CASE STUDY: CONSOLIDATION COAL'S BURNING STAR 4 NORTH FIELD

GALUM & BONNIE CREEKS

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STREAM RECONSTRUCTION UNDER SMCRA

What is a stream?

Ditch

Waterway

Diversion

Channel

Conveyance

Drainage

WHAT IS SMCRA?

- SURFACE MINING CONTROL AND RECLAMATION ACT OF 1977
- A FAIRLY COMPREHENSIVE SET OF ENVIRONMENTAL CONTROLS FOR COAL MINING IN THE US

SMCRA PURPOSE

- Section 102 of the Act
- TO STRIKE A BALANCE BETWEEN PROTECTION OF THE ENVIRONMENT AND THE NATION'S NEED FOR COAL AS AN ESSENTIAL SOURCE OF ENERGY
- REGULATIONS USE TERMS LIKE "BEST TECHNOLOGY CURRENTLY AVAILABLE," "ECONOMINCALLY & TECHNOLOGICALLY FEASIBLE", "WHERE PRACTICABLE"

SMCRA AND STREAMS

- 780.16 REQUIRES SITE SPECIFIC RESOURCE INFORMATION AND PROTECTION AND ENHANCEMENT PLANS FOR HABITATS OF UNUSUALLY HIGH VALUE INCLUDING "IMPORTANT STREAMS" AND RIPARIAN AREAS
- 816.97(f) REQUIRES AVOIDANCE, ENHANCEMENT, RESTORATION OR REPLACEMENT OF RIPARIAN VEGETATION ALONG RIVERS AND STREAMS

SMCRA AND STREAMS

- 816.57 GENERALLY PROHIBITS ACTIVITIES WITHIN 100 FEET OF AN INTERMITTENT OR PERENNIAL STREAM WITHOUT A SPECIFIC EXEMPTION MEETING CERTAIN CRITERIA AND UPON MAKING A WRITTEN FINDING
- ONE OF THOSE CRITERIA IS A SHOWING OF NO ADVERSE AFFECT ON “OTHER ENVIRONMENTAL RESOURCES OF THE STREAM”

SMCRA AND STREAMS

- 816.97(a) THE OPERATOR SHALL, TO THE EXTENT POSSIBLE USING BEST TECHNOLOGY CURRENTLY AVAILABLE, MINIMIZE DISTURBANCES AND ADVERSE IMPACTS OF THE ACTIVITIES ON FISH, WILDLIFE, AND RELATED ENVIRONMENTAL VALUES, AND SHALL ACHIEVE ENHANCEMENT OF SUCH WHERE PRACTICABLE.

SMCRA AND STREAMS

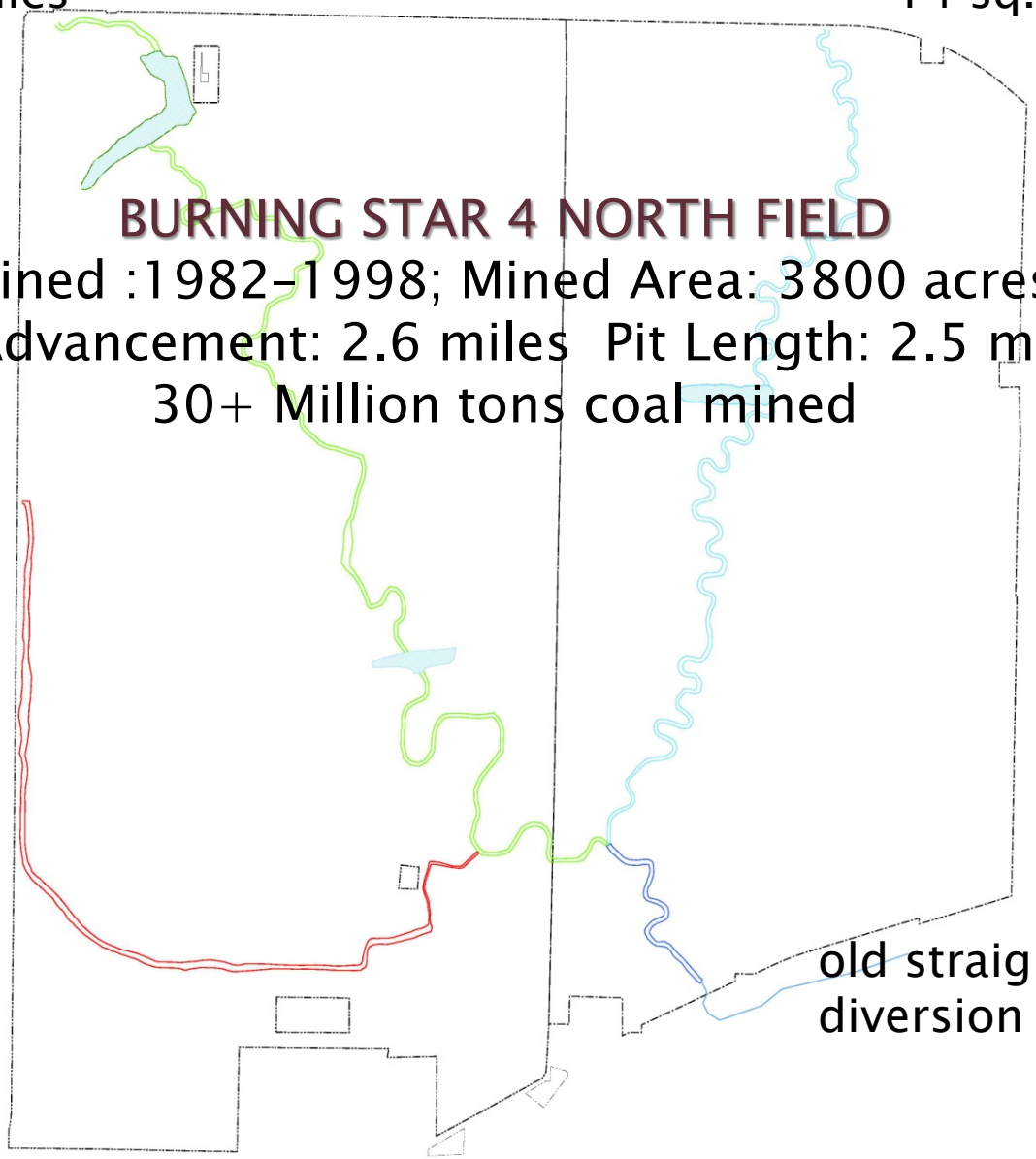
- 701 DEFINITION
- <u>INTERMITTENT STREAM</u>
- A STREAM OR REACH OF A STREAM THAT DRAINS A WATERSHED OF AT LEAST ONE SQUARE MILE; OR THAT IS BELOW THE LOCAL WATER TABLE FOR AT LEAST SOME PART OF THE YEAR, AND OBTAINS ITS FLOW FROM BOTH SURFACE RUNOFF AND GROUND WATER DISCHARGE.

ILLINOIS SMCRA PROGRAM APPROACH

- STREAMS < 640 ACRES DRAINAGE – DESIGN BASED PRIMARILY ON HYDROLOGIC AND STABILITY FACTORS
- STREAMS > 640 ACRES DRAINAGE – DESIGN INCLUDES BIOLOGICAL ASPECTS AS WELL
  - TRIGGERS BUFFER ZONE RULE

Galum Upstream
22 sq. miles

Bonnie Upstream
14 sq. miles



BURNING STAR 4 NORTH FIELD

Mined :1982–1998; Mined Area: 3800 acres
Pit Advancement: 2.6 miles Pit Length: 2.5 miles
30+ Million tons coal mined

Rock Fork
3 sq. miles

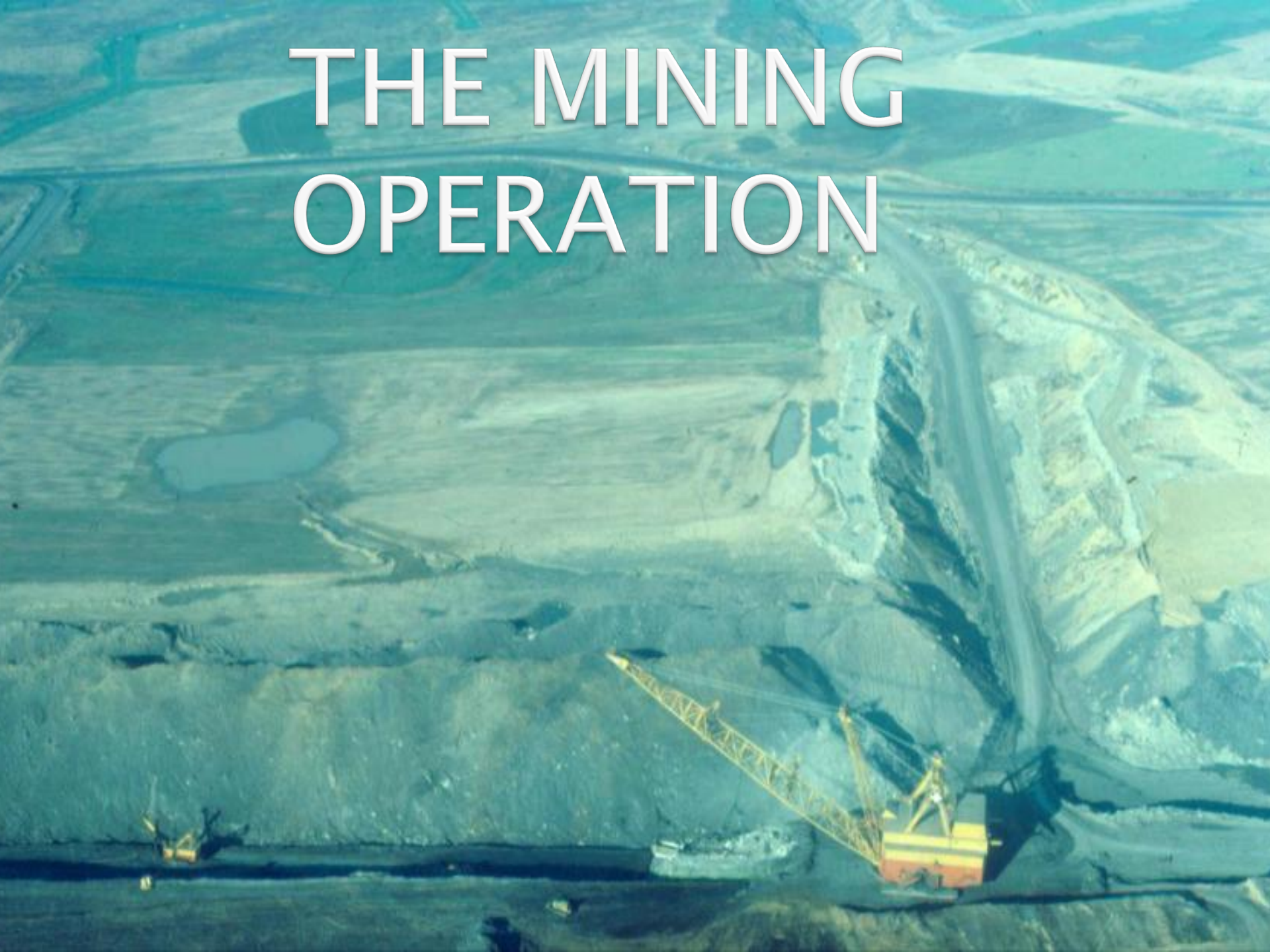
Horse Creek
Mine

Streamline
Mine

old straight line
diversion

Burning Star 4 South
Field

THE MINING OPERATION



154
150
East C Streamline Lake
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THE RESTORATION PLAN

- PAST PROJECTS SHOWED NEEDED FLEXIBILITY IN LOCATING THE CHANNEL, WHICH WAS ACCOMMODATED
- PAST PROJECTS FOCUSED ON CHANNEL MORPHOLOGY & STREAM LENGTH
- THIS PROJECT FOCUSED ALSO ON FLOOD PLAIN, RIPARIAN CORRIDORS, IN STREAM MICRO HABITATS, ADJACENT WETLANDS

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East C Streamline Lake
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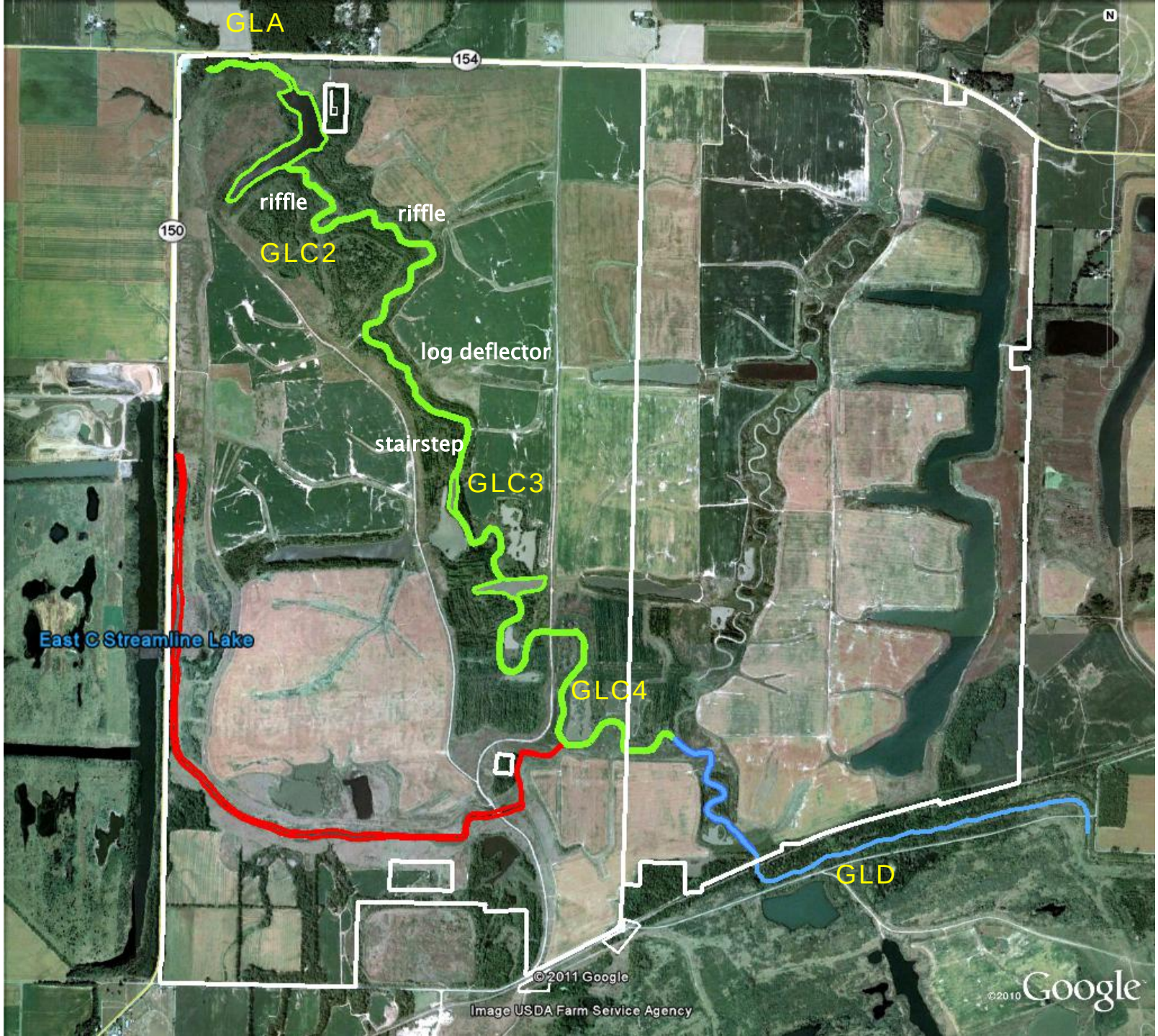
GLA
154
riffle
riffle
150
GLC2
log deflector
stairstep
GLC3
East C Streamline Lake
GLC4
GLD
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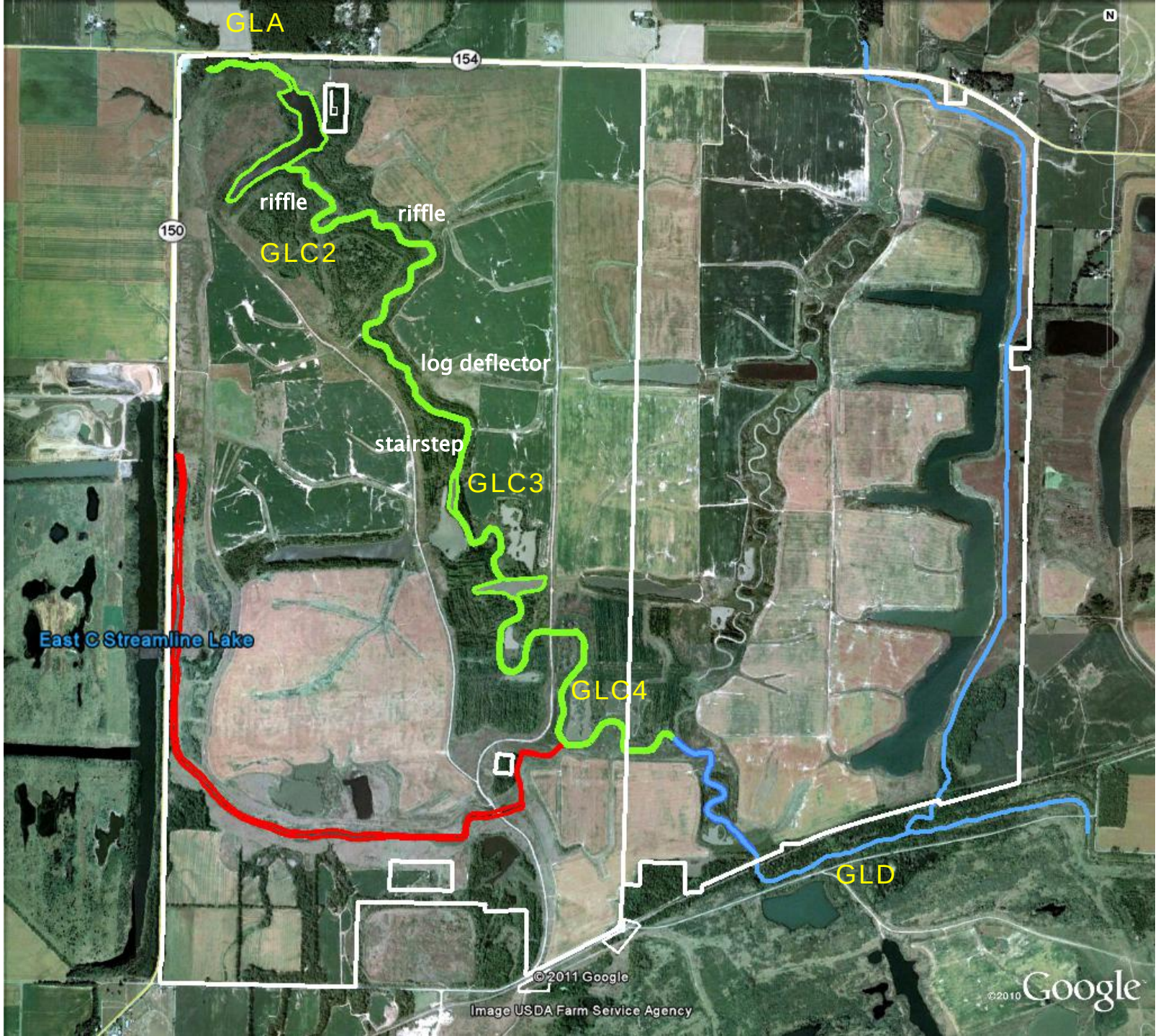
GLA
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East C Streamline Lake
GLC4
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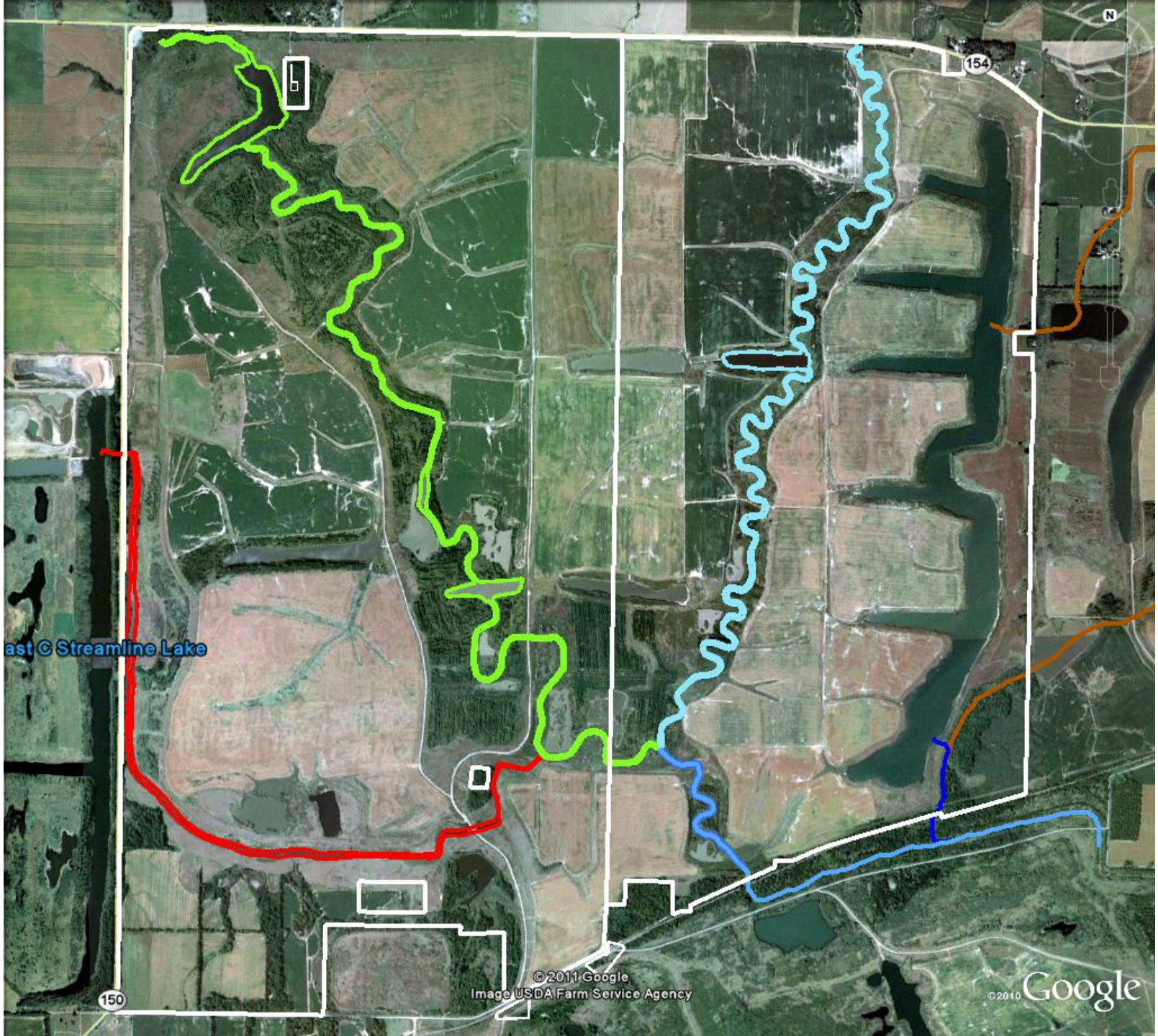
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FLOOD PLAIN RECONSTRUCTION

WETLANDS

RIPARIAN CORRIDOR

POST MINING MONITORING

- 10 SAMPLING POINTS ALONG GALUM & BONNIE CREEKS
- SAMPLED TWICE A YEAR 2002-2006
- POST RECONNECTION BUT BEFORE BOND RELEASE
- WATER QUALITY SAMPLING
- AQUATIC INVERTEBRATE SAMPLING
- FISH SAMPLING

WHAT DO THE DATA TELL US ABOUT:

- DIFFERENCES IN POST MINING WATER QUALITY DOWNSTREAM OF THE MINE COMPARED TO UPSTREAM OF THE MINE?

- COMPARED pH, TSS, Fe, Mn, DO, Cl, SO4

GALUM UPSTREAM SAMPLING LOCATION

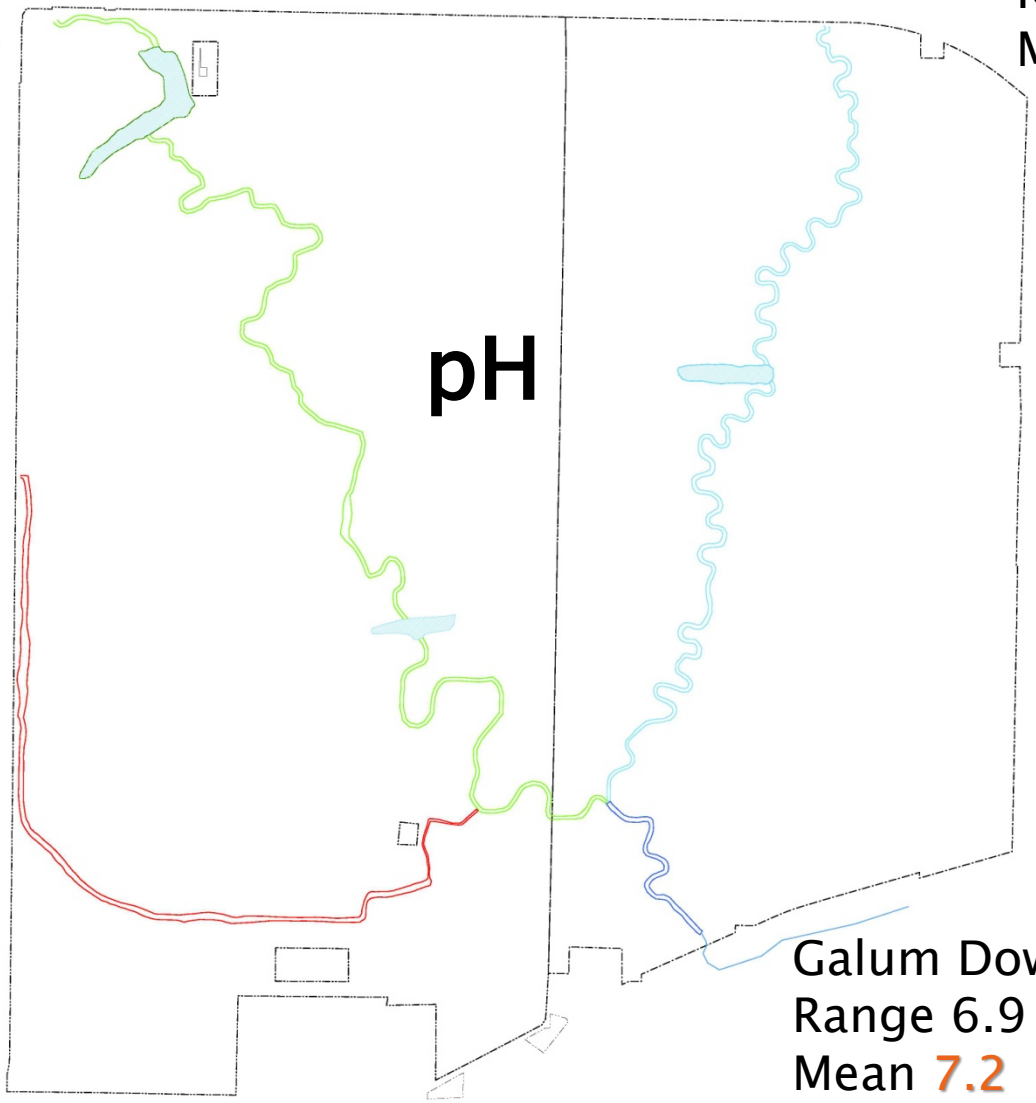
WE MUST PROTECT OUR
STREAM RESOURCES

BONNIE UPSTREAM
SAMPLING
LOCATION

GALUM DOWMSTREAM
SAMPLING LOCATION

Galum Upstream
Range 7.2 – 8.3
Mean 7.8

Bonnie Upstream
Range 7.6 – 8.4
Mean 8.0

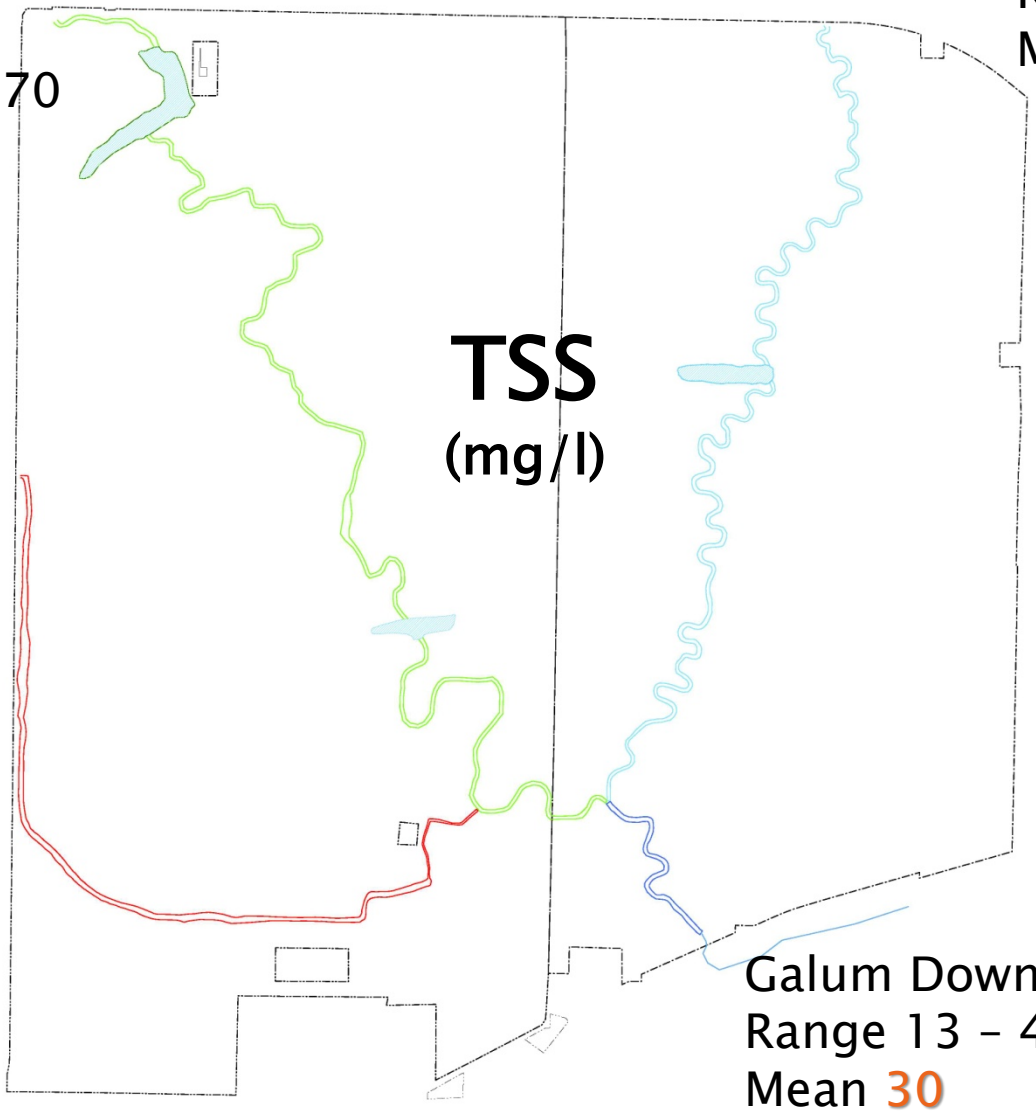


Galum Downstream
Range 6.9 – 7.5
Mean 7.2

Compare with NPDES limit 6.0 – 9.0

Galum Upstream
Range 5 – 80
Mean 22
1 sample > 70

Bonnie Upstream
Range 7 – 30
Mean 14

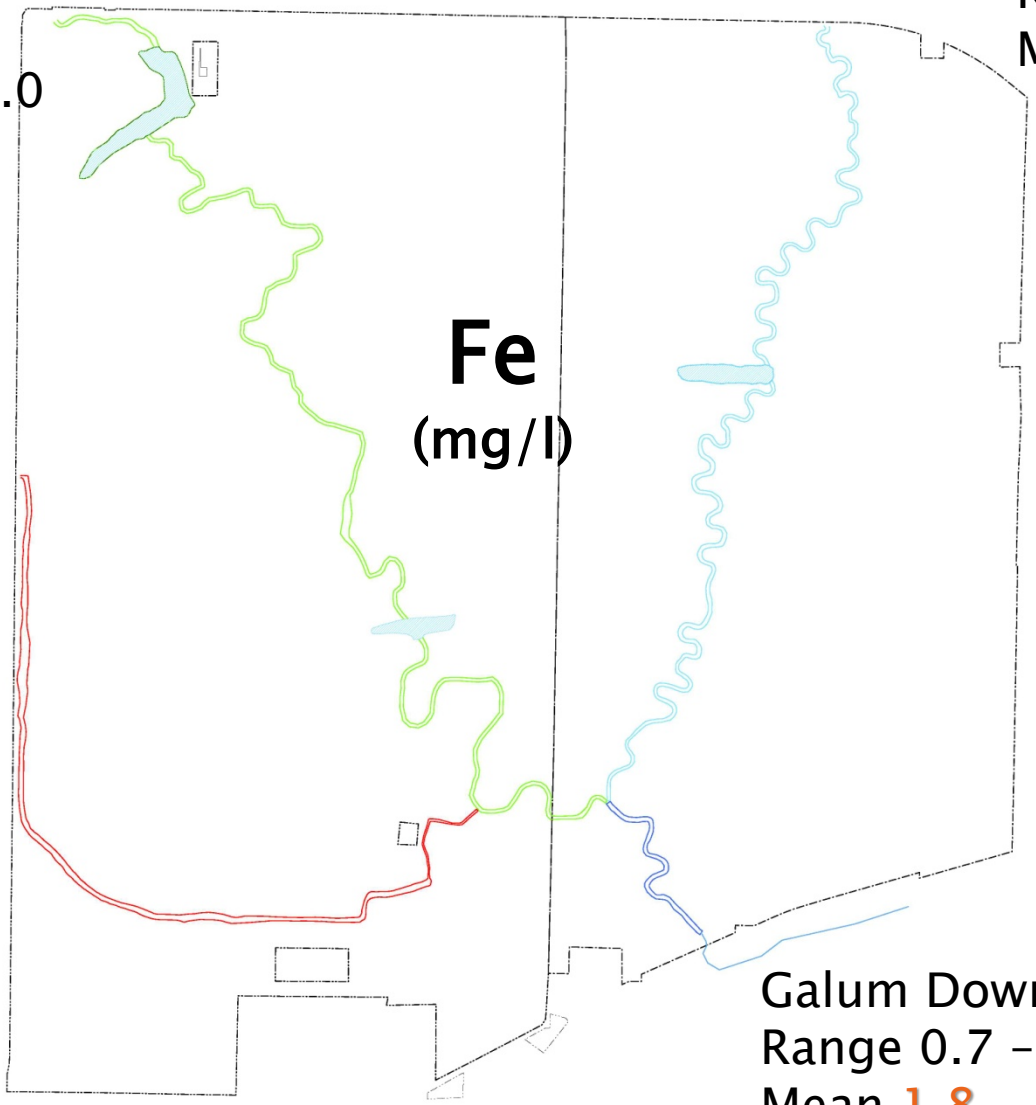


Galum Downstream
Range 13 – 45
Mean 30

Compare with NPDES limit of 70

Galum Upstream
Range 0.4 – 1.6, 34.9
Mean 4.3
1 sample > 6.0

Bonnie Upstream
Range 0.3 – 2.0
Mean 0.9

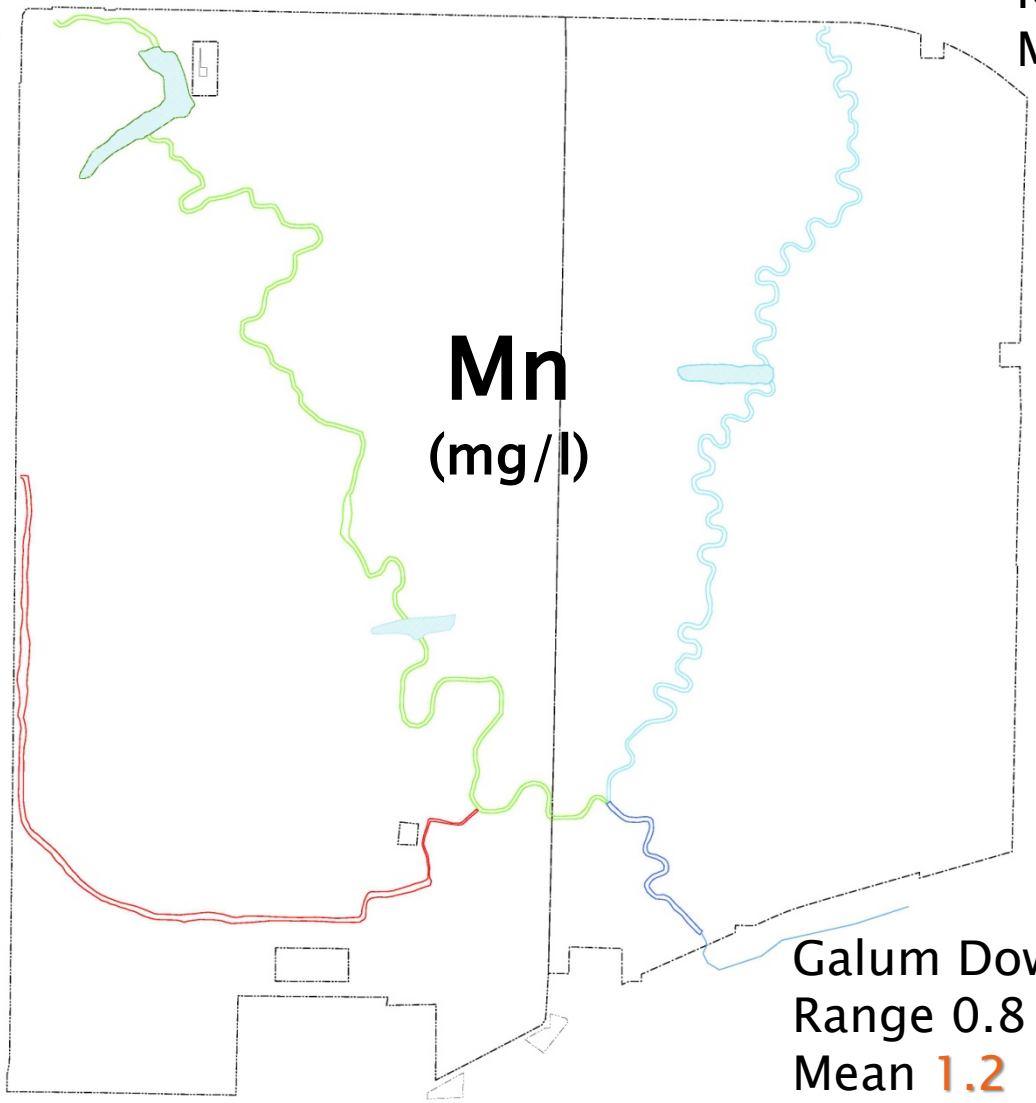


Galum Downstream
Range 0.7 – 3.5
Mean 1.8

Compare with NPDES limit of 6.0

Galum Upstream
Range 0.2 – 4.5
Mean 0.9

Bonnie Upstream
Range 0.1 – 1.1
Mean 0.5

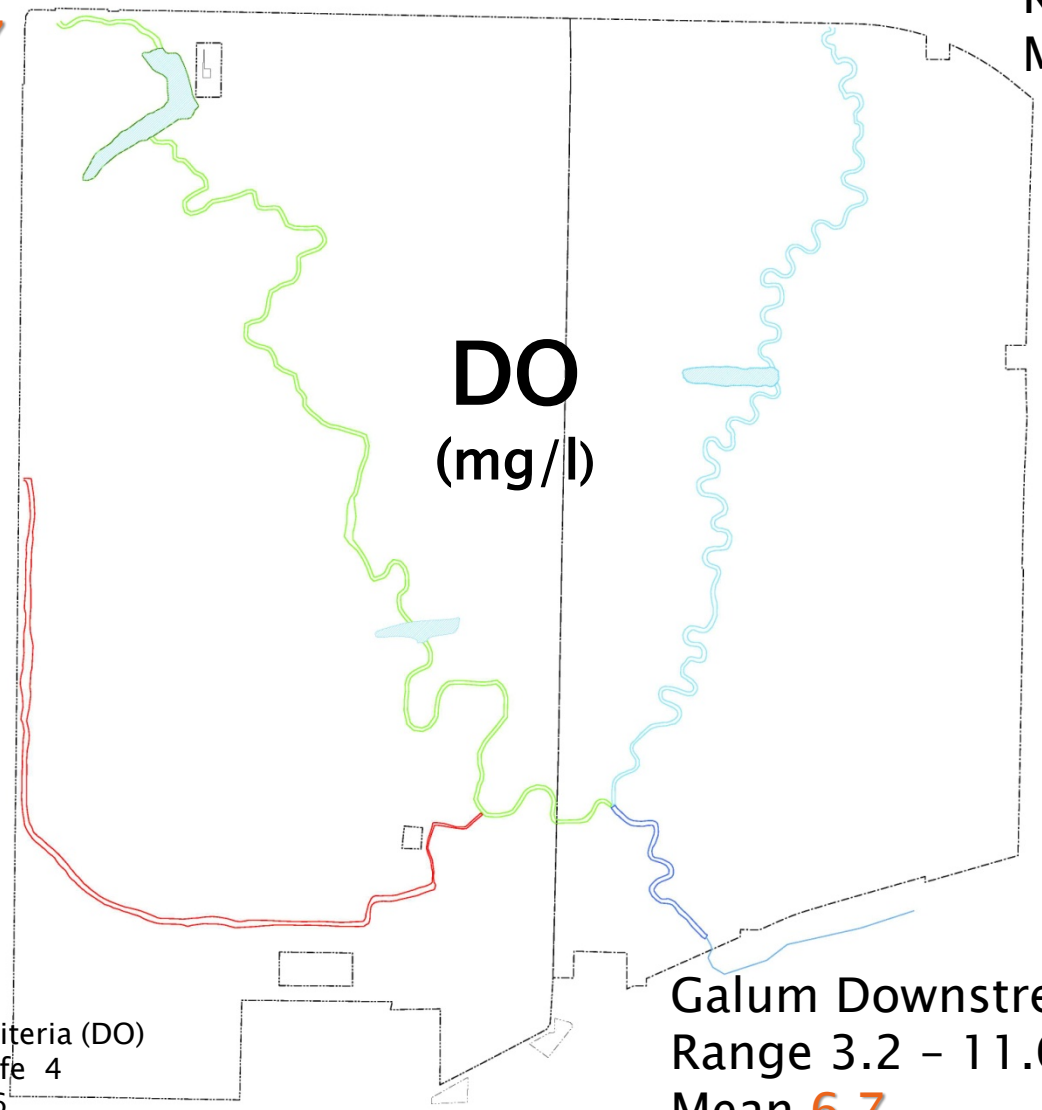


Galum Downstream
Range 0.8 – 1.6
Mean 1.2

Compare with NPDES limit of 4, 2

Galum Upstream
Range 1.4 – 9.2
Mean 5.7

Bonnie Upstream
Range 2.2 – 9.4
Mean 6.0

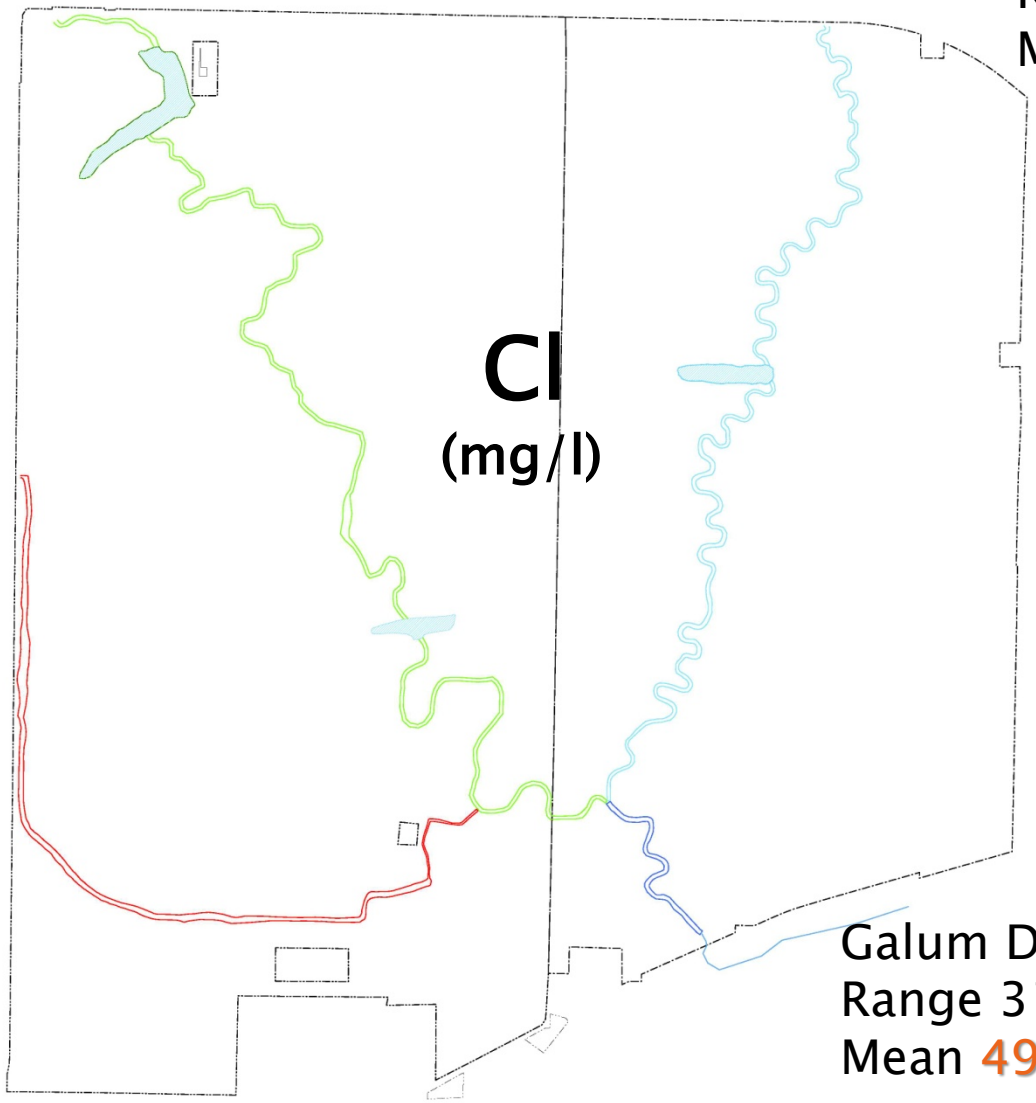


Galum Downstream
Range 3.2 – 11.0
Mean 6.7

National Aquatic Life Criteria (DO)
stressful to aquatic life 4
supports spawning 6
supports growth/activity 7
supports abundant fish population 9

Galum Upstream
Range 7 – 104
Mean 45

Bonnie Upstream
Range 15 – 44
Mean 30



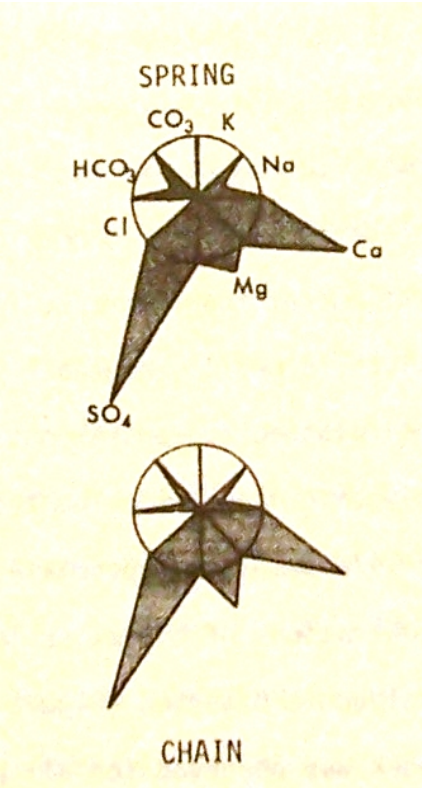
Galum Downstream
Range 31 – 71
Mean 49

National Aquatic
Life Criteria (Cl–)
Acute 860
Chronic 230

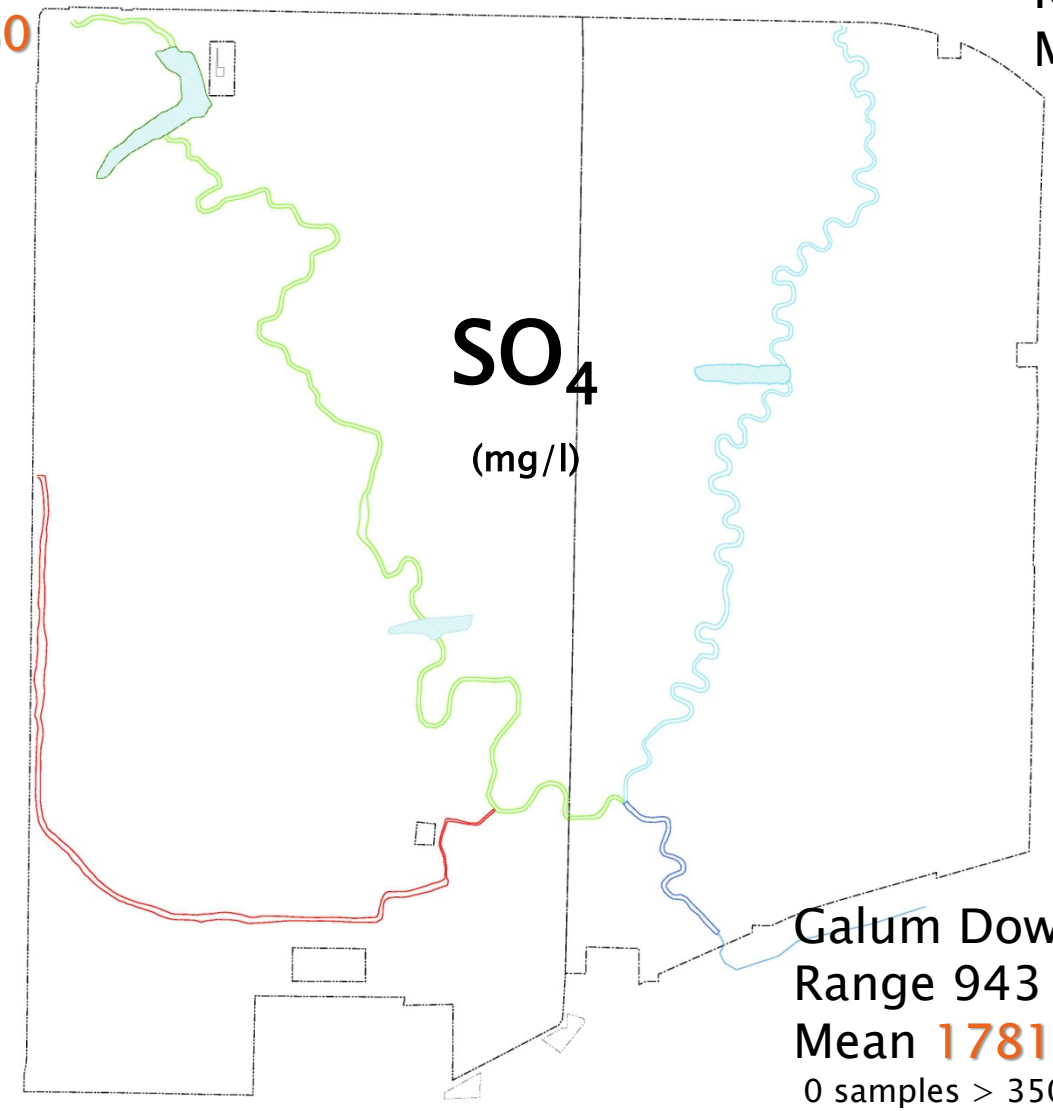
Compare with NPDES limit of 1000

Galum Upstream
Range 14 – 417
Mean 180

Bonnie Upstream
Range 43 – 498
Mean 270



from Konik 1980



Galum Downstream
Range 943 – 2517
Mean 1781 (4 samples > 2000;
0 samples > 3500)

Compare with NPDES limit of 3500, 2000

STREAM FLOW THROUGH LAKE: GOOD OR BAD?

GOOD

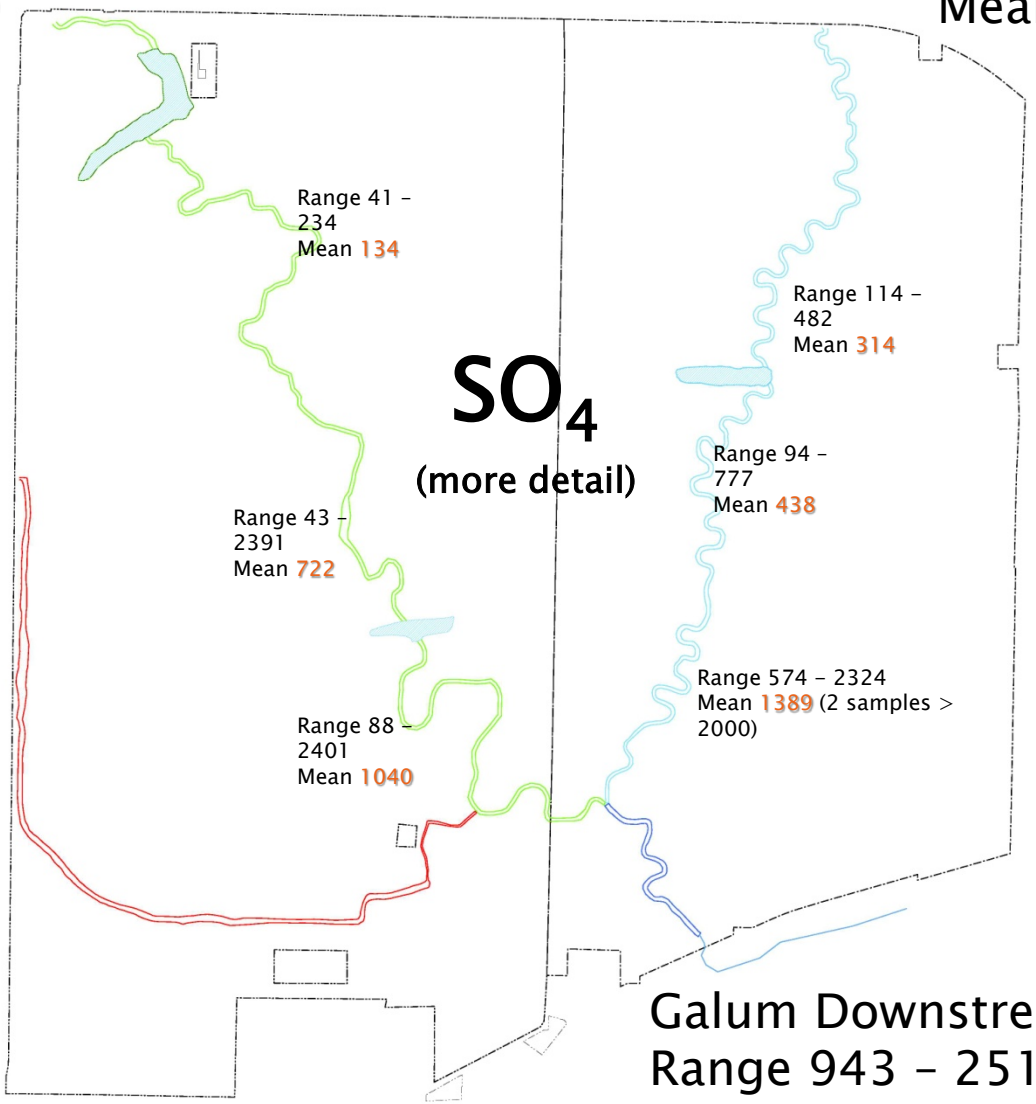
- SEDIMENT TRAP
- SURGE BIN FOR FLOOD STORAGE
- CONTINUITY OF SUMMER BASE FLOW

BAD

- BIOLOGIC MIGRATION BARRIER?
- INCREASED SULFATE?

Galum Upstream
Range 14 – 417
Mean 180

Bonnie Upstream
Range 43 – 498
Mean 270



Galum Downstream
Range 943 – 2517
Mean 1781 (4 samples > 2000; 0 samples > 3500)

Compare with NPDES limit of 3500, 2000

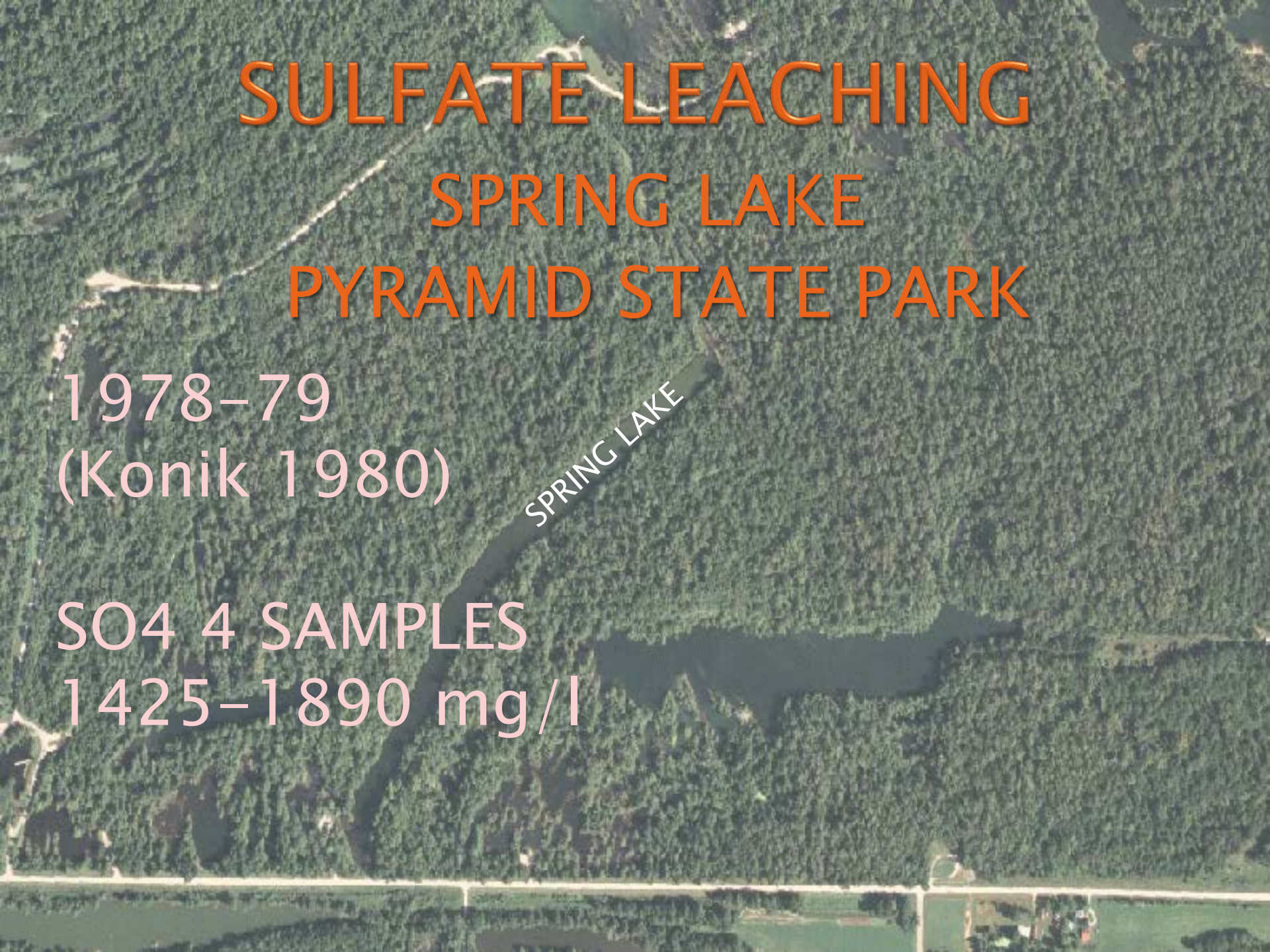
Chloride / Hardness mg/L as $CaCO_3$	Cl- < 5 mg/L	5 ≤ Cl- < 25	25 ≤ Cl- ≤ 500
H < 100 mg/L	500	500	500
100 ≤ H ≤ 500	500	[-57.478 + 5.79 (hardness) + 54.163 (chloride)] * 0.65	[1276.7 + 5.508 (hardness) – 1.457 (chloride)] * 0.65
H > 500	500	2,000	2,000

SULFATE LEACHING

SPRING LAKE
PYRAMID STATE PARK

1978–79
(Konik 1980)

SO4 4 SAMPLES
1425–1890 mg/l



SULFATE LEACHING

SPRING LAKE
PYRAMID STATE PARK

1978-79
(Konik 1980)

SPRING LAKE

APRIL 2011

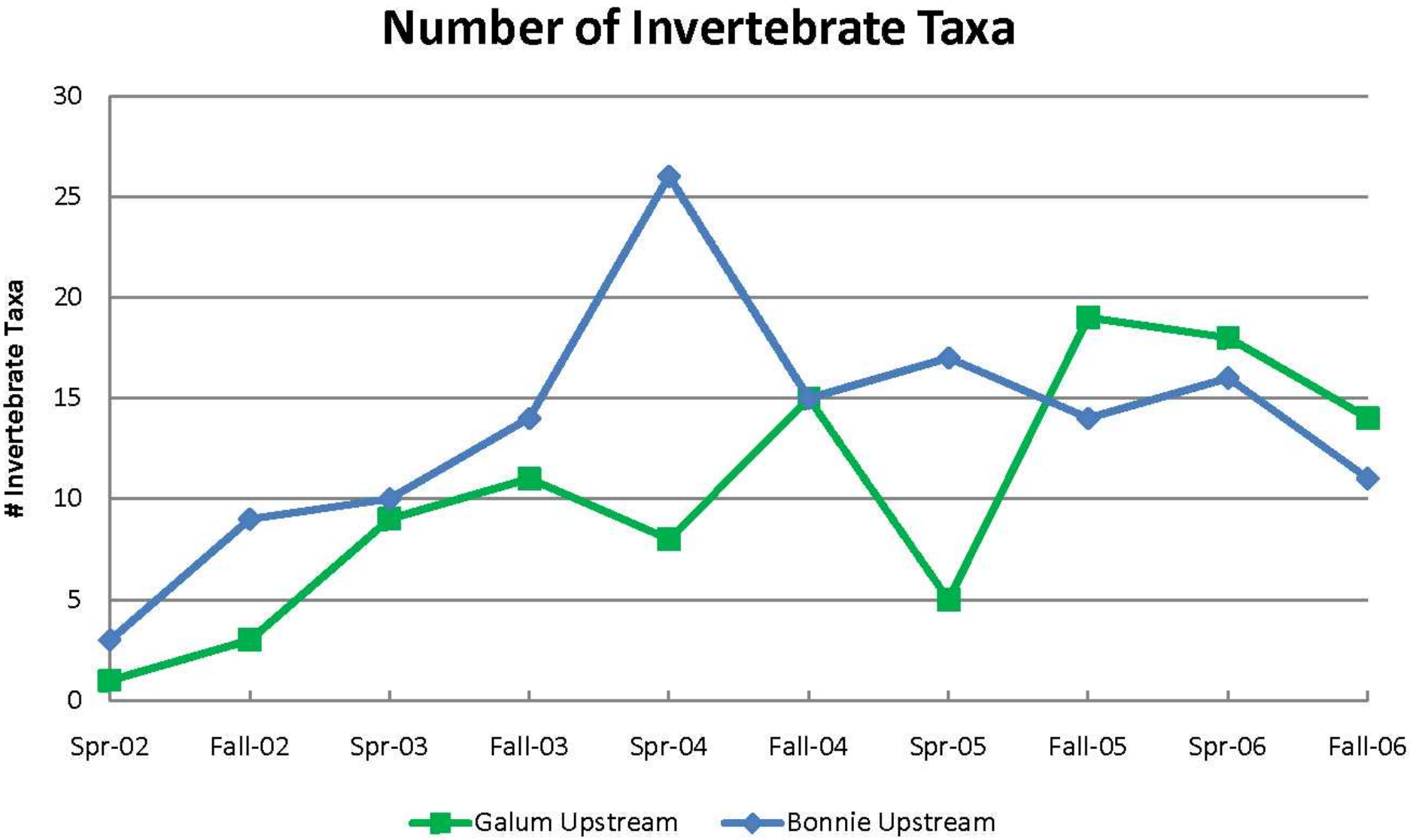
SO4 4 SAMPLES
1425-1890 mg/l

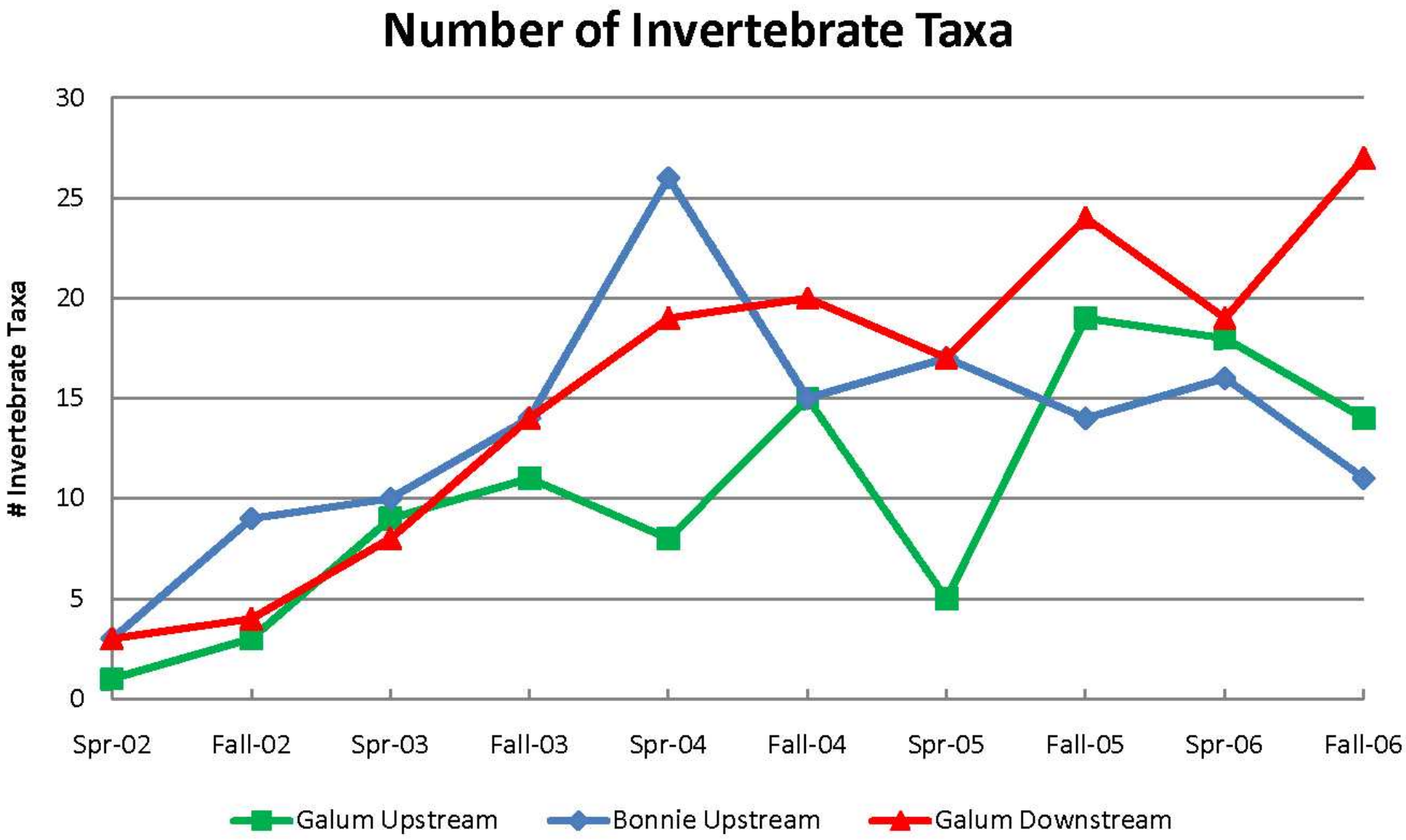
SO4
592 mg/l

WHAT DO THE DATA TELL US ABOUT:

- DIFFERENCES IN POST MINING INVERTEBRATE DIVERSITY DOWNSTREAM OF THE MINE COMPARED TO UPSTREAM OF THE MINE?

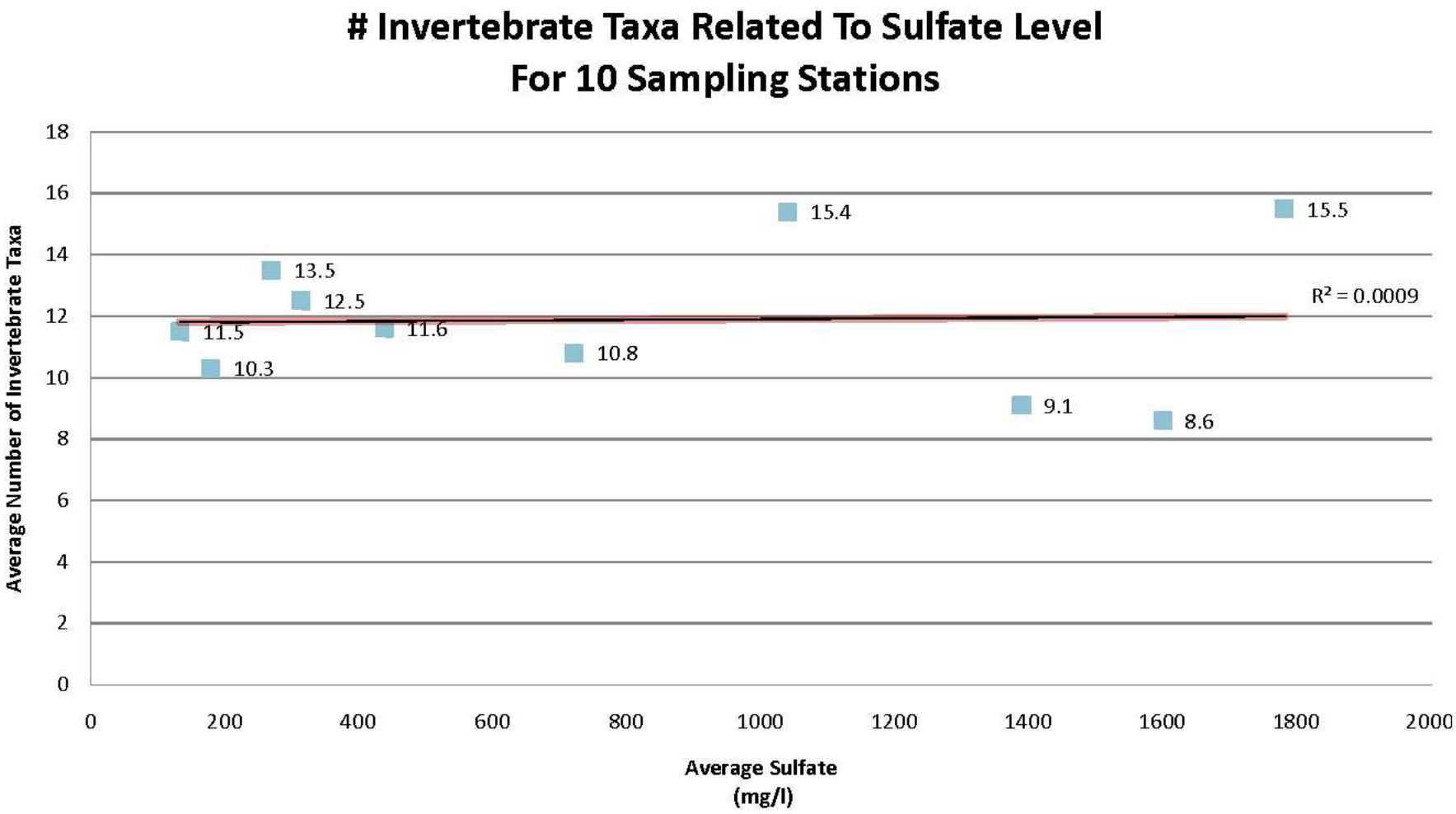
- SIMPLE COMPARISONS IN NUMBER OF INVERTEBRATE TAXA WERE MADE

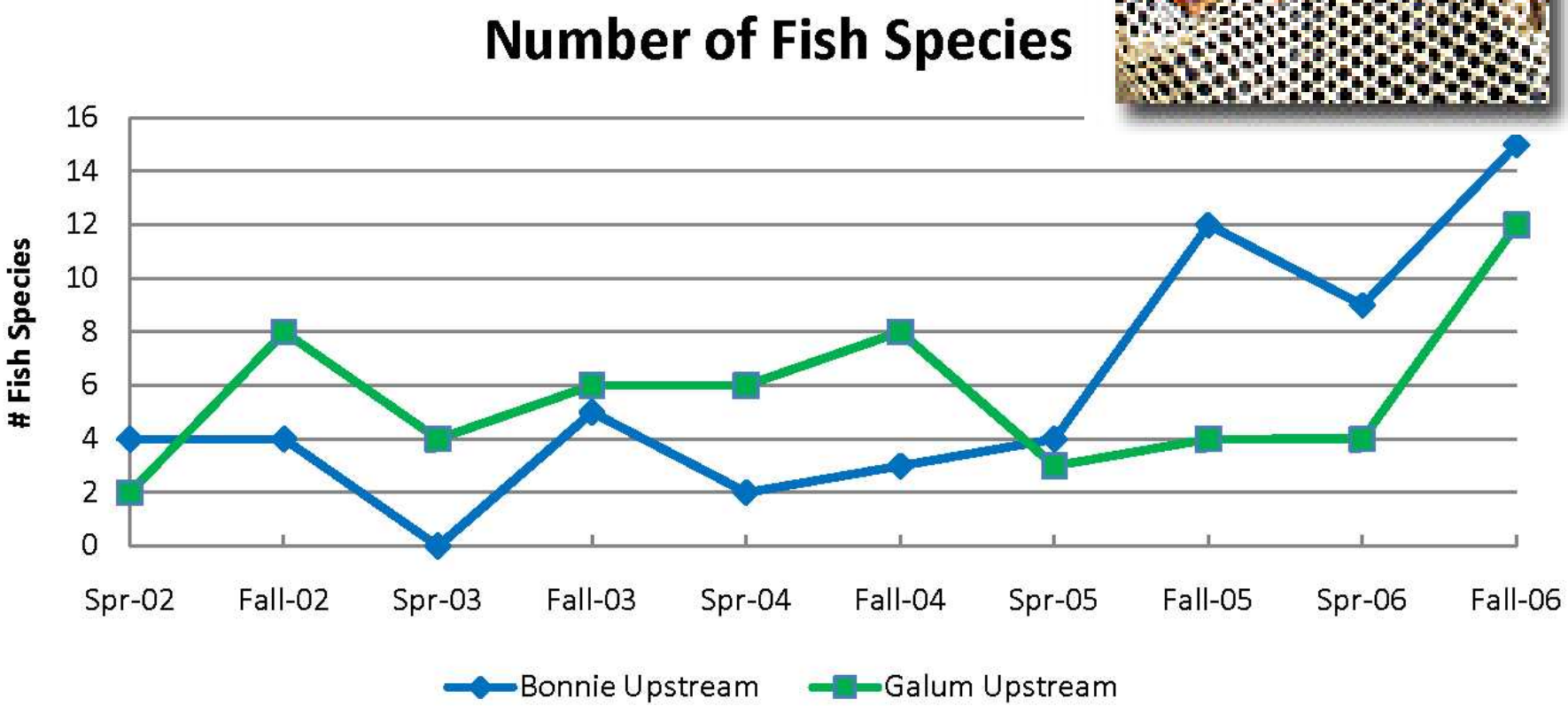

Number of Invertebrate Taxa
Invertebrate Taxa
30
25
20
15
10
5
0
Spr-02
Fall-02
Spr-03
Fall-03
Spr-04
Fall-04
Spr-05
Fall-05
Spr-06
Fall-06
Galum Upstream
Bonnie Upstream

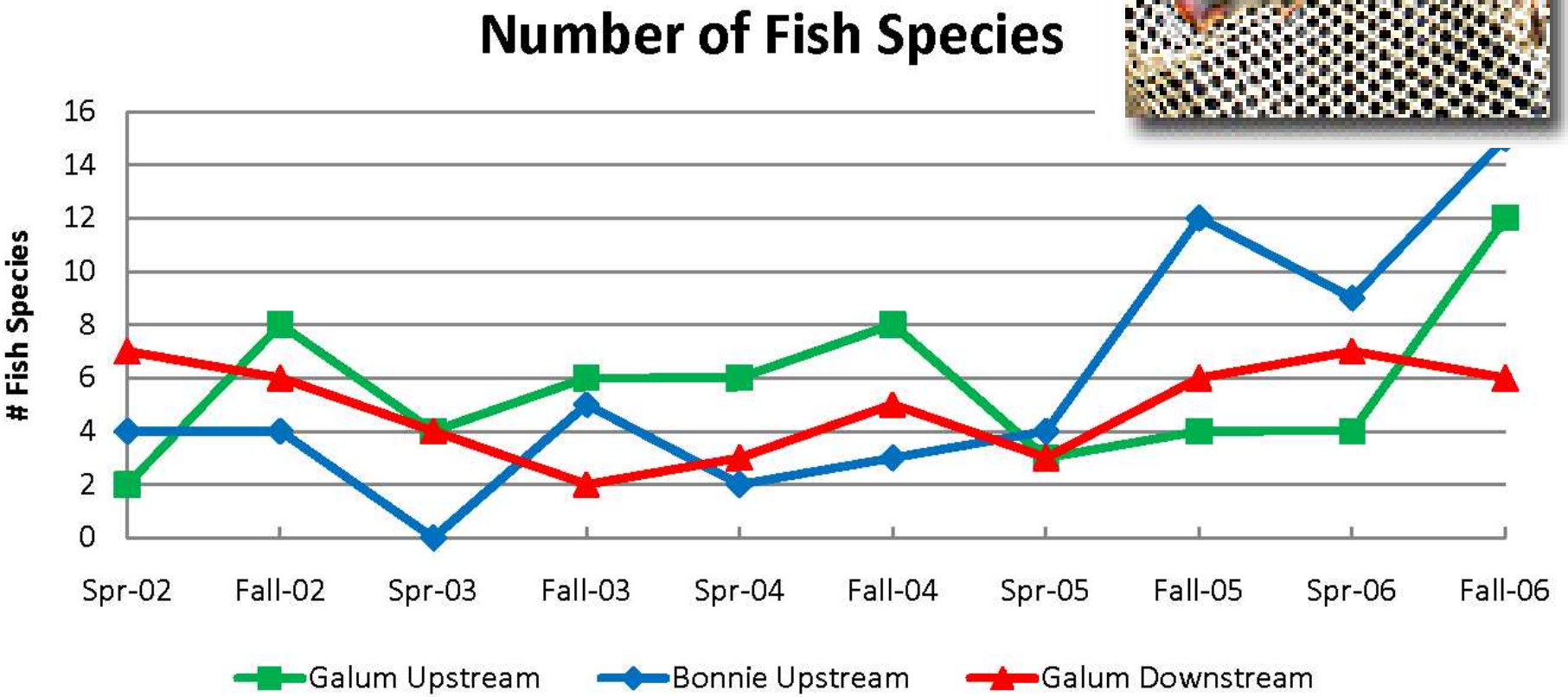

Number of Invertebrate Taxa
Invertebrate Taxa
30
25
20
15
10
5
0
Spr-02
Fall-02
Spr-03
Fall-03
Spr-04
Fall-04
Spr-05
Fall-05
Spr-06
Fall-06
Galum Upstream
Bonnie Upstream
Galum Downstream

WHAT DO THE DATA TELL US ABOUT:

- THE RELATIONSHIP BETWEEN POST MINING SULFATE LEVELS AND POST MINING INVERTEBRATE DIVERSITY?


Invertebrate Taxa Related To Sulfate Level
For 10 Sampling Stations
Average Number of Invertebrate Taxa
Average Sulfate
(mg/l)
0
2
4
6
8
10
12
14
16
18
0
200
400
600
800
1000
1200
1400
1600
1800
2000
15.4
15.5
13.5
12.5
11.5
11.6
10.3
10.8
9.1
8.6
R² = 0.0009


Number of Fish Species
Fish Species
16
14
12
10
8
6
4
2
0
Spr-02
Fall-02
Spr-03
Fall-03
Spr-04
Fall-04
Spr-05
Fall-05
Spr-06
Fall-06
Bonnie Upstream
Galum Upstream


Number of Fish Species
Fish Species
16
14
12
10
8
6
4
2
0
Spr-02
Fall-02
Spr-03
Fall-03
Spr-04
Fall-04
Spr-05
Fall-05
Spr-06
Fall-06
Galum Upstream
Bonnie Upstream
Galum Downstream

MONITORING DATA CONCLUSIONS

- WATER QUALITY DATA SHOWED NO REDUCTION IN WATER QUALITY FOR pH, TSS, Fe, Mn, Cl, or DO, BUT DID SHOW AN INCREASE IN SO4 CONCENTRATIONS BY AN ORDER OF MAGNITUDE

MONITORING DATA CONCLUSIONS

- INVERTEBRATE SAMPLING SHOWED COMPARABLE NUMBER OF INVERTEBRATE TAXA DOWNSTREAM COMPARED TO UPSTREAM BASELINE DATA

- NUMBER OF INVERTEBRATE TAXA WAS UNRELATED TO SULFATE LEVELS

MONITORING DATA CONCLUSIONS

- FISH SAMPLING SHOWED COMPARABLE NUMBER OF FISH SPECIES DOWNSTREAM COMPARED TO UPSTREAM BASELINE DATA

ARE WE STRIKING THE BALANCE BETWEEN

- ENVIRONMENTAL PROTECTION AND COAL PRODUCTION WITH RESPECT TO STREAM RECONSTRUCTION?

- ARE WE DOING THAT WHICH IS "PRACTICABLE", "ECONOMICALLY AND TECHNOLOGICALLY FEASABLE", & USING "BEST TECHNOLOGY CURRENTLY AVAILABLE" TO MINIMIZE ADVERSE IMPACTS TO OUR STREAM RESOURCES FROM COAL MINING?

YOU BE THE JUDGE