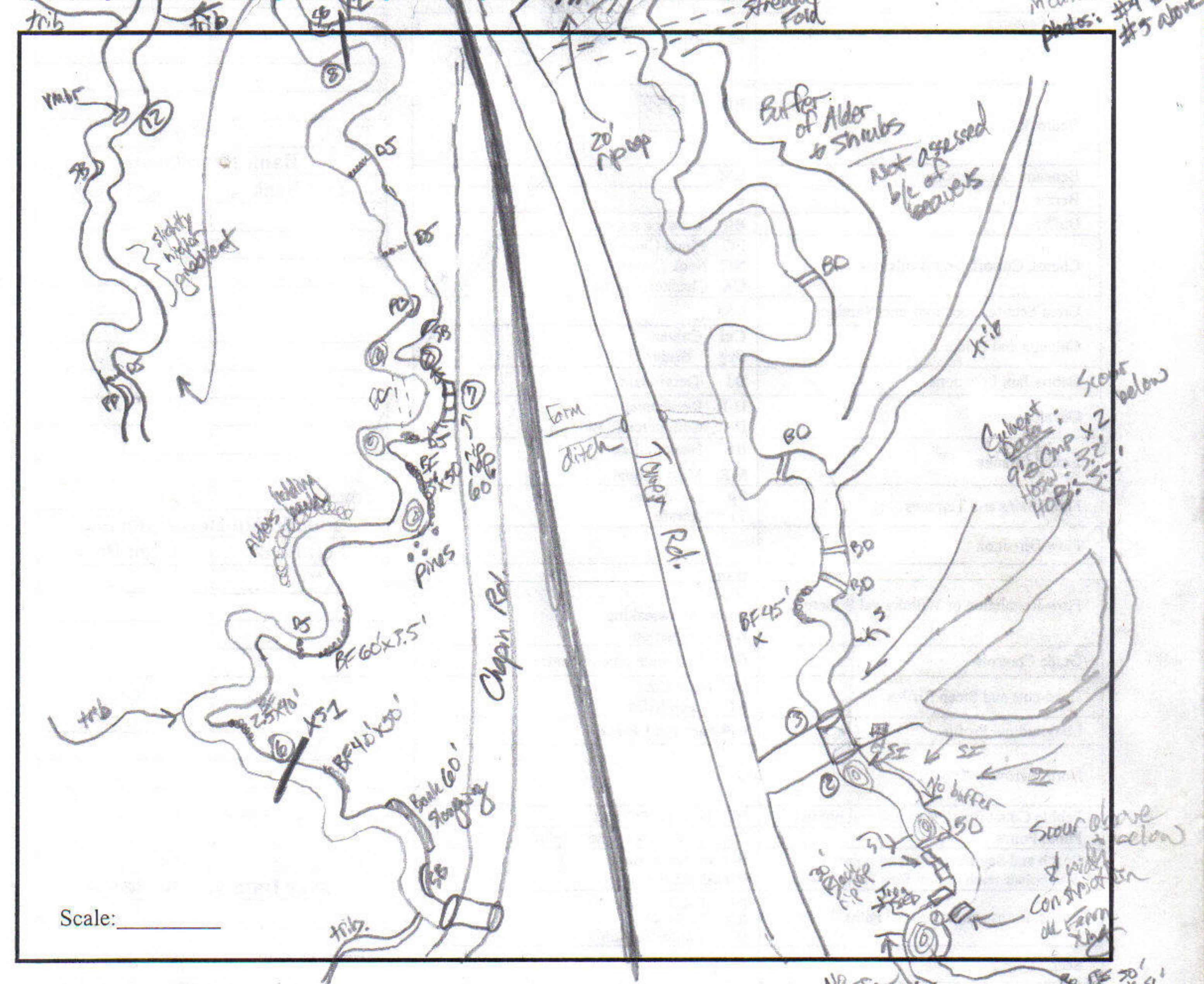
LWD – (tally marks)

Stream Name: Alder BK
Location: Along Tower Rd. & Chapin Rd.
Observers: FDF & LB & KP
Organization /Agency: FEA & ENA

Segment or Site ID: M08
Date: 8/4/06
Town: Essex
Elevation: ________ Ft.

Chapin Rd. Culvert Data:
15' CMP
HOB: 2.6'
depth in culvert: 2.6'
photos: #4 below #5 above

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Scale: ________

Height of bankfull features above water surface (Ft.)
2.9'

Selected BKF Height

LWD tally ________
Debris Jams ________
Stormwater ________
Constrictions ________
(culverts, bridges, old footings, bedrock

April, 2004

"great cube"

LWD:

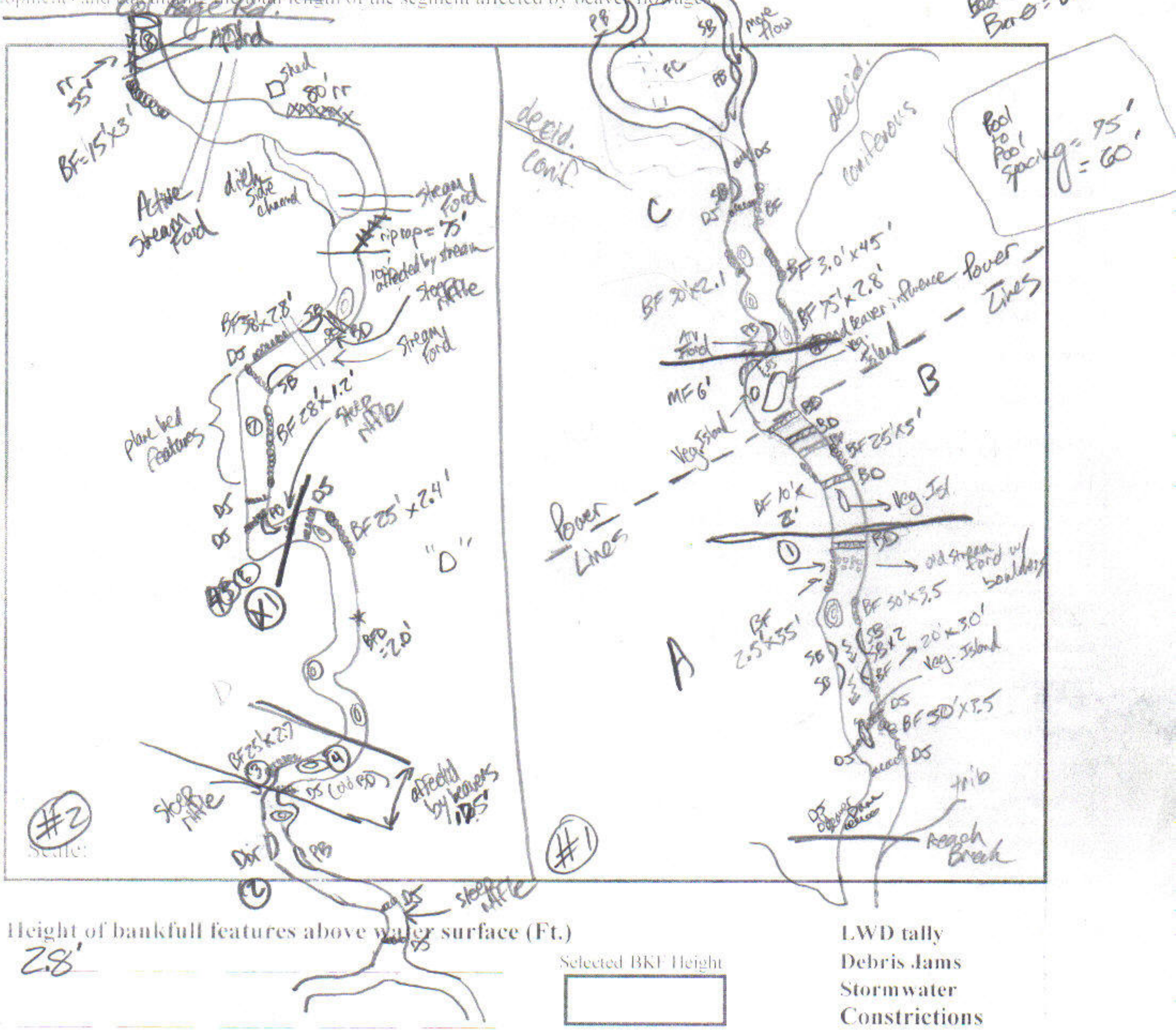
Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 8/9/06
Observers: EPF + KP
Organization/Agency: PEA + EWA

Segment or Site ID: M09
Town: Essex Jt
Elevation: 490 (?) Ft.
bottom

(0.3')
Bed ⊘ = 0.2'–0.4'
Bar ⊘ = 0.15

Site Sketch – see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



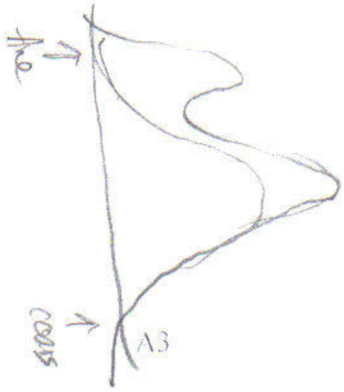
Scale:

Height of bankfull features above water surface (Ft.)
2.8'

Selected BKF Height

LWD tally
Debris Jams
Stormwater
Constrictions
(culverts, bridges, old footings, bedrock)

Culvert data:

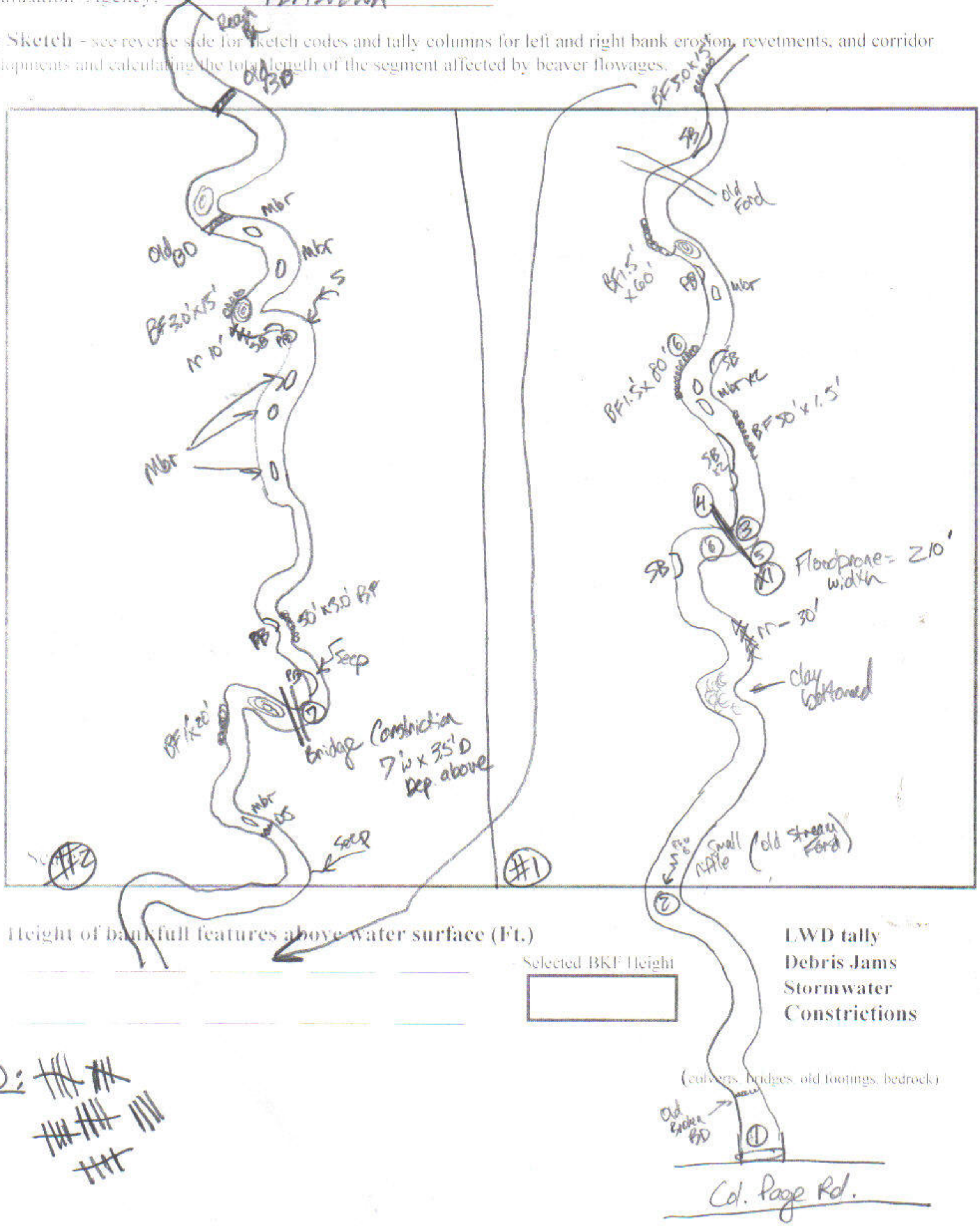


Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 8/11/06
Observers: EPF
Organization /Agency: ~~X~~ FEA + EWA

Segment or Site ID: M10
Town: Essex, VT
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally
Debris Jams
Stormwater
Constrictions
(culverts, bridges, old footings, bedrock)

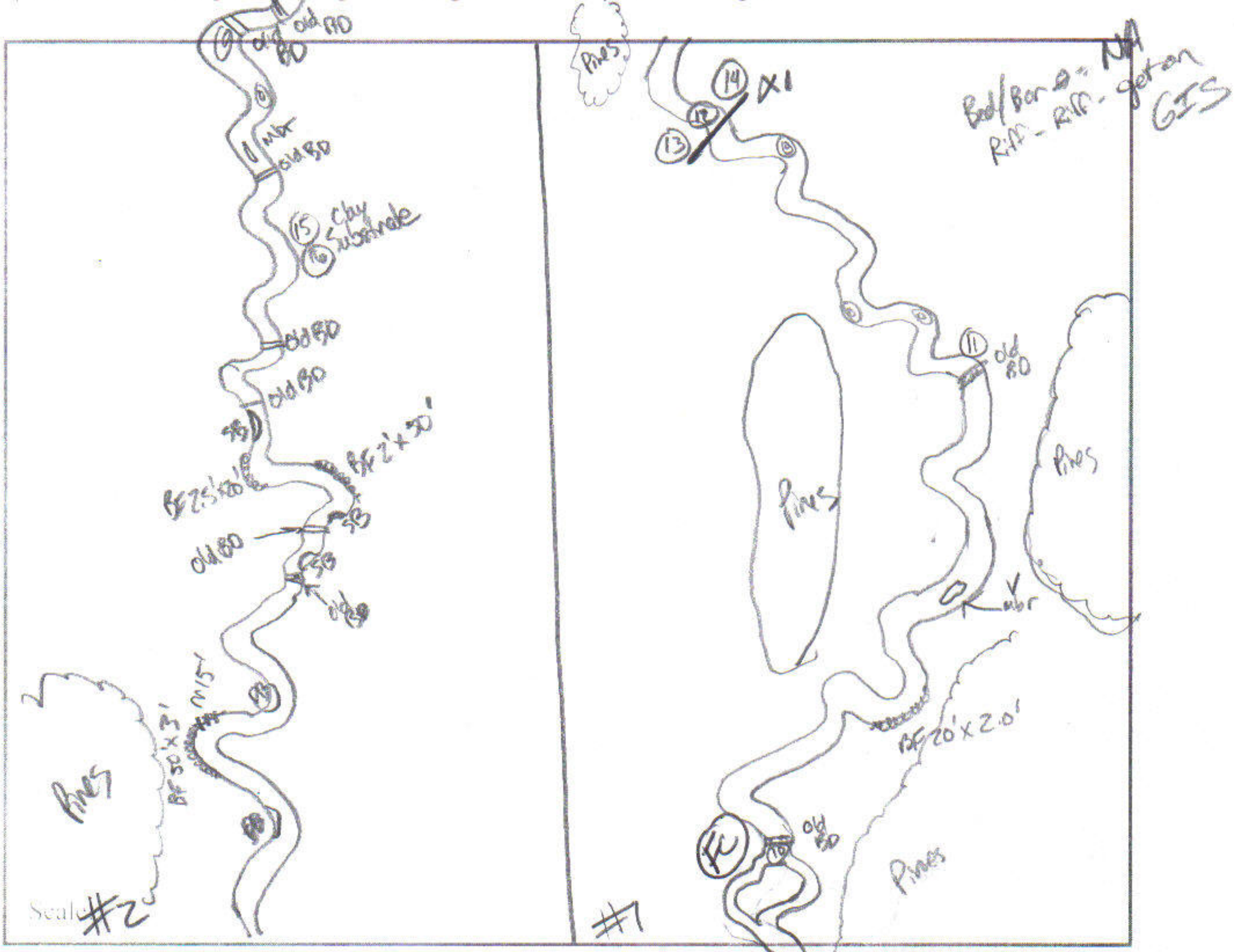
LWD: 卌 卌 卌 卌 |||| 卌

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 8/11/06
Observers: EPF
Organization /Agency: FWA + FEA

Segment or Site ID: M11
Town: Essex, VT
Elevation: 495 (?) Ft.

Site Sketch - see reverse side for sketch icons and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

BF 2'x30'

LWD tally
Debris Jams
Stormwater
Constrictions (culverts, bridges, old footings, bedrock)

BD

Reach Break

LWD
卌 卌 卌 卌 |||

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk

Date:

Observers:

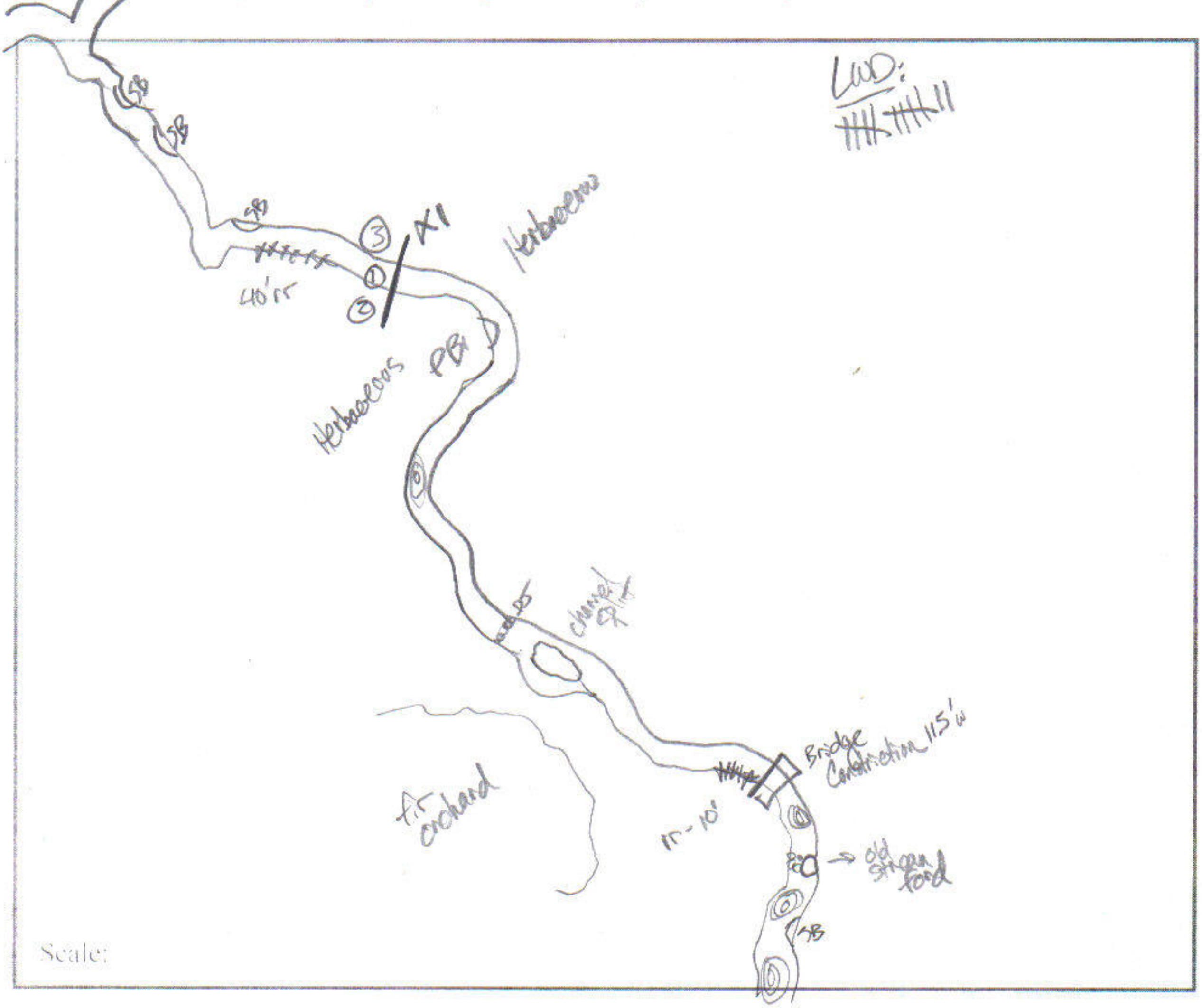
Organization/Agency:

Segment or Site ID: M13-B

Town:

Elevation: Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor development, and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally

Debris Jams

Stormwater

Constrictions

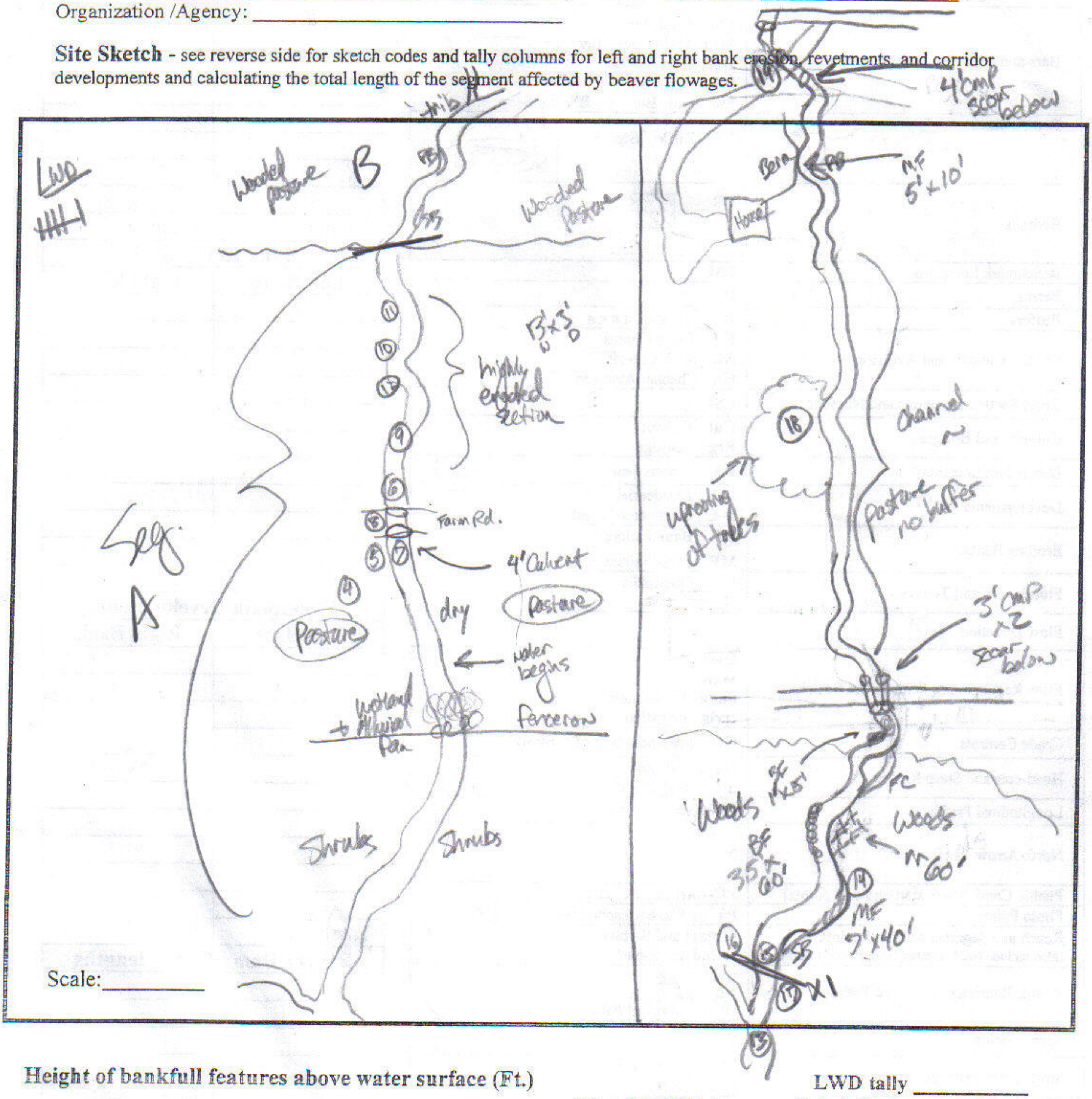
(culverts, bridges, old footings, bedrock)

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Location: ______
Observers: ______
Organization /Agency: ______

Segment or Site ID: M14-B
Date: 8/15/06
Town: Westford
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally ______
Debris Jams ______
Stormwater ______
Constrictions ______
(culverts, bridges, old footings, bedrock

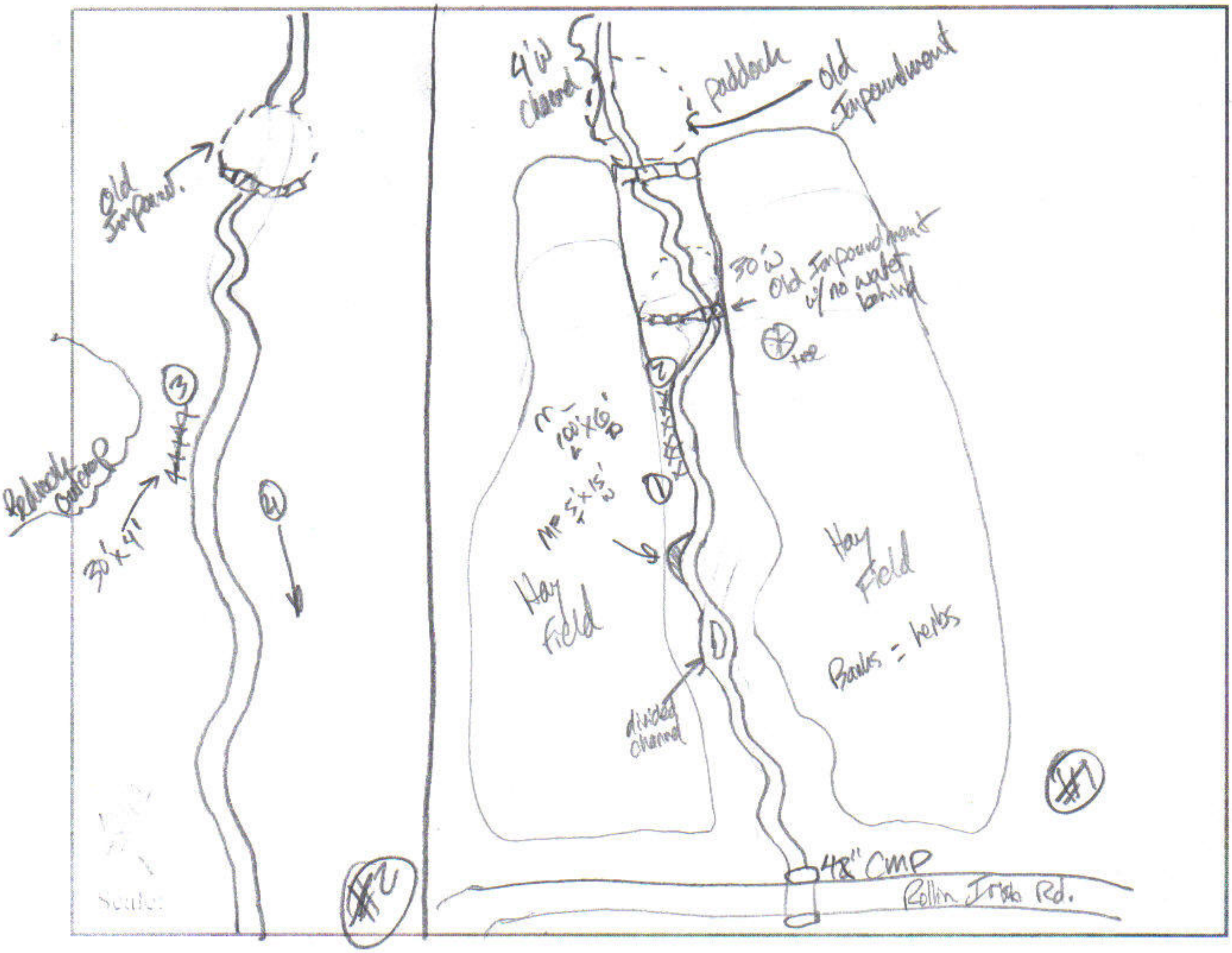
April, 2004

Sketch Form for Sites – Segments – Reaches

Stream Name: Allen BK
Date:
Observers:
Organization / Agency:

Segment or Site ID: M15
Town:
Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally
Debris Jams
Stormwater
Constrictions

(culverts, bridges, old footings, bedrock)

Born - Property owner above

Reynolds - Below in pasture

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk

Date: ______

Observers: ______

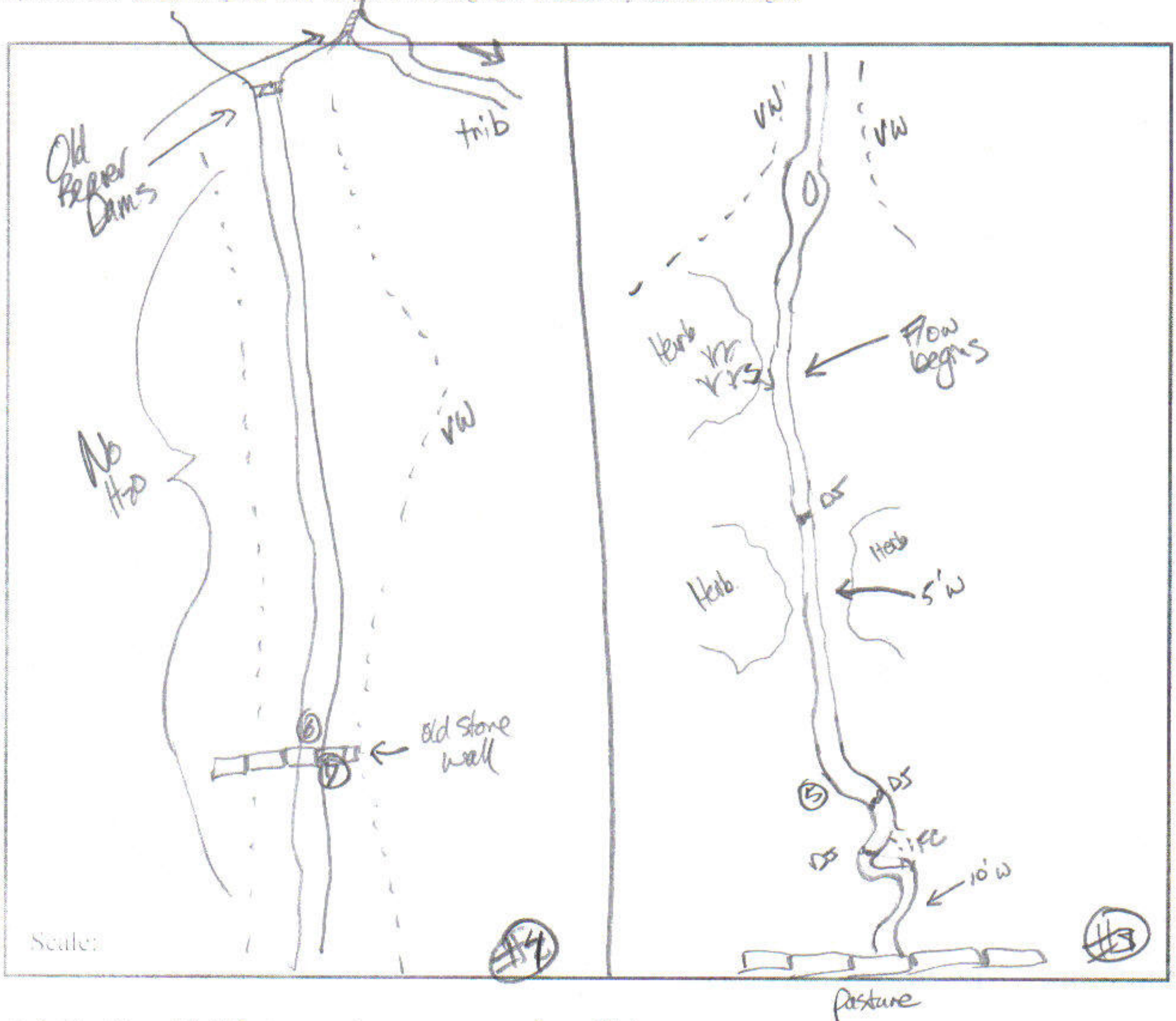
Organization/Agency: ______

Segment or Site ID: M15

Town: ______

Elevation: ______ Ft.

Site Sketch - see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.



Height of bankfull features above water surface (Ft.)

Selected BKF Height

LWD tally

Debris Jams

Stormwater

Constrictions

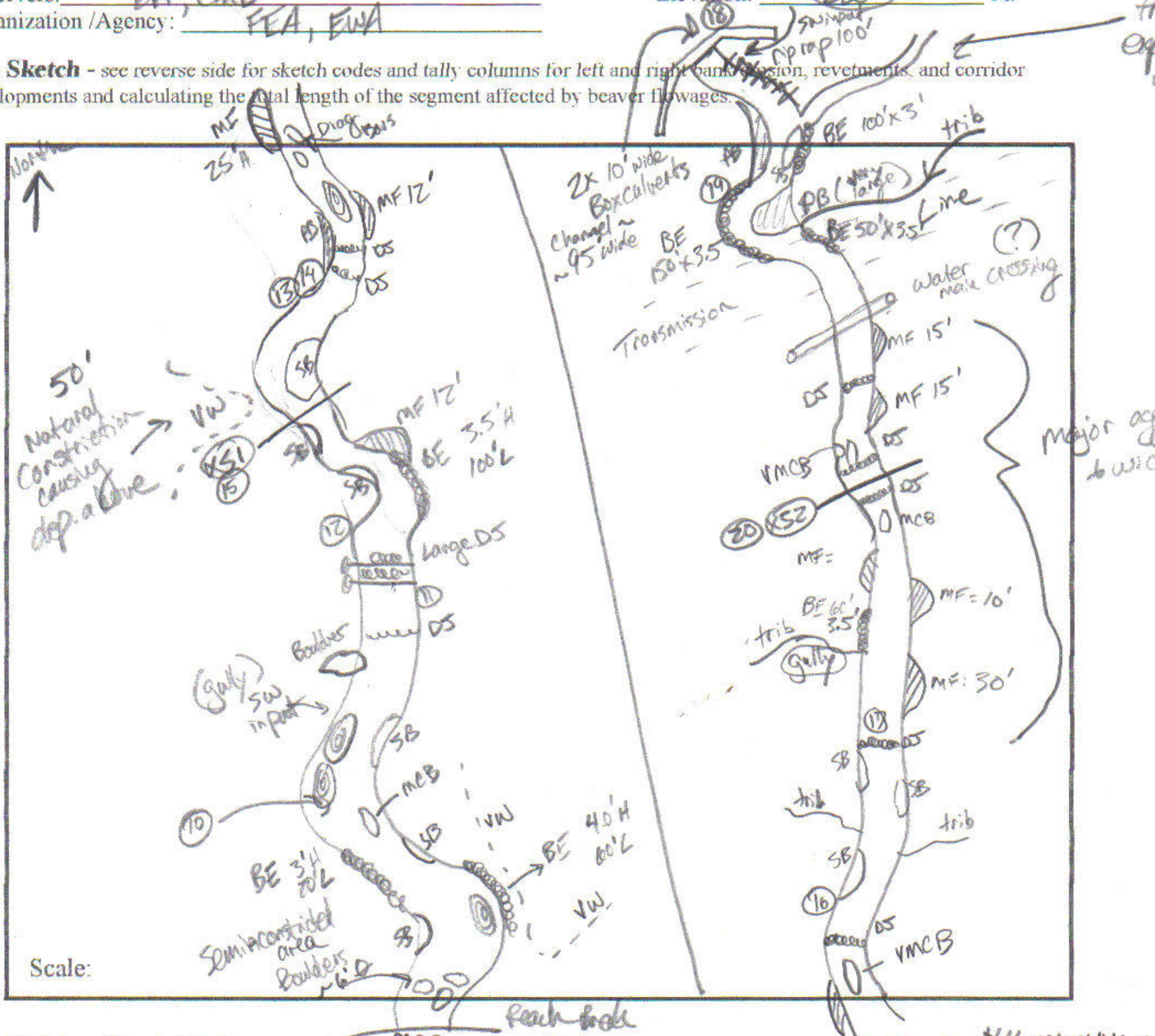
(culverts, bridges, old footings, bedrock)

Sketch Form for Sites – Segments – Reaches

Stream Name: Alder Bk
Date: 7/31/06
Observers: EPF, CMB
Organization /Agency: FEA, EWA

Segment or Site ID: M02
Town: Essex
Elevation: 280' Ft.

Site Sketch - *see reverse side for sketch codes and tally columns for left and right bank erosion, revetments, and corridor developments and calculating the total length of the segment affected by beaver flowages.*



Height of bankfull features above water surface (Ft.)

3.5'

Selected BKF Height

LWD tally ~~||||~~ ~~||||~~ ~~||||~~ ||| ~~||||~~
Debris Jams 9
Stormwater
Constrictions

(culverts, bridges, old footings, bedrock)

(#) = Photo #

Appendix 8. Alder Brook ANR Biomonitoring Results							
Date Sampled	ANR SiteID	Stream Mile	SGA Reach	Mean Density	Mean Species Richness	Mean EPT Richness	Community Assessment
10/17/1996	490700000003	0.3	M01	1368	37	17	Good
10/10/2001	490700000003	0.3	M01	1604	35	15	Good - Fair
10/2/2003	490700000003	0.3	M01	2220	44	18	Good - Very Good
8/24/2004	490700000003	0.3	M01	929	39	17	Good
9/30/1993	490700000028	2.8	M07	2210	27	14	Fair
10/13/2005	490700000041	4.1	M08-A	898	57	8	Good
10/14/1992	490700000048	4.8	M08-B	1004	44	15	Unrated

EPT: Sensitive Families of Ephemenoptera, Plecoptera, Trichoptera