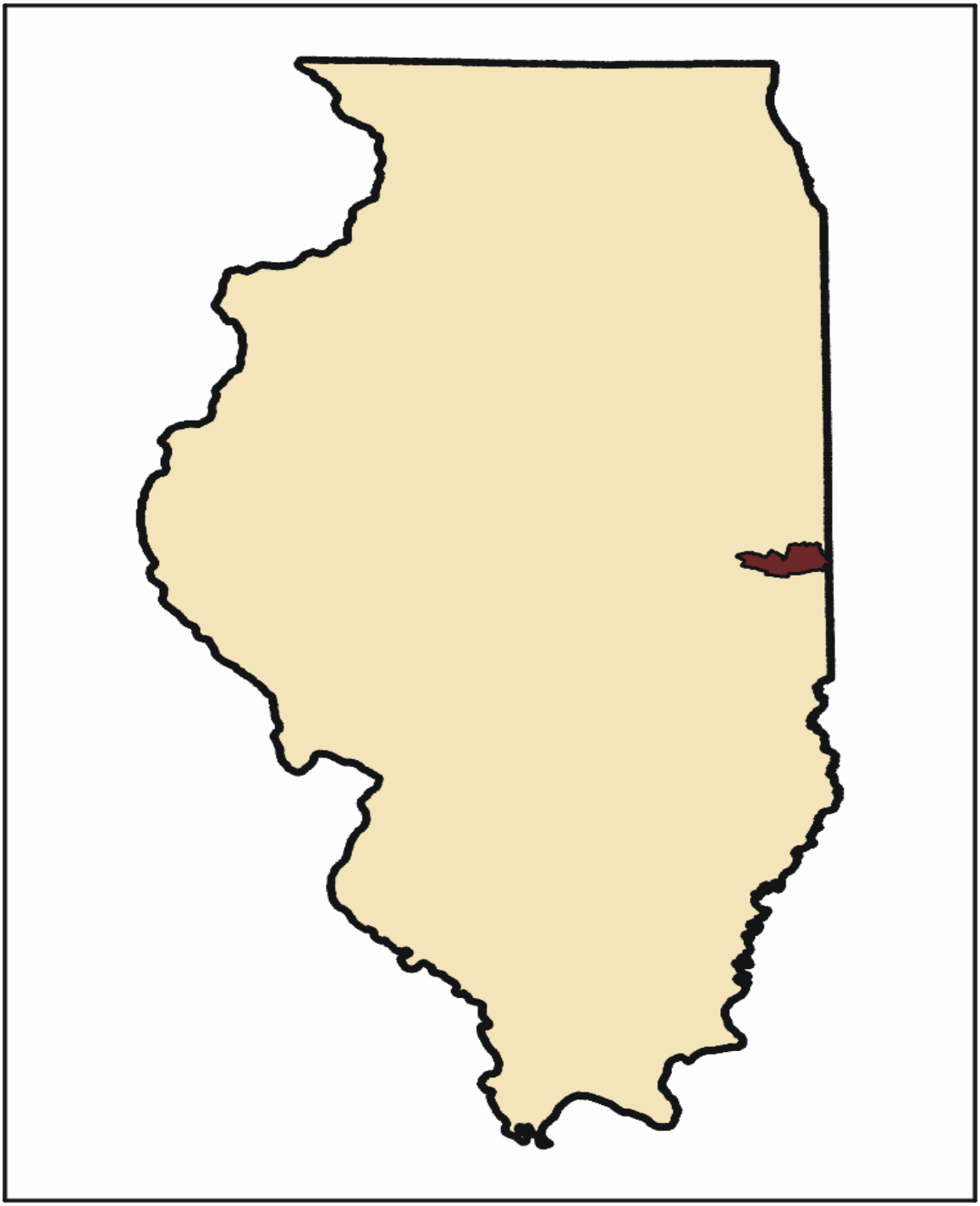


AERIAL ASSESSMENT LITTLE VERMILLION RIVER

CHAMPAIGN AND VERMILLION COUNTIES

SEPTEMBER 2005

PREPARED BY WAYNE KINNEY FOR IL. DEPT. OF AGRICULTURE

A public review draft stage three report on TMDL development for the Little Vermillion River by Tetra-Tech, Inc. was produced in August 2005. The key findings of this report identified two waterbodies as being impaired; Lake Georgetown (segment RBS) and the Little Vermilion River (segment BO07). Lake Georgetown is impaired by total phosphorus (TP) and the Little Vermillion River by fecal coliform, although the report states that there is insufficient data collection to confirm the fecal coliform impairment. Potential sources of Total Phosphorus to Georgetown Lake include sheet and rill erosion, lake shoreline erosion, stream channel erosion, fertilizers applied to both crops and lawns, livestock operations, storm water runoff, atmospheric deposition, and natural sources. A Forty-Six percent reductions in TP loading is indicated as being required to meet the 0.05 mg/L water quality standard.
This report will address only the potential TP contributions of stream channel erosion to the Little Vermillion Watershed.

Assessment Procedure

Low level geo-referenced video was taken of the Little Vermilion River in March, 2004. Video taping was completed by Fostaire Helicopters, Sauget, IL, using a camera mounted beneath a helicopter to record data from just above tree top level in DVD format for further evaluation and assessment. Video mapping began at the Illinois-Indiana State Line. The mapping progressed upstream to just above the confluence of Goodall Branch above Road 420E in Vermilion Co. Aerial video of tributaries was not part of the project, regardless of the stream size or vegetation.

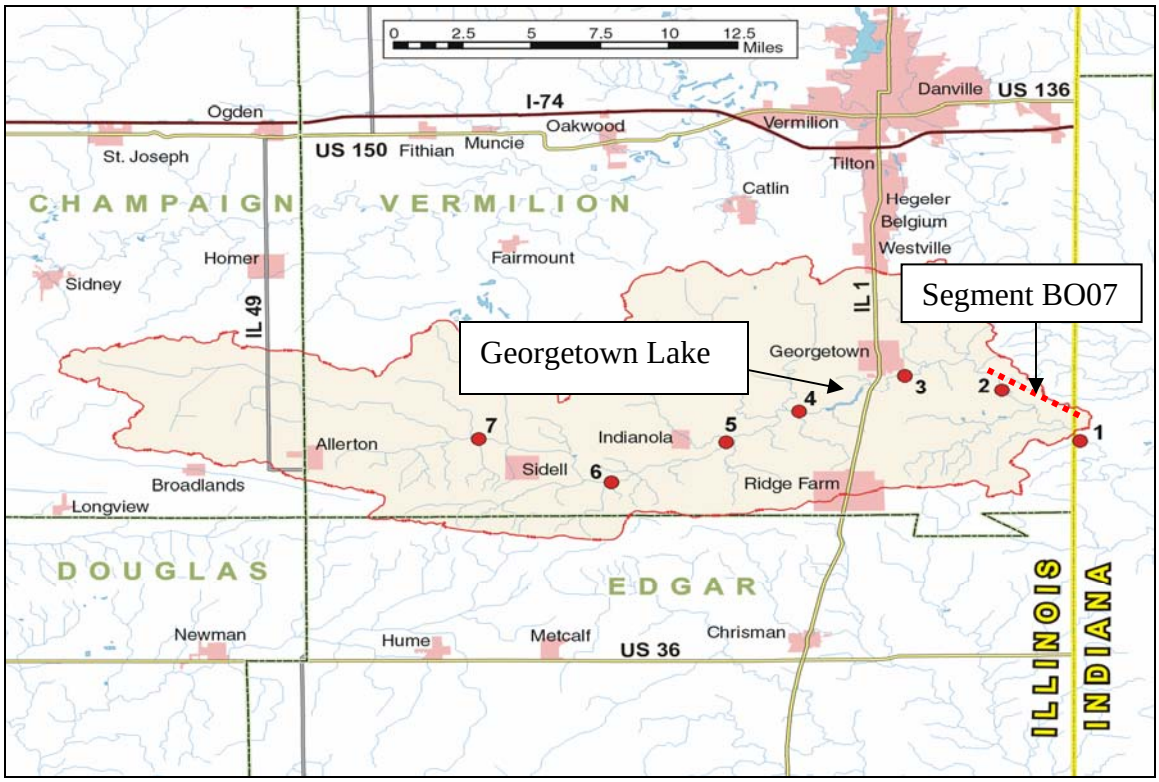


Fig. 1 Aerial Assessment Map of Sugar Creek

After videotaping the stream, the DVD tapes were processed by USGS to produce a geo-referenced DVD showing flight data and location. Next, USGS identified features from the video and created shapefiles containing the GPS location, type of feature identified, and the time on the DVD to allow cross referencing. The shape-files along with the DVD were then used to identify and locate the points where ground investigations were needed to verify aerial assessment assumptions and gather additional data.

The ground investigations or "ground truthing" is intended to accomplish two primary functions. First, it provides those viewing videos the opportunity to verify the correct interpretation of the video. Second, the video allows the user to identify and gather field data at the most appropriate locations to more closely represent the entire study portion of the stream.

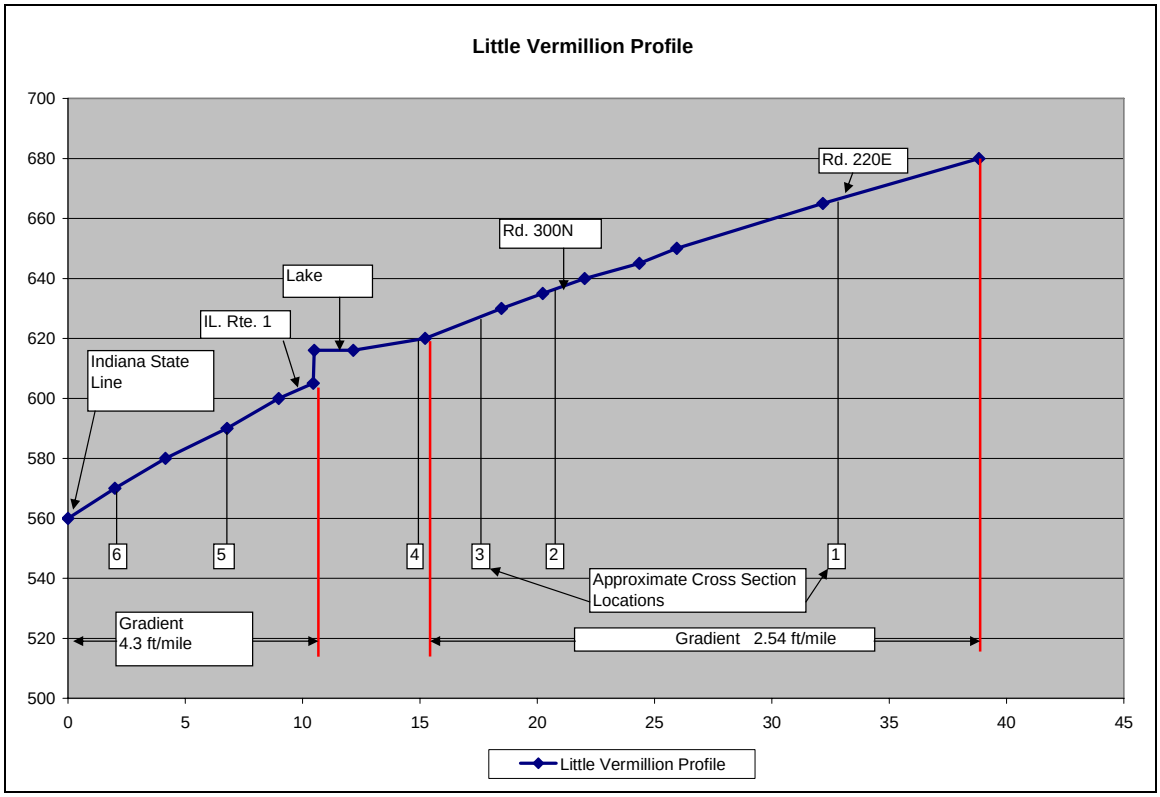


Figure 2 Channel Profile of Sugar Creek

Detailed elevation data is not available; therefore the channel slope is calculated from USGS topo maps by measuring the channel length between contour lines. The report refers to this as "valley profile" although a true valley profile would use a straight line distance down the floodplain rather than channel length. However, this method is used because it incorporates sinuosity into the calculation and allows the channel slope to be assume equal to "valley slope" in order to estimate channel capacity, velocity, etc., although there are short segments where the channel slope may differ significantly near roads, logjams, knickpoints, etc.

CHAPTERS ON DVD AND ASSESSMENT REPORT Little Vermillion River--Vermilion Co.				
DVD Disc	DVD chapter	Beginning Time	Report Chapter	Cross Sections
1	2	5:00	1	6
1	3	10:00	2	5
1	4	15:00	3	
1	5	20:00	4	4
1	6	25:00	5	3
1	7	30:00	6	2
1	8	35:00	7	1

Note: Flight path is from downstream to upstream

Fig. 3 DVD Chapters and Report Guide

The DVD has been divided into "chapters" of approximately five minutes of video (Fig. 3) to enhance the ability to navigate within the flight video and provide a simple way to identify and discuss different stream segments. Although the report will begin with a broader more general assessment of the entire study reach, it will also provide an assessment and treatment recommendations by chapter or group of chapters. The chapter divisions are clearly arbitrary and do not reflect "change points" in the stream characteristics or treatment recommendations. For clarity the conclusions and recommendations are presented for each stream "chapter".

The major factors indicating channel conditions identified from the aerial assessment have been totaled by DVD chapter in Table 1 below. This tabulation allows a general comparison of the relative dominance of features found in each chapter and provides a means of comparing stream characteristic between chapters. A discussion of the major differences will follow later in this report.

FEATURES IDENTIFIED BY CHAPTER Little Vermilion River								
CHAPTER	ROCK OUTCROP	LOGJAM	GEOTECH FAILURE	DEPOSITION	BED CONTROL	BREAK POINT	EROSION	STREAMBED STRUCTURE
1	8	5	3	8	0	0	33	0
2	12	3	3	5	0	6	23	0
3	1	1	2	2	1	1	16	1
4	1	7	4	0	0	0	22	3
5	2	5	10	2	1	0	15	3
6	0	0	4	6	0	1	6	0
7	0	0	0	2	0	1	2	0
TOTALS	24	21	26	25	2	9	117	7

Table 1 Features by Chapter Identified with Aerial Assessment

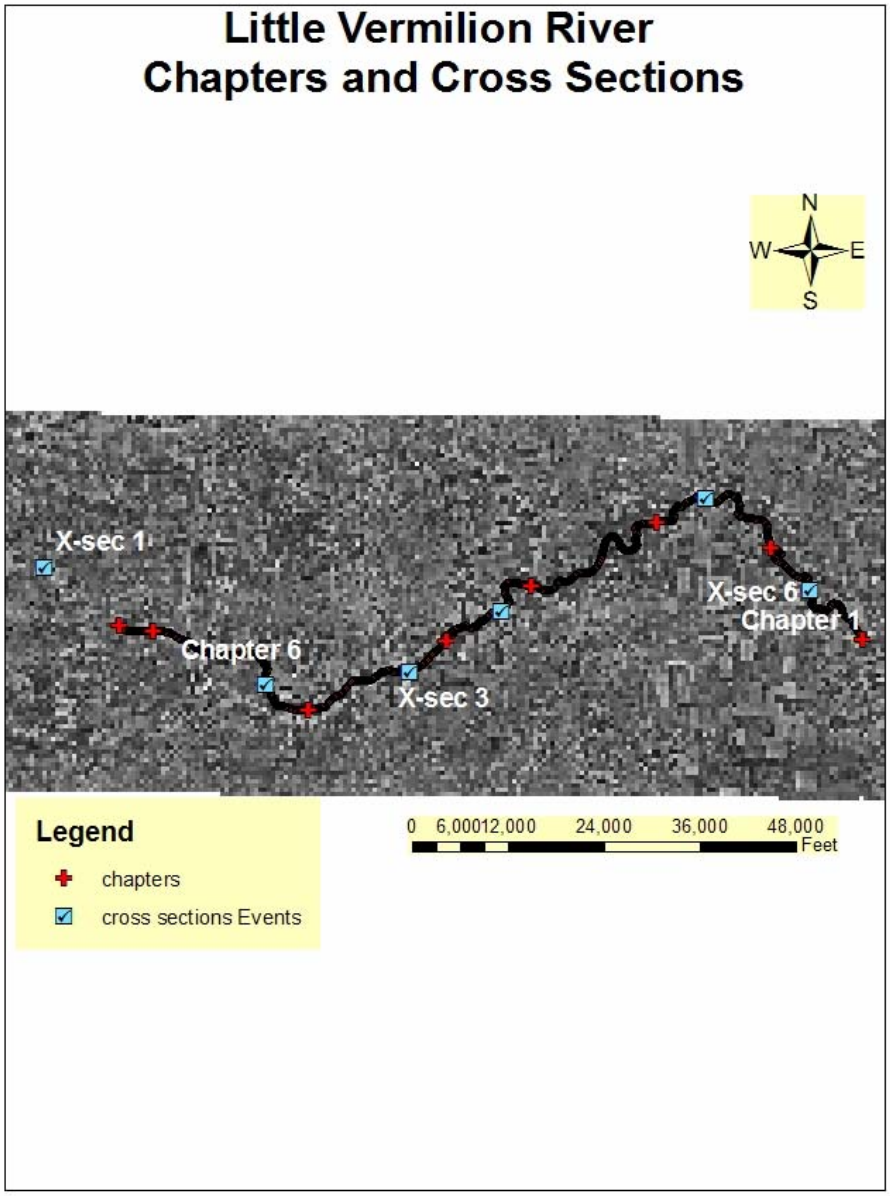


Fig. 4 Chapter Division and Cross Section locations

Six cross sections were taken at selected locations on the Little Vermilion River after viewing the DVD's. The cross sections are located at "riffle" locations to best represent the channel characteristics and to allow for comparison of width, depth, x-sec. area, etc.

along the channel at similar geometric locations. The result of the hydraulic analysis at each site is presented in summary form in Table 2 and the approximate location of each cross section along the channel profile is found in Fig. 2. Aerial views of cross sections locations are shown in Figs. 17 thru 23. Exact locations as Eastings and Northings and more detail can be found in Appendix A.

Cross Section Data --Little Vermilion River
Vermilion County, IL

X-sec	Easting	Northing	ADA Sq. Mi.	Valley Slope ft/mi.	Q2 cfs	Bank Full Q cfs	Width Ft.	Mean Depth Ft.	W/D Ratio	Vel. fps	Bedload Dia. Inches	CEM Simon	CFS/ sq. mi.	BKF Q/ Q2
1	423427	4422494	33.22	2.3	492	298	42	3.71	11.3	1.9	1	2	8.97	0.61
2	431943	4418014	73.48	2.4	941	607	51	5.09	10	2.3	1	5	8.26	0.65
3	437449	4418486	91.54	2.5	1142	719	63	4.91	12.8	2.3	1	5	7.85	0.63
4	440932	4420789	120.5	2.5	1418	837	64	5.45	11.7	2.4	1	6	6.94	0.59
5	448746	4425136	171.2	2.8	1977	1537	87	5.43	16	3.3	3	5	8.98	0.78
6	452735	4421633	190.5	3	2223	1766	76	6.54	11.6	3.6	3	5	9.27	0.79

Table 2 Cross Section Summary

Figures 5 through 14 show a snapshot of Little Vermillion River from downstream to upstream highlighting typical stream features identified.

Fig. 5 Cross Section 6—Above Road 500N: Stable riffle site keeping channel well connected to floodplain

Fig. 6 Shale bed grade control in Chapter 2 has prevented downcutting

Fig. 8 Logjam resulting in split channel flow and mid channel island. Chapter 2

Fig. 9 Stable riffle at cross section 5 above Road 1800E; Chapter 3

Fig. 10 Dam at Georgetown Lake —Above Rte. 1; Chapter 4

Fig. 11 Channelized reach with no woody riparian area; notice meanders forming in channel that will tend to undercut stable banks.

Fig. 12 Split channel; likely the result of past logjam blocking channel; Chapter 6

Fig. 13 Slumped bank; geotech failure possible caused by improper bank shaping

Fig. 14 Eroding bank and deposition building on inside bend as opposite bank erodes; Chapter 7

Natural Open Channel Flow

Project:	Xsec2	
Assisted by:	Wayne Kinney	
Date:	9/20/2005	
Channel Slope (*S*):	0.000480	ft/ft
Manning's *n*:	0.040	
Flow Depth:	6.6	ft

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

back to I&E form

Clear Cells

			Trial Depth 2	Trial Depth 3
Selected Flow Depth:	6.6	ft	13.4	
Channel Flow (*Q*):	586.5	cfs	2,423.5	
Channel Velocity:	2.3	ft/sec	3.3	
Cross-Sectional Area (*A*):	259.8	sq.ft.	731.5	
Hydraulic Radius (*R*):	4.6	ft	8.2	

Survey Data:

Rod (ft)	Distance (ft)
2.1	0.0
7.0	8.0
9.3	12.0
12.5	17.0
13.8	19.0
14.5	21.0
14.8	31.0
14.9	44.0
15.5	53.0
13.80	58
9.10	62
8.70	65
7.80	71
4.70	77
1.90	82
-3.8	90

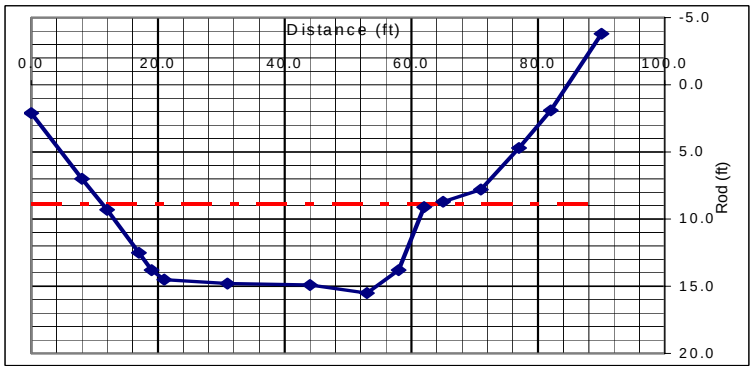


Fig. 15 Cross Section 2 showing "bankfull flow" depth at less than 50% of top bank depth.

Natural Open Channel Flow

Project:	Xsec 4	
Assisted by:	Wayne Kinney	
Date:	9/20/2005	
Channel Slope (*S*):	0.000480	ft/ft
Manning's *n*:	0.040	
Flow Depth:	7.4	ft

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

back to I&E form

Clear Cells

			Trial Depth 2	Trial Depth 3
Selected Flow Depth:	7.4	ft	7.4	
Channel Flow (*Q*):	791.7	cfs	791.7	
Channel Velocity:	2.3	ft/sec	2.3	
Cross-Sectional Area (*A*):	348.8	sq.ft.	348.8	
Hydraulic Radius (*R*):	4.7	ft	4.7	

Survey Data:

Rod (ft)	Distance (ft)
9.6	0.0
9.7	9.0
9.7	15.0
9.7	25.0
10.2	29.0
14.6	36.0
15.0	38.0
16.4	44.0
17.0	57.0
17.30	67
16.50	73
16.10	75
14.40	80
14.40	87
10.10	92
9.9	98
9.8	105
9.8	118

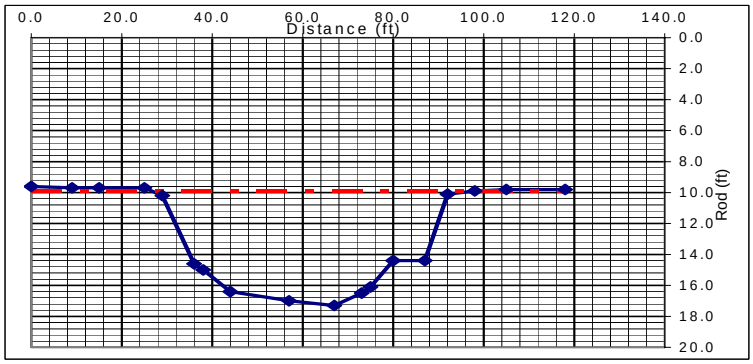


Fig. 16 Cross section 4 showing "bankfull flow" at the top bank depth.

General Observations

1. Channel degradation (downcutting) is not active in the Little Vermillion River Watershed. Cross sections 1and 2 in the upper reaches of the aerial assessment are incised artificially by channelization for improved drainage, but show no signs of active downcutting and have relatively low bankfull velocities of around 2 ft/sec. (Fig. 15) Cross sections 3 through 6 show the channel to be well connected to the floodplain with little or no indication of any incision, past or present. (Fig. 16)
2. Lateral stream channel erosion is active, especially in Chapters 1 through 4 which include BO07 and Georgetown Lake, but less activity is found in the upper portions of the main channel.
3. Woody debris concentrated in logjams is a significant factor in the stream channel erosion in Chapters 1 thru 5. These chapters contain 21 logjams currently (March 2004) and often cause flow to bypass the logjam to one side creating a new channel (Fig. 8 and 12) and resulting in a split flow "mid-channel island" even after the logjam has been removed or naturally deteriorates.
4. Timely and appropriate management of logjams would reduce the stream channel erosion, however the presence of woody debris has positive effects also on both the channel stability and aquatic habitat; therefore wholesale removal of woody debris should be avoided.
5. Geotechnical erosion problems are of two types. In chapter 1 thru 5 they are generally the result of differing soil materials (loess over till, or stone/shale outcrops) that produce seepage areas and slipzones at the interface of the differing materials. In Chapters 6 and 7 they are often the result of oversteepened banks created by improper bank shaping during channel modifications or oversteepening due to undermining of the bank by lateral migration. (Fig. 13) In many instances either type can be corrected or diminished by providing "toe protection" and/or drainage, however each site requires analysis to determine the proper treatment.

Treatment Recommendations

The Little Vermillion River has no degradation problems. Although deeply incised the incision at X-sec 1 and 2 appears to be the result of channelization with no active downcutting. Therefore the entire Little Vermillion can be treated as a single segment. The recommendations are divided by chapter so a regional breakdown above and below Georgetown Lake is possible, although the chapter divisions do not coincide perfectly.

The general recommendation is to treat only the lateral bank migration with a combination of Stone Toe Protection, Stream Barbs or Bendway Weirs. The Width/depth ratio's of 10 to 16 lend themselves well to all three techniques and final design will have to take into account the radius of curvature, bedload size, presence or absence of any

geotechnical concerns, etc. at individual sites. All three techniques are estimated at approximately $30.00 per lineal foot of bank protected and will require use of about 0.75 to 1.0 ton of quarry stone per lineal foot. There are no “large” logjams on the aerial assessment; therefore it is assumed that there will be lateral bank treatment at all sites with current logjams and the cost of removal is included in the estimated cost of bank treatment. Wholesale removal of woody debris is not recommended.

Rock Riffles could be installed in the Little Vermilion without increasing flooding or backwater conditions, but riffles would not be effective in meeting the TP reduction goals other than helping to reduce bank erosion and replacing a portion of the lateral bank treatment needs. Rock Riffles are therefore not included in the recommendations.

Table 3 shows the estimated treatment needs and cost for each chapter of aerial assessment for the Little Vermilion River. No costs are assigned for bank shaping or revegetation as experience has shown that natural regeneration will quickly provide the vegetative cover and soil stability needed. If shaping and vegetating is included in the projects a minimal additional cost of approximately $5.00 to $10.00 per lineal foot should be added to all estimates.

`	TREATMENT --CHAPTERS 1 THRU 7				
	Lateral Bank Protection				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
1	33	400	13200	$30.00	$396,000.00
2	23	400	9200	$30.00	$276,000.00
3	16	400	6400	$30.00	$192,000.00
4	22	300	6600	$30.00	$198,000.00
5	15	300	4500	$30.00	$135,000.00
6	6	250	1500	$30.00	$45,000.00
7	2	200	400	$30.00	$12,000.00
Total	117		41800		$1,254,000.00

Table 3 Treatment cost for lateral bank erosion in the Little Vermillion River using either Stone Toe Protection, Streambarbs or Bendway Weirs for stabilization.

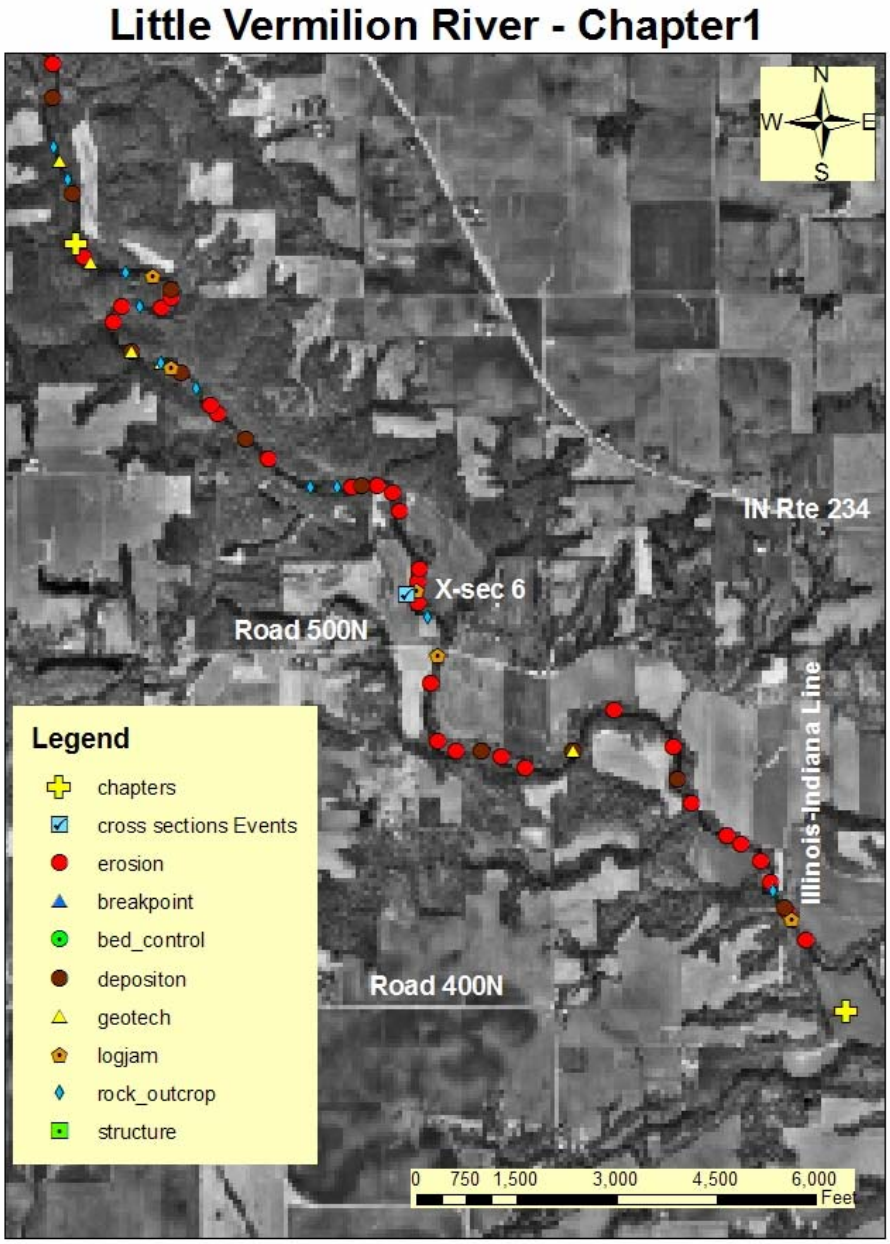


Fig. 17 Chapter 1

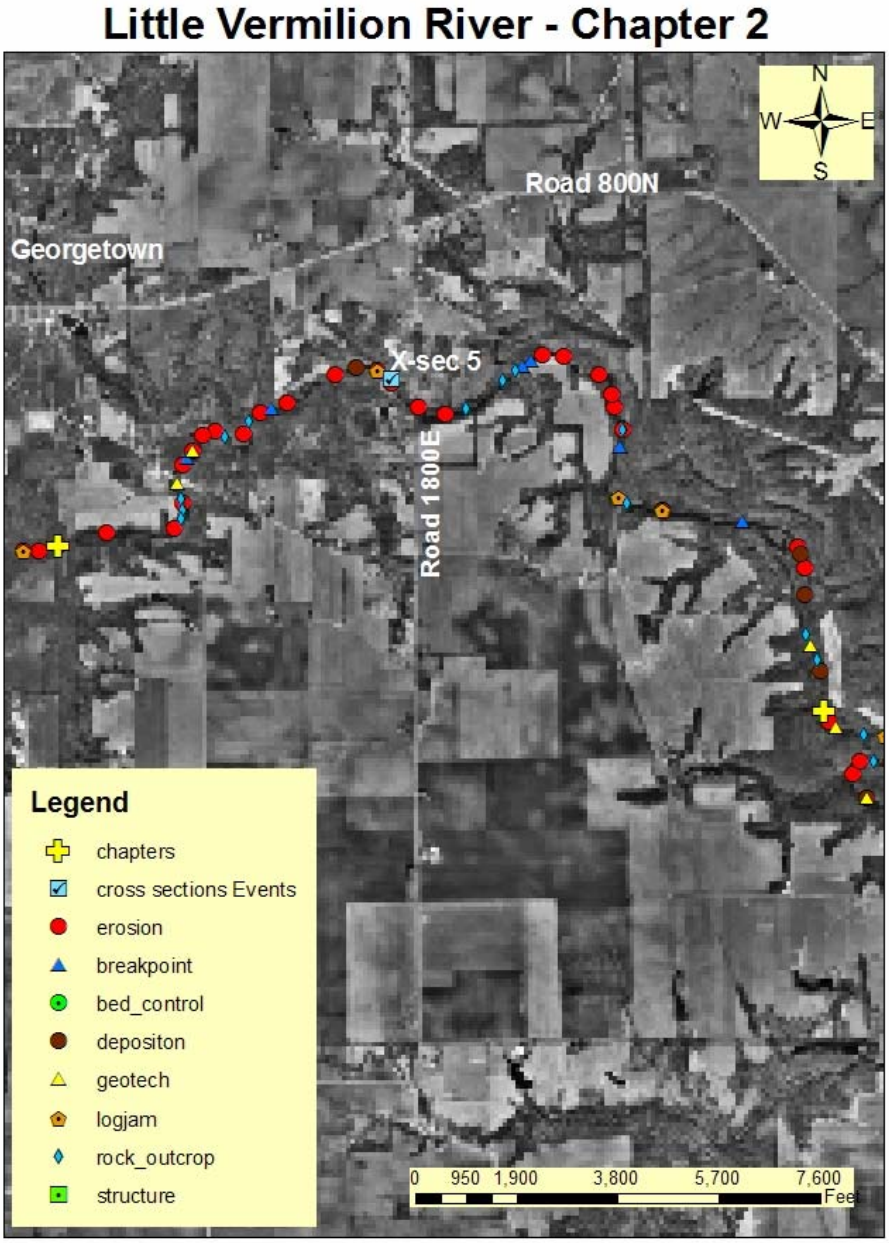


Fig. 18 Chapter 2

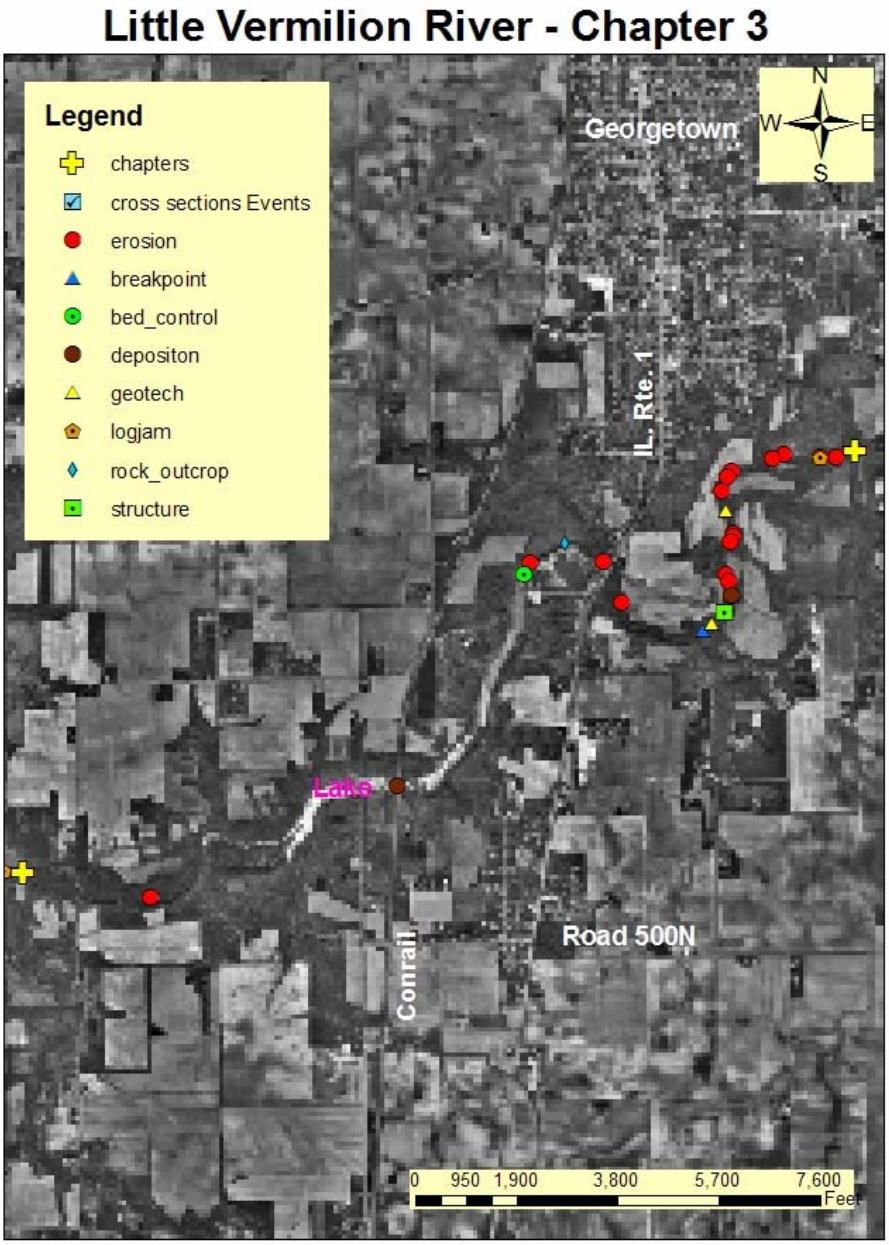


Fig. 19 Chapter 3

Fig. 20 Chapter 4

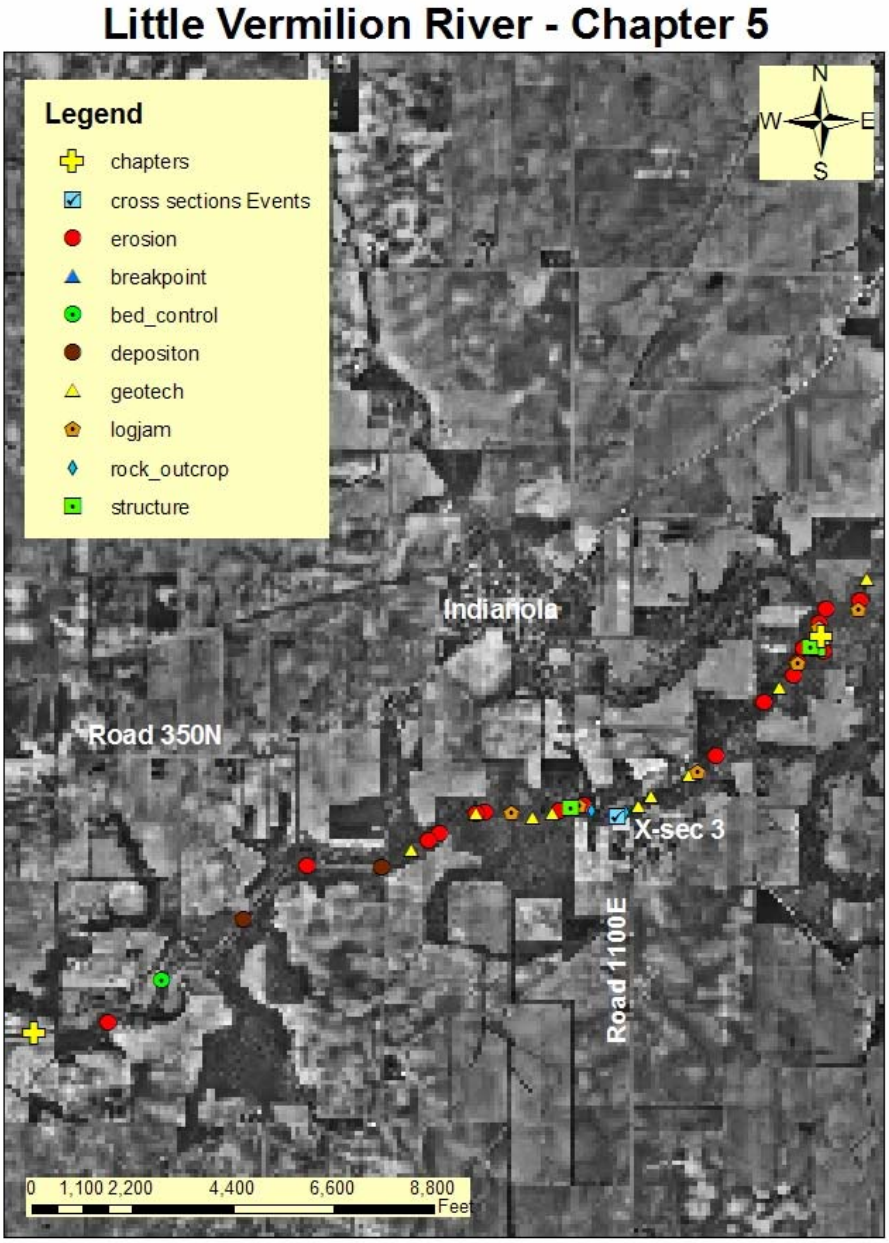


Fig. 21 Chapter 5

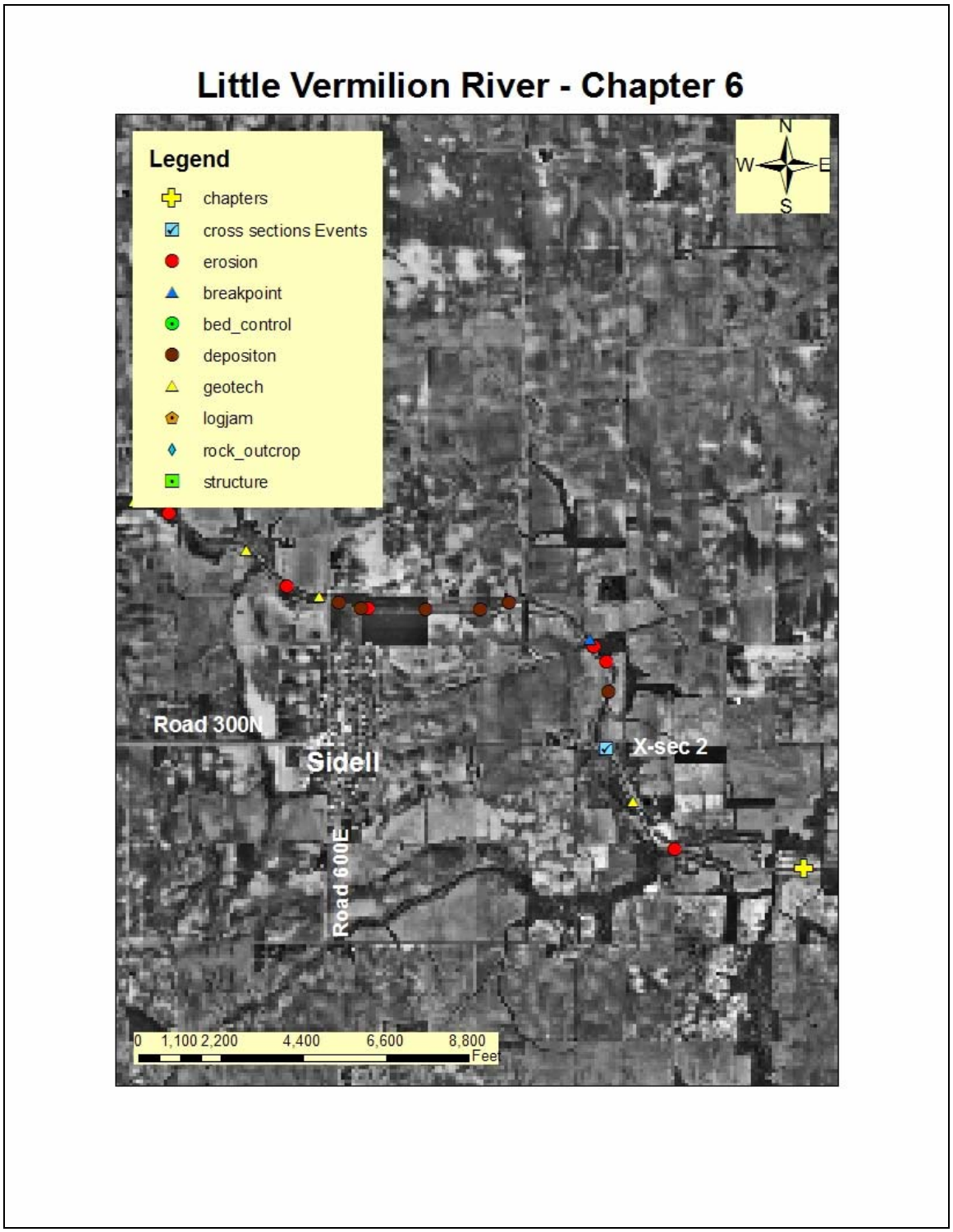


Fig. 22 Chapter 6

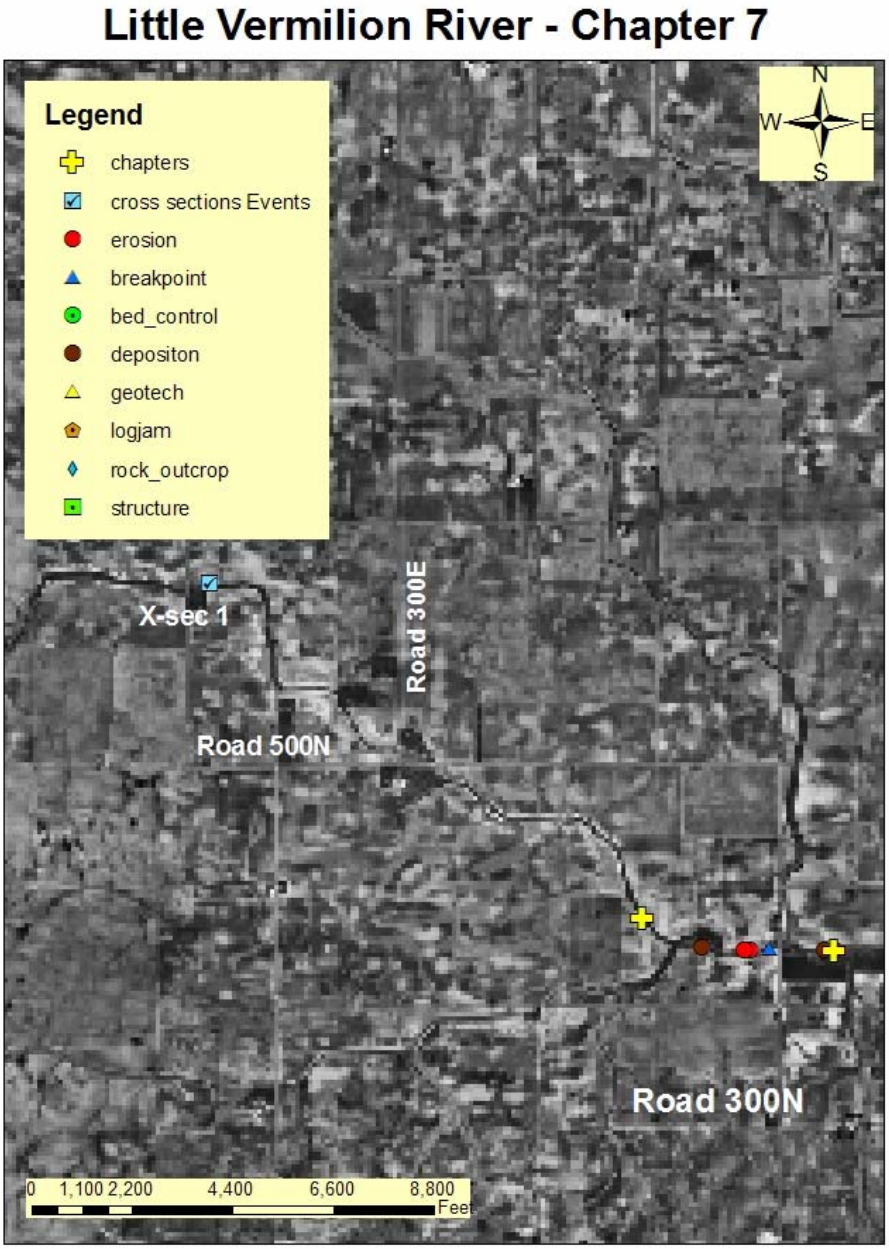


Fig. 23 Chapter 7

APPENDIX A

CROSS SECTION DATA

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E423427 N4422494

Landowner Name X-sec 1

Drainage Area 33.22 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 59 ft. Cross Sectional Area 242 sq. ft.

Depth 4.1 ft.

Reference Stream Gage:

Salt Fork near Homer Station No. 03338000 Gage Q_2 3760 cfs

Drainage Area 344 sq.mi Regression (4290 cfs

Champaign County, IL **REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope: 2.3 *ft./mi. (user-entered)* Regression Q_2 562 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 492 cfs

0.0004 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

190 to 400 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Stream Length *ft.*

Basic Field Data: Valley Length *ft.*

Bankfull Width 42 *ft.* Contour Interval feet

Mean Bankfull Depth 3.71 *ft.* Estimated Sinuosity

Width/Depth Ratio 11.32

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 5.1 *ft.* Surveyed: 0.00048 *ft./ft.* Cross-Section 291 *cfs*

Width at twice max. depth 58 *ft.* Estimated: *ft./ft.* Basic field data 305 *cfs*

(10.2 ft.) Selected Q 298 *cfs*

Entrenchment Ratio 1.38 Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload: D_{90} 1 *in.* Velocity required to move D_{90}: 2.1 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 1.86 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 1.96 *ft./sec.*

velocities from different sources. Velocity from selected Q: 1.9 *ft./sec.*

Channel Evolution Stage II Stream Type (Rosgen)

Notes

8.97 cfs/sq. mi.

Natural Open Channel Flow

Project:	X-sec 1	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000480	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	5.1	*ft*

$$Q \quad \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

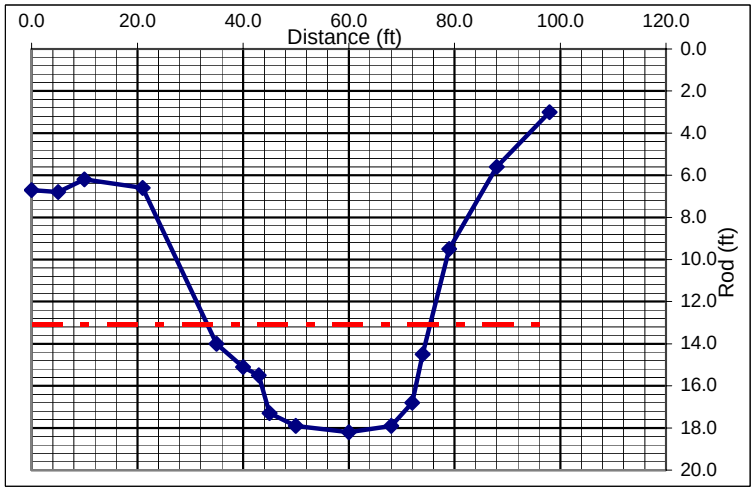
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	5.1 *ft*	12.0	
Channel Flow (***Q***):	290.6 *cfs*	1,367.3	
Channel Velocity:	1.9 *ft/sec*	2.6	
Cross-Sectional Area (***A***):	155.9 *sq.ft.*	528.7	
Hydraulic Radius (***R***):	3.5 *ft*	5.7	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.7	0.0
6.8	5.0
6.2	10.0
6.6	21.0
14.0	35.0
15.1	40.0
15.5	43.0
17.3	45.0
17.9	50.0
18.20	60
17.90	68
16.80	72
14.50	74
9.50	79
5.60	88
3.0	98



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E431943 N4418014

Landowner Name Xsec2

Drainage Area 73.48 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 80 ft. Cross Sectional Area 414 sq. ft.

Depth 5.2 ft.

Reference Stream Gage:

Salt Fork near Homer Station No. 03338000 Gage Q_2 3760 cfs

Drainage Area 344 sq.mi Regression (4290 cfs

Champaign County, IL **REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope: 2.4 *ft./mi. (user-entered)* Regression Q_2 1074 cfs

ft/mi (from worksheet) Rainfall 2.95 in *(2 yr, 24 hr)* Adjusted Q_2 941 cfs

0.0005 *ft./ft.* Regional Factor 1.057 Typical Range for Bankfull Discharge:

370 to 760 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Stream Length *ft.*

Basic Field Data: Valley Length *ft.*

Bankfull Width 51 *ft.* Contour Interval feet

Mean Bankfull Depth 5.09 *ft.* Estimated Sinuosity

Width/Depth Ratio 10.02

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 6.6 *ft.* Surveyed: 0.00048 *ft./ft.* Cross-Section 587 *cfs*

Width at twice max. depth 80 *ft.* Estimated: *ft./ft.* Basic field data 627 *cfs*

(13.2 ft.) Selected Q 607 *cfs*

Entrenchment Ratio 1.57 Radius of Curvature (Rc) ft.

Rc/Bankfull width: 0.00

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload: D_{90} 1 *in.* Velocity required to move D_{90}: 2.1 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 2.26 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 2.42 *ft./sec.*

velocities from different sources. Velocity from selected Q: 2.3 *ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

8.26 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec2	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000480	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.6	*ft*

$$Q \equiv \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

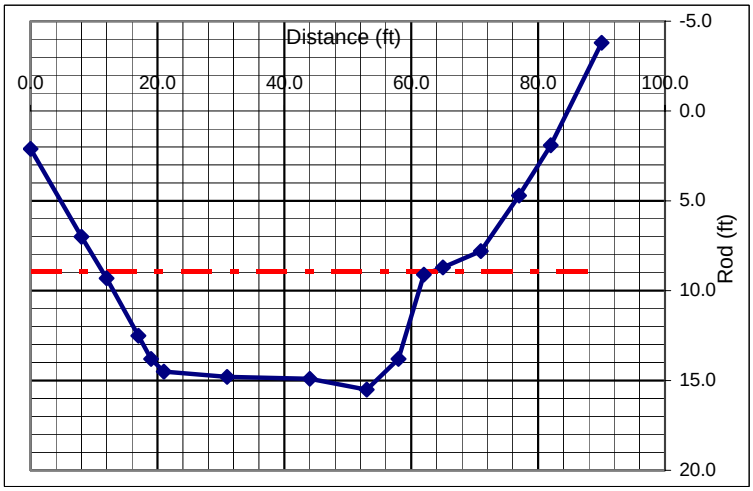
back to I&E form

Clear Cells

		Trial Depth 2	Trial Depth 3
Selected Flow Depth:	6.6 *ft*	13.4	
Channel Flow (***Q***):	586.5 *cfs*	2,423.5	
Channel Velocity:	2.3 *ft/sec*	3.3	
Cross-Sectional Area (***A***):	259.8 *sq.ft.*	731.5	
Hydraulic Radius (***R***):	4.6 *ft*	8.2	

Survey Data:

Rod *(ft)*	Distance *(ft)*
2.1	0.0
7.0	8.0
9.3	12.0
12.5	17.0
13.8	19.0
14.5	21.0
14.8	31.0
14.9	44.0
15.5	53.0
13.80	58
9.10	62
8.70	65
7.80	71
4.70	77
1.90	82
-3.8	90



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E437449 N4418486

Landowner Name Xsec 3

Drainage Area 91.54 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	87 ft.	Cross Sectional Area	481 sq. ft.
	Depth	5.5 ft.		

Reference Stream Gage:

Salt Fork near Homer	Station No.	03338000	Gage Q_2 3760 cfs
	Drainage Area	344 sq.mi	Regression (4290 cfs
Champaign County, IL			**REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope:	2.5	*ft./mi. (user-entered)*			Regression Q_2 1302 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in *(2 yr, 24 hr)*	Adjusted Q_2 1142 cfs
	0.0005	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge: 450 to 920 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	63	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.91	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	12.83				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	5.9	*ft.*	Surveyed:	0.00048 *ft./ft.*	Cross-Section 707 *cfs*
Width at twice max. depth	800	*ft.*	Estimated:	*ft./ft.*	Basic field data 730 *cfs*
(11.8 ft.)					Selected Q 719 *cfs*
Entrenchment Ratio	12.70		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	1 *in.*	Velocity required to move D_{90}:	2.1	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	2.28	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	2.36	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	2.3	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

7.85 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 3	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000480	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:		*ft*

$$Q \equiv \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

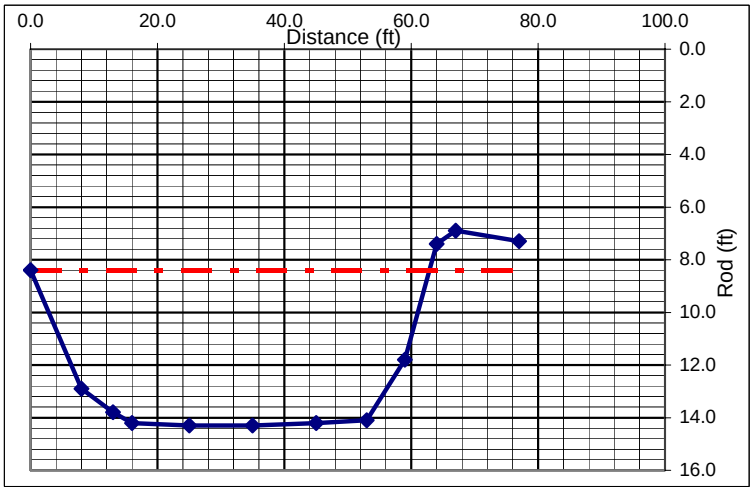
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	5.9 *ft*	5.9	
Channel Flow (***Q***):	707.0 *cfs*	707.0	
Channel Velocity:	2.3 *ft/sec*	2.3	
Cross-Sectional Area (***A***):	309.6 *sq.ft.*	309.6	
Hydraulic Radius (***R***):	4.7 *ft*	4.7	

Survey Data:

Rod *(ft)*	Distance *(ft)*
8.4	0.0
12.9	8.0
13.8	13.0
14.2	16.0
14.3	25.0
14.3	35.0
14.2	45.0
14.1	53.0
11.8	59.0
7.40	64
6.90	67
7.30	77



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E440932 N4420789

Landowner Name Xsec 4

Drainage Area 120.46 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	96 ft.	Cross Sectional Area	579 sq. ft.
	Depth	6.0 ft.		

Reference Stream Gage:

Salt Fork near Homer	Station No.	03338000	Gage Q_2 3760 cfs
	Drainage Area	344 sq.mi	Regression (4290 cfs
Champaign County, IL			**REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope:	2.5	*ft./mi. (user-entered)*				Regression Q_2 1618 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in	*(2 yr, 24 hr)*	Adjusted Q_2 1418 cfs
	0.0005	*ft./ft.*	Regional Factor	1.057		Typical Range for Bankfull Discharge:
						560 to 1140 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	64	*ft.*	Contour Interval		feet
Mean Bankfull Depth	5.45	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	11.74				

			Channel Slope:			Bankfull Q from:		
Max. Bankfull Depth	7.4	*ft.*	Surveyed:	0.00048	*ft./ft.*	Cross-Section	792	*cfs*
Width at twice max. depth	1000	*ft.*	Estimated:		*ft./ft.*	Basic field data	882	*cfs*
(14.8 ft.)						Selected Q	837	*cfs*
Entrenchment Ratio	15.63		Radius of Curvature (Rc)		ft.			
			Rc/Bankfull width:	0.00				

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	1 *in.*	Velocity required to move D_{90}:	2.1	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	2.27	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	2.53	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	2.4	*ft./sec.*

Channel Evolution Stage VI Stream Type (Rosgen)

Notes

6.94 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 4	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000480	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.4	*ft*

$$Q \equiv \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

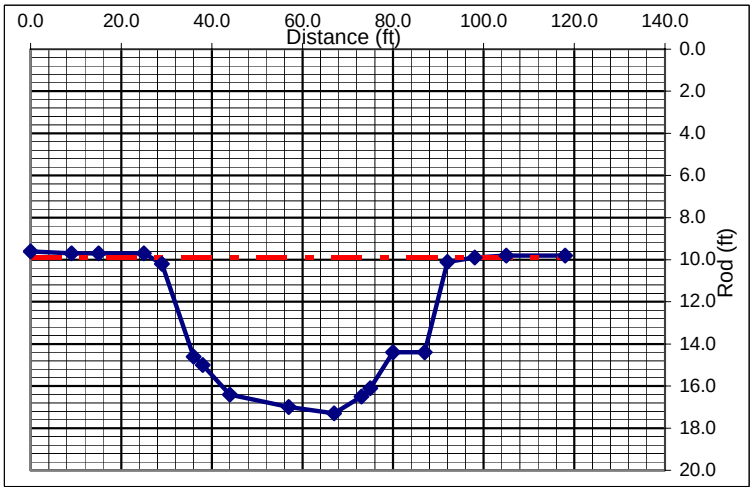
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.4 *ft*	7.4	
Channel Flow (***Q***):	791.7 *cfs*	791.7	
Channel Velocity:	2.3 *ft/sec*	2.3	
Cross-Sectional Area (***A***):	348.8 *sq.ft.*	348.8	
Hydraulic Radius (***R***):	4.7 *ft*	4.7	

Survey Data:

Rod *(ft)*	Distance *(ft)*
9.6	0.0
9.7	9.0
9.7	15.0
9.7	25.0
10.2	29.0
14.6	36.0
15.0	38.0
16.4	44.0
17.0	57.0
17.30	67
16.50	73
16.10	75
14.40	80
14.40	87
10.10	92
9.9	98
9.8	105
9.8	118



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E448746 N4425136

Landowner Name Xsec 5

Drainage Area 171.22 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	111 ft.	Cross Sectional Area	735 sq. ft.
	Depth	6.6 ft.		

Reference Stream Gage:

Salt Fork near Homer	Station No.	03338000	Gage Q_2 3760 cfs
	Drainage Area	344 sq.mi	Regression (4290 cfs
Champaign County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	2.8	*ft./mi. (user-entered)*			Regression Q_2	2256 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in *(2 yr, 24 hr)*	Adjusted Q_2	1977 cfs
	0.0005	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					790 to 1590 cfs	

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

			Stream Length		*ft.*
Basic Field Data:			Valley Length		*ft.*
Bankfull Width	87	*ft.*	Contour Interval		feet
Mean Bankfull Depth	5.43	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	16.02				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	7.2	*ft.*	Surveyed:	0.00081 *ft./ft.*	Cross-Section 1526 *cfs*
Width at twice max. depth	400	*ft.*	Estimated:	*ft./ft.*	Basic field data 1548 *cfs*
(14.4 ft.)					Selected Q 1537 *cfs*
Entrenchment Ratio	4.60		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	3 *in.*	Velocity required to move D_{90}:	3.6	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.23	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.28	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.3	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

8.98 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 5	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000810	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.2	*ft*

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

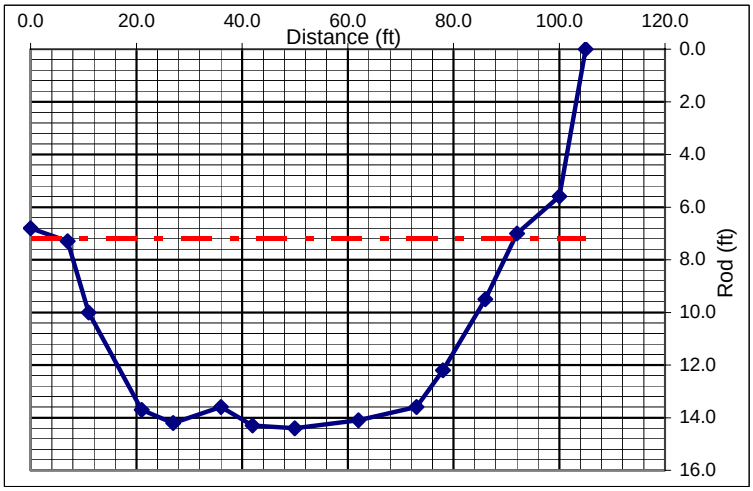
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.2 *ft*	7.6	
Channel Flow (***Q***):	1,525.8 *cfs*	1,634.4	
Channel Velocity:	3.2 *ft/sec*	3.2	
Cross-Sectional Area (***A***):	472.7 *sq.ft.*	508.4	
Hydraulic Radius (***R***):	5.3 *ft*	5.3	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.8	0.0
7.3	7.0
10.0	11.0
13.7	21.0
14.2	27.0
13.6	36.0
14.3	42.0
14.4	50.0
14.1	62.0
13.60	73
12.20	78
9.50	86
7.00	92
5.60	100
0.00	105



COMMENTS:

Stream Stabilization I & E Form

ILLINOIS NRCS - Version 2.05- modified 9/12/04 R.Book

County Vermilion T. R. Sec.

Date 9/19/2005 By Wayne Kinney

Stream Name Little Vermillion River UTM Coord. E452735 N4421384

Landowner Name Xsec 6

Drainage Area 190.47 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	115 ft.	Cross Sectional Area	790 sq. ft.
	Depth	6.9 ft.		

Reference Stream Gage:

Salt Fork near Homer	Station No.	03338000	Gage Q_2 3760 cfs
	Drainage Area	344 sq.mi	Regression (4290 cfs
Champaign County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	3.0	*ft./mi. (user-entered)*			Regression Q_2	2537 cfs
		ft/mi (from worksheet)	Rainfall	2.95 in *(2 yr, 24 hr)*	Adjusted Q_2	2223 cfs
	0.0006	*ft./ft.*	Regional Factor	1.057	Typical Range for Bankfull Discharge:	
					880	to 1780 cfs

Local Stream Morphology:

Channel Description: (c) Clean, winding, some pools and shoals

Manning's "n" 0.04

Basic Field Data:					
			Stream Length		*ft.*
			Valley Length		*ft.*
Bankfull Width	76	*ft.*	Contour Interval		feet
Mean Bankfull Depth	6.54	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	11.62				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	7.6	*ft.*	Surveyed:	0.00081 *ft./ft.*	Cross-Section 1688 *cfs*
Width at twice max. depth	1000	*ft.*	Estimated:	*ft./ft.*	Basic field data 1844 *cfs*
(15.2 ft.)					Selected Q 1766 *cfs*
Entrenchment Ratio	13.16		Radius of Curvature (Rc)		ft.
			Rc/Bankfull width:	0.00	

Bankfull Velocity Check: *(typical Illinois streams will have average bankfull velocity between 3 and 5 ft/sec.)*

Bedload:	D_{90}	3 *in.*	Velocity required to move D_{90}:	3.6	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	3.39	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.71	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.6	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

9.27 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 6	
Assisted by:	Wayne Kinney	
Date:	9/19/2005	
Channel Slope (***S***):	0.000810	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.6	*ft*

$$Q = \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

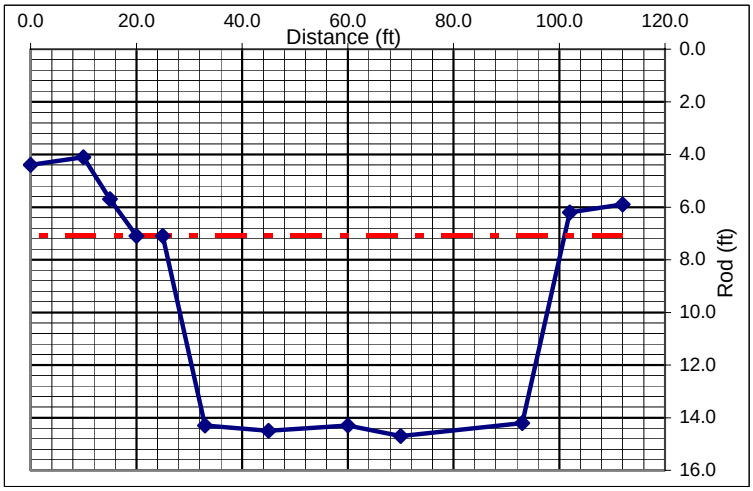
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.6 *ft*	8.8	
Channel Flow (***Q***):	1,687.9 *cfs*	2,059.6	
Channel Velocity:	3.4 *ft/sec*	3.4	
Cross-Sectional Area (***A***):	497.3 *sq.ft.*	599.3	
Hydraulic Radius (***R***):	5.8 *ft*	5.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
5.9	112.0
6.2	102.0
14.2	93.0
14.7	70.0
14.3	60.0
14.5	45.0
14.3	33.0
7.1	25.0
7.1	20.0
5.70	15
4.10	10
4.40	0



COMMENTS: