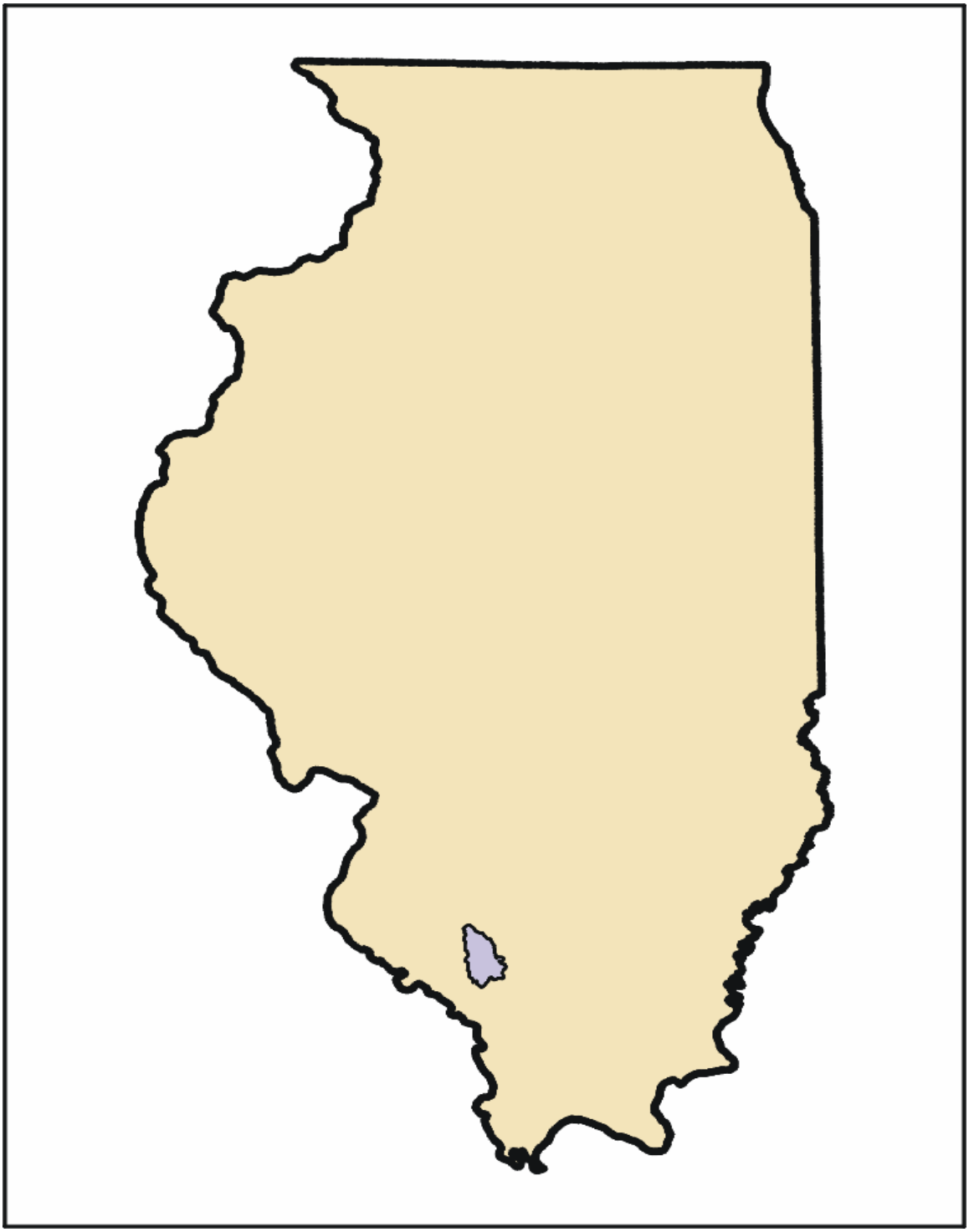


Aerial Assessment of Bonnie and Galum Creeks

Perry and Jackson Counties

November, 2005

Prepared by Wayne Kinney for IL. Dept. of Agriculture

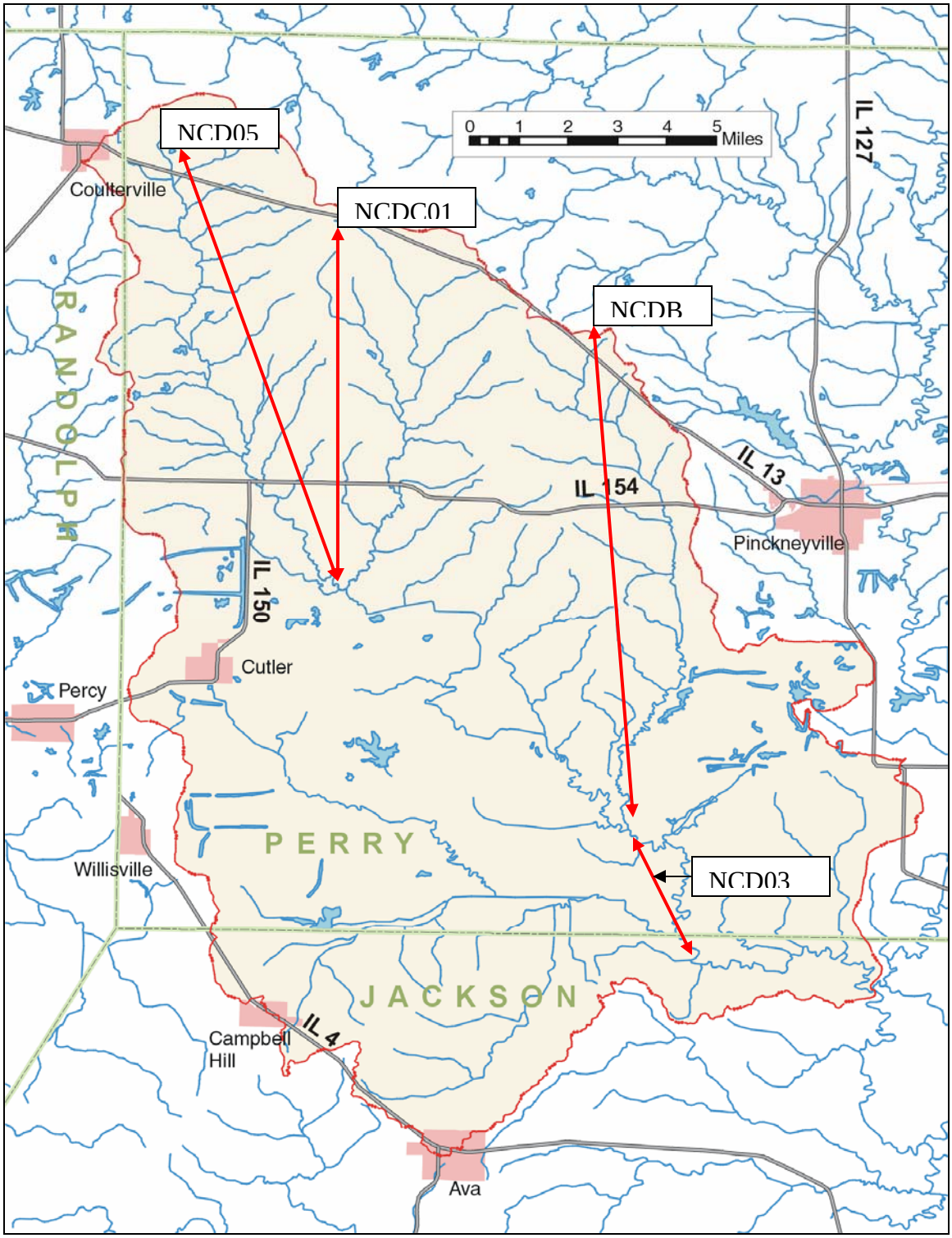


Fig. 1 Impaired Segments for TMDL Development—Bonnie and Galum Creeks

The final TMDL Report for Bonnie Creek watershed (June 2004) has four segments identified as having impaired stream segments. (Fig. 1) All segments have the major source of contamination as “potentially contaminated groundwater”, while NCD05 has additional sources of “stagnant stream conditions, elevated instream temperatures and nonpoint source loading from agriculture. The concerns in NCD05 are manganese and dissolved oxygen. Concerns in other impaired segments are sulfates in NCDC01, silver, sulfates and TDS in NCD03 and manganese, sulfates and TDS in NCDB.

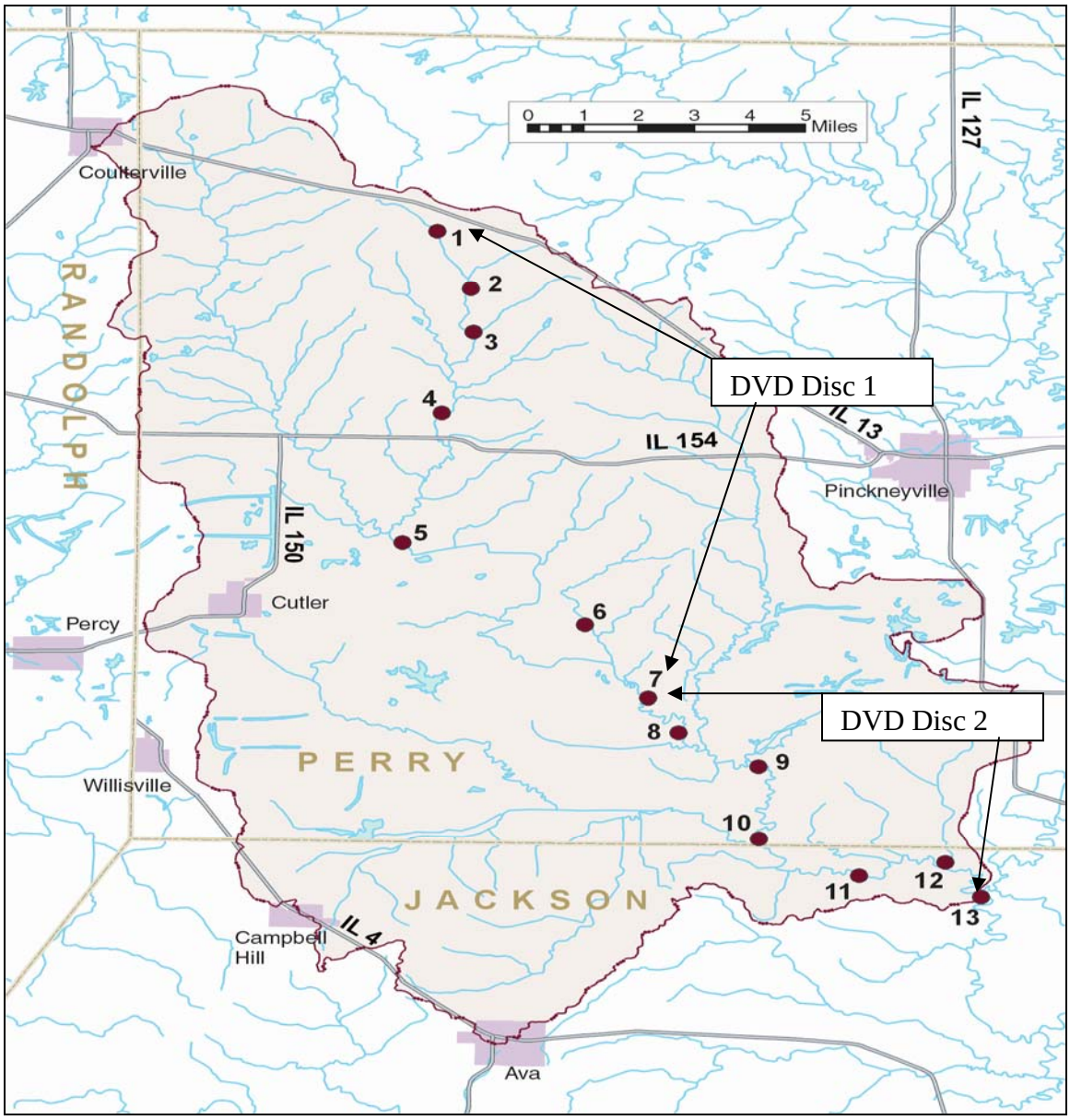


Fig. 2 Aerial Assessment Chapters on DVD’s

Assessment Procedure

Low level geo-referenced video was taken of Bonnie and Galum Creeks 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 upper end of the channel just downstream of Rte. 13 east of Swanwick, IL. The mapping progressed downstream thru Perry County and ended in Jackson County at the confluence with Beaucoup Creek near Matthews, IL. Aerial video of tributaries was not part of the project, regardless of the stream size or vegetation.

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.

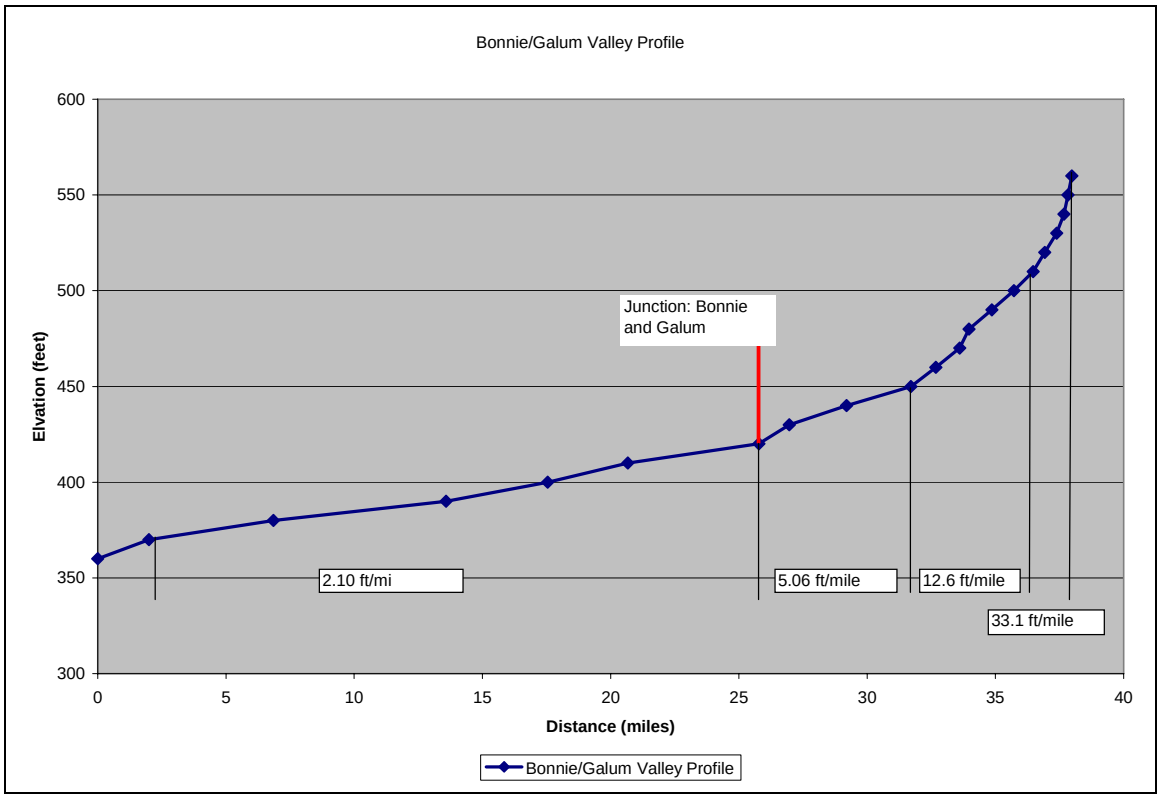


Figure 3 Channel Profile of Bonnie and Galum Creeks

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.

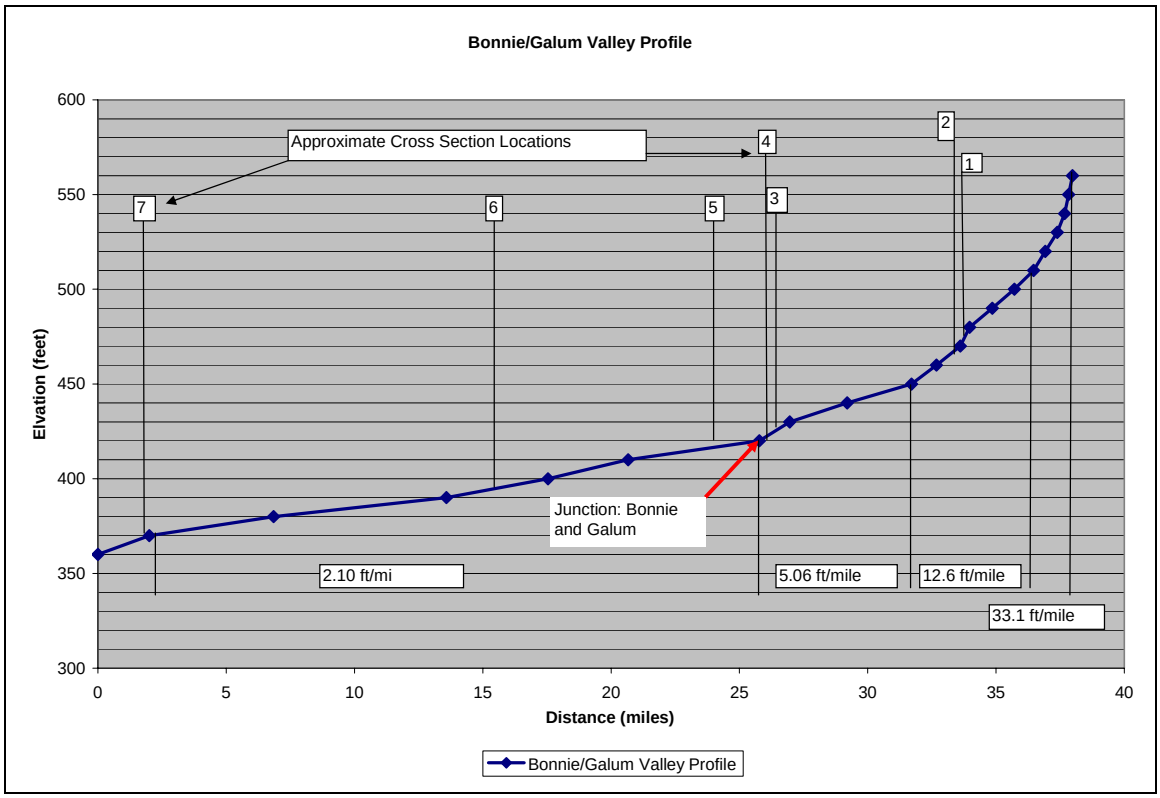


Figure 4 Valley Profile with Cross Section Locations

CHAPTERS ON DVD AND ASSESSMENT REPORT Bonnie and Galum Creeks				
DVD Disc	DVD chapter	Beginning Time	Report Chapter	Cross Section
1	2	5:00	1	
1	3	10:00	2	1,2
1	4	15:00:00	3	
1	5	20:00:00	4	3,4,5
1	6	25:00:00	5	6
1	7	30:00:00	6	
2	2	5:00	7	
2	3	10:00	8	
2	4	15:00:00	9	
2	5	20:00:00	10	
2	6	25:00:00	11	
2	7	30:00:00	12	7
2	8	35:00:00	13	

Note: Flight path is from upstream to downstream

Table 1 DVD Chapters and Report Guide

The DVD has been divided into "chapters" of approximately five minutes of video (Table 1) 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”.

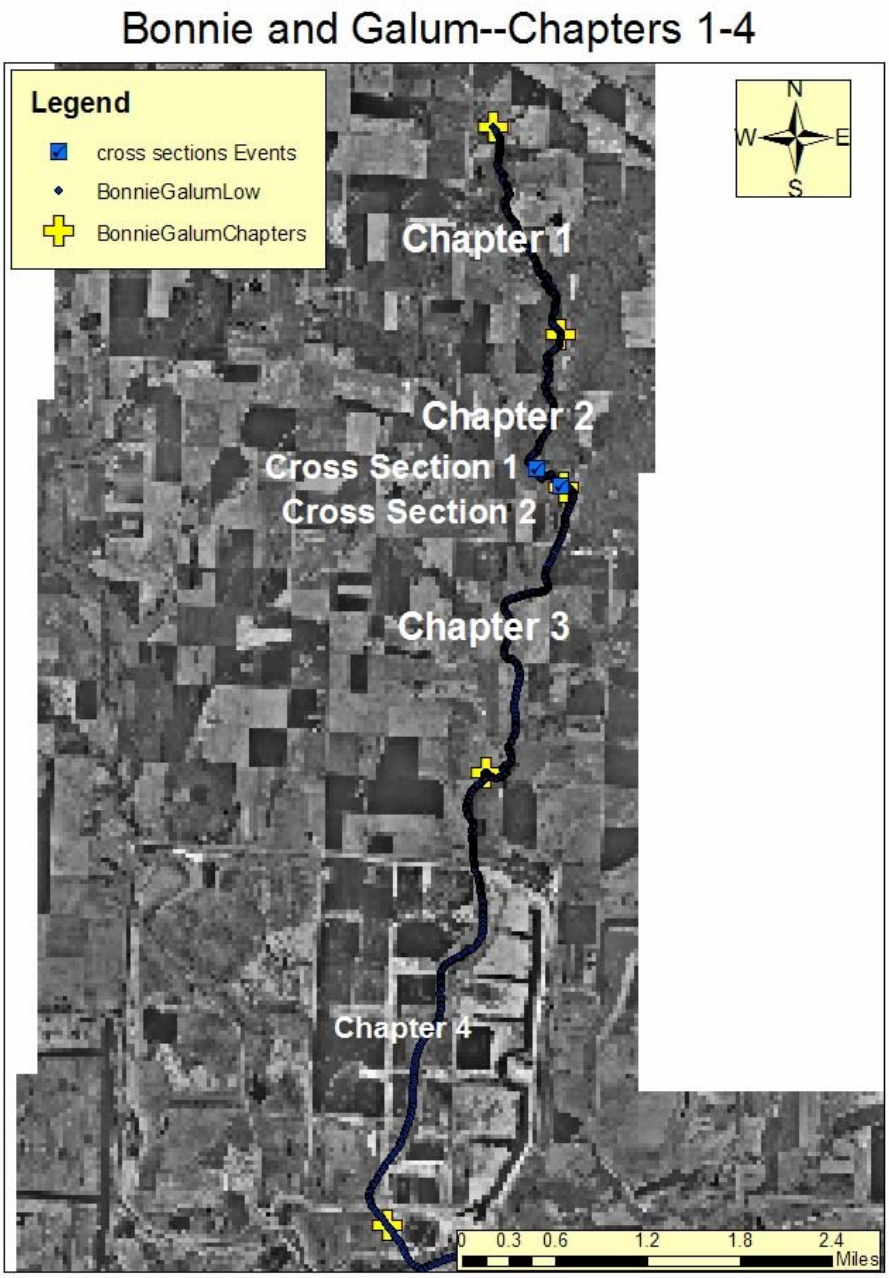


Figure 5 Chapter Division and Cross Section Locations ---Upper Reach

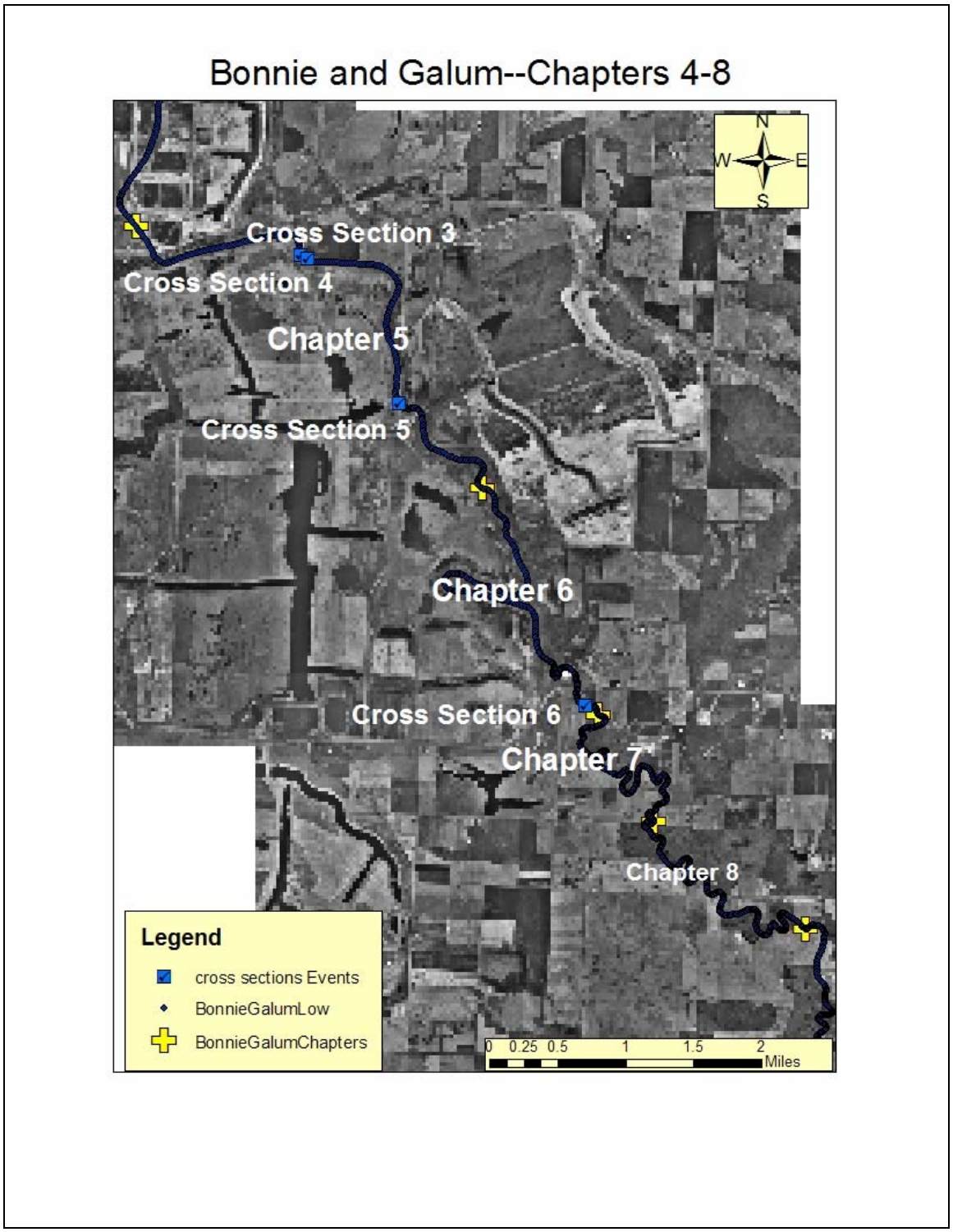


Figure 6 Chapter Division and Cross Section Locations –Middle Reach

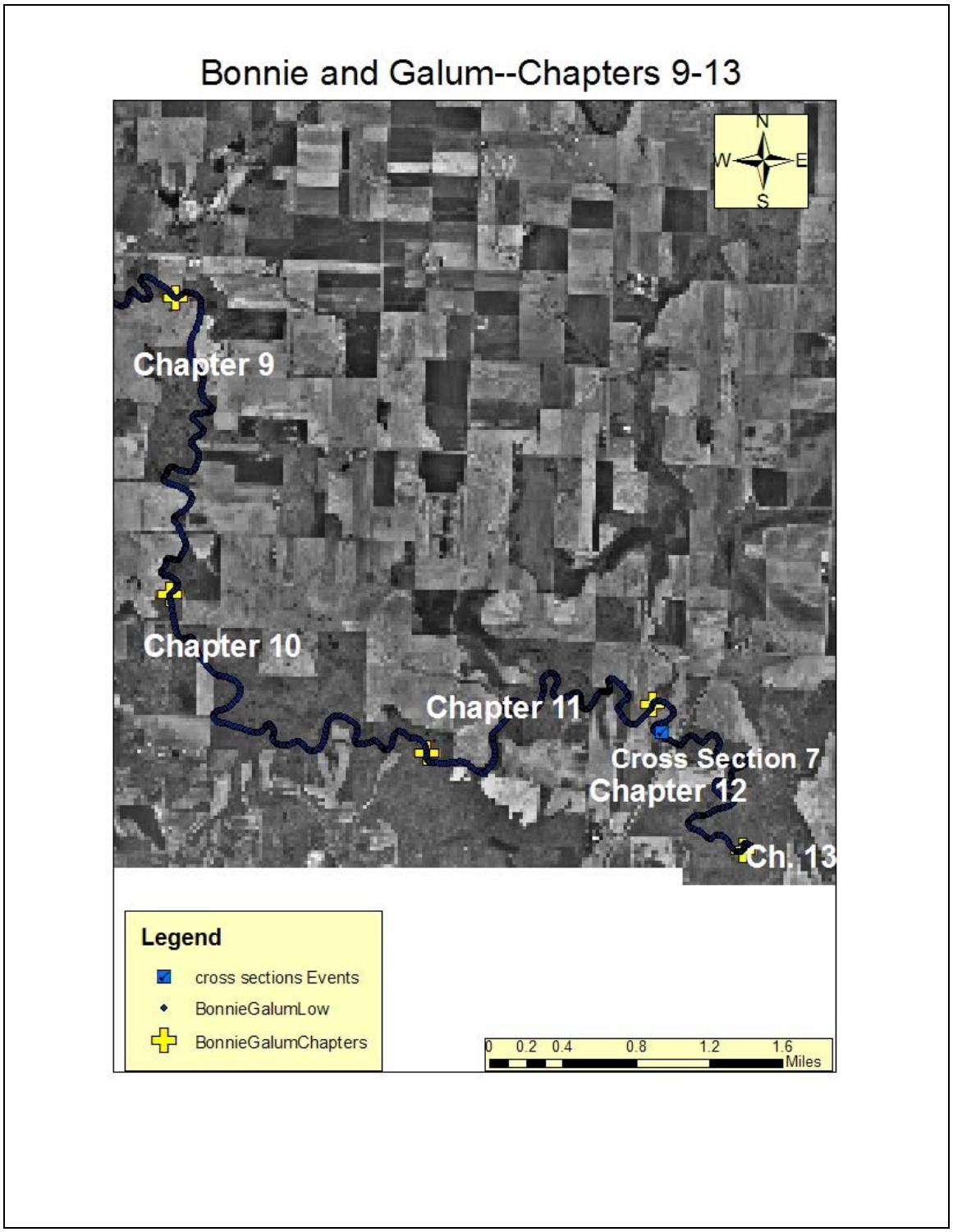


Fig. 7 Chapter Division and Cross Section Locations—Lower Reach

The major factors indicating channel conditions identified from the aerial assessment have been totaled by DVD chapter in Table 2 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									
Bonnie and Galum Creeks									
CHAPTER	ROCK OUTCROP	LOGJAM	GEOTECH FAILURE	DEPOSITION	BED CONTROL	BANK CONTROL	BREAK POINT	EROSION	SEVERE EROSION
1	2	3	2	0	0	0	3	32	0
2	0	9	1	0	0	0	1	31	0
3	2	1	1	2	1	1	2	41	0
4	5	0	0	1	9	3	1	28	1
5	1	0	3	4	6	6	7	14	0
6	2	3	1	1	1	0	4	9	0
7	0	0	0	0	0	0	0	14	0
8	0	1	1	0	0	0	2	7	0
9	0	1	0	0	1	0	1	17	0
10	0	5	2	1	0	0	1	17	0
11	0	2	4	0	0	0	1	15	0
12	0	2	3	0	0	0	2	18	0
13	0	1	0	0	0	0	0	0	0
TOTALS	12	28	18	9	18	10	25	243	1

Table 2 Features by Chapter Identified with Aerial Assessment

Seven cross sections were taken at selected locations on Bonnie and Galum Creek 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 3 and the approximate location of each cross section along the channel profile is found in Fig. 4. Aerial views of cross sections locations are shown in Figs. 5 thru 7. Exact locations as Eastings and Northings and more detail can be found in Appendix A

Cross Section Data --Bonnie and Galum Creeks Perry Co. Illinois														
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	280115	4222350	4.28	14.6	429	191	29	4.48	6.47	1.5	2	3	44.63	0.45
2	280376	4222167	4.32	14.6	432	204	23	2.65	8.68	3.3	3	3	47.22	0.47
3	280515	4214261	56.24	8.4	2240	1133	70	4.93	14.2	3.3	1	5	20.15	0.51
4	280600	4214211	56.24	8.4	2240	1108	71	4.81	14.8	3.2	1	5	19.70	0.49
5	281685	4212497	59.34	8.4	2337	1191	86	5.85	14.7	2.4	5	5	20.07	0.51
6	283895	4218908	71.13	4.2	1932	1295	64	7.38	8.67	2.7	1	5	18.21	0.67
7	290794	4202424	158.7	3.1	3147	1436	56	8.63	6.49	3	1	6	9.05	0.46

Table 3 Cross Section Summary

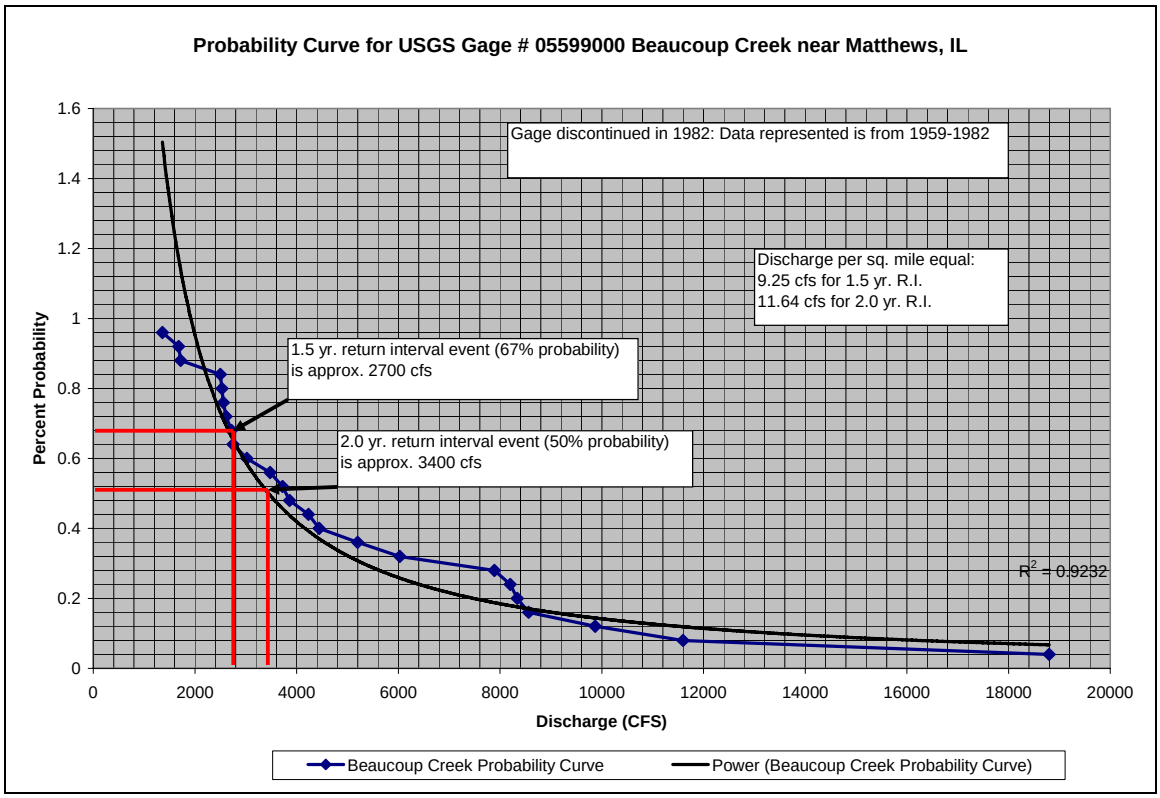


Fig. 8 USGS Gage Data for Beaucoup Creek near Matthews

General Observations

1. There is no gage data available for Bonnie or Galum Creek, however data is available on Beaucoup Creek just above the junction with Galum. (Fig. 8) The drainage area of Beaucoup at 262 sq. mi. is somewhat large than Galum at 160 sq. mi. however the soils, topography, etc. are very similar. The predicted "geomorphic bankfull" discharges on Beaucoup where drainage exceed 160 sq. mi are 7.75 and 8.61 cfs/sq. mi. which compares very well with the estimated discharge of Galum at 9.05 cfs/sq. mi. at 158 sq. mi. drainage. Therefore using Beaucoup data suggests that the "bankfull" discharge for Galum Creek is around the 1.5 yr. return interval.
2. Coal mining operations have resulted in the relocation and channelization of Bonnie and Galum Creek in Chapters 4, 5 and 6 for about 12 miles of the aerial assessment. During relocation remeandering was part of channel design Chapter 4 and some grade control structures were placed in all three chapters.
3. The success of the channel relocation efforts to establish a stable channel is questionable. The channel is deeply incised in many location and many of the grade control structures are in need of maintenance to prevent failure.
4. Bonnie Creek above the reclaimed strip mine land is downcutting and Galum Creek below the strip mined land is generally widening and slightly aggrading.
5. The TMDL final report states that it is likely that the main contributors to impairments within the watershed are abandoned mine sites. The report also suggests that passive treatment systems would be the best solution for controlling

manganese from abandoned coal mines. Pages 9-3 and 9-4 describe the treatment options and suggest that the simplest method may be “open limestone channels” to add alkalinity to the water and raise the pH.

6. The TMDL final report also provides an implementation plan for management of dissolved oxygen that includes reaeration structures and reducing stream temperatures.
7. Use of limestone to construct Stone Toe Protection and Grade Control Structures to stabilize Bonnie and Galum Creeks can provide the benefits recommended by the TMDL final report.

Recommendations Chapter 1-3

This section of Bonnie Creek is located above the reclaimed mine land and represents about two-thirds of the segment NCDC01. Cross sections 1 and 2 are located in this reach. On DVD Disc 1 at 14:45 a sandstone bed can be seen in Bonnie Creek that providing some bed control, however Bonnie is incised and appears to be continuing to downcut where the bed is other than sandstone. There are 104 erosion sites in these chapters or about 43% of all sites identifies.

The recommendation for these chapters is to install Rock Riffle Grade Controls 2.5 ft. above the channel bed, which will prevent any increase in out of bank flow or backwater according to preliminary calculations. Approximately one-half of all erosion sites will also need to have Stone Toe Protection applied between the grade controls to control the lateral migration.

By installing these practices with quarried limestone the TMDL report suggests that the pH will be increased, and the dissolved oxygen will be increased as well as the riparian corridor will be protected to maintain or reduce water temperatures.

Table 4 provides the estimated quantities and cost to treat this segment.

`	TREATMENT --CHAPTERS 1 THRU 3				
	Lateral Bank Protection with Stone Toe Protection (STP)				
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
1	32	150	4800	$25.00	$120,000.00
2	31	150	4650	$25.00	$116,250.00
3	41	150	6150	$25.00	$153,750.00
Total	104		15600		$390,000.00
	Rock Riffle Grade Control				
Chapter	Rock Riffles	Average Tonnage	Ave. Cost Ton	Average Cost/Riffle	Total Cost
1	41	250	$30.00	$7,500.00	$307,500.00
2	42	250	$30.00	$7,500.00	$315,000.00
3	67	250	$30.00	$7,500.00	$502,500.00
Total	150				$1,125,000.00

Table 4 Treatment Chapters 1 thru 3 Bonnie Creek

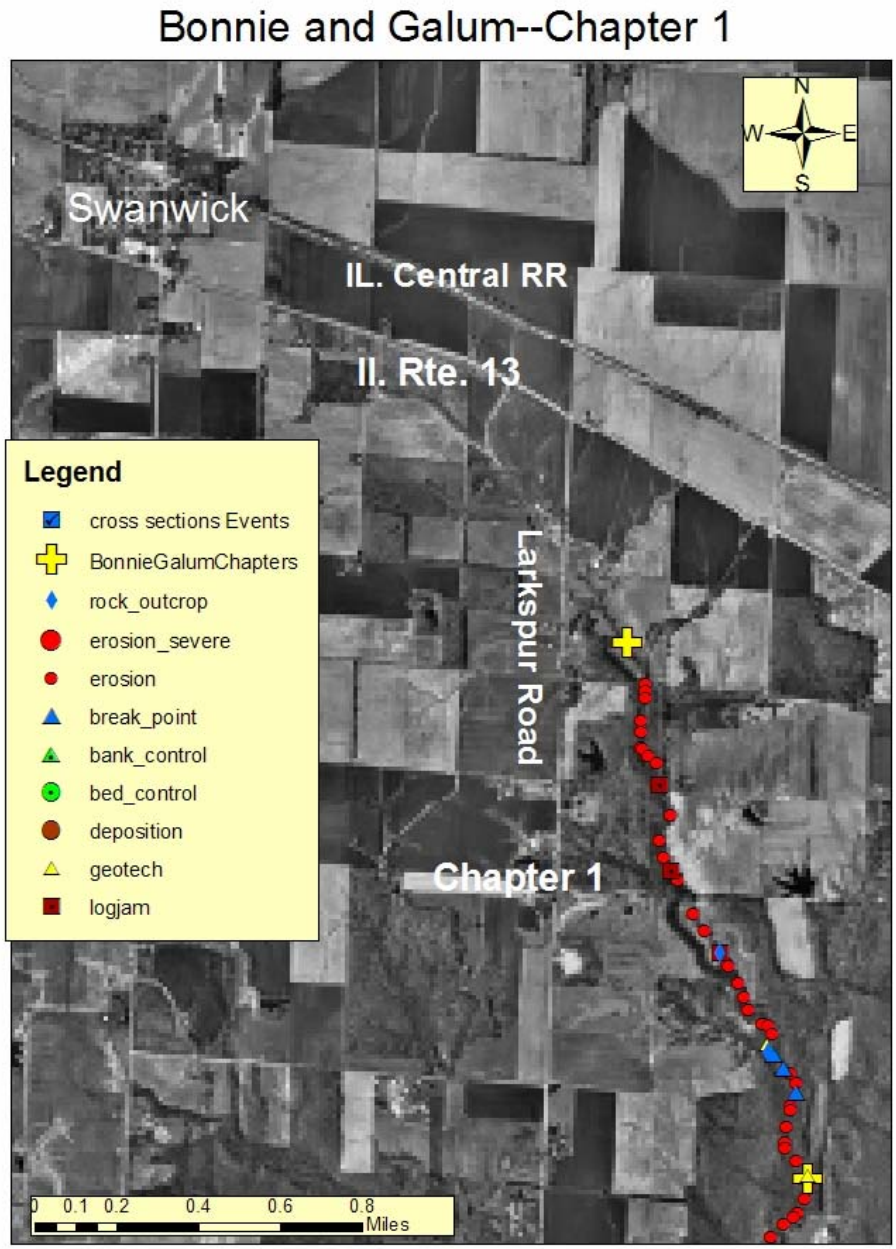


Fig. 9 Chapter 1

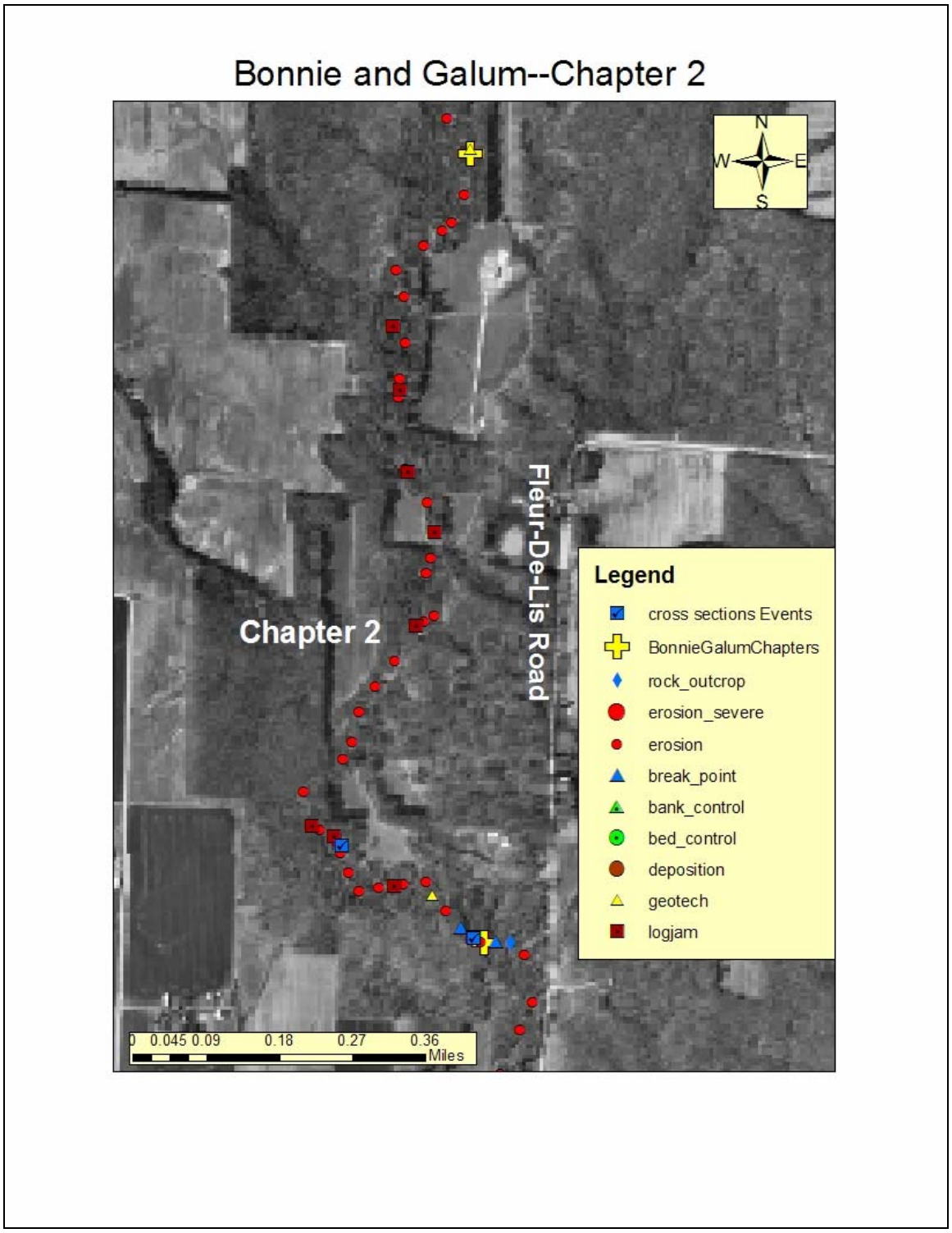


Fig. 10 Chapter 2

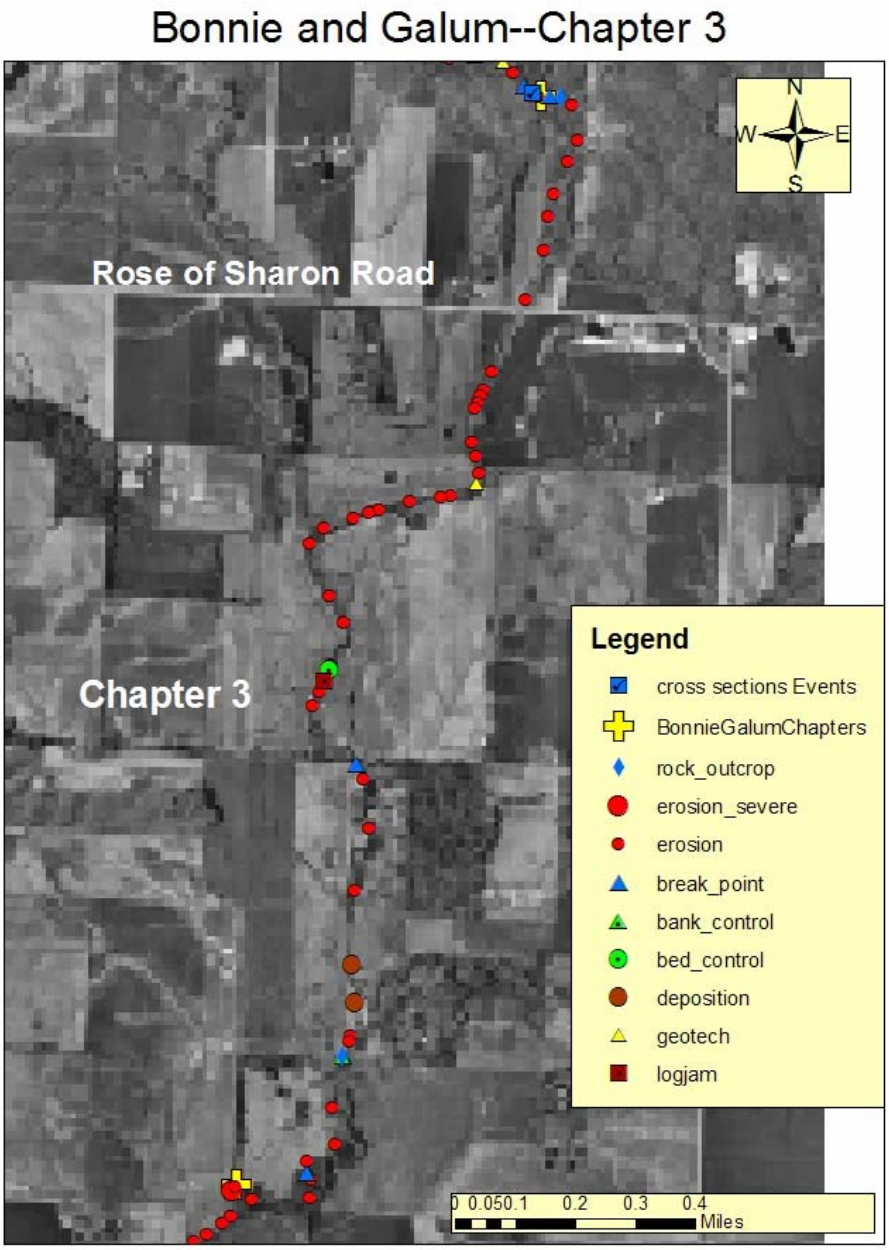


Fig. 11 Chapter 3

Recommendation Chapter 4 thru 6

This segment contains the remainder of NCDC01 and then continues thru the remainder of the strip mined land. Cross sections 3, 4 and 5 are in this reach. The mining and reclamation process has resulted in Bonnie and Galum Creeks being relocated and completely modified from the orginal planform and profile. During the reclamation it appears the channel was built with a sinuous planform down to the junction of Bonnie and Galum Creeks with a series of loose rock grade control structures. The structures identified by the aerial assessment are spaced from 800 to 1600 feet while the normal spacing of 6 bankfull widths would be about 450 feet. Bedload is generally below one inch in diameter, however the mining process has left many larger stones in the channel bed and banks, although there was no observation of the pools above the structures filling excessively. The gradient is approximately 5 ft. per mile above the junction of Bonnie and Galum providing good opportunities for reaeration while it drops to approximately 2.1 ft/mi. downstream of the confluence for the remainder of its length making reaeration less effective.

The recommendation for this reach is to install additional grade control structures and repair or maintain the existing structures so that the spacing is reduced to approximately 6 bankfull widths. This will increase aeration and also provide additional channel stability. Due to the nature of the reclaimed soils in this reach and the need to raise pH levels, it is also recommended that Stone Toe Protection and/or Streambarbs using quarried limestone be applied on all outside meander bends.

Table 5 provides an estimate of the quantities and cost for treatment.

TREATMENT --CHAPTERS 4 through 6					
Lateral Bank Treatment with STP and/or Streambarbs					
Chapter	Total Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
4	50	450	22500	$30.00	$675,000.00
5	54	450	24300	$30.00	$729,000.00
6	39	500	19500	$30.00	$585,000.00
Total	**104**		**46800**		**$1,404,000.00**
Rock Riffle Grade Control					
	Rock Riffles	Average Tonnage	Ave. Cost Ton	Average Cost/Riffle	
4	50	500	$30.00	$15,000.00	$750,000.00
5	54	600	$30.00	$18,000.00	$972,000.00
6	39	600	$30.00	$18,000.00	$702,000.00
Total	**77**				$2,424,000.00

Table 5 Treatment Chapters 4 through 6—Bonnie and Galum Creek

Fig. 12 Blowout area—Severe Erosion, DVD Disc 1 at 20:03

Fig. 13 Reconstructed channel in reclaimed strip mine land. DVD Disc 1 at 22:28

Fig. 14 Failed Grade Control Structure in reclaimed mine land. DVD Disc 1 at 22:37

Fig. 15 Successful Grade Control Structure, reclaimed land. DVD Disc 1 at 24:20

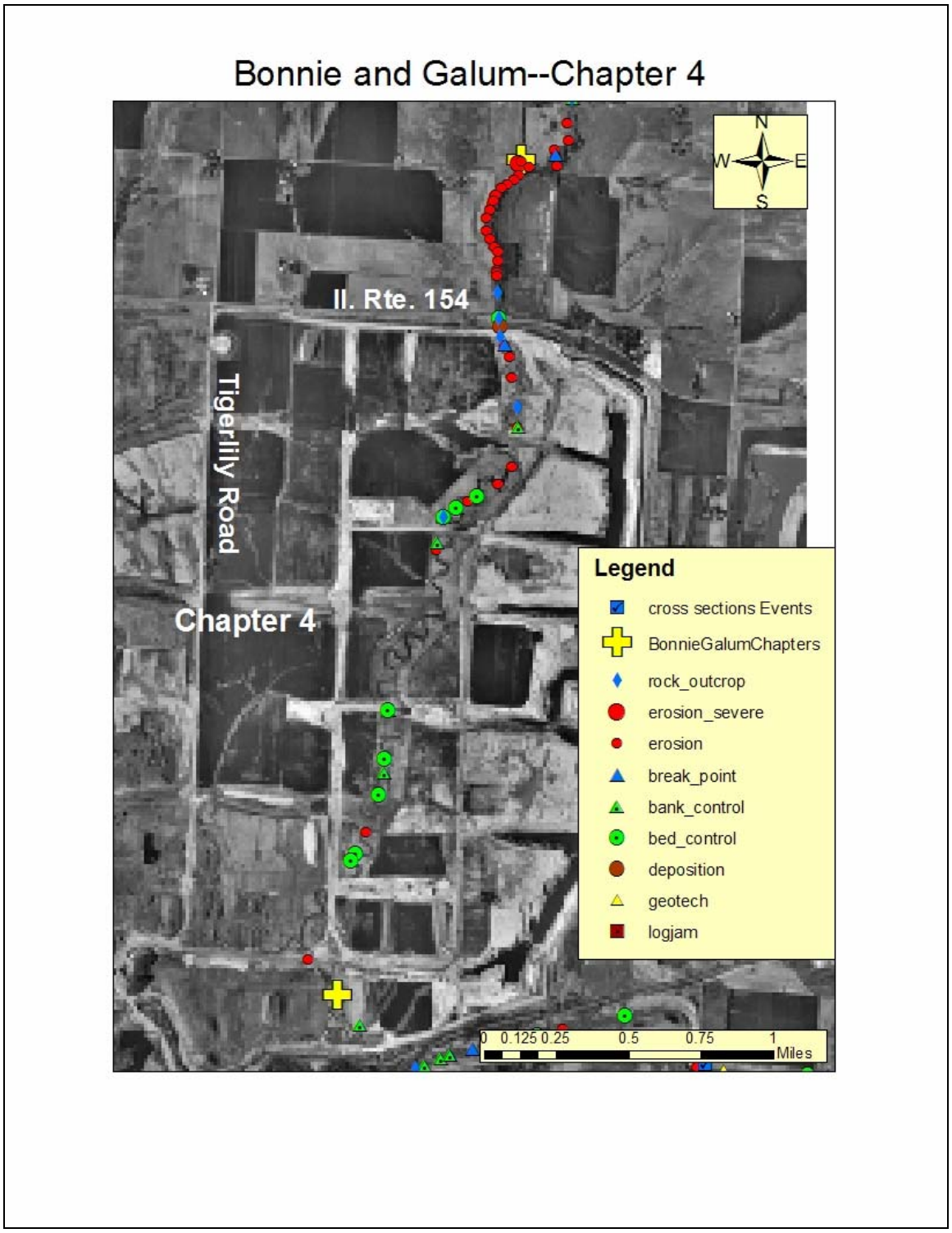


Fig. 16 Chapter 4

Fig. 17 Grade Control Structure Needing Maintenance at DVD Disc 1 26:30

Fig. 18 Deposition as Central Bar at DVD Disc 1 29:01

Fig. 19 Chapter 5

Fig. 20 Logjam at DVD Disc 1 34:47

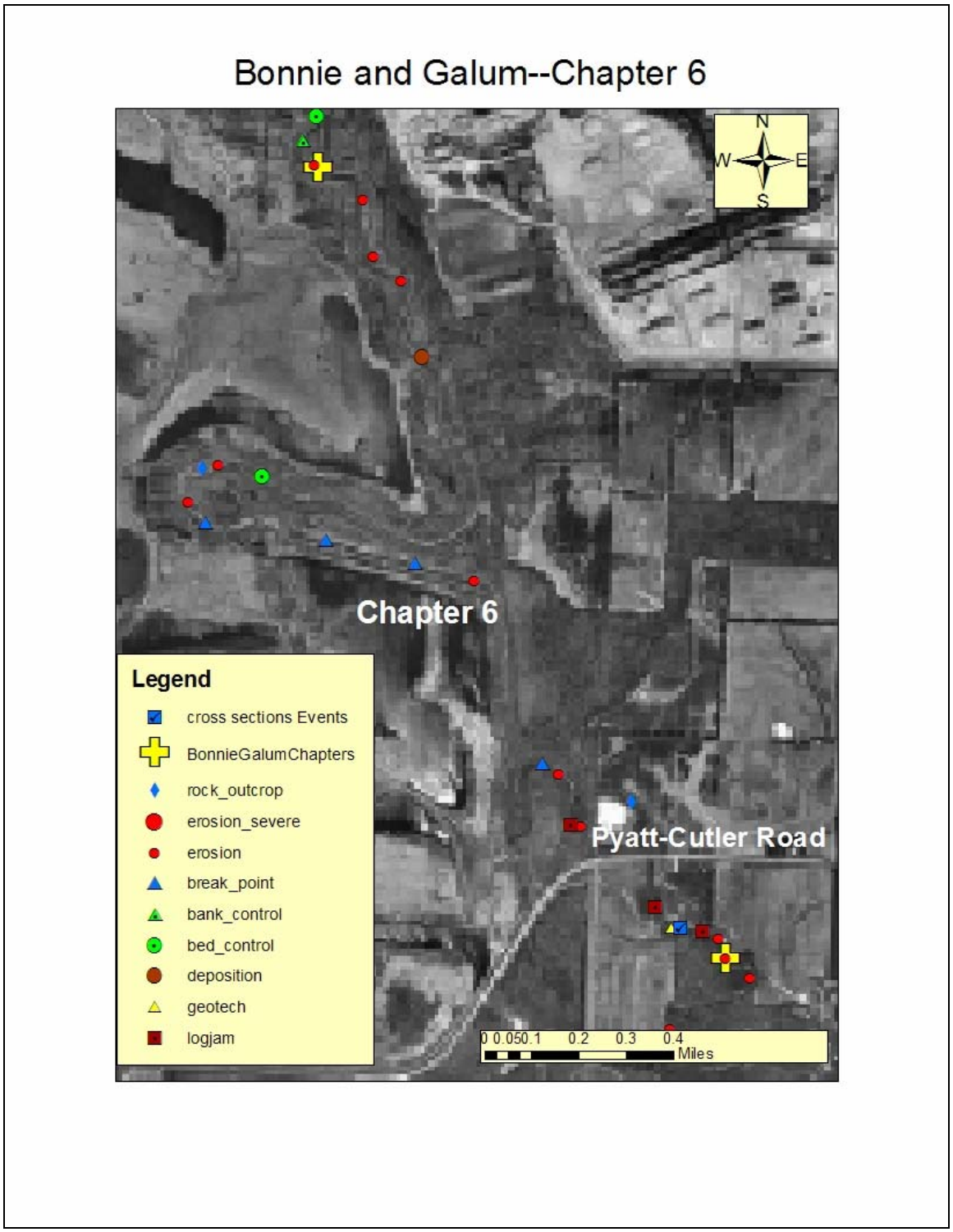


Fig. 21 Chapter 6

Recommendation Chapter 7 through 9

This reach extends from the Pyatt Blacktop downstream to the Perry County line. This reach is CEM stage 5 in Chapter 7 but although there is no cross section the aerial assessment would place Chapter 9 in a CEM stage 3 below the bed control found at DVD Disc 2 at 15:12. TMDL segment NCD03 impaired by silver, sulfates and TDS is in this reach.
The recommendation for this segment is to treat the lateral bank instability with Stone Toe Protection only in Chapter 7 and 8. Chapter 9 will require the same treatment but with the addition of Rock Riffle Grade Control structures to provide bed stability.
The quantities and estimated costs are found in Table 6.

TREATMENT --CHAPTERS 7 through 9					
Lateral Bank Treatment--Stone Toe Protection					
Chapter	Erosion Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
7	14	350	4900	$25.00	$122,500.00
8	7	350	2450	$25.00	$61,250.00
9	17	350	5950	$25.00	$148,750.00
Total	**38**		**13300**		**$332,500.00**

Rock Riffle Grade Control					
Chapter	Number Riffles	Average Tons Stone	Total Tons Stone	Average Cost/ton	Total Cost
7	n/a				$0.00
8	n/a				$0.00
9	36	450	16200	$30.00	$486,000.00
Total	**36**		**16200**		**$486,000.00**

Table 6 Treatment Chapters 7 through 9—Bonnie and Galum Creek

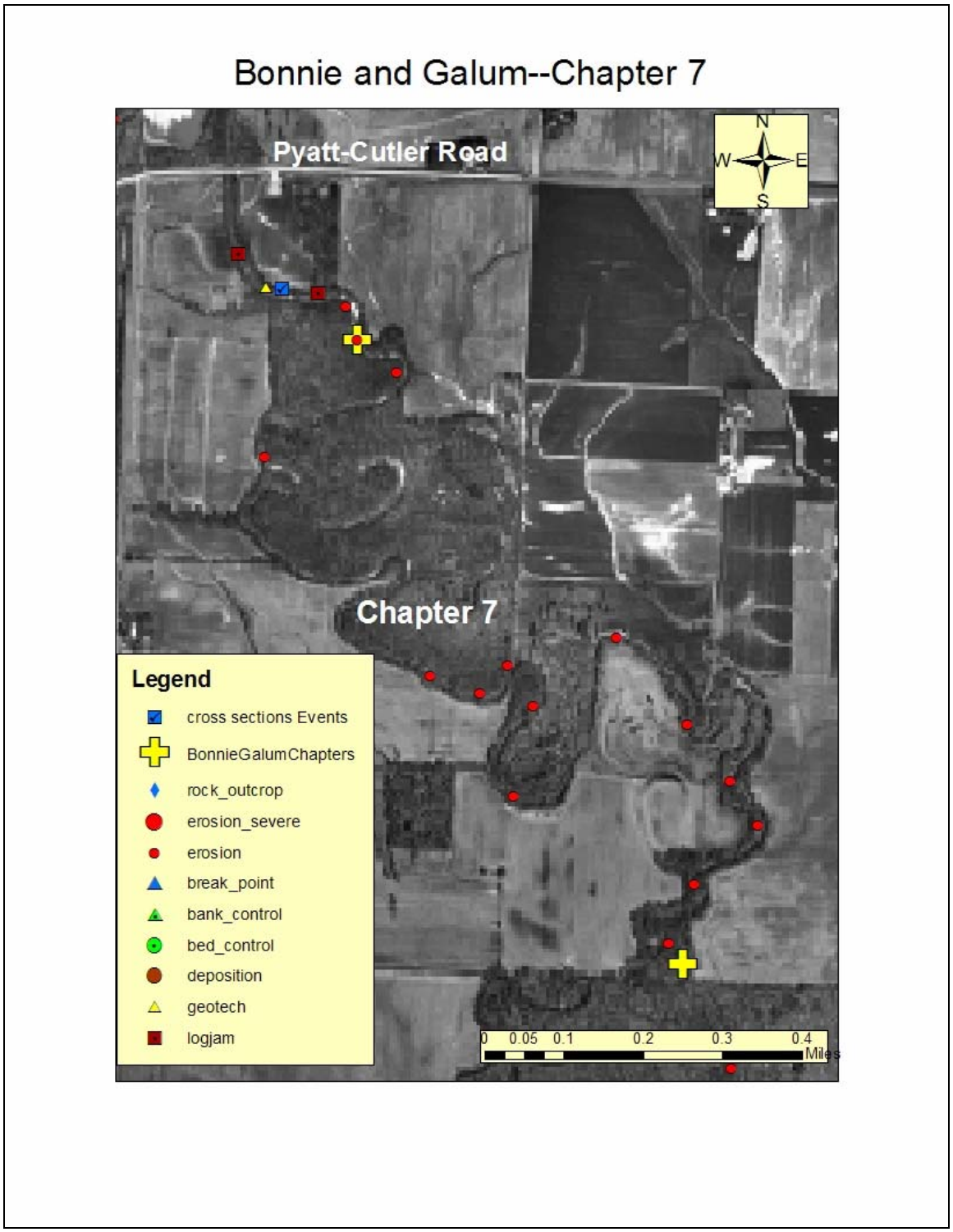


Fig. 22 Chapter 7

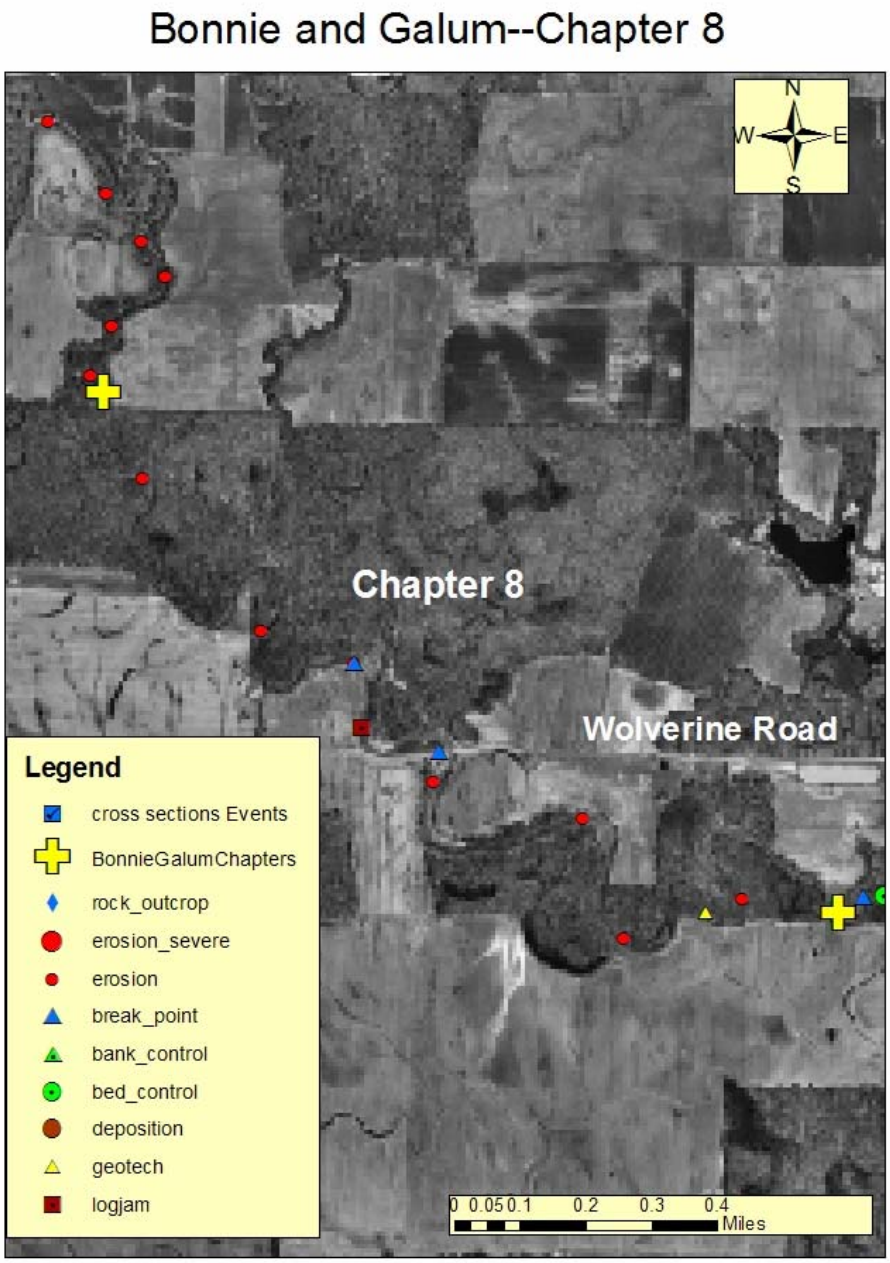


Fig. 23 Chapter 8

Fig. 24 Road Crossing with Large Overfall Downstream at DVD Disc 2 15:12

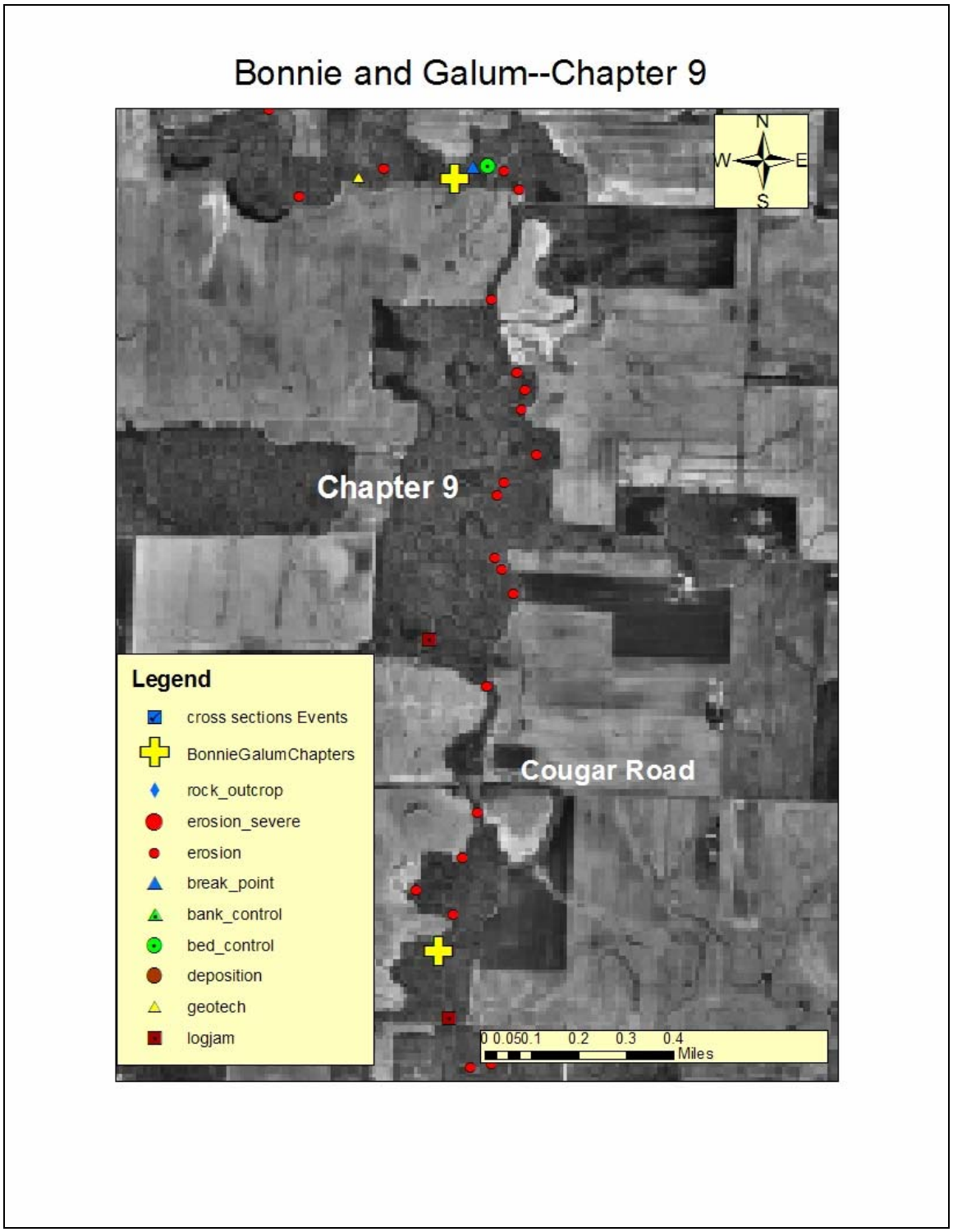


Fig. 25 Chapter 9

Recommendation—Chapter 10-13

This reach extends from the Perry Co.-Jackson Co. line to the confluence with Beaucoup Creek. Galum Creek in this area is CEM stage 5 or stage 6 as it nears the confluence with Beaucoup. It is outside the area considered for TMDL development. There are however 50 eroding streambank sites identified in the aerial assessment. The recommended treatment for these sites is to use Stone Toe Protection to provide the lateral stability. Table 7 provides the quantities and cost estimates for this reach.

TREATMENT --CHAPTERS 10 through 13					
Lateral Bank Treatment with STP					
Chapter	Total Sites	Average Length(ft)	Total Length	Average Cost/foot	Total Cost
10	17	300	5100	$30.00	$153,000.00
11	15	300	4500	$30.00	$135,000.00
12	18	300	5400	$30.00	$162,000.00
13	0	300	0	$30.00	$0.00
Total	**32**		**9600**		**$288,000.00**

Table 7 Treatment Chapters 10 through 13—Bonnie and Galum Creek

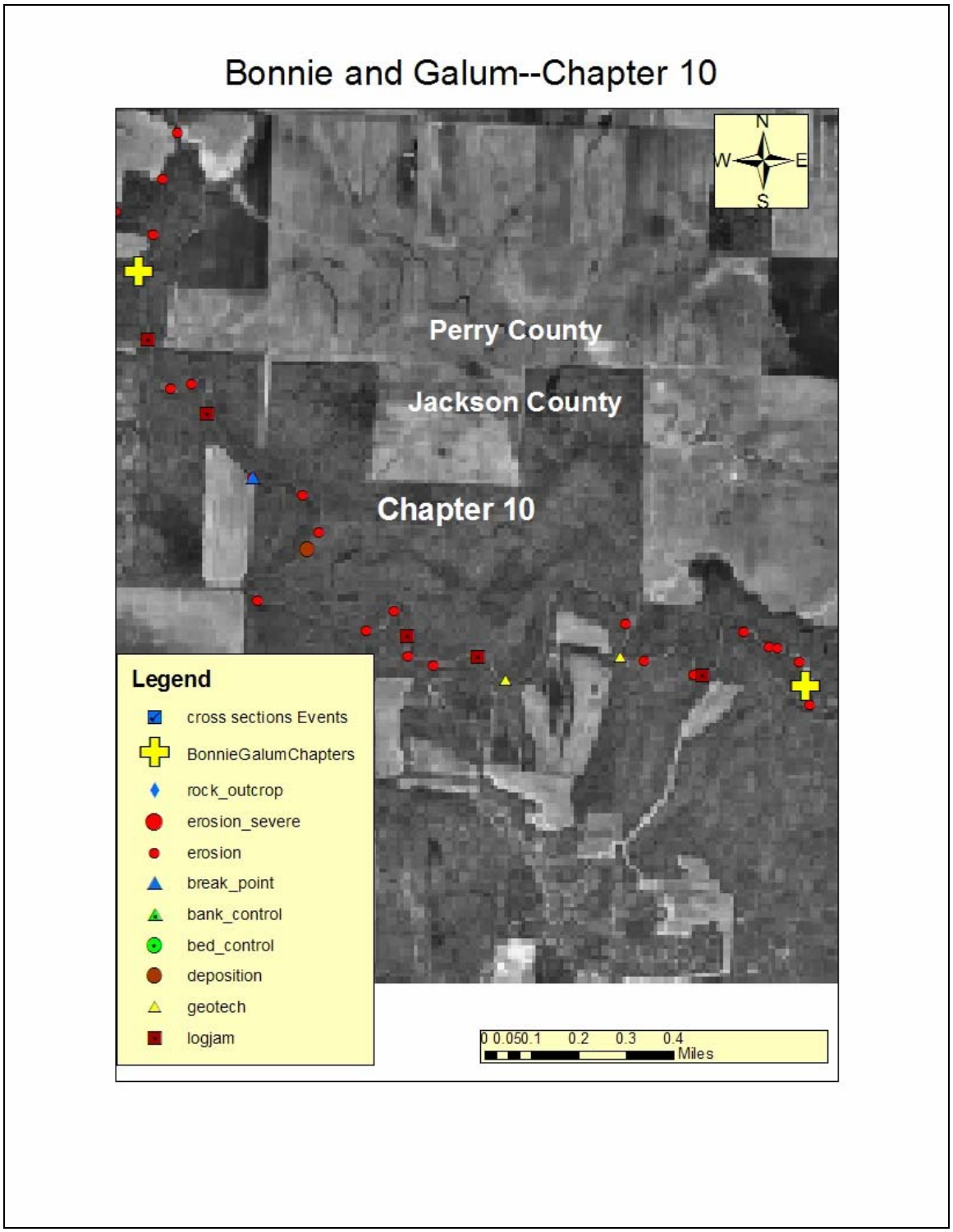


Fig. 26 Chapter 10

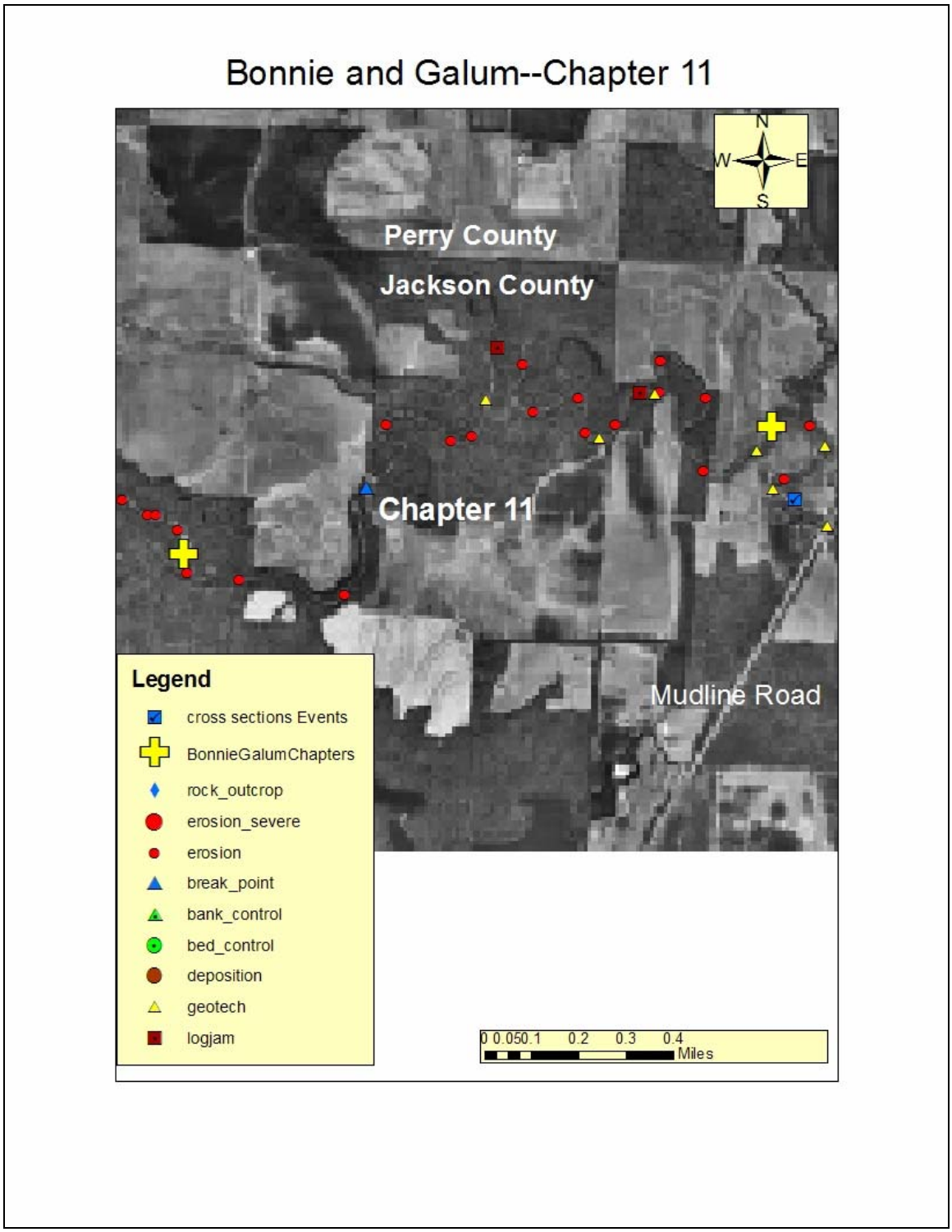


Fig. 27 Chapter 11

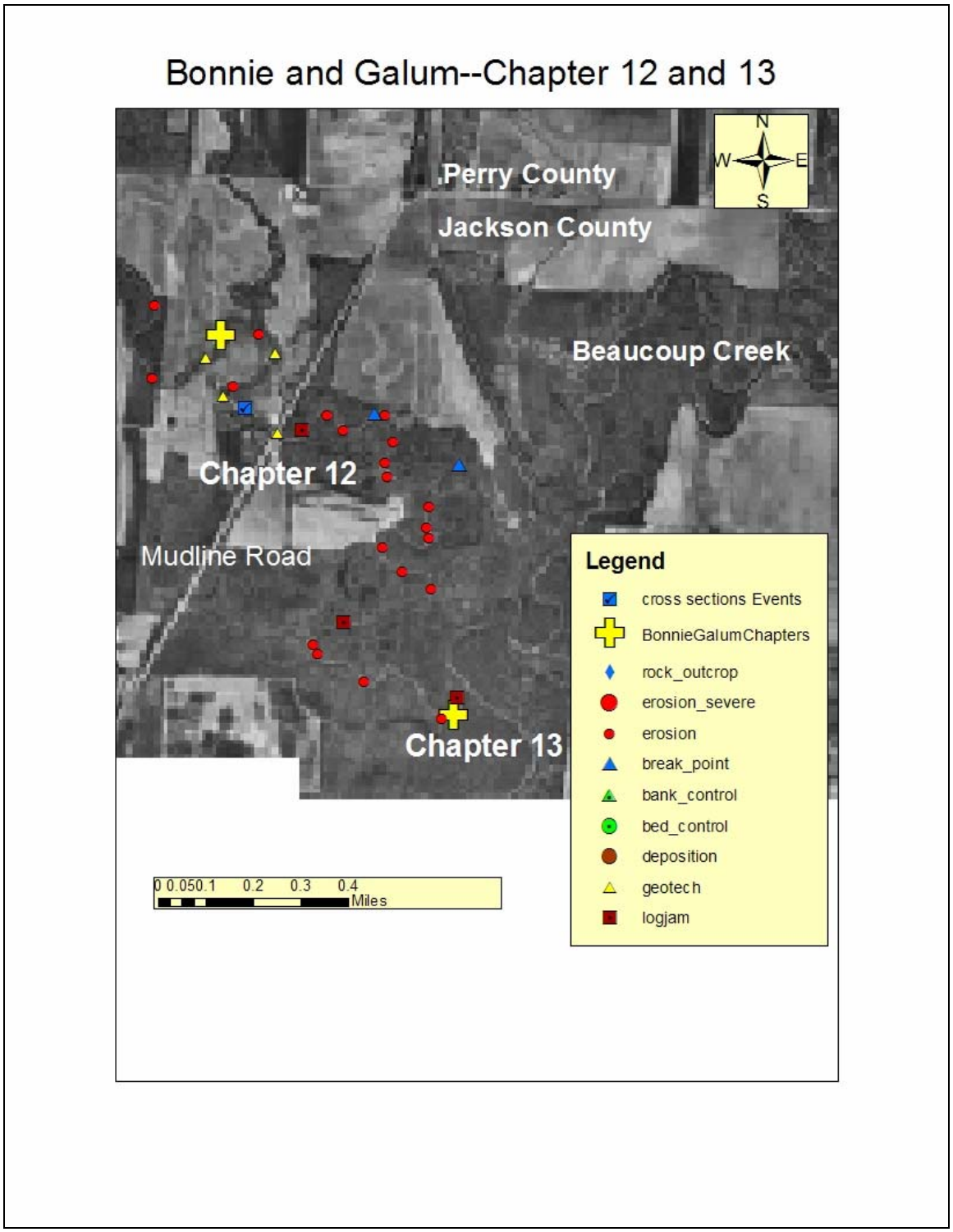


Fig. 28 Chapter 12 and 13

APPENDIX A
CROSS SECTION DATA

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E280115 N4222350

Landowner Name Xsec 1

Drainage Area 4.28 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions Width 26 ft. Cross Sectional Area 60 sq. ft.

Depth 2.3 ft.

Reference Stream Gage:

none Station No. - Gage Q_2 -

Drainage Area - Regression (-

0 - **REFERENCE STREAM DATA ONLY**

USGS Flood-Peak Discharge Predictions:

Valley Slope: 14.6 *ft./mi. (user-entered)* Regression Q_2 429 cfs

ft/mi (from worksheet) Rainfall 3.50 in *(2 yr, 24 hr)* Adjusted Q_2 -

0.0028 *ft./ft.* Regional Factor 0.983 Typical Range for Bankfull Discharge:

170 to 350 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 29 *ft.* Contour Interval feet

Mean Bankfull Depth 4.48 *ft.* Estimated Sinuosity

Width/Depth Ratio 6.47

Channel Slope: Bankfull Q from:

Max. Bankfull Depth 5.8 *ft.* Surveyed: 0.000239 *ft./ft.* Cross-Section 179 *cfs*

Width at twice max. depth 1000 *ft.* Estimated: *ft./ft.* Basic field data 203 *cfs*

(11.6 ft.) Selected Q 191 *cfs*

Entrenchment Ratio 34.48 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} 2 *in.* Velocity required to move D_{90}: 2.9 *ft./sec.*

D_{50} *in.* Velocity from Cross-Section data: 1.37 *ft./sec.*

GOAL: Develop confidence by matching Velocity from basic field data: 1.57 *ft./sec.*

velocities from different sources. Velocity from selected Q: 1.5 *ft./sec.*

Channel Evolution Stage III Stream Type (Rosgen)

Notes

44.6 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 1	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000239	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	5.8	*ft*

$$Q\ 0\ \frac{1.486}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

assuming uniform, steady flow

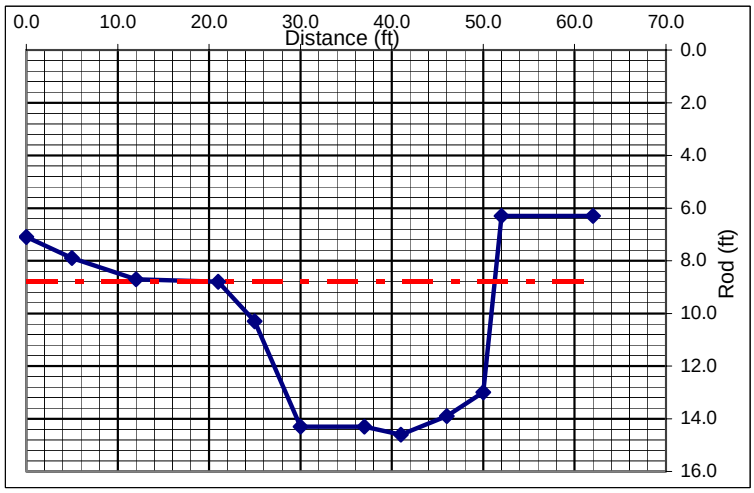
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	5.8 *ft*	7.5	
Channel Flow (***Q***):	178.5 *cfs*	277.8	
Channel Velocity:	1.4 *ft/sec*	1.3	
Cross-Sectional Area (***A***):	130.1 *sq.ft.*	207.2	
Hydraulic Radius (***R***):	3.7 *ft*	3.6	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.1	0.0
7.9	5.0
8.7	12.0
8.8	21.0
10.3	25.0
14.3	30.0
14.3	37.0
14.6	41.0
13.9	46.0
13.00	50
6.30	52
6.30	62



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E280376 N4222167

Landowner Name Xsec 2

Drainage Area 4.32 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	26 ft.	Cross Sectional Area	61 sq. ft.
	Depth	2.3 ft.		

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2 4720 cfs
	Drainage Area	292 sq.mi	Regression (5300 cfs
Perry County, IL		**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	14.6	*ft./mi. (user-entered)*			Regression Q_2	432 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in *(2 yr, 24 hr)*	Adjusted Q_2	385 cfs
	0.0028	*ft./ft.*	Regional Factor	0.983	Typical Range for Bankfull Discharge:	
					150	to 310 cfs

Local Stream Morphology:

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

Manning's "n" 0.04

Basic Field Data:					
Bankfull Width	23	*ft.*	Stream Length		*ft.*
Mean Bankfull Depth	2.65	*ft.*	Valley Length		*ft.*
Width/Depth Ratio	8.68		Contour Interval		feet
			Estimated Sinuosity		
Max. Bankfull Depth	3	*ft.*	*Channel Slope:* Surveyed:	0.00239 *ft./ft.*	Bankfull Q from:
Width at twice max. depth	28	*ft.*	Estimated:	*ft./ft.*	Cross-Section 195 *cfs*
(6.0 ft.)					Basic field data 213 *cfs*
					Selected Q 204 *cfs*
Entrenchment Ratio	1.22		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:	3.20	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.49	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.3	*ft./sec.*

Channel Evolution Stage III Stream Type (Rosgen)

Notes

47.2 cfs/sq. mi.---cannot downcut any more as it has reached sandstone bedrock

Natural Open Channel Flow

Project:	Xsec 2	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.002390	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	3.0	*ft*

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

assuming uniform, steady flow

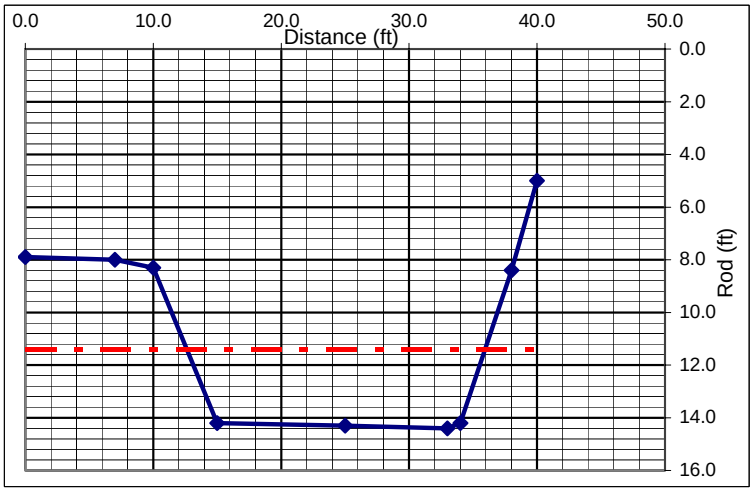
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	3.0 *ft*	6.5	
Channel Flow (***Q***):	195.3 *cfs*	634.2	
Channel Velocity:	3.2 *ft/sec*	4.1	
Cross-Sectional Area (***A***):	61.0 *sq.ft.*	153.0	
Hydraulic Radius (***R***):	2.3 *ft*	3.4	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.9	0.0
8.0	7.0
8.3	10.0
14.2	15.0
14.3	25.0
14.4	33.0
14.2	34.0
8.4	38.0
5.0	40.0



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E280515 N4214261

Landowner Name Xsec 3

Drainage Area 56.24 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	72 ft.	Cross Sectional Area	346 sq. ft.
	Depth	4.8 ft.		

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2	4720 cfs
	Drainage Area	292 sq.mi	Regression (	5300 cfs
Perry County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	8.4	*ft./mi. (user-entered)*			Regression Q_2	2515 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in *(2 yr, 24 hr)*	Adjusted Q_2	2240 cfs
	0.0016	*ft./ft.*	Regional Factor	0.983	Typical Range for Bankfull Discharge:	
					890	to 1800 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	70	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.93	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	14.20				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	6.6	*ft.*	Surveyed:	0.000958 *ft./ft.*	Cross-Section 1113 *cfs*
Width at twice max. depth	400	*ft.*	Estimated:	*ft./ft.*	Basic field data 1153 *cfs*
(13.2 ft.)					Selected Q 1133 *cfs*
Entrenchment Ratio	5.71		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:	3.22	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.34	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.3	*ft./sec.*

Channel Evolution Stage III Stream Type (Rosgen)

Notes

20.1 cfs/sq. mi.---manmade channel in strip mine land

Natural Open Channel Flow

Project:	Xsec 3	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000958	*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

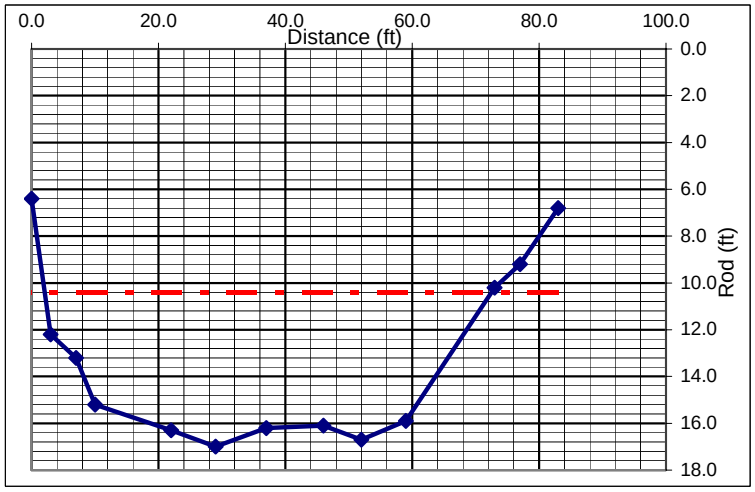
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.6 *ft*	10.2	
Channel Flow (***Q***):	1,112.7 *cfs*	2,624.5	
Channel Velocity:	3.2 *ft/sec*	4.2	
Cross-Sectional Area (***A***):	345.2 *sq.ft.*	622.6	
Hydraulic Radius (***R***):	4.7 *ft*	7.0	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.8	83.0
9.2	77.0
10.2	73.0
15.9	59.0
16.7	52.0
16.1	46.0
16.2	37.0
17.0	29.0
16.3	22.0
15.20	10
13.20	7
12.20	3
6.40	0



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E280600 N4214211

Landowner Name Xsec 4

Drainage Area 56.24 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	72 ft.	Cross Sectional Area	346 sq. ft.
	Depth	4.8 ft.		

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2	4720 cfs
	Drainage Area	292 sq.mi	Regression (	5300 cfs
Perry County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	8.4	*ft./mi. (user-entered)*			Regression Q_2	2515 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in *(2 yr, 24 hr)*	Adjusted Q_2	2240 cfs
	0.0016	*ft./ft.*	Regional Factor	0.983	Typical Range for Bankfull Discharge:	
					890	to 1800 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	71	*ft.*	Contour Interval		feet
Mean Bankfull Depth	4.81	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	14.76				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	6.6	*ft.*	Surveyed:	0.000958 *ft./ft.*	Cross-Section 1093 *cfs*
Width at twice max. depth	800	*ft.*	Estimated:	*ft./ft.*	Basic field data 1123 *cfs*
(13.2 ft.)					Selected Q 1108 *cfs*
Entrenchment Ratio	11.27		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:	3.20	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.29	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.2	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

19.7 cfs/sq. mi. ---manmade channel in stripmine land

Natural Open Channel Flow

Project:	Xsec 4	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000958	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	6.6	*ft*

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

assuming uniform, steady flow

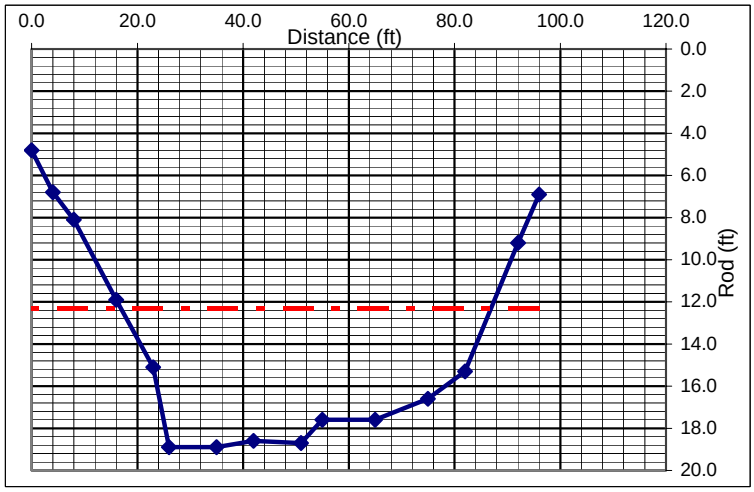
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	6.6 *ft*	12.0	
Channel Flow (***Q***):	1,092.8 *cfs*	3,544.0	
Channel Velocity:	3.2 *ft/sec*	4.6	
Cross-Sectional Area (***A***):	341.7 *sq.ft.*	775.7	
Hydraulic Radius (***R***):	4.6 *ft*	7.9	

Survey Data:

Rod *(ft)*	Distance *(ft)*
6.9	96.0
9.2	92.0
15.3	82.0
16.6	75.0
17.6	65.0
17.6	55.0
18.7	51.0
18.6	42.0
18.9	35.0
18.90	26.0
15.10	23
11.90	16
8.10	8
6.80	4
4.80	0



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E281685 N4212497

Landowner Name X-sec 5

Drainage Area 59.34 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	73 ft.	Cross Sectional Area	359 sq. ft.
	Depth	4.9 ft.		

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2	4720 cfs
	Drainage Area	292 sq.mi	Regression (	5300 cfs
Perry County, IL			**REFERENCE STREAM DATA ONLY**	

USGS Flood-Peak Discharge Predictions:

Valley Slope:	8.4	*ft./mi. (user-entered)*			Regression Q_2	2624 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in *(2 yr, 24 hr)*	Adjusted Q_2	2337 cfs
	0.0016	*ft./ft.*	Regional Factor	0.983	Typical Range for Bankfull Discharge:	
					930	to 1870 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	86	*ft.*	Contour Interval		feet
Mean Bankfull Depth	5.85	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	14.70				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	7.8	*ft.*	Surveyed:	0.000398 *ft./ft.*	Cross-Section 1167 *cfs*
Width at twice max. depth	300	*ft.*	Estimated:	*ft./ft.*	Basic field data 1215 *cfs*
(15.6 ft.)					Selected Q 1191 *cfs*
Entrenchment Ratio	3.49		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}	5 *in.*	Velocity required to move D_{90}:	4.6	*ft./sec.*
	D_{50}	*in.*	Velocity from Cross-Section data:	2.32	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	2.41	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	2.4	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

20.07 cfs/sq. mi. ----manmade channel in strip mined land

Natural Open Channel Flow

Project:	X-sec 5	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000398	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	7.8	*ft*

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

assuming uniform, steady flow

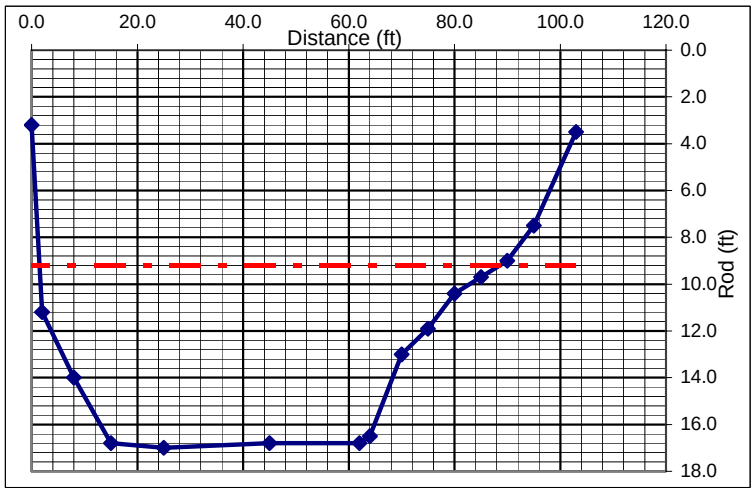
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	7.8 *ft*	13.5	
Channel Flow (***Q***):	1,167.1 *cfs*	3,456.9	
Channel Velocity:	2.3 *ft/sec*	3.3	
Cross-Sectional Area (***A***):	503.8 *sq.ft.*	1,052.0	
Hydraulic Radius (***R***):	5.5 *ft*	9.3	

Survey Data:

Rod *(ft)*	Distance *(ft)*
3.5	103.0
7.5	95.0
9.0	90.0
9.7	85.0
10.4	80.0
11.9	75.0
13.0	70.0
16.5	64.0
16.8	62.0
16.80	45
17.00	25
16.80	15
14.00	8
11.20	2
3.20	0



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonnie and Galum UTM Coord. E283895 N4208908

Landowner Name Xsec 6

Drainage Area 71.13 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	79 ft.	Cross Sectional Area	405	sq. ft.
	Depth	5.2 ft.			

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2	4720 cfs
	Drainage Area	292 sq.mi	Regression (	5300 cfs
Perry County, IL		**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	4.2	*ft./mi. (user-entered)*			Regression Q_2	2170 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in *(2 yr, 24 hr)*	Adjusted Q_2	1932 cfs
	0.0008	*ft./ft.*	Regional Factor	0.983	Typical Range for Bankfull Discharge:	
					770 to 1550 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	64	*ft.*	Contour Interval		feet
Mean Bankfull Depth	7.38	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	8.67				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	11.4	*ft.*	Surveyed:	0.000398 *ft./ft.*	Cross-Section 1258 *cfs*
Width at twice max. depth	800	*ft.*	Estimated:	*ft./ft.*	Basic field data 1331 *cfs*
(22.8 ft.)					Selected Q 1295 *cfs*
Entrenchment Ratio	12.50		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:	2.66	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	2.82	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	2.7	*ft./sec.*

Channel Evolution Stage V Stream Type (Rosgen)

Notes

18.17 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 6	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000398	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	11.4	*ft*

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

assuming uniform, steady flow

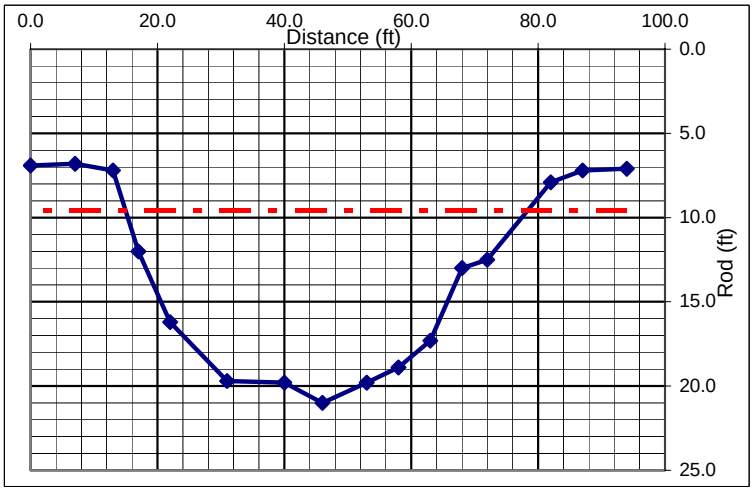
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	11.4 *ft*	13.9	
Channel Flow (***Q***):	1,257.8 *cfs*	1,761.7	
Channel Velocity:	2.7 *ft/sec*	2.7	
Cross-Sectional Area (***A***):	472.5 *sq.ft.*	642.2	
Hydraulic Radius (***R***):	6.8 *ft*	7.1	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.1	94.0
7.2	87.0
7.9	82.0
12.5	72.0
13.0	68.0
17.3	63.0
18.9	58.0
19.8	53.0
21.0	46.0
19.80	40
19.70	31
16.20	22
12.00	17
7.20	13
6.80	7
6.9	0



COMMENTS:

Stream Stabilization I & E Form

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

County Perry T. R. Sec.

Date 11/21/2005 By Wayne Kinney

Stream Name Bonni and Galum UTM Coord. E290794 N4202424

Landowner Name Xsec 7

Drainage Area 158.66 sq. mi. Clear Cells

Regional Curve Predictions:

Bankfull dimensions	Width	107 ft.	Cross Sectional Area	698	sq. ft.
	Depth	6.5 ft.			

Reference Stream Gage:

Beaucoup Creek near Matthews	Station No.	05599000	Gage Q_2	4720 cfs	
	Drainage Area	292 sq.mi	Regression (	5300 cfs	
Perry County, IL			**REFERENCE STREAM DATA ONLY**		

USGS Flood-Peak Discharge Predictions:

Valley Slope:	3.1	*ft./mi. (user-entered)*				Regression Q_2	3533 cfs
		ft/mi (from worksheet)	Rainfall	3.50 in	*(2 yr, 24 hr)*	Adjusted Q_2	3147 cfs
	0.0006	*ft./ft.*	Regional Factor	0.983		Typical Range for Bankfull Discharge:	
						1250	to 2520 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	56	*ft.*	Contour Interval		feet
Mean Bankfull Depth	8.63	*ft.*	Estimated Sinuosity		
Width/Depth Ratio	6.49				
			Channel Slope:		Bankfull Q from:
Max. Bankfull Depth	12	*ft.*	Surveyed:	0.000398 *ft./ft.*	Cross-Section 1360 *cfs*
Width at twice max. depth	1000	*ft.*	Estimated:	*ft./ft.*	Basic field data 1512 *cfs*
(24.0 ft.)					Selected Q 1436 *cfs*
Entrenchment Ratio	17.86		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:	2.81	*ft./sec.*
GOAL: Develop confidence by matching			Velocity from basic field data:	3.13	*ft./sec.*
velocities from different sources.			Velocity from selected Q:	3.0	*ft./sec.*

Channel Evolution Stage VI Stream Type (Rosgen)

Notes

9.05 cfs/sq. mi.

Natural Open Channel Flow

Project:	Xsec 7	
Assisted by:	Wayne Kinney	
Date:	11/21/2005	
Channel Slope (***S***):	0.000398	*ft/ft*
Manning's ***n***:	0.040	
Flow Depth:	12.0	*ft*

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

assuming uniform, steady flow

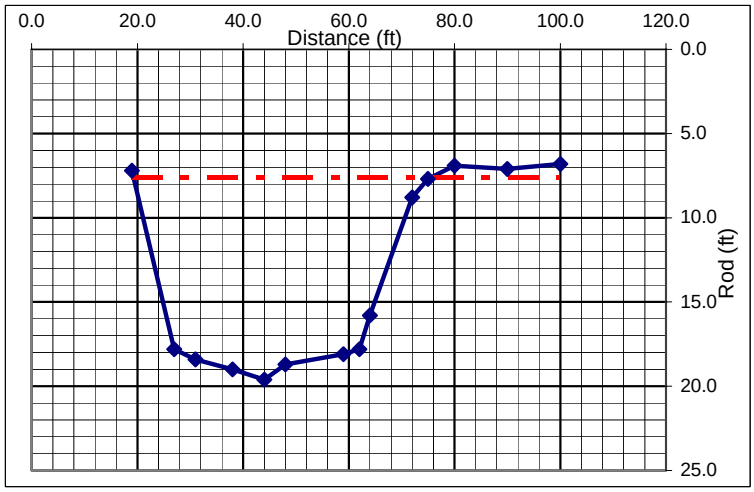
back to I&E form

Clear Cells

		Trial Depth 2	*Trial Depth 3*
Selected Flow Depth:	12.0 *ft*	12.4	
Channel Flow (***Q***):	1,359.9 *cfs*	1,426.1	
Channel Velocity:	2.8 *ft/sec*	2.8	
Cross-Sectional Area (***A***):	483.2 *sq.ft.*	506.3	
Hydraulic Radius (***R***):	7.4 *ft*	7.4	

Survey Data:

Rod *(ft)*	Distance *(ft)*
7.2	19.0
17.8	27.0
18.4	31.0
19.0	38.0
19.6	44.0
18.7	48.0
18.1	59.0
17.8	62.0
15.8	64.0
8.80	72
7.70	75
6.90	80
7.10	90
6.80	100



COMMENTS: