

2008

IN-STREAM

WATER QUALITY

SCREENING

FOR SELECTED

MS4 SITES

PREPARED BY ELISE PFAFF, MS4 ENVIRONMENTALIST II
DATA ANALYSIS BY NATHAN HUGHES

TABLE OF CONTENTS

In-Stream Sampling Protocols for MS4 Sites.	1-2
Parameter Definitions and Their Importance.	3-5
Sampling Results.	6-11
Graphs for E. Coli Levels.	12-21
Maps of Sampling Sites.	22-29
Summary and Conclusion.	32
Acknowledgements.	33

IN-STREAM SAMPLING PROTOCOLS FOR MS4 SITES

In-stream sampling was conducted to provide data to help prioritize sites with illicit discharge potential and to document the long term success of the illicit discharge detection and elimination program. The Elkhart County Health Department collected water samples from June through September at eight different sites in four different creeks or ditches. In June two dry events were sampled. In July and August two dry events and one wet event were sampled. September sampling was for one dry event and one wet event. A wet event is defined as a rain event with precipitation greater than .1 inches as measured in the rain gauge located at 4230 Elkhart Road, Goshen. The wet samples were collected within twenty-four hours of the wet weather event. A dry weather event is defined as a sampling event with no precipitation twenty-four hours prior to collection.

The samples were collected on Tuesday mornings. The parameters and methods of collection are as follows:

Data gathered for dissolved oxygen, pH, temperature, and conductivity are obtained in the field by using an analytical device called a Hydrolab Quanta Water Quality Monitoring System. The hydrolab is lowered into the center part of the stream and placed below the water surface to obtain actual real-time data. Pre and post calibrations are conducted in accordance with the equipment manual.

Test samples for nitrates, chlorides, phosphates, total suspended solids, and E. coli are collected with a dipper and placed in prelabeled and prepared sample containers at each site. The dipper is rinsed three times at each site prior to collection to prevent cross contamination between sample sites.

Nitrates, chlorides, and phosphate samples are collected for analysis in the Elkhart County Health Department Laboratory. Chain of custody procedures are required and followed. These include labeling the bottles with the sample site number and all other information as recorded on the water sampling form. Items on the water sampling form include sampling site identification, sampling date and time, sampling number, dry or wet event and the name of the individual(s) who collected the samples.

Total suspended solids and E. coli samples are collected, labeled, and transported to the Elkhart Public Works and Utilities Laboratory for analysis. A label is filled out with the site number, location, collection date, who collected the sample, who transported and relinquished the sample and is attached to the sample container. Upon arrival at the lab, the time is also added to the label. The label also includes a space for who receives the sample. The Elkhart County Health Department's water sampling form is also signed by the laboratory representative with the time of the sample delivery. This procedure is implemented to verify chain of custody.

Surfactant testing was added on August 26, 2008 and was conducted at all the sites. A courier from a private laboratory picked up the samples at the Elkhart County Health Department.

All samples that are collected are immediately placed in a cooler with chill packs in order to maintain proper temperature requirements during transportation.

The sampling sites were chosen based upon various land uses and where the streams entered the MS4 boundaries. The MS4 entities for Elkhart and Goshen were consulted in site selection.

The following is the list of streams and their sampling locations.

Horn Ditch – CR 31

Rock Run – CR 21 and CR 34

Pine Creek – CR 17, CR 18, CR 23, and CR 27

Putterbaugh Creek – Reedy Drive

PARAMETER DEFINITIONS AND THEIR IMPORTANCE

CHLORIDES (Cl_2) are found in groundwater, streams, and lakes and may be of natural mineral origin or from human or animal sewage, industrial process wastewaters, agricultural fields and roadway deicing salts. It is recommended if very high levels (500 mg/l or more) are found, further investigation should take place to locate the source.

CONDUCTIVITY (SpC) is a measure of how easily electricity flows through water. It is strongly correlated with total dissolved solids. It is useful as a general measure of water quality. Each stream has a fairly constant range of conductivity that can be used for baseline readings. Significant changes in conductivity may be an indicator that a discharge or some other source of pollution has entered the stream. If this occurs, it is recommended that further investigation should take place to locate the source.

DISSOLVED OXYGEN (DO) is considered to be one of the most important parameters of water quality in streams, rivers, and lakes. All aquatic organisms need dissolved oxygen in the water to survive. Stream systems produce and consume oxygen. If more oxygen is consumed than produced, dissolved oxygen levels decline and some organisms move away, weaken, or die. The higher the concentration of dissolved oxygen, the better the water quality. Aquatic life is stressed at levels below 5.0 mg/l. Dissolved oxygen is very sensitive to temperature. The solubility of oxygen in water decreases as temperature increases. A waste discharge can have a dramatic effect on the oxygen balance of a waterbody by raising water temperature or introducing pollutants which remove the dissolved oxygen.

E. COLI is a species of fecal coliform bacteria that is specific to fecal matter from humans and other warm-blooded animals. E. coli indicates the possible presence of pathogenic bacteria, viruses, and protozoans that also live in the digestive systems of humans and animals. Their presence in streams suggests pathogens might be present and that swimming/ full body contact recreation can be a health risk. As required by the United States Environmental Protection Agency, total maximum daily load (TMDL) calculations have been established by the Indiana Pollution Control Board (327 IAC 2-1-6 Section 6(d)) for E.coli using membrane filter count are the following numeric standards:

"Concentrations shall not exceed 125 cfu/100 ml as a geometric mean based on not less than five samples equally spaced over a 30-day period nor exceed 235 cfu/100 ml in any one sample in a 30-day period."

NITRATES (NO_3) are one of the four forms of nitrogen in the nitrogen cycle. They are essential plant nutrients but in excess amounts they can cause significant water

quality problems. Together with phosphorus they can cause increases in plant growth and changes in the types of plants and animals that live in the streams. In turn this affects dissolved oxygen and temperature. Excess nutrients can cause hypoxia which is condition characterized by low levels of dissolved oxygen when the plants decay. The natural level of nitrates in streams is typically low, less than 1 mg/l. Sources of nitrates include failing onsite septic systems, runoff from animal manure storage areas, fertilizer runoff from lawns and cropland, wastewater treatment plants, and industrial discharges that contain corrosion inhibitors.

pH - The pH scale measures the logarithmic concentration of hydrogen and hydroxide ions which make up water. Pure water, equal ion concentrations, is neutral with a pH of 7.0. Below 7.0 the water is acidic and above 7.0 the water is alkaline. pH affects many chemical and biological processes in water. The majority of aquatic organisms survive and thrive at a range of 6.5-8.0. pH outside of this range reduces the diversity of the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH also allows toxic elements and compounds to become soluble and available for uptake by aquatic plants and animals. Some industrial discharges contain very high 12-14 pH or very low 1-3 pH. pH is a good monitoring parameter and significant fluctuations need to be investigated.

PHOSPHATES (PO_4) are the inorganic form of phosphorus and have been used in detergents in the past even with the ban on phosphate based detergents, the amount of phosphorus entering water continues to be a significant problem. Some powdered automatic dishwashing detergents still contain phosphates. Like nitrogen, phosphorus is an essential nutrient for plants and animals that make up the aquatic food web. Phosphorus in streams accelerates plant growth and algae blooms and with their decomposition result in low dissolved oxygen and death of some fish, invertebrates and other aquatic species. There are many natural and human sources of phosphorus. These include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and cropland, failing onsite septic systems, runoff from animal manure storage areas, disturbed land areas and commercial cleaning preparations. Phosphorus is the limiting nutrient in many aquatic environments and very small inputs greatly affect photosynthetic production and can precipitate a massive bloom of plants and algae in slow moving streams and ponds. These blooms are not desired and have a deleterious effect on the aquatic environments where phosphorus has been enriched.

SURFACTANTS, also known as surface active agents, are organic chemicals that reduce surface tension in water and other liquids. Surfactants are used in everyday household items such as soaps, laundry detergents, dishwashing liquids and shampoos. The surfactants enable the detergents to work more effectively in cleaning an item by aiding the wetting of the items being washed. Other important uses are in the many industrial applications for surfactants in lubricants, emulsifiers, and cleansers.

Surfactants are not found in nature. Surfactants can cause significant oxygen demands on surface waters resulting in lower dissolved oxygen levels. The level of surfactants is measured by the amount of methylene blue active substance (MBAS).

TEMPERATURE is a very important water quality parameter and influences all biological and chemical reactions. Temperature influences the dissolved oxygen content of the water, the metabolism of all aquatic organisms, the rate of photosynthesis, and the sensitivity of organisms to pollutions such as toxic wastes and parasites. All aquatic organisms have optimal temperatures for their survival. Many factors affect temperature including stream flow, sunlight, shade, water depth, turbidity, soil erosion, stormwater runoff, and seasonal changes. Temperature is measured in degrees Celsius.

TOTAL SUSPENDED SOLIDS (TSS) are particulates in water and can include many types of material such as silt, decaying plant and animal matter, sewage and industrial wastes. They cause the water to be milky or muddy looking due to the light scattering from very small particles in the water. This is called turbidity. It is not so much the particles themselves that cause the problem, though they can, but more importantly it is what the particles carry on them. Pollutants and contaminants adhere to the suspended solids. High levels of total suspended solids have harmful effects on fish and other aquatic organisms. Total suspended solids are measured in mg/l. There are no numeric standards for total suspended solids however they must meet narrative standards which state in part: "all waters at all times and places, including the mixing zone, shall meet the minimum conditions of being free from substances, materials, floating debris, oil, or scum attributable to municipal, industrial, agricultural, and other land use practices, or other discharges which are in amounts sufficient to injure, be acutely toxic to, or otherwise produce serious adverse physiological responses in humans, animals, aquatic life or plants."

NOTE: The above information was obtained from the United States Environmental Protection Agency, the Indiana Department of Environmental Management and the Center for Watershed Protection.

SAMPLING RESULTS

The results of the samples are presented in the following surface water table. Data for nitrates, NO₃, is available for June 10th and June 17th only due to lab equipment failure at the Elkhart County Health Department. Total suspended solids, TSS, testing was not conducted at the first sampling event on June 10th but was added on June 17th. Phosphates, PO₄, and Chlorides, Cl₂, were not tested on August 12th.

The results of the surfactant testing conducted by Sherry Laboratories are on a separate sheet as is the chain of custody record.

Surface Water Table

10/22/2008

Site #	Site Location	Time	Date	Temp	SpC	DO	pH	NO3	PO4	Cl2	TSS	E Coli
10	CR 31 - Horn Ditch	9:30 AM	6/10/2008	16.33	588	8.87	7.82	3.6	0.7	45		2700
20	CR 34 - Rock Run	9:30 AM	6/10/2008	17.73	625	8.28	7.87	4.58	0.6	45		1440
33	CR 27 - Pine Creek	9:55 AM	6/10/2008	15.63	607	8.4	7.88	5.26	0.3	25		5900
32	CR 23 - Pine Creek	10:05 AM	6/10/2008	16.47	602	8.08	7.8	4.05	0.35	35		1500
31	CR 18 - Pine Creek	10:20 AM	6/10/2008	16.96	601	8.83	7.98	3.75	0.5	45		1120
30	CR 17 - Pine Creek	10:35 AM	6/10/2008	17.88	607	9.2	8.07	3.14	0.4	40		960
40	Reedy Dr - Putterbaugh Creek	10:55 AM	6/10/2008	22.27	383	5.33	7.68	0.06	0.1	20		100
30	CR 17 - Pine Creek	11:45 AM	6/17/2008	15.14	667	12.3	8.17	2.42	0.6	35	6	263
40	Reedy Dr - Putterbaugh Creek	12:00 PM	6/17/2008	19.43	417	7.84	7.85	0.7	0.5	30	3	112
31	CR 18 - Pine Creek	11:30 AM	6/17/2008	14.09	660	10.6	8.02	2.4	0.5	45	9	390
32	CR 23 - Pine Creek	11:15 AM	6/17/2008	14.42	667	10.04	7.89	2.7	0.5	45	6	380
20	CR 34 - Rock Run	10:15 AM	6/17/2008	14.49	694	10.18	7.78	3.04	2.4	45	3	550
10	CR 31 - Horn Ditch	9:45 AM	6/17/2008	14.61	645	10.93	7.83	3.67	0.5	40	3	1560
21	CR 21 - Rock Run	10:35 AM	6/17/2008	15.04	646	9.72	8.01	1.55	0.5	45	4	540
33	CR 27 - Pine Creek	11:05 AM	6/17/2008	13.74	691	13.16	7.87	3.95	0.4	40	5	380
33	CR 27 - Pine Creek	9:50 AM	7/8/2008	17.02	635	11.2	7.91		0.2	40	8	1360
40	Reedy Dr - Putterbaugh Creek	10:50 AM	7/8/2008	21.11	512	7.09	8.01		0.6	40	4	270
30	CR 17 - Pine Creek	10:35 AM	7/8/2008	17.85	629	9.8	8.07		0.4	60	4	440
21	CR 21 - Rock Run	8:45 AM	7/8/2008	18.93	599	9.07	8.08	2.59	0.3	55	28	630
32	CR 23 - Pine Creek	10:00 AM	7/8/2008	17.62	625	8.48	7.84		0.6	45	10	7200
20	CR 34 - Rock Run	9:30 AM	7/8/2008	19.14	647	9.53	7.8		0.4	60	2	830
10	CR 31 - Horn Ditch	9:15 AM	7/8/2008	18.01	632	8.7	7.93		0.5	40	3	2000
31	CR 18 - Pine Creek	10:20 AM	7/8/2008	17.50	619	10.28	8.06		0.7	50	10	4600
40	Reedy Dr - Putterbaugh Creek	10:40 AM	7/15/2008	21.09	419	8.05	7.9		0.4	30	4	250
33	CR 27 - Pine Creek	9:40 AM	7/15/2008	14.50	709	8.8	7.88		0.4	45	9	920
21	CR 21 - Rock Run	8:35 AM	7/15/2008	16.61	659	9.7	8.05		0.6	55	5	630
20	CR 34 - Rock Run	9:15 AM	7/15/2008	16.17	721	8.65	7.82		0.3	45	4	900
32	CR 23 - Pine Creek	10:00 AM	7/15/2008	15.25	689	10.55	7.91		0.5	40	7	1040
31	CR 18 - Pine Creek	10:10 AM	7/15/2008	15.38	679	9.51	8.05		0.4	40	8	860
30	CR 17 - Pine Creek	10:20 AM	7/15/2008	16.54	689	10.58	8.08		0.4	40	6	660
10	CR 31 - Horn Ditch	9:00 AM	7/15/2008	15.81	685	9.01	7.87		0.6	50	3	1260
20	CR 34 - Rock Run	9:25 AM	7/22/2008	17.81	679	8.04	7.79		0.3	40	5	625
10	CR 31 - Horn Ditch	9:00 AM	7/22/2008	17.45	664	8.54	7.93		0.5	45	4	685

Surface Water Table

10/22/2003

Site #	Site Location	Time	Date	Temp	SpC	DO	pH	NO3	PO4	Cl2	TSS	E Coll
21	CR 21 - Rock Run	9:45 AM	7/22/2008	17.15	624	10.45	8.01		0.7	50	3	13600
32	CR 23 - Pine Creek	10:30 AM	7/22/2008	17.15	651	8.78	7.88		0.4	45	5	645
31	CR 18 - Pine Creek	10:40 AM	7/22/2008	17.03	639	9.86	8.04		0.5	40	8	650
30	CR 17 - Pine Creek	11:00 AM	7/22/2008	18.04	646	11.78	8.1		0.4	55	3	420
40	Reedy Dr - Putterbaugh Creek	11:15 AM	7/22/2008	22.49	388	7.03	7.9		0.3	30	3	155
33	CR 27 - Pine Creek	10:05 AM	7/22/2008	16.50	667	10.67	7.93		0.4	40	8	825
21	CR 21 - Rock Run	9:10 AM	8/5/2008	18.33	614	9.47	7.96		0.6	60	9	3450
40	Reedy Dr - Putterbaugh Creek	11:40 AM	8/5/2008	22.14	392	7.01	7.89		0.1	30	2	347
30	CR 17 - Pine Creek	11:15 AM	8/5/2008	17.15	639	9.76	8.03		0.4	40	4	1570
31	CR 18 - Pine Creek	11:00 AM	8/5/2008	17.06	632	11.27	8.02		0.5	40	19	2550
32	CR 23 - Pine Creek	10:40 AM	8/5/2008	17.27	645	8.09	7.86		0.8	40	5	15100
33	CR 27 - Pine Creek	10:20 AM	8/5/2008	16.70	614	10.78	7.89		0.4	45	8	1485
20	CR 34 - Rock Run	10:00 AM	8/5/2008	18.40	676	9.1	7.88		0.8	50	2	695
10	CR 31 - Horn Ditch	9:45 AM	8/5/2008	17.99	659	7.45	7.85		0.6	45	3	1040
33	CR 27 - Pine Creek	11:00 AM	8/12/2008	14.20	688	9.35	7.72				8	380
31	CR 18 - Pine Creek	11:40 AM	8/12/2008	15.01	661	10	8.08				6	280
32	CR 23 - Pine Creek	11:25 AM	8/12/2008	15.42	670	9.19	7.83				4	385
30	CR 17 - Pine Creek	11:50 AM	8/12/2008	16.92	675	11.43	8.13				3	144
10	CR 31 - Horn Ditch	10:00 AM	8/12/2008	15.48	686	9.47	7.93				7	1120
21	CR 21 - Rock Run	9:00 AM	8/12/2008	15.38	712	10.17	8.04				2	520
40	Reedy Dr - Putterbaugh Creek	12:05 AM	8/12/2008	16.29	534	8.92	7.76				2	465
20	CR 34 - Rock Run	10:25 AM	8/12/2008	15.15	718	10.05	7.96				3	390
32	CR 23 - Pine Creek	10:05 AM	8/26/2008	14.61	589	9.91	8.04		0.6	45	5	415
40	Reedy Dr - Putterbaugh Creek	11:00 AM	8/26/2008	15.83	438	8.79	7.92		0.3	30	6	1040
31	CR 18 - Pine Creek	10:20 AM	8/26/2008	14.85	660	9.39	8.12		0.5	40	9	460
33	CR 27 - Pine Creek	9:50 AM	8/26/2008	14.42	690	10.09	7.99		0.9	50	10	795
20	CR 34 - Rock Run	9:30 AM	8/26/2008	14.83	708	9.32	8.02		0.7	50	4	570
10	CR 31 - Horn Ditch	9:10 AM	8/26/2008	14.62	669	9.61	8		0.6	45	5	670
21	CR 21 - Rock Run	8:45 AM	8/26/2008	16.17	642	8.49	8.08		0.4	55	5	200
30	CR 17 - Pine Creek	10:35 AM	8/26/2008	15.70	672	9.95	8.21		0.6	45	6	296
21	CR 21 - Rock Run	9:00 AM	9/9/2008	15.20	578	7	7.91		0.4	45	10	510
10	CR 31 - Horn Ditch	9:30 AM	9/9/2008	14.50	690	7.07	7.96		0.5	55	5	1125
33	CR 27 - Pine Creek	10:10 AM	9/9/2008	14.21	661	8.19	7.91		0.5	40	7	11200

Surface Water Table

10/22/2008

Site #	Site Location	Time	Date	Temp	SpC	DO	pH	NO3	PO4	Cl2	TSS	E Coll
20	CR 34 - Rock Run	9:45 AM	9/9/2008	14.35	715	7	7.93		0.4	40	5	2250
32	CR 23 - Pine Creek	10:30 AM	9/9/2008	14.60	674	8	7.95		0.4	50	13	4900
31	CR 18 - Pine Creek	10:45 AM	9/9/2008	14.31	656	8.46	8.1		0.5	50	12	2100
30	CR 17 - Pine Creek	11:00 AM	9/9/2008	14.64	658	8.23	8.04		0.4	60	10	1450
40	Reedy Dr - Putterbaugh Creek	11:20 AM	9/9/2008	16.60	435	8.47	7.93		0.3	35	5	640
21	CR 21 - Rock Run	8:45 AM	9/23/2008	15.19	668	6.44	8		0.8	60	6	570
10	CR 31 - Horn Ditch	9:15 AM	9/23/2008	13.76	710	5.86	7.89		0.7	50	10	2700
20	CR 34 - Rock Run	9:30 AM	9/23/2008	13.86	719	6.58	7.72		0.8	60	8	1080
33	CR 27 - Pine Creek	10:00 AM	9/23/2008	13.90	646	6.52	7.87		0.7	55	8	540
32	CR 23 - Pine Creek	10:10 AM	9/23/2008	13.85	634	6.75	7.87		0.6	50	10	1380
31	CR 18 - Pine Creek	10:20 AM	9/23/2008	14.03	630	6.65	7.99		0.6	50	12	615
40	Reedy Dr - Putterbaugh Creek	10:55 AM	9/23/2008	18.00	392	5.02	7.71		0.5	35	2	92
30	CR 17 - Pine Creek	10:40 AM	9/23/2008	14.50	641	6.93	7.98		0.6	45	11	520

SAMPLE RESULTS



Page 2 of 2

Client Name: Elkhart County Health Dept
Client Project: MS 4 Sites

SHERRYLaboratories
Testing Today - Protecting Tomorrow®

Report Date: 9/4/08
Sherry Order No: 080800258

Lab Number	Client Description	Sample Date	Parameter	Result	Units	RDL	Test Date	Analyst ID	Method
123553	21-CR 21 Rock Run	8/26/08	Surfactants (MBAS)	<0.1	mg/L	0.1	8/27/08	E21	5540 C
123554	10-CR 31 Horn	8/26/08	Surfactants (MBAS)	<0.1	mg/L	0.1	8/27/08	E21	5540 C
123555	20-CR 34 Rock Run	8/26/08	Surfactants (MBAS)	0.12	mg/L	0.1	8/27/08	E21	5540 C
123556	33-CR 27 Pine	8/26/08	Surfactants (MBAS)	<0.1	mg/L	0.1	8/27/08	E21	5540 C
123557	32-CR 23 Pine	8/26/08	Surfactants (MBAS)	0.20	mg/L	0.1	8/27/08	E21	5540 C
123558	31-CR 18 Pine	8/26/08	Surfactants (MBAS)	0.1	mg/L	0.1	8/27/08	E21	5540 C
123559	30-CR 17 Pine	8/26/08	Surfactants (MBAS)	<0.1	mg/L	0.1	8/27/08	E21	5540 C
123560	40- Reddy Potterbrugh	8/26/08	Surfactants (MBAS)	<0.1	mg/L	0.1	8/27/08	E21	5540 C

3292

Sherry Laboratories - Chain of Custody Record

Laboratory
Number:

Client Information:		Billing Information:		PO Number:	Project Name/Number:	Page of
Elkhart County Health Dept		Karla Kreczmer		Quote Number: none on quotation dated 3-3-08	MS 4 sites	Matrix Code
Address: 4230 Elkhart Rd.		Same		Required QC Level	Sampler's Signature <i>Elise W. Daff</i>	DW = Drinking Water WW = Waste Water GW = Ground Water AQ = Aqueous SL = Sludge O = Oil F = Food NG = Natural Gas NGL = Natural Gas Liquid PW = Produced Water CF = Completion Fluid
City, State, Zip: Elkhart IN 46517		Ext:		Bill Monthly <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Shipping Method: UPS / FedEx / Airborne DHL (Sherry) / Hand / Mail	
Phone Number: 574-875-3391		Ext:				
Fax Number: 574-875-3376						
E-mail Address:						

Which Regulations Apply:				Turn Time		(Rush turn times will incur a surcharge and must be pre-approved by lab.)		Container		Pres.		Requested Tests							Comments
<input type="checkbox"/> RCRA <input type="checkbox"/> POTW <input type="checkbox"/> NPDES <input type="checkbox"/> USDA/FDA <input type="checkbox"/> RECAP/RISC				<input checked="" type="checkbox"/> Standard <input checked="" type="checkbox"/> RUSH <input type="checkbox"/> 1 Day <input type="checkbox"/> 2 Day <input type="checkbox"/> Other				Type P=Plastic, G=Glass, V=Vial		HCl, HNO ₃ , H ₂ SO ₄ , NaOH, Na ₂ SO ₃									0808.258
								Quantity											
																			Surface water samples 123553 123554 123555 123556 123557 123558 123559 123560

	Requisitioned by		Date/Time		Received by		Date/Time		Field Notes:	
1	<i>Ant</i>		8/26/08 1:43pm		Dan Sherry		8-26-08 1:43			
2									Received at lab on ice?	
3									<input type="checkbox"/> Yes <input type="checkbox"/> No Temp:	

All samples submitted to Sherry Laboratories for analysis are accepted on a custodial basis only. Ownership of the material remains with the client submitting the samples. Sherry Laboratories reserves the right to return unused sample portions.

9301 Innovation Drive, Suite 125 PO Box 569 Daleville, IN 47334-0569 765-378-4103 Fax: 765-378-4109	629 Washington St. Suite 300 Columbus, IN 47201 812-375-0531 Fax: 812-375-0731	2121 E. Washington Blvd. Fort Wayne, IN 46803 260-471-7000 Fax: 260-471-7777	560 South Zimmer Road P.O. Box 1849 Warsaw, IN 46581-1849 574-267-3305 Fax: 574-269-6569	2417 W. Pinhook Rd Lafayette, LA 70508 337-235-0483 Fax: 337-233-6540	1701 North Ironwood Drive Suite B South Bend IN 46653 574-273-4599 Fax: 574-273-4599
---	--	---	--	--	---

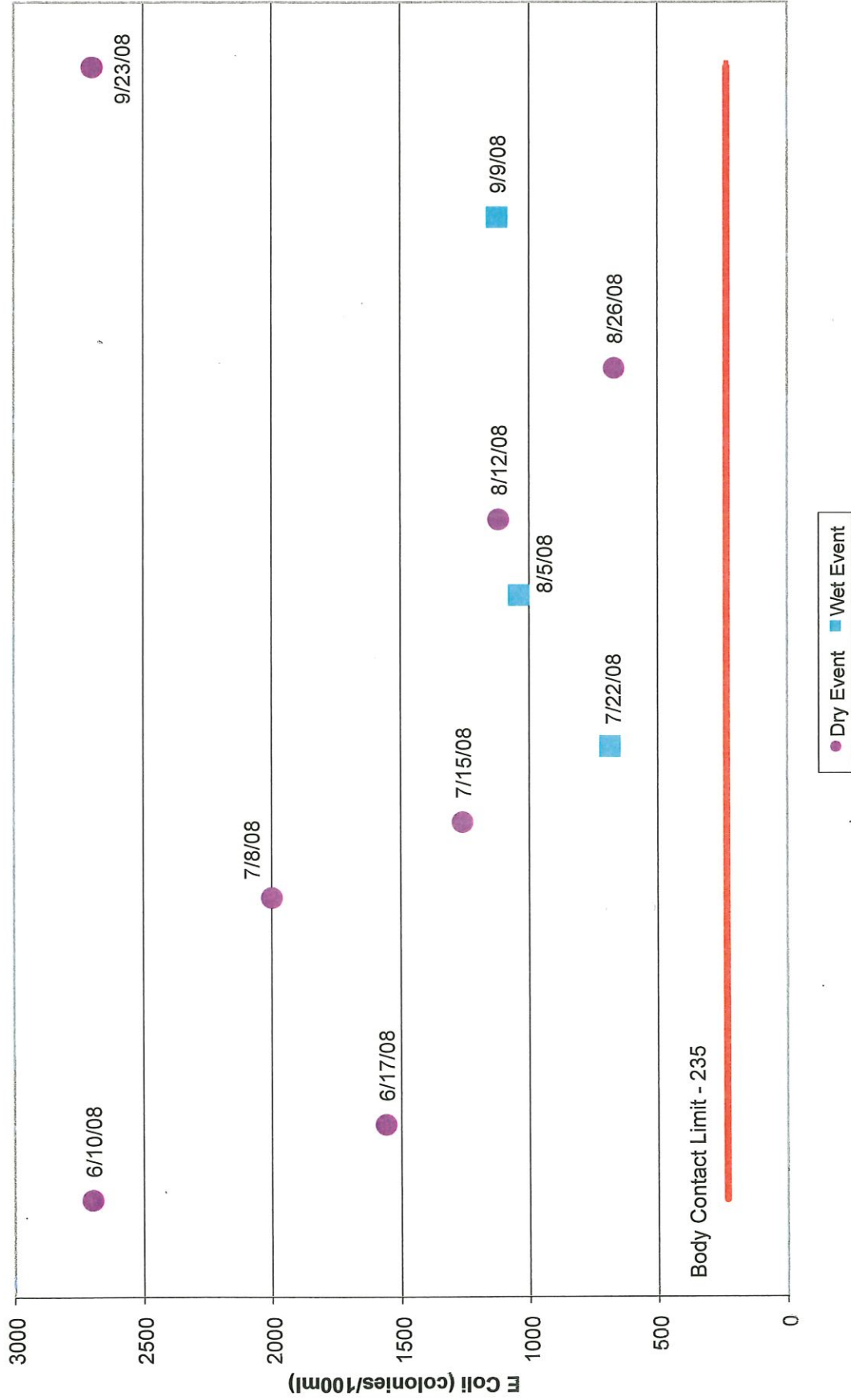
GRAPHS FOR E.COLI LEVELS

Graphs for E. coli were prepared due to the public health risk associated with E. coli levels exceeding 235 colonies/100ml. The vertical axis represents the E. coli concentrations. Each sampling site has a unique scale. Each graph demonstrates the wide range of results. For example, CR 31 – Horn Ditch had E. coli levels greater than 500 and less than 3,000 colonies/100ml, while CR 23 – Pine Creek had levels greater than 379 and less than 15,200 colonies/100 ml. The bold red horizontal line on each chart represents the 235 colonies/100 ml. The sampling dates and E. coli results are plotted in the graph.

Dry weather water sampling events were on June 10th and 17th, July 8th and 15th, August 12th and 26th, and September 23rd. Wet weather events were on July 22nd, August 5th, and September 9th. The wet weather events have a blue square by the date and the dry weather events have a purple circle by the date. In general, wet weather events tend to have higher levels of pollution due to the runoff associated with them. As the following graphs illustrate, the E. coli levels were elevated even during dry weather events.

Also, included is a chart plotting all sampling results and site locations. The vertical axis represents the E. coli concentrations and the horizontal axis represents the site locations. The sampling dates are omitted from the chart. The bold green line represents the 235 colonies/100 ml. The wet weather events are indicated by open blue squares and the dry weather events are indicated by closed orange circles.

CR 31 - Horn Ditch



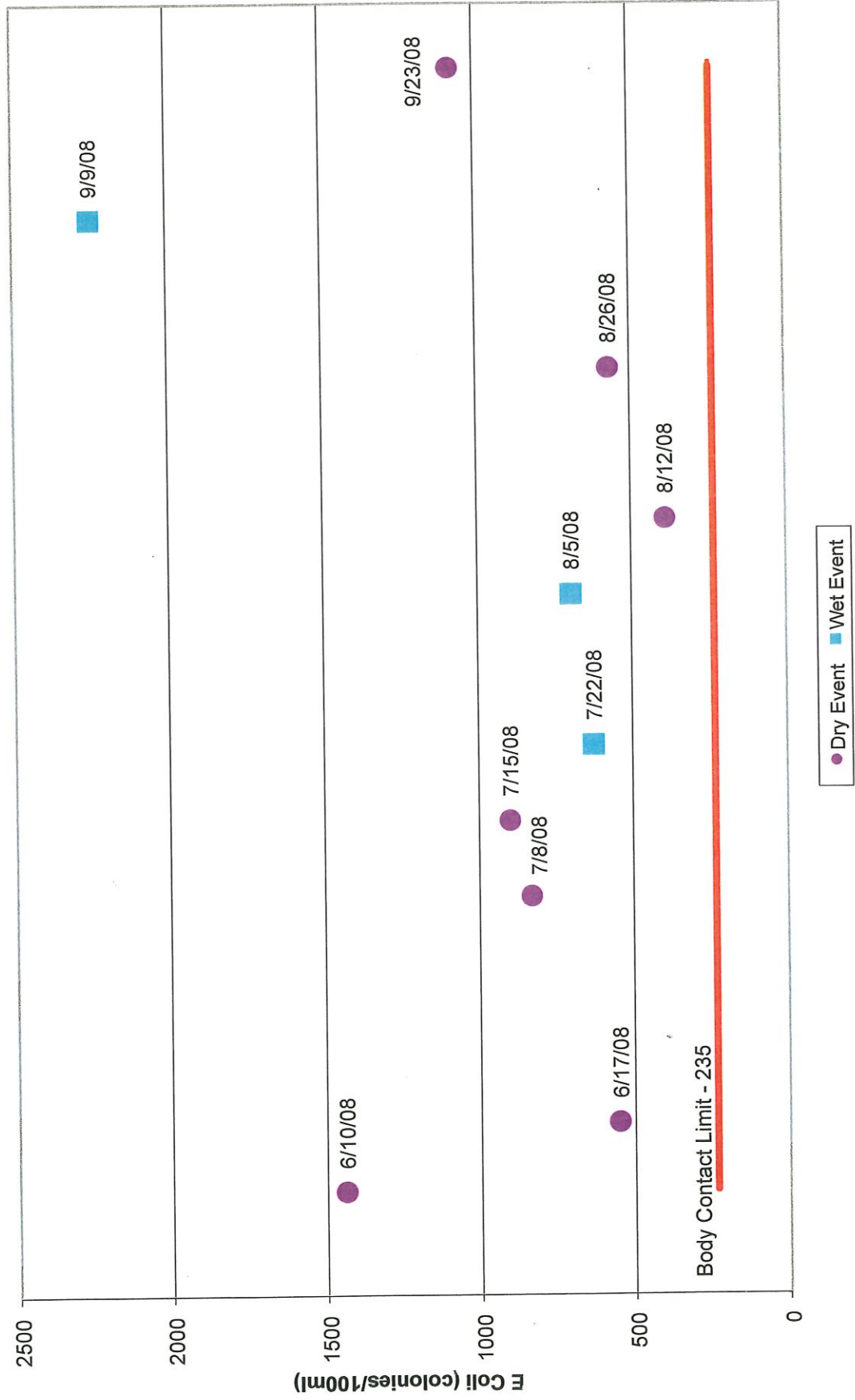
CR 21 - Rock Run

Outliers:

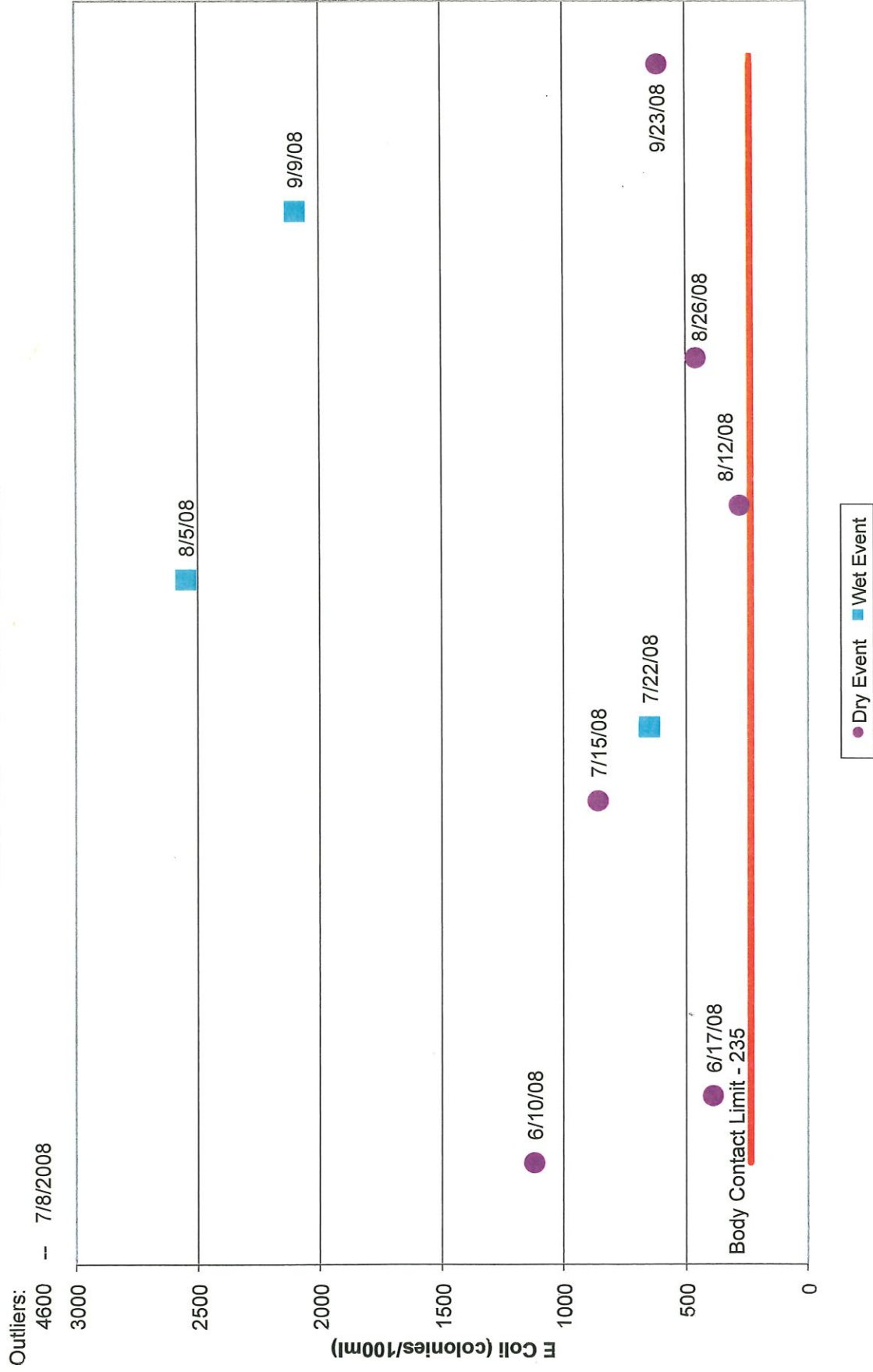
-- 7/22/2008
-- 8/5/2008



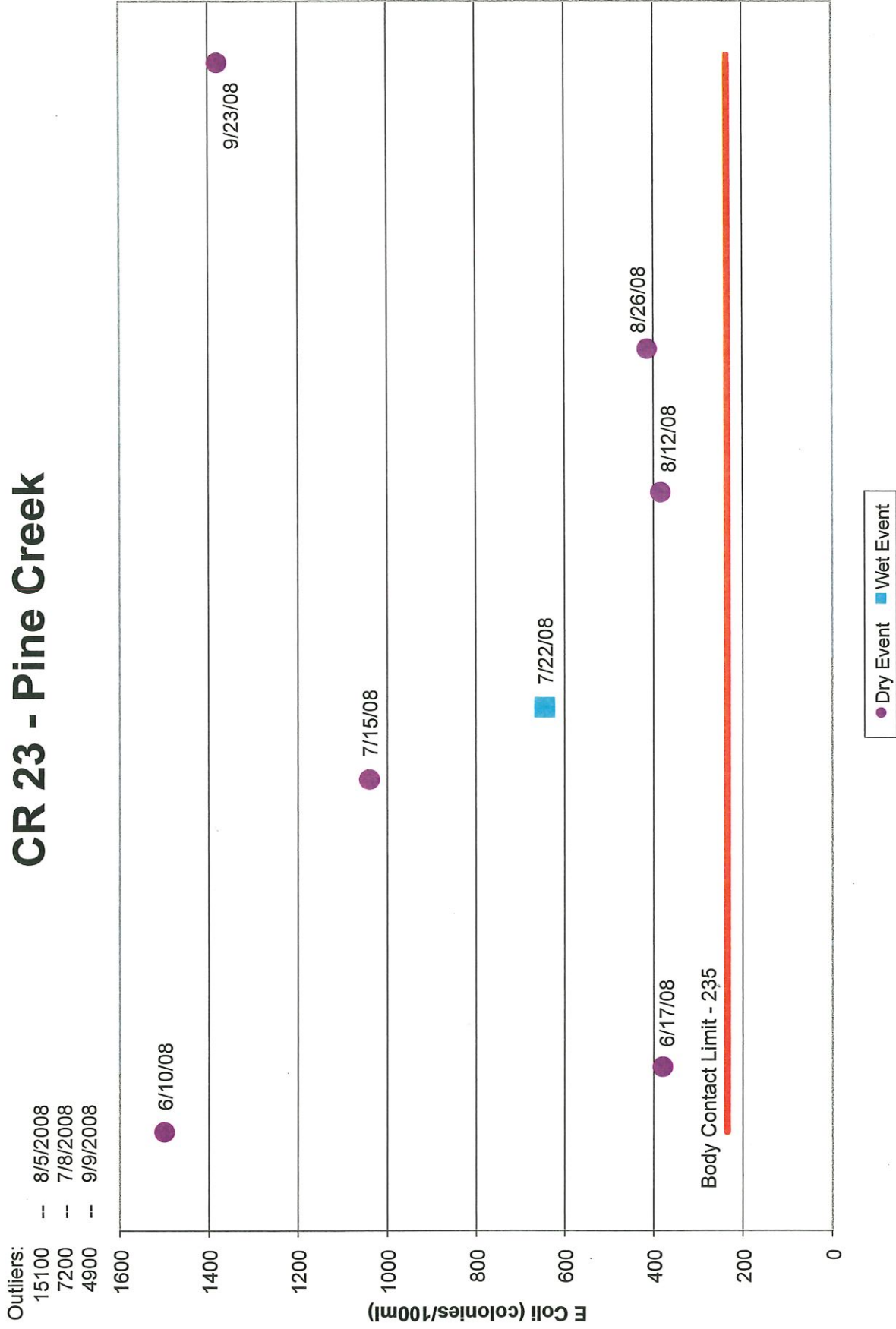
CR 34 - Rock Run



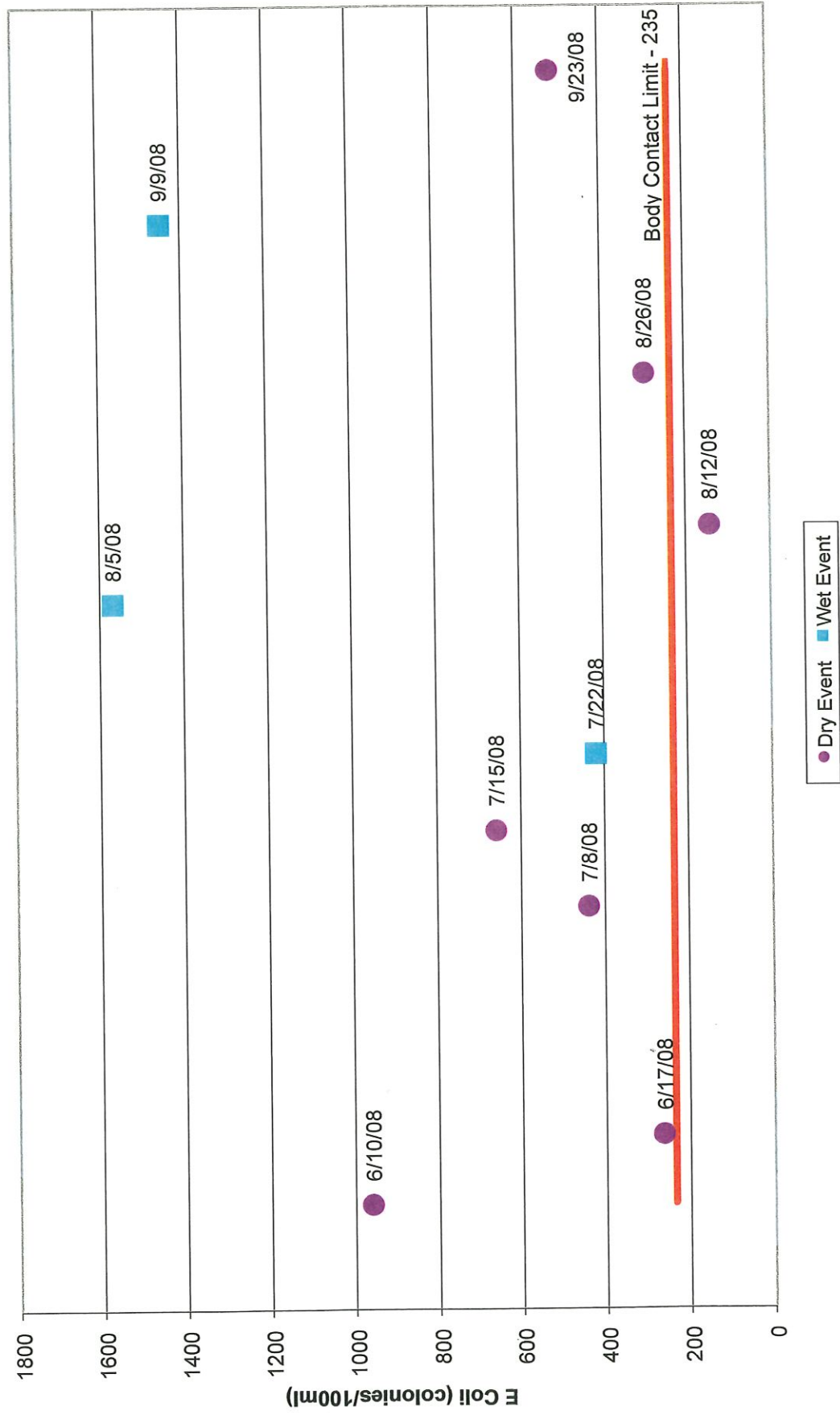
CR 18 - Pine Creek



CR 23 - Pine Creek



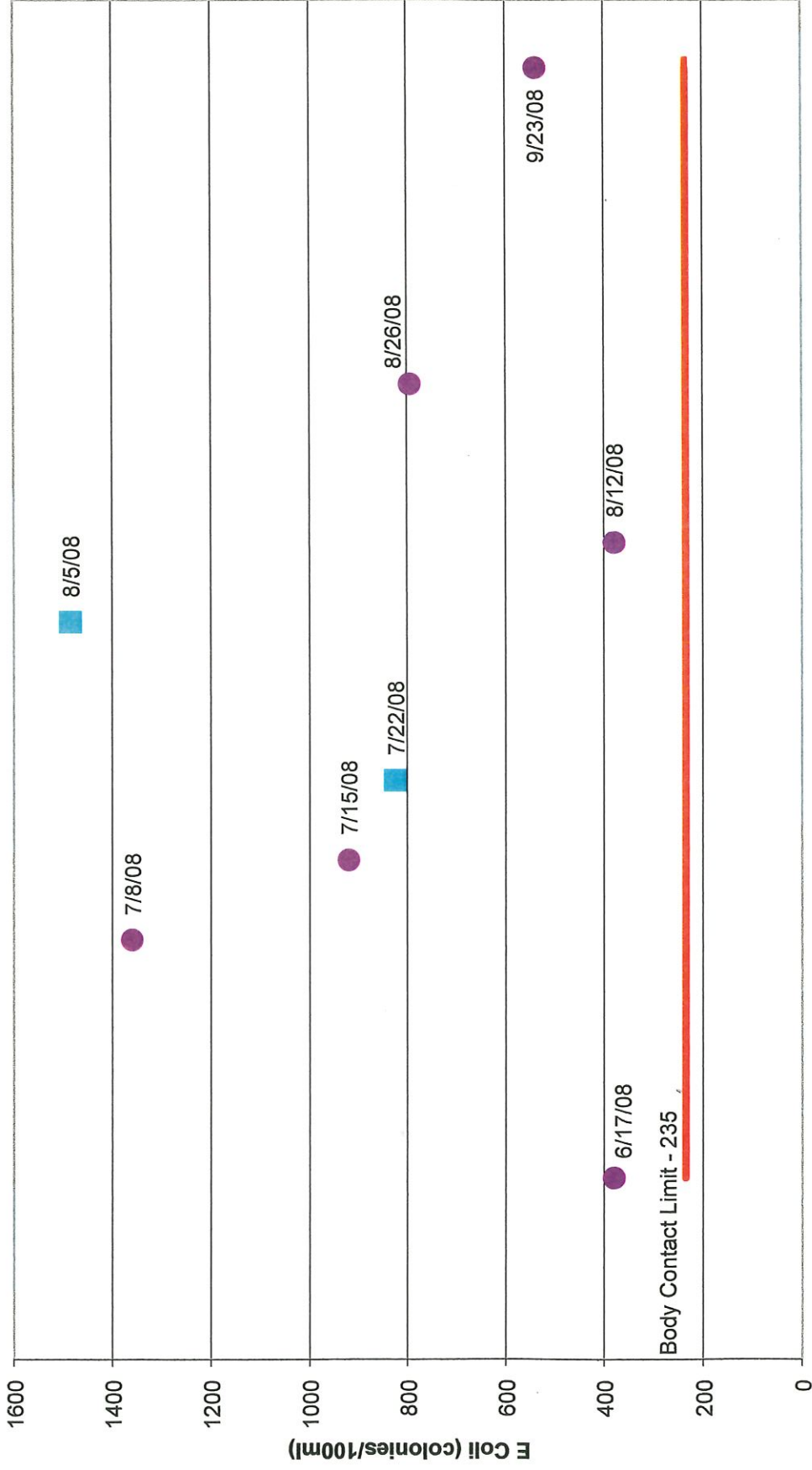
CR 17 - Pine Creek



CR 27 - Pine Creek

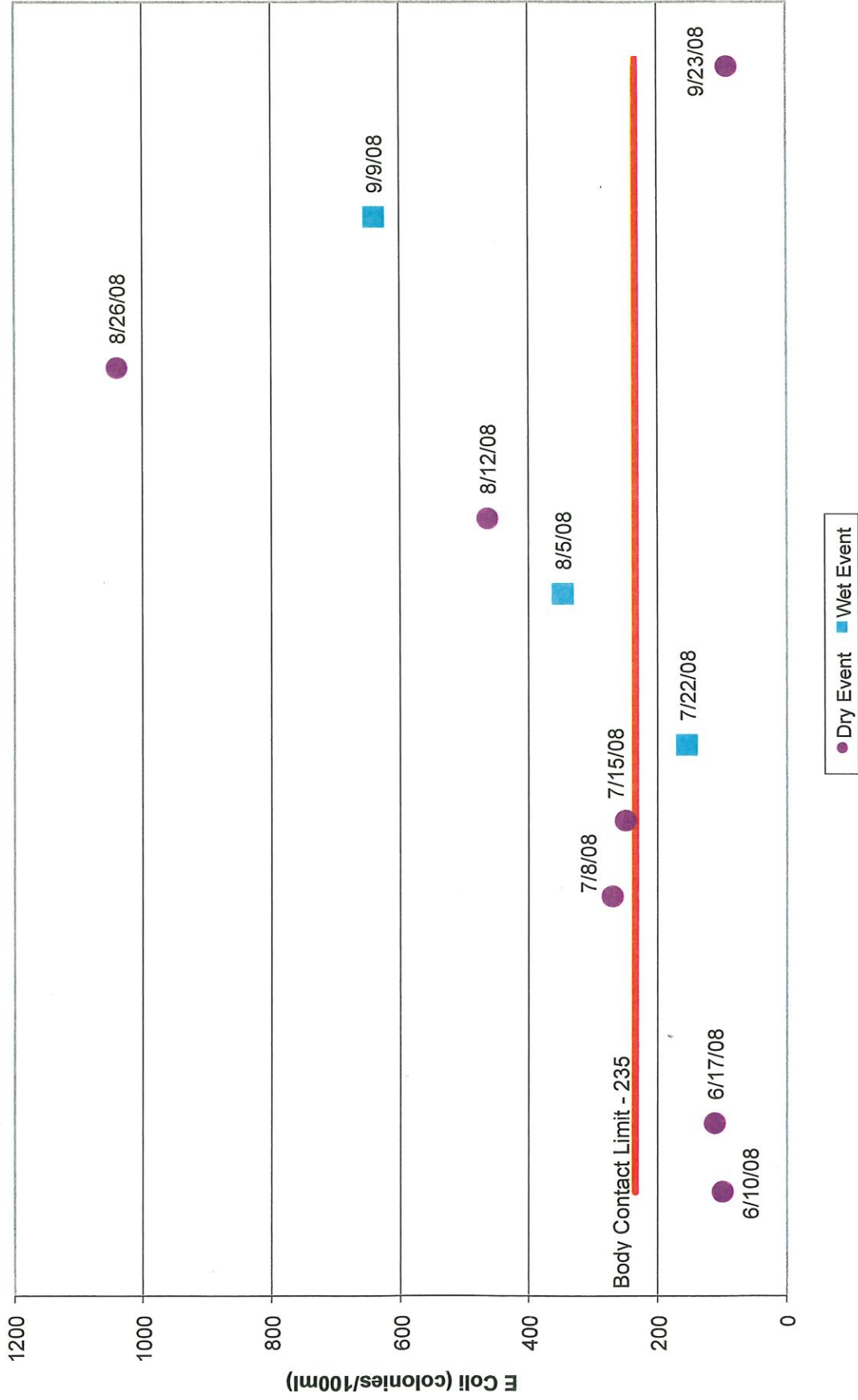
Outliers:

-- 9/9/2008
-- 6/10/2008

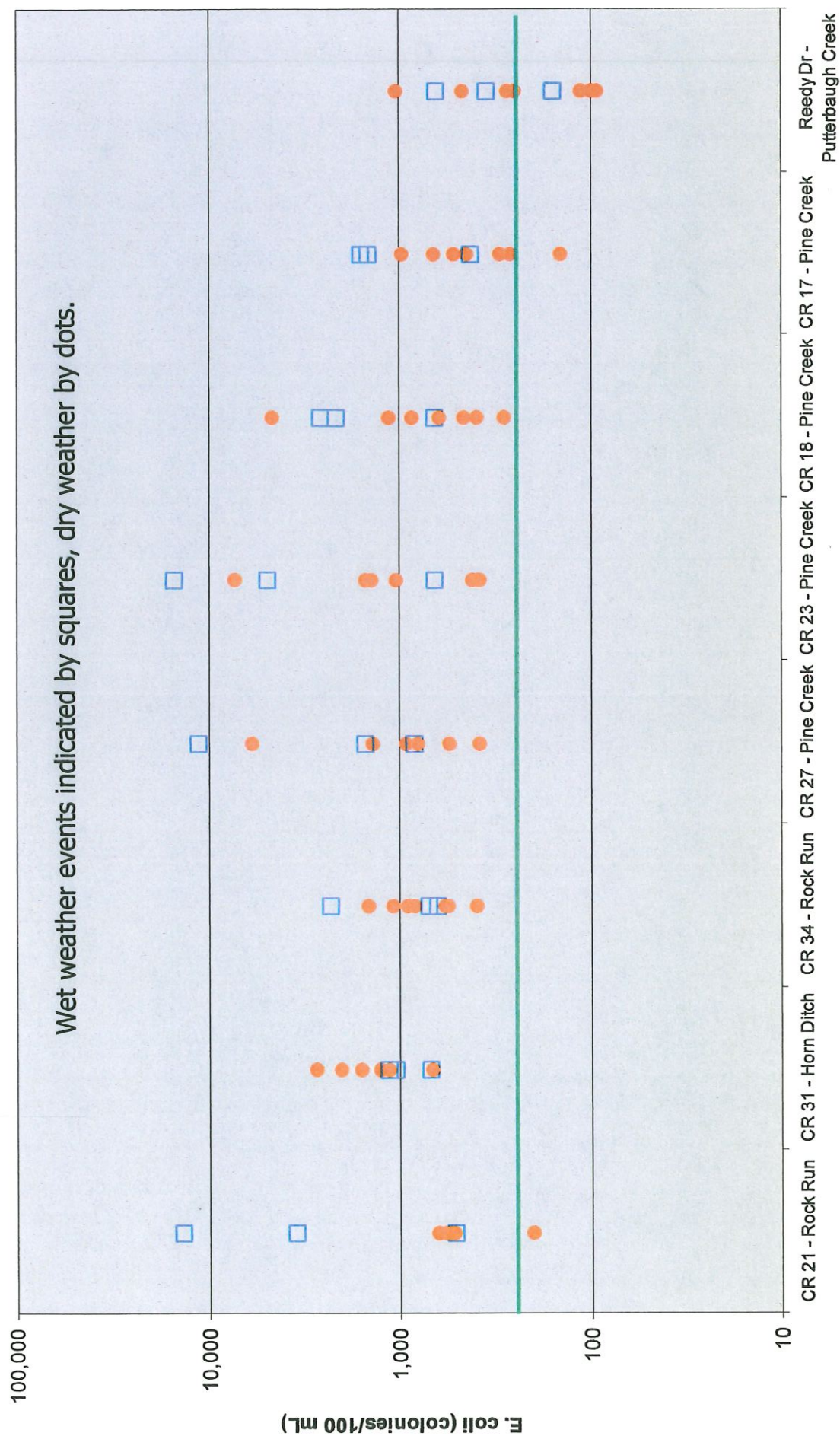


● Dry Event ■ Wet Event

Reedy Dr - Putterbaugh Creek



Wet weather events indicated by squares, dry weather by dots.

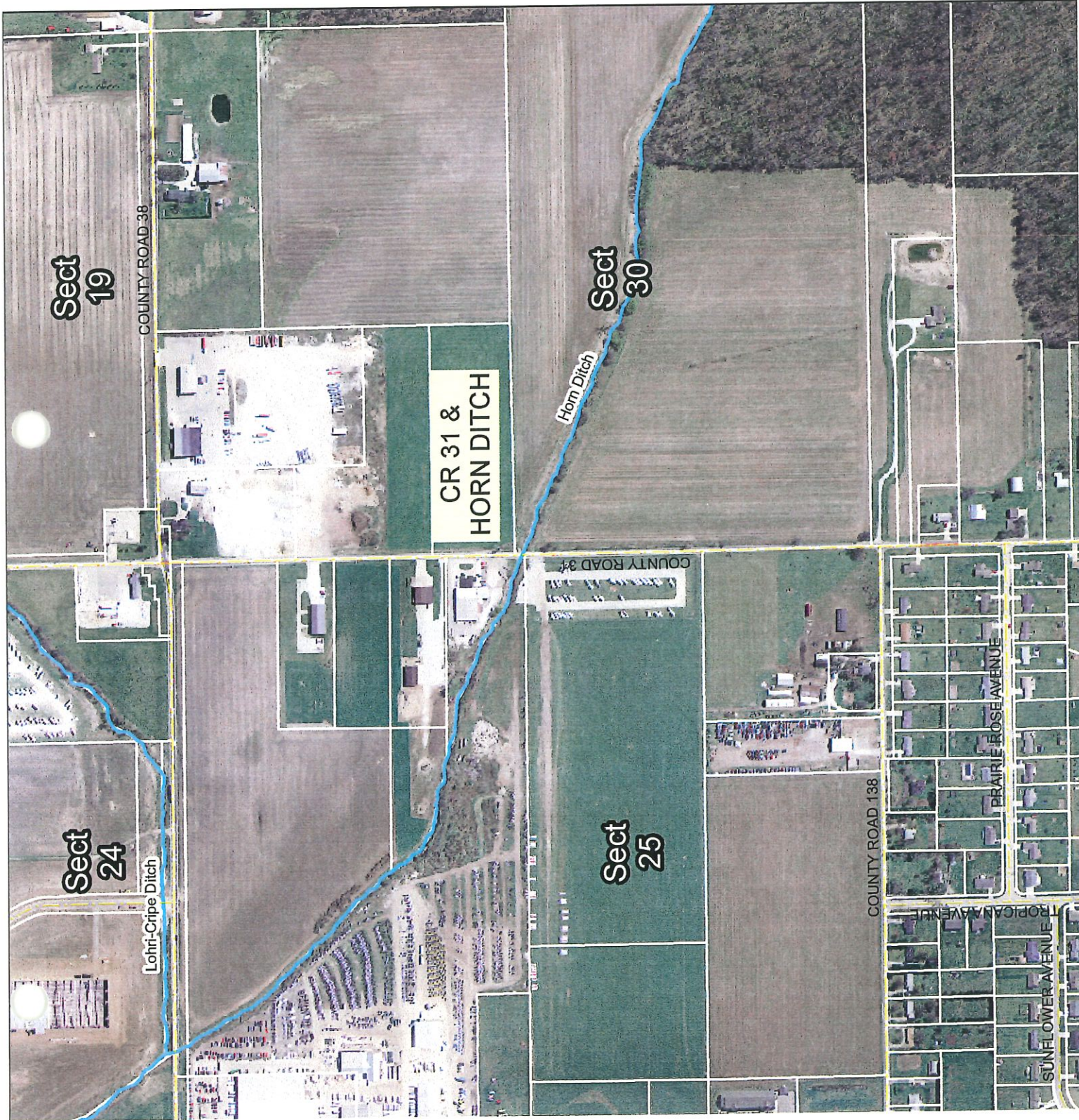
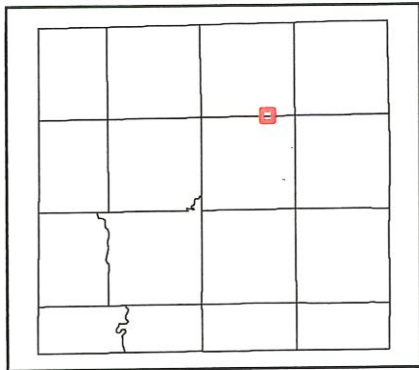


MAPS OF SAMPLING SITES

Maps of the sampling sites are provided to illustrate sampling locations and various land uses at each location. Land use includes residential, commercial and agricultural areas. Most have mixtures of these uses within the watersheds of these sampling sites.

Also, included is an Elkhart County map identifying each individual sampling site in relationship to the designated MS4 area. The sampling site locations are identified by green circles and the MS4 boundaries are highlighted with purple dots and a purple border.

Elkhart County



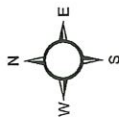
Road_Centerline

Ditches

Parcel_working

Section_Poly

1 inch equals 500 feet

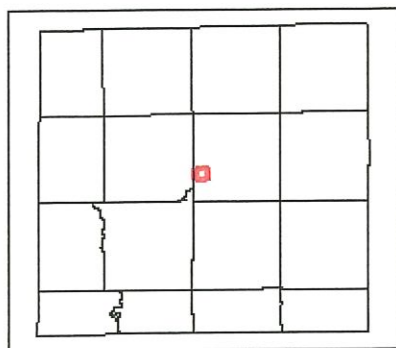


This map does not constitute a survey nor an engineering drawing. The map and any information contained therein is not warranted for accuracy, reliability, or fitness for a particular purpose. The user assumes all responsibility for any use of this map. The user is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhart, Indiana.



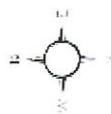
Elkhart County Planning Division
4230 Elkhart Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005

Elkhart County



- Road_Centerline
- Ditches
- Parcel_working
- Section_Poly

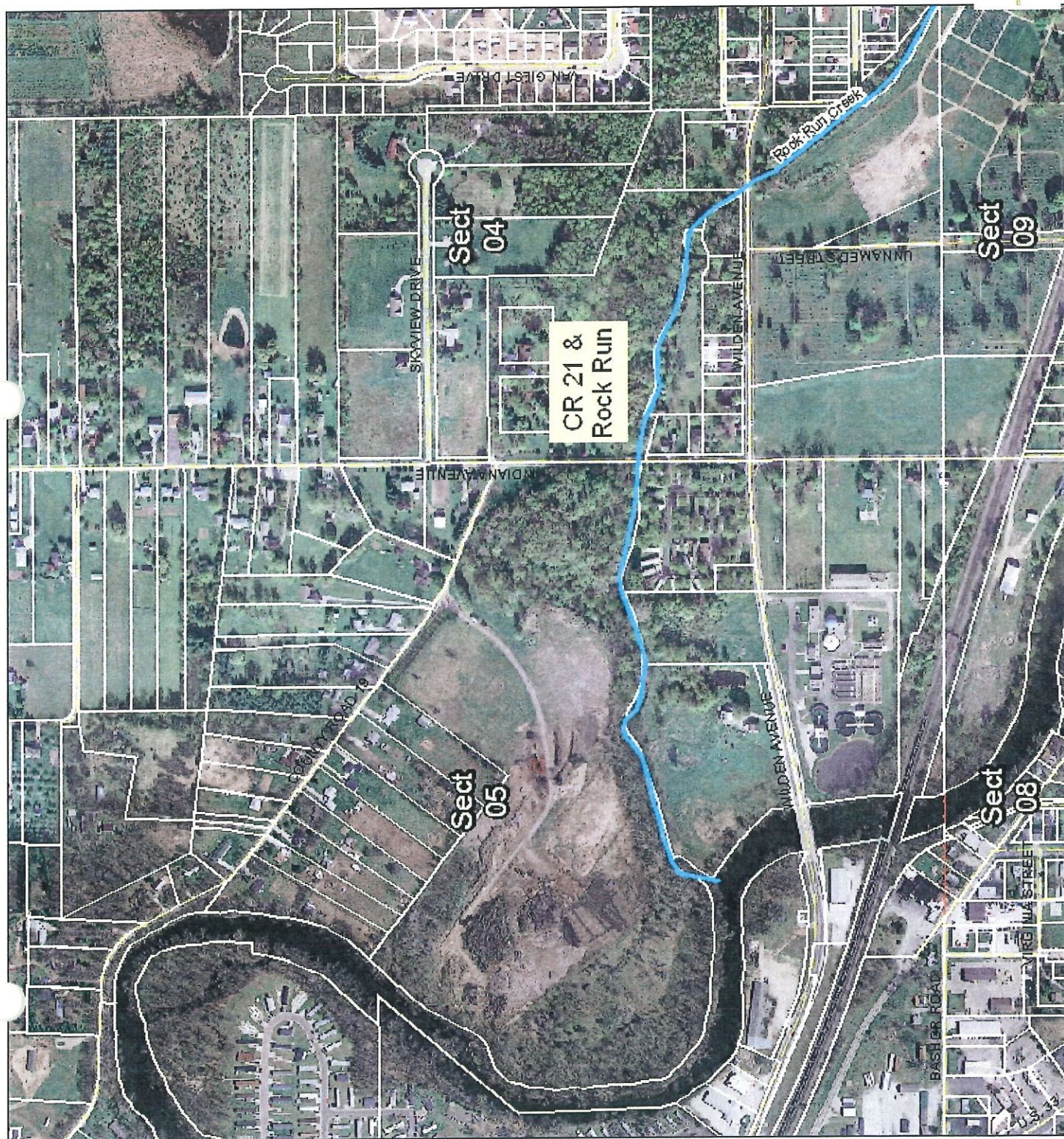
1 inch equals 500 feet



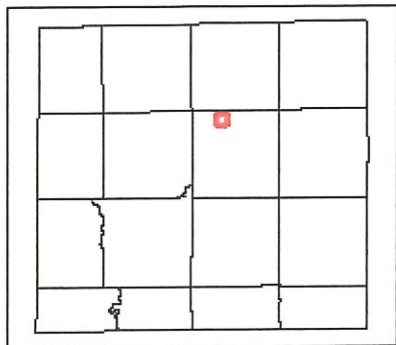
This map does not constitute a survey, nor does it constitute a warranty. The map and any information contained therein are not warranted for accuracy, completeness, or fitness for a particular purpose. Reliance on the user's risk. Copying or other reproduction of this map and any information shown on it without written consent of the county official, Indiana.








Elkhart County Planning Division
4350 Elkhart Road
Goshen, Indiana 46535
Aerial Imagery: April, 2005

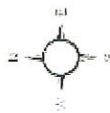


Elkhart County



-  incorporated areas
-  Road_Centerline
-  Ditches
-  Parcel_working
-  Section_Poly

1 inch equals 500 feet



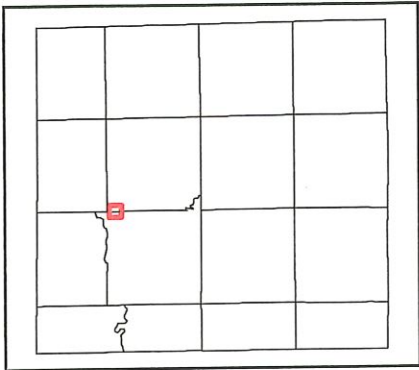
This map does not constitute a survey nor are any boundary lines shown here intended to be used as evidence of title. It is for informational purposes only. The user assumes all liability for any use of this map for any purpose other than that for which it was prepared. The user assumes all liability for any use of this map for any purpose other than that for which it was prepared. The user assumes all liability for any use of this map for any purpose other than that for which it was prepared.



Elkhart County Planning Division
4230 Elkhart Road
Goshen, Indiana 46526
Serial Image: April, 2005



Elkhan County



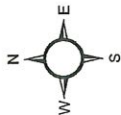
Road_Centerline

Ditches

Parcel_working

Section_Poly

1 inch equals 500 feet

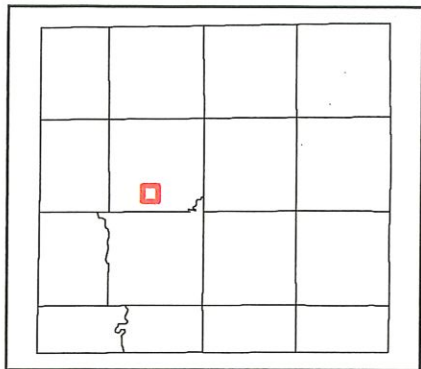


This map does not constitute a survey nor an engineering drawing. The map and any information shown on it is not warranted for accuracy, merchantability, or fitness for a particular purpose. Reliance is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhan, Indiana.



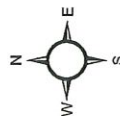
Elkhan County Planning Division
4230 Elkhan Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005

Elkhart County



- Road_Centerline
- Ditches
- Parcel_working
- Section_Poly

1 inch equals 667 feet



This map does not constitute a survey nor an engineering drawing. The map and any information shown on it is not warranted for accuracy, merchantability, or fitness for a particular purpose. Reliance is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhart, Indiana.



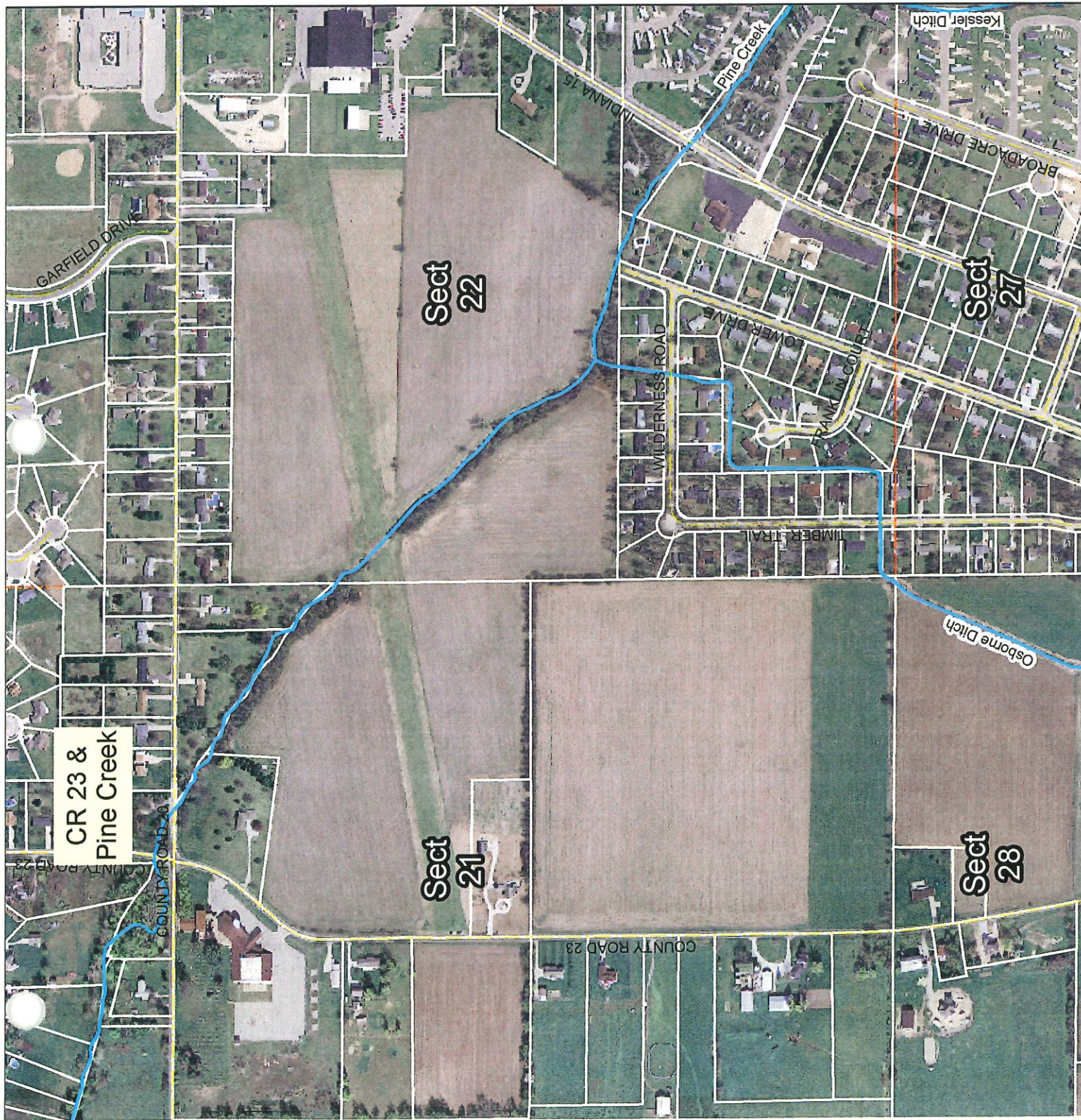
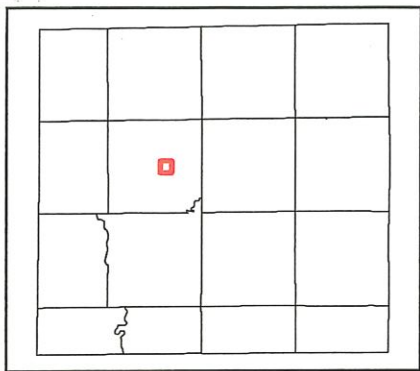
Elkhart County Planning Division
4230 Elkhart Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005

CR 18 &
Pine Creek

Pine Creek

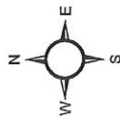


Elkhart County



- Road_Centerline
- Ditches
- Parcel_working
- Section_Poly

1 inch equals 500 feet

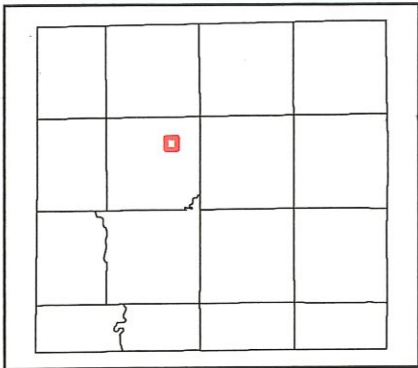


This map does not constitute a survey nor an engineering drawing. The map and any information shown on it is not warranted for accuracy, merchantability, or fitness for a particular purpose. Reliance is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhart, Indiana.



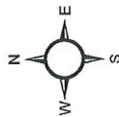
Elkhart County Planning Division
4230 Elkhart Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005

Elkhan County



- Road_Centerline
- Ditches
- Parcel_working
- Section_Poly

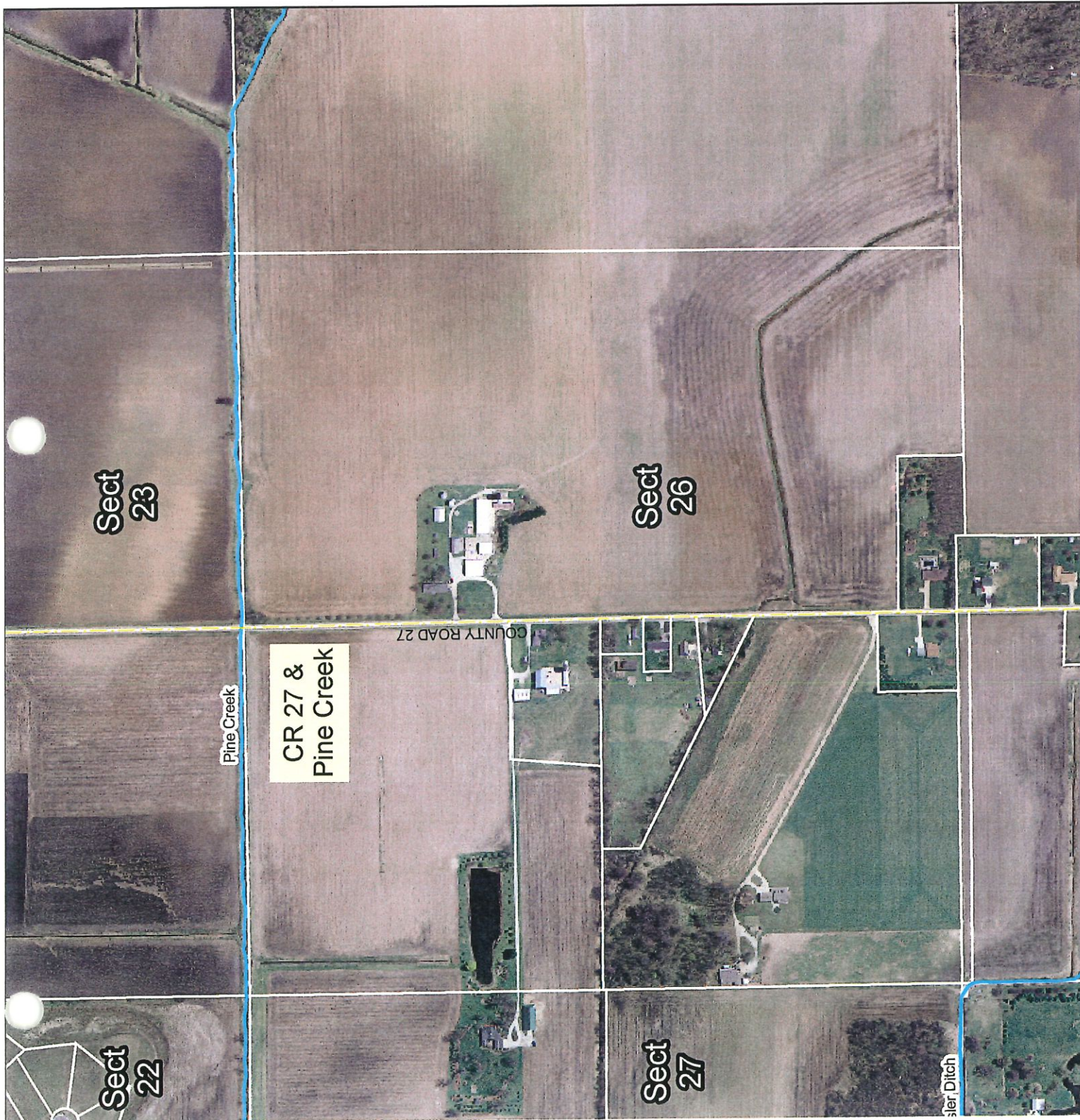
1 inch equals 500 feet



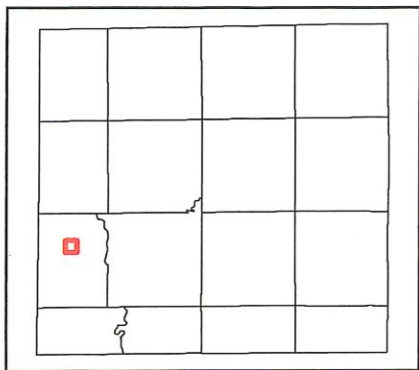
This map does not constitute a survey nor an engineering drawing. The map and any information shown on it is not warranted for accuracy, merchantability, or fitness for a particular purpose. Reliance is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhan, Indiana.



Elkhan County Planning Division
4230 Elkhan Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005

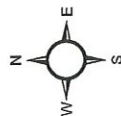


Elkhart County



- Road_Centerline
- Ditches
- Parcel_working
- - - Section_Poly

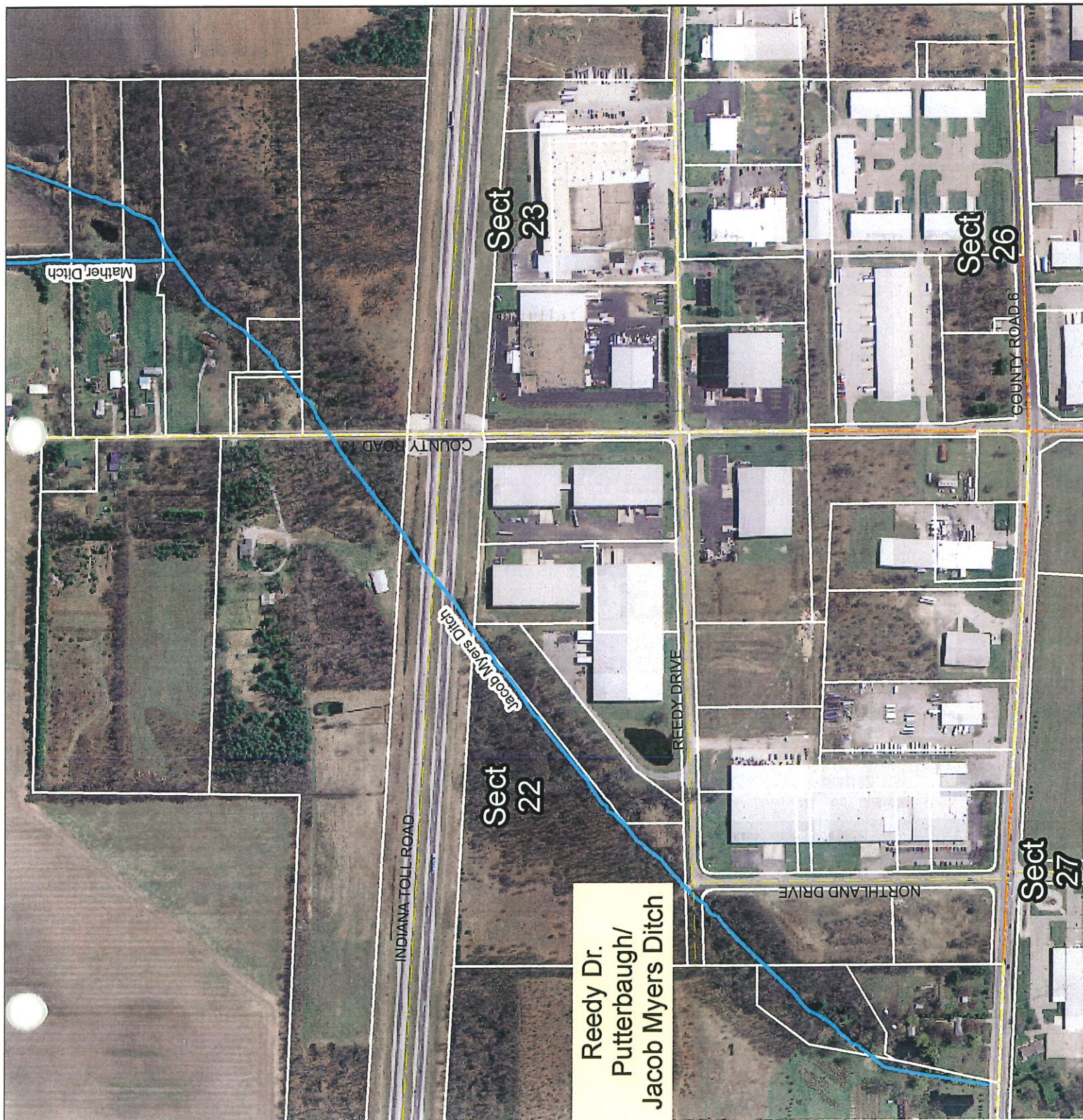
1 inch equals 500 feet



This map does not constitute a survey nor an engineering drawing. The map and any information shown on it is not warranted for accuracy, merchantability, or fitness for a particular purpose. Reliance is at the user's risk. Copying or other reproduction of this map and any information shown on it is prohibited without the prior written permission of the County of Elkhart, Indiana.



Elkhart County Planning Division
4230 Elkhart Road
Goshen, Indiana 46526
Aerial Imagery: April, 2005



Elkhart County



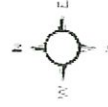
MS4 monitoring sites 2008

county_drains

MS4_area

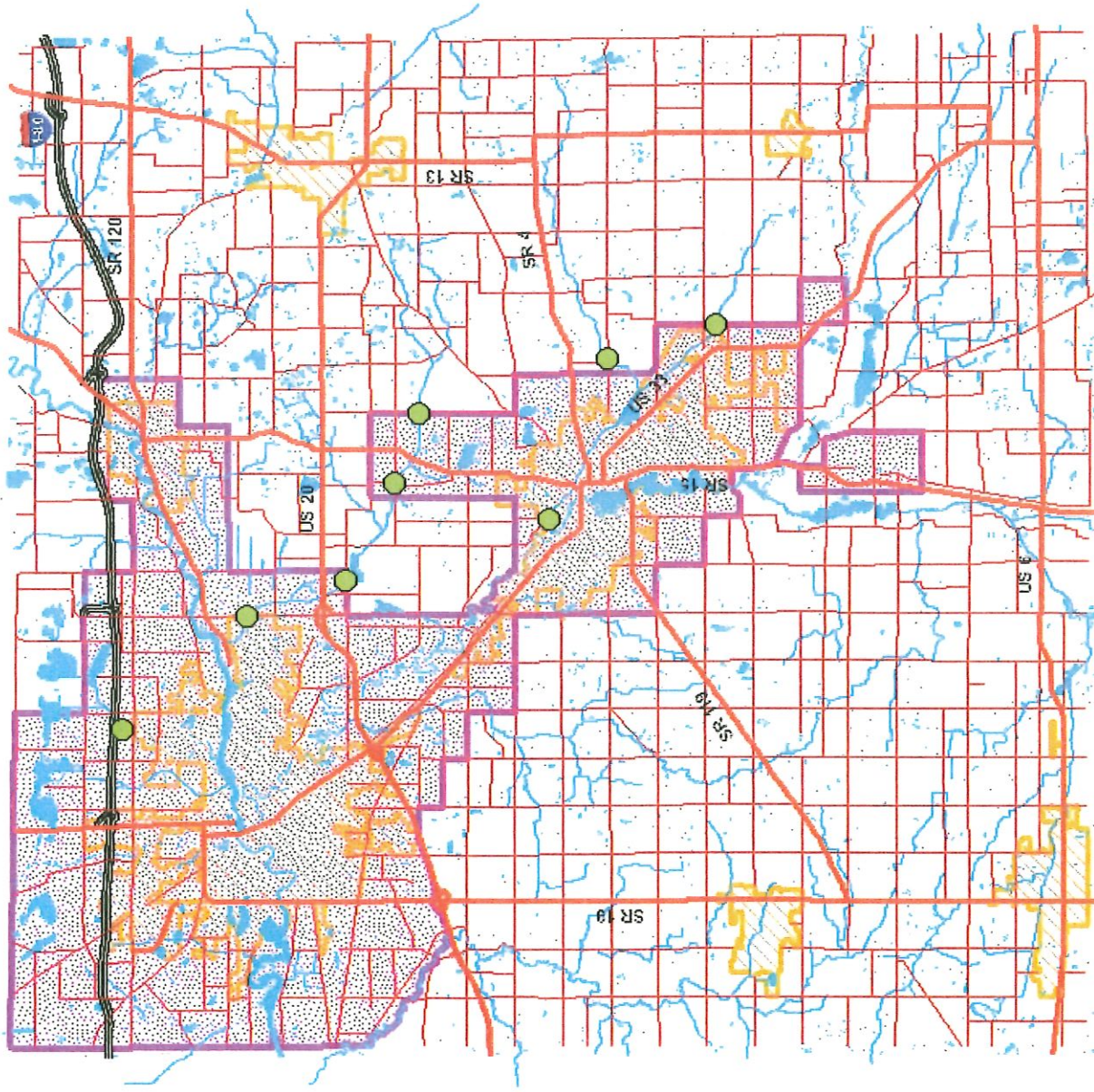
incorporated areas

0 7,500 15,000 30,000 Feet



This map does not constitute a survey, nor are the boundaries depicted. The map is only for informational purposes and is not to be used for legal or financial purposes. It is not a legal document. Please refer to the official records of the County of Elkhart for the most accurate information.

Elkhart County Planning Division
1230 Elkhart Road
Goshen, Indiana 46535
April 2008



SUMMARY AND CONCLUSION

According to the United States Environmental Protection Agency “a waterbody is considered impaired when a water quality standard is violated, whether through exceedance of a numeric or narrative criterion, impairment of designated use or violation of an antidegradation policy.” The results from the 2008 sampling effort indicated levels of *E. coli* in excess of the total maximum daily load of 235cfu/100 ml, known as the full body contact standard, in all of the streams studied. A total of 92.4% of the samples exceeded the total maximum daily load limit each time they were taken. Only 7.6% of the samples were below the total maximum daily load limit and four of those six samples were obtained from Putterbaugh Creek which is fed by water from Heaton Lake.

These results indicated all eight sampling sites are impaired and unsafe for human body contact due to the associated risk of disease transmission. All waterbodies are capable of assimilating a certain amount of pollution without adverse effects because of the dilution and self-purification capabilities present in each stream. The ability of a stream to mitigate an organic pollutant such as *E. coli* is dependent on many factors such as stream flow, depth, dissolved oxygen, temperature, available sunlight, and time. However, the high levels of *E. coli* indicate these pathogens are being infused at a rate greater than background concentrations into the receiving streams and the source must be determined. These results are definite indicators of illicit discharges and will require further investigation to identify and eliminate each one.

ACKNOWLEDGEMENTS

I would like to thank Nathan Hughes for his assistance with this project. Nathan assisted with collecting the samples from June 10, 2008 through August 12, 2008. In addition he also conducted the laboratory analysis for nitrates, chlorides and phosphates at the Elkhart County Health Department and provided outstanding computer and technical skills for the data analysis. Nathan attends college at Indiana University, South Bend and his assistance was invaluable.

I would also like to thank fellow staff members Bill Hartsuff and John Hulewicz, Supervisors, who provided oversight of the program. Bill Hartsuff also assisted with sample collection on August 26, 2008. And John Weidner, Environmentalist, who assisted with collecting the samples on September 9 and September 23, 2008.

Additional contributors include Eric Kurtz, Elkhart County Stormwater Coordinator, who provided the Elkhart County Map and Joseph Foy, Stormwater Manager for the City of Elkhart, who provided the chart compiling all the E. coli sampling results.

Special recognition goes to the Laboratory Staff at the Elkhart City Public Works and Utilities who conducted the E. coli and total suspended solids analysis. Their cooperation and expertise was very instrumental to the success of this effort and was very much appreciated.

Elise Pfaff