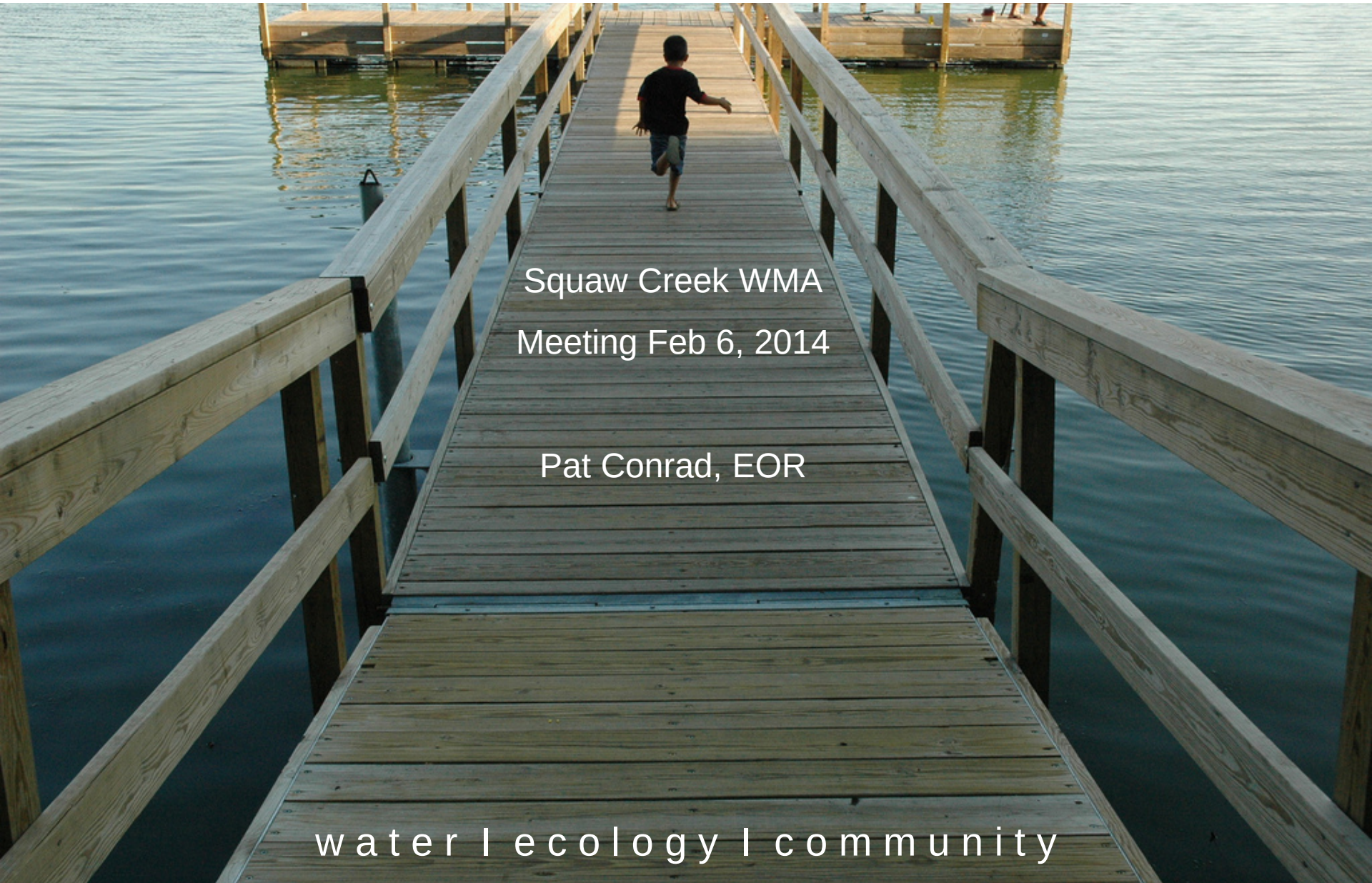
Emmons & Olivier Resources, Inc.



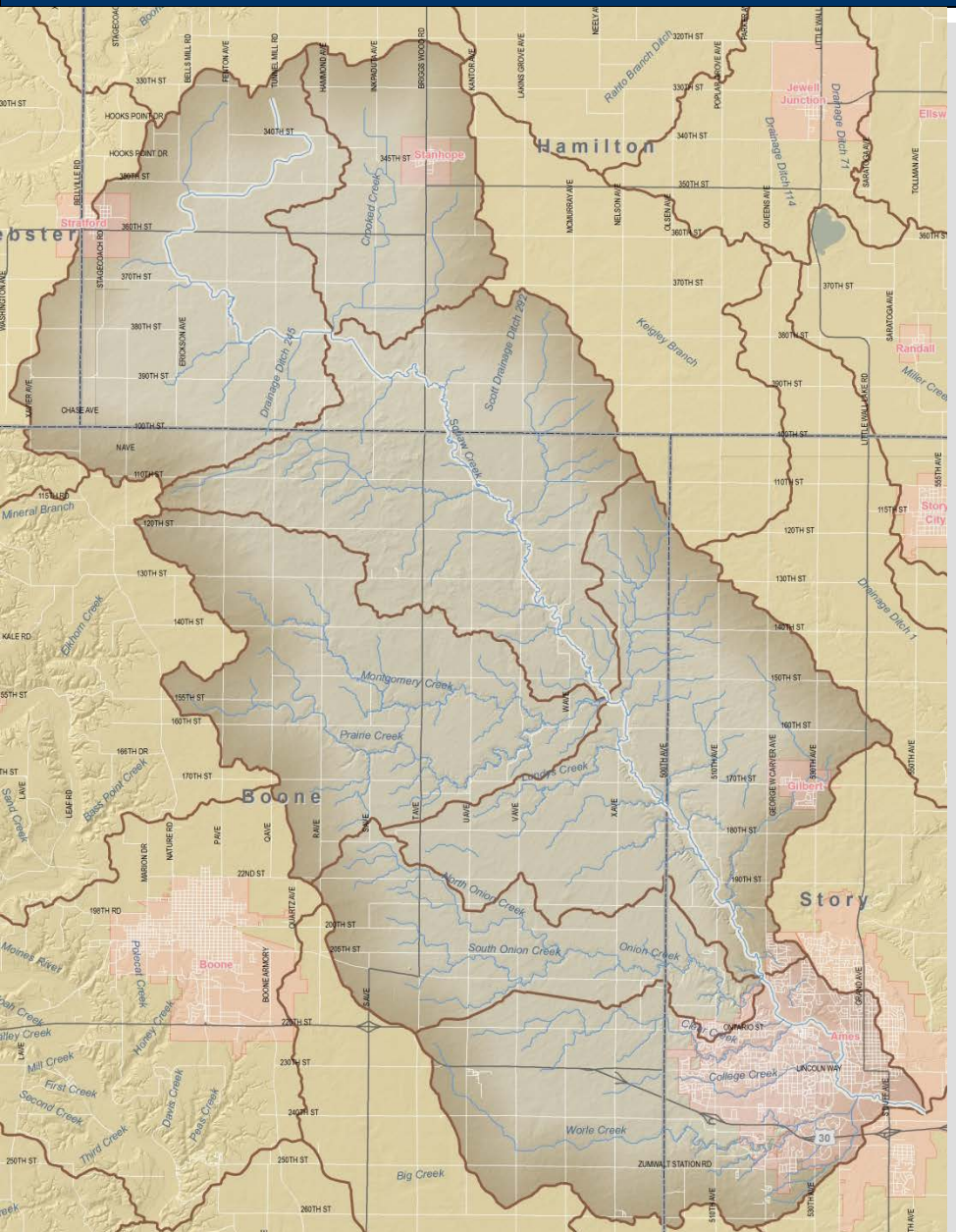
Squaw Creek WMA

Meeting Feb 6, 2014

Pat Conrad, EOR

w a t e r I e c o l o g y I c o m m u n i t y

Presentation Overview



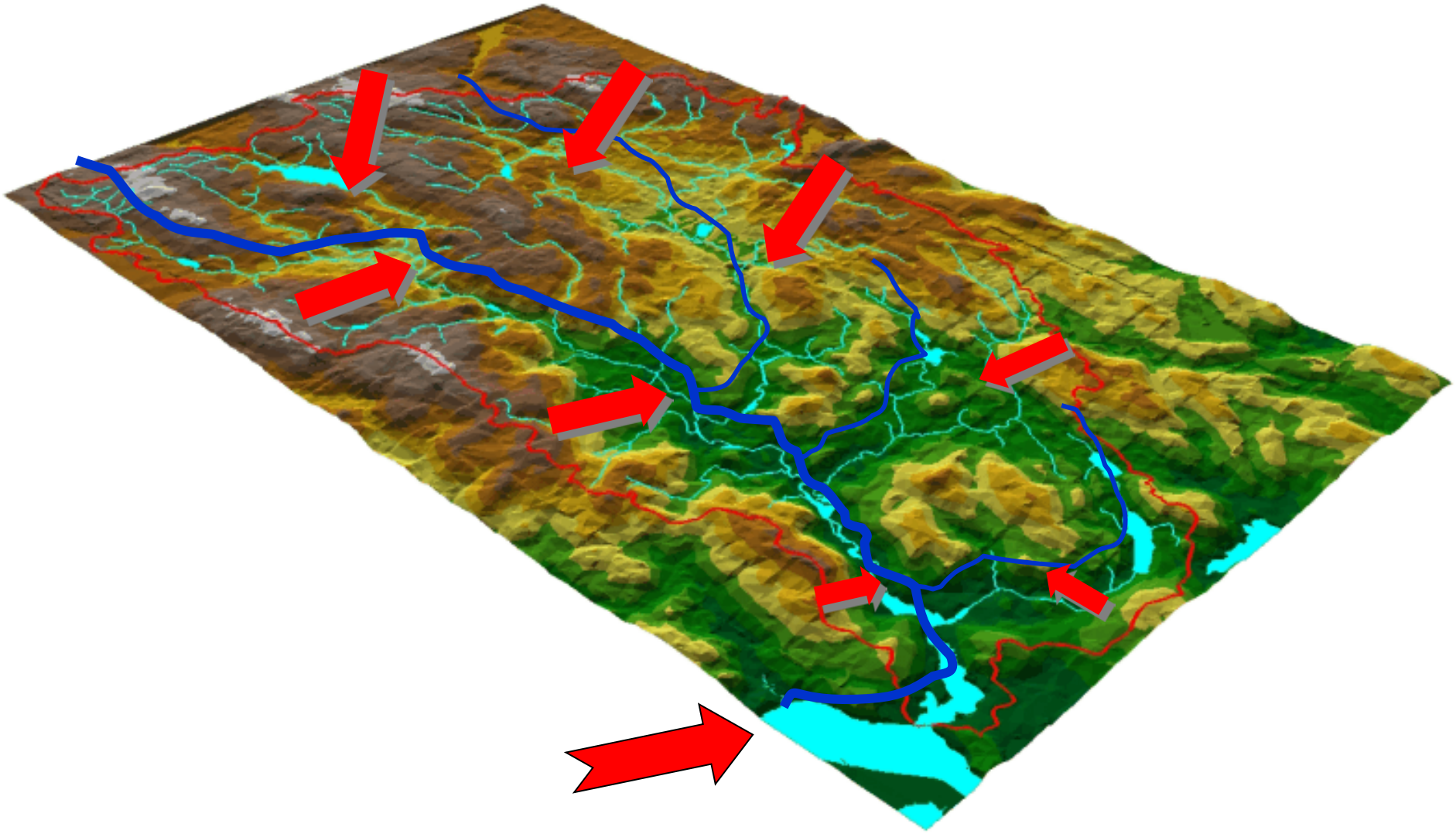
Watershed Management Overview

- Primary Issues
- Management Alternatives
- Approaches to Management

Watershed Assessment: Initial Findings

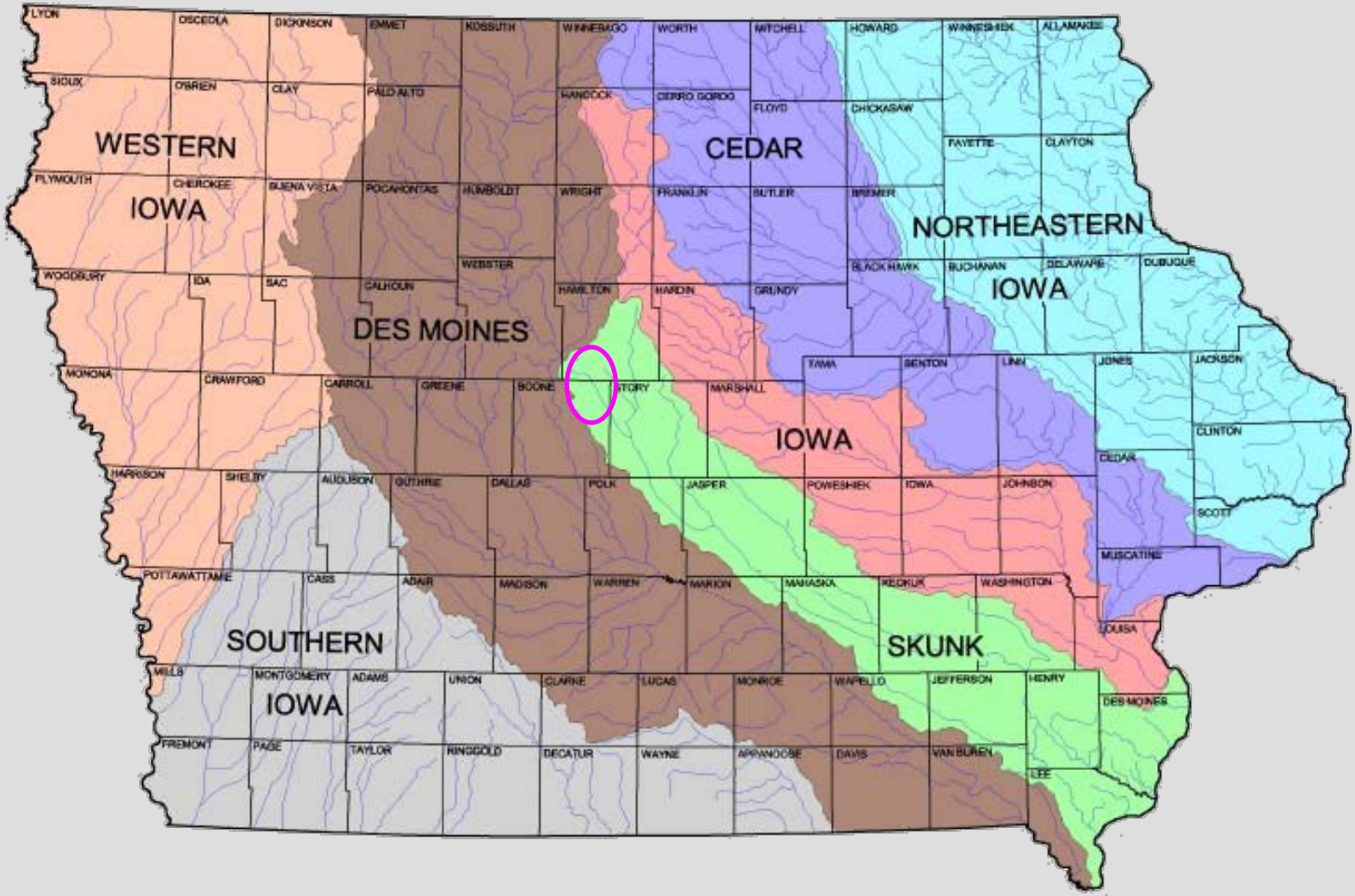
- WQ Summary
- Stream Assessment
- Bacterial Source Assessment

What is a “watershed”?



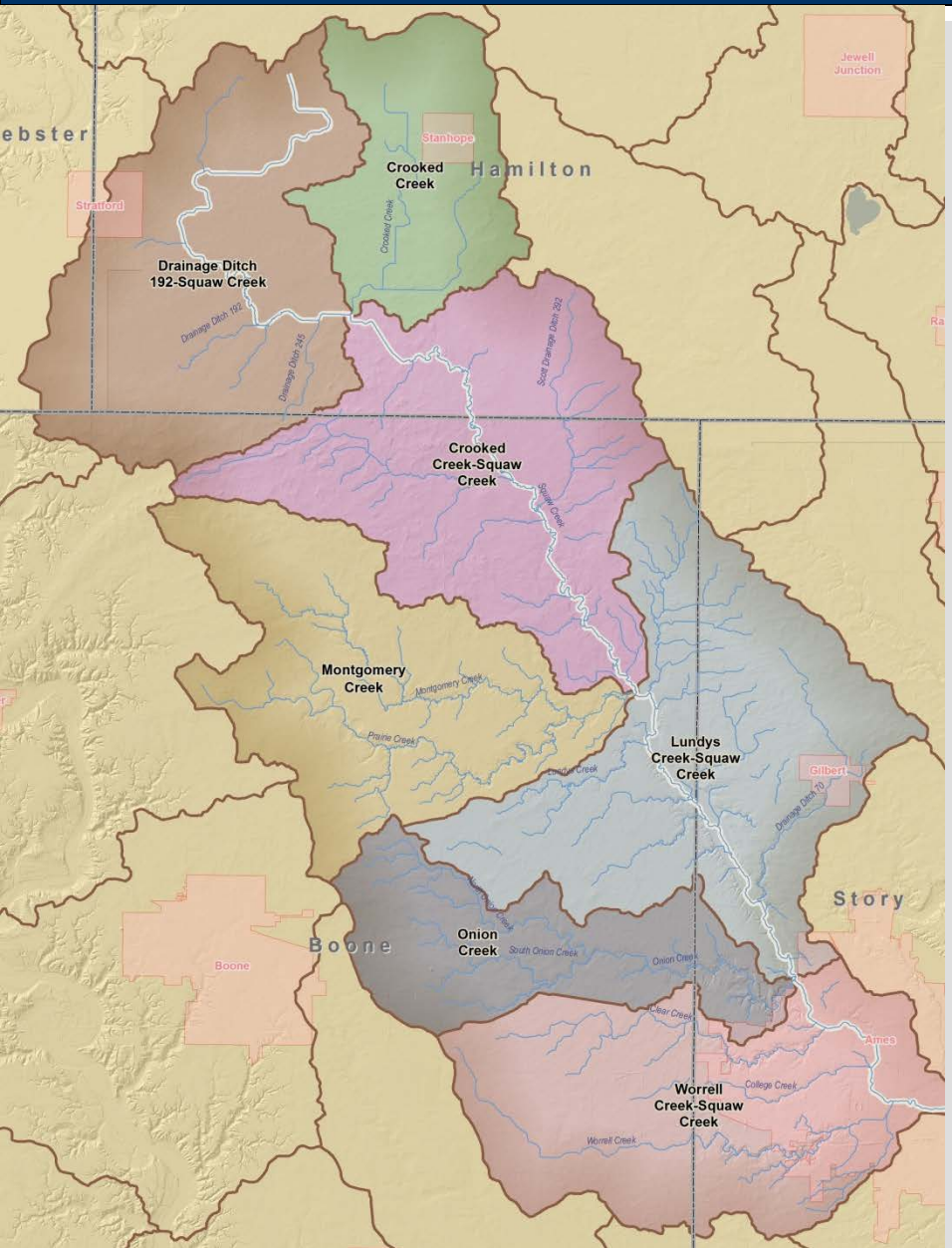
Upper Mississippi River

Skunk River


WESTERN
IOWA
CEDAR
NORTHEASTERN
IOWA
DES MOINES
IOWA
SOUTHERN
IOWA
SKUNK

Upper Skunk Creek

Squaw Creek Subwatersheds



Watershed Management

Primary Issue Areas

- Water Quality
- Water Quantity
- Recreation & Aesthetics
- Wildlife/Ecological Integrity
- Related Issues

Management Approaches

Water Quality

Clean Water Act

- Designated uses,
- Pollutants
- TMDLs

Gulf of Mexico Dead Zone

Iowa Nutrient Reduction Strategy

Water Quantity

Drainage / Connectivity

- Drain tiles
- Stormsewer

Flooding

Streambank stability
Erosion

Recreation & Aesthetics

- User Surveys
- Kayaking, Canoeing
- Wading - contact
- Fisheries
- Walking/Biking Corridors

Wildlife/Ecological Integrity

Habitat

Wildlife / Bird Viewing

Aesthetics

Related Issues

- Groundwater Recharge
- Aquifer Pollution
- Climate Change
- Monitoring
- Contaminants of Emerging Concern
- Funding Mechanisms
- Education / Outreach
- Socio-Economic

Watershed Management Techniques

Urbanized Areas

- Managing impervious surfaces
- Rate and Volume Control
- Sediment/Nutrient, Pollutant Removal

Agricultural Areas

- In-Field
- Edge of Field
- Land Use Changes

Watershed Management Tools

- Regulation
- Capital Improvement Expenditures
- Stewardship

Watershed Management Models

MN Watershed Districts

Regulation, Taxing Authority

Iowa-Cedar

Interagency Coordination

Yahara Pride Farms

Stewardship/Certification

Watershed Assessment: Initial Findings

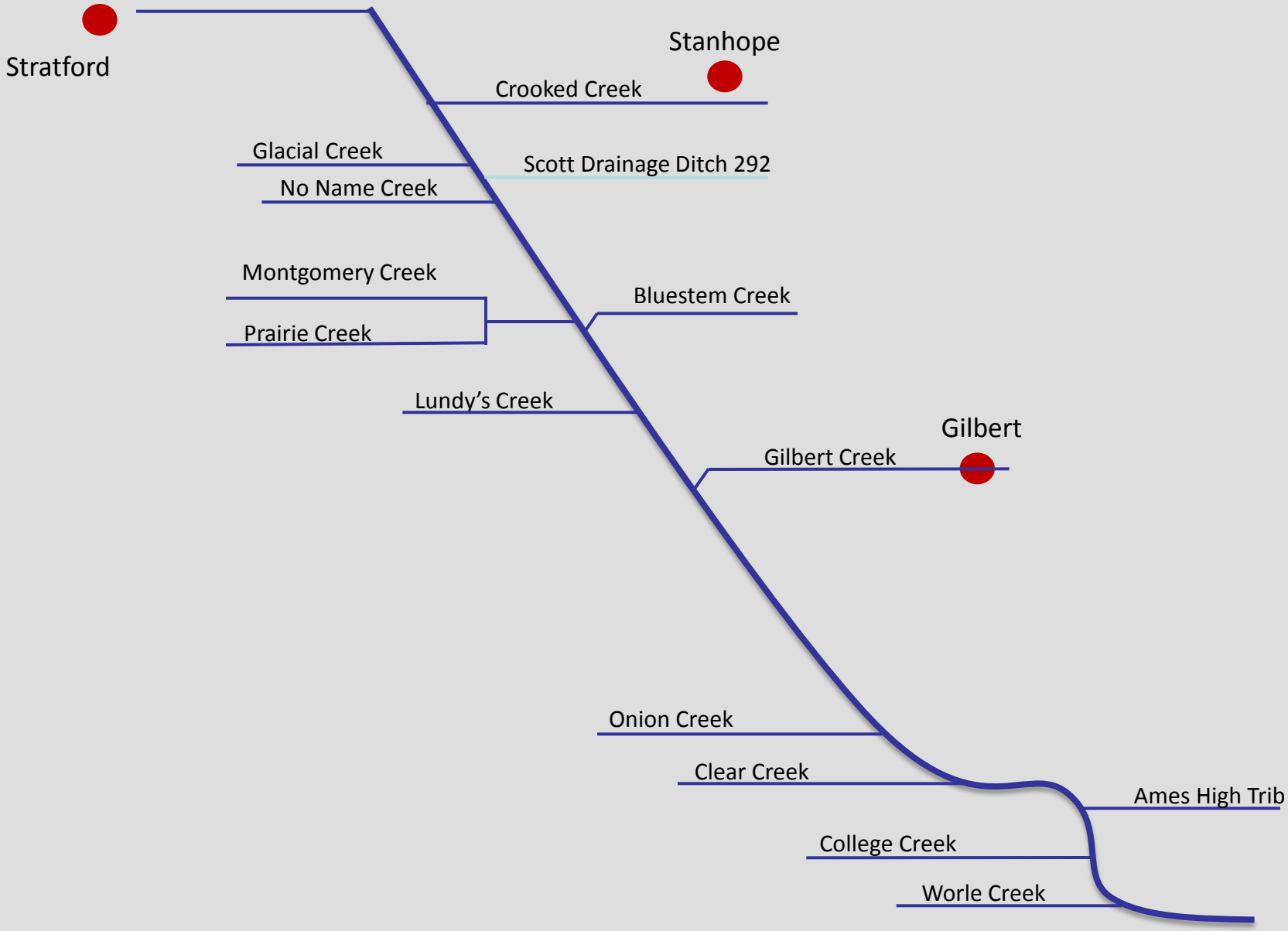
Water Quality Summary

Stream Assessment

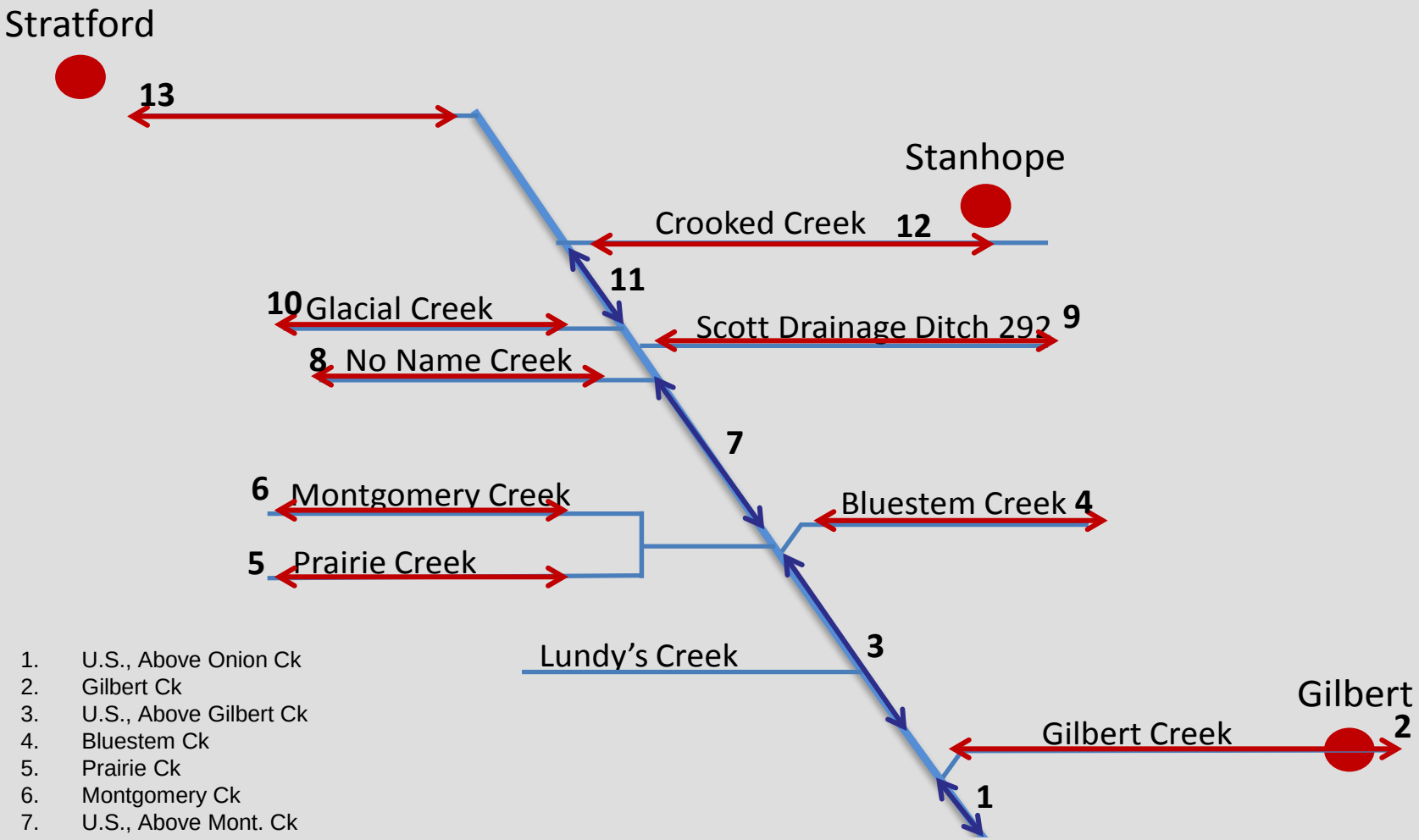
Bacteria Source Inventory

Watershed Modeling

Watershed Stream Network

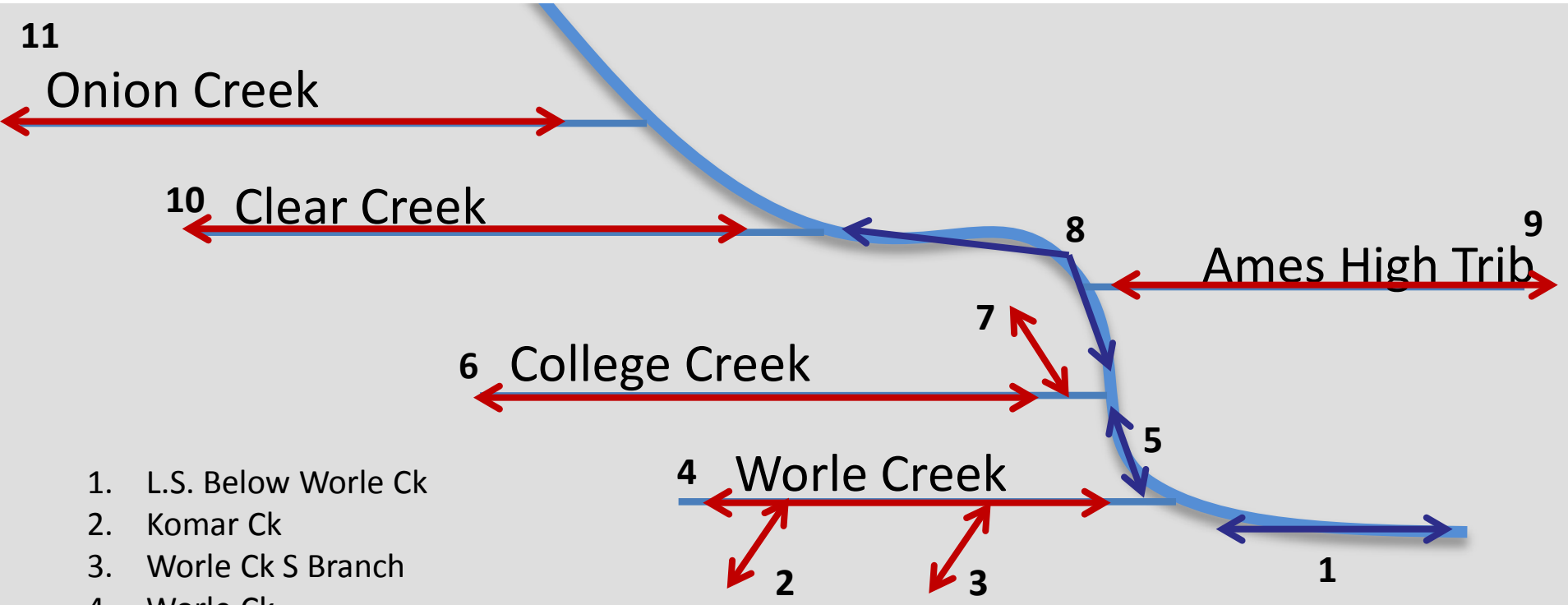


Upper Squaw Reaches



1. U.S., Above Onion Ck
2. Gilbert Ck
3. U.S., Above Gilbert Ck
4. Bluestem Ck
5. Prairie Ck
6. Montgomery Ck
7. U.S., Above Mont. Ck
8. No Name Ck
9. Scott Drainage Ditch 292
10. Glacial Ck
11. U.S., Above Glacial Ck
12. Crooked Ck
13. U.S., Stratford

Lower Squaw Reaches



1. L.S. Below Worle Ck
2. Komar Ck
3. Worle Ck S Branch
4. Worle Ck
5. L.S. Above Worle Ck
6. College Ck
7. College Ck Trib
8. L.S. Above College Ck
9. Ames High Trib
10. Clear Ck
11. Onion Ck

Phosphorus

	Mean Orthophosphate (µg/L)
EPA Ecoregion Standard (total P)	**76.25 µg/L**
Subregion 25th Percentile	**118.13**
Squaw Creek (Downstream of Glacial to mouth)	290
Upper Squaw Creek (source to Onion)	260
Lower Squaw Creek (Onion to Mouth)	300
Worle Creek	210
Squaw Creek (Glacial Creek to Headwaters)	260
Glacial Creek	200
North Onion Creek	200
South Onion Creek	200
Onion Creek	410
College Creek	260
Clear Creek	330
Onion Creek (all grouped)	360

Nitrogen

	Mean NO_3/NO_2 (mg/L)
EPA Ecoregion Standard	**2.18 mg/L**
Subregion 25th Percentile	**3.26 mg/L**
Squaw Creek (Downstream of Glacial to mouth)	6.5
Upper Squaw Creek (source to Onion)	6.7
Lower Squaw Creek (Onion to Mouth)	5.9
Worle Creek	9.2
Squaw Creek (Glacial Creek to Headwaters)	3.9
Glacial Creek	1.8
North Onion Creek	1.15
South Onion Creek	0.15
Onion Creek	6.7
College Creek	2.5
Clear Creek	6.8
Onion Creek (all grouped)	5.3

E. coli – Sites Meeting Data Req.

	E. coli (org/100mL)	
	Geometric Mean	% of Samples > 235
Iowa Standard	**126 org/100mL**	**None**
Squaw Creek (Downstream of Glacial to mouth)	330	74.70%
Lower Squaw Creek (Onion to Mouth)	330	74.70%
Clear Creek	18	30.70%

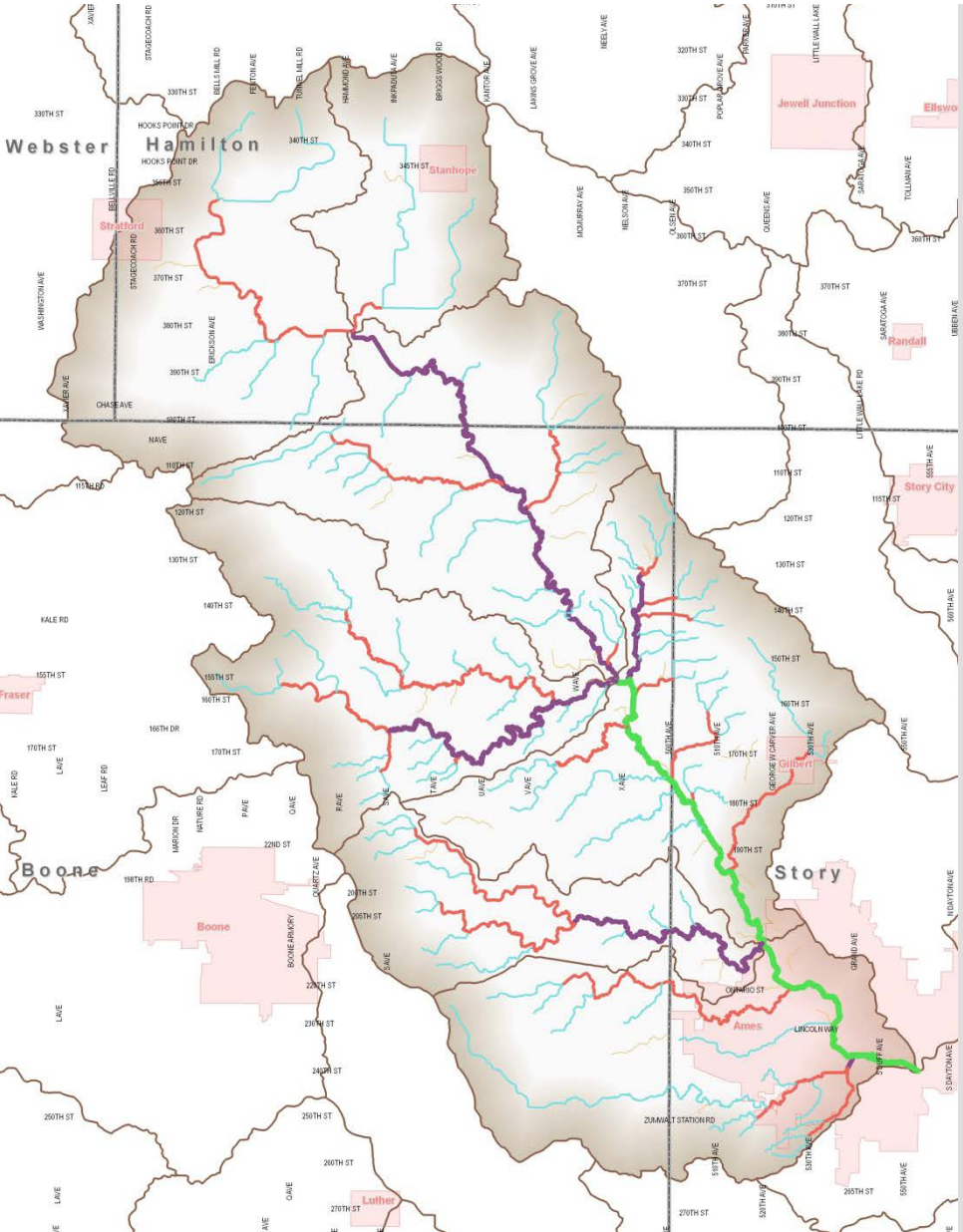
E. coli – All Sites

Stream Reach	Year	Number of Samples	Geometric Mean (org/100mL)	Number of Samples > 235 (org/100mL)
		Standard	126 org/100mL	None
Lower Squaw, Below Worrell Creek	2009	8	703	6
	2010	9	891	8
	2011	9	118	5
	2012	5	921	4
	2013	5	19	3
Lower Squaw, Above Worrell Creek	2009	8	577	6
	2010	10	353	5
	2011	9	846	7
	2012	4	443	2
	2013	4	6	1
Lower Squaw, Above College Creek	2009	2	2200	2
	2011	2	428	2
Ames High Tributary	2009	2	566	1
	2010	3	<1	0
Clear Creek	2009	5	176	2
	2010	8	5	1
	2011	5	1	3
	2012	6	117	2
	2013	2	33	0
Prairie Creek	2011	2	5686	2
Montgomery Creek	2011	2	2155	2

Dissolved Oxygen

	DO (mg/L)
Standard **(Min for at least 16 hours of every 24-hour period)**	**5**
Squaw Creek (Downstream of Glacial to mouth)	9.2
Upper Squaw Creek (source to Onion)	9.7
Lower Squaw Creek (Onion to Mouth)	9
Worle Creek	9.9
Squaw Creek (Glacial Creek to Headwaters)	9.6
Glacial Creek	9.4
North Onion Creek	10
South Onion Creek	8
Onion Creek	8.7
College Creek	8.6
Clear Creek	9.3
Onion Creek (all grouped)	8.9

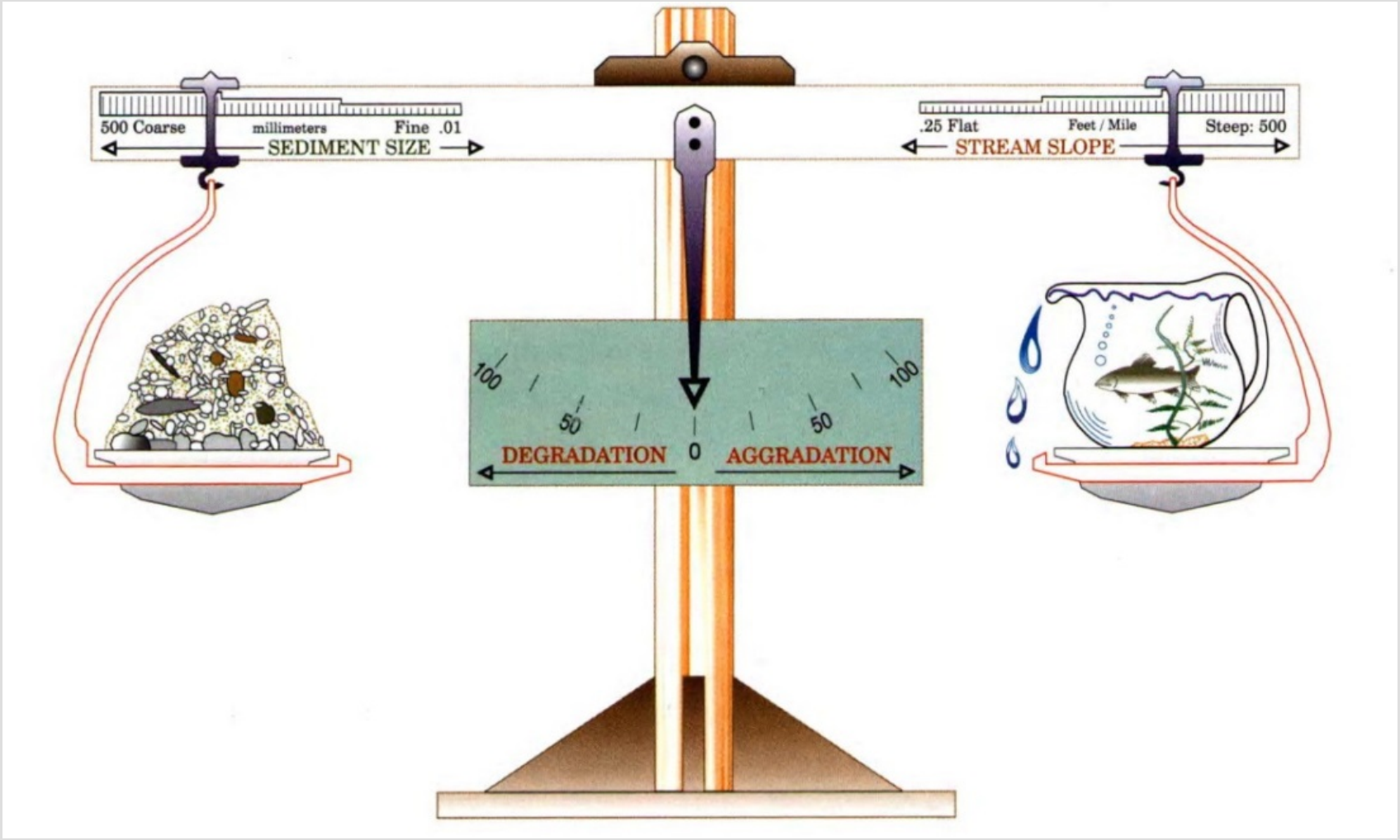
Stream Assessment



Health

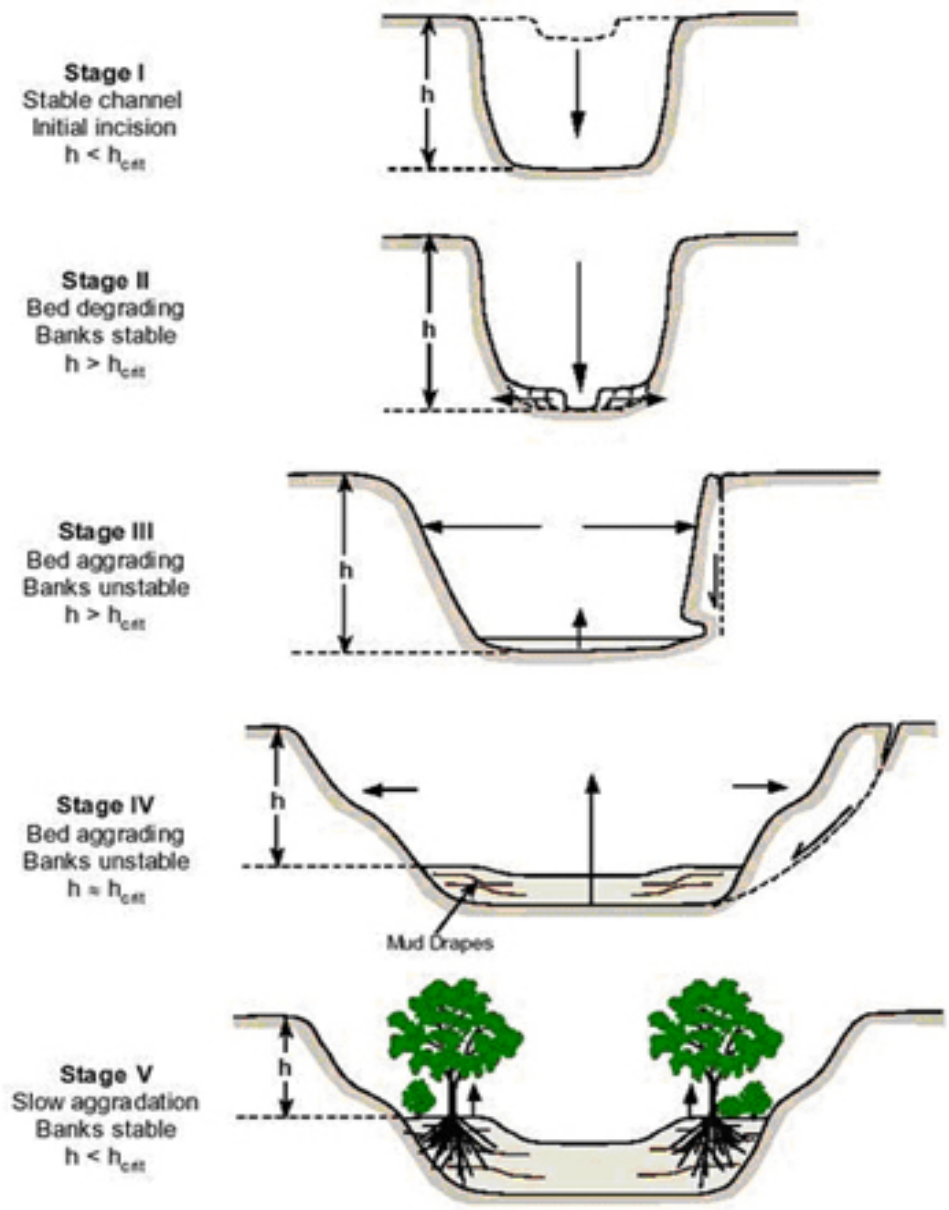
The integrity of surface waters can be affected by actions on the landscape that are directly adjacent to the waterbody, or at the farthest-most up-gradient point in a watershed

Stream Assessment

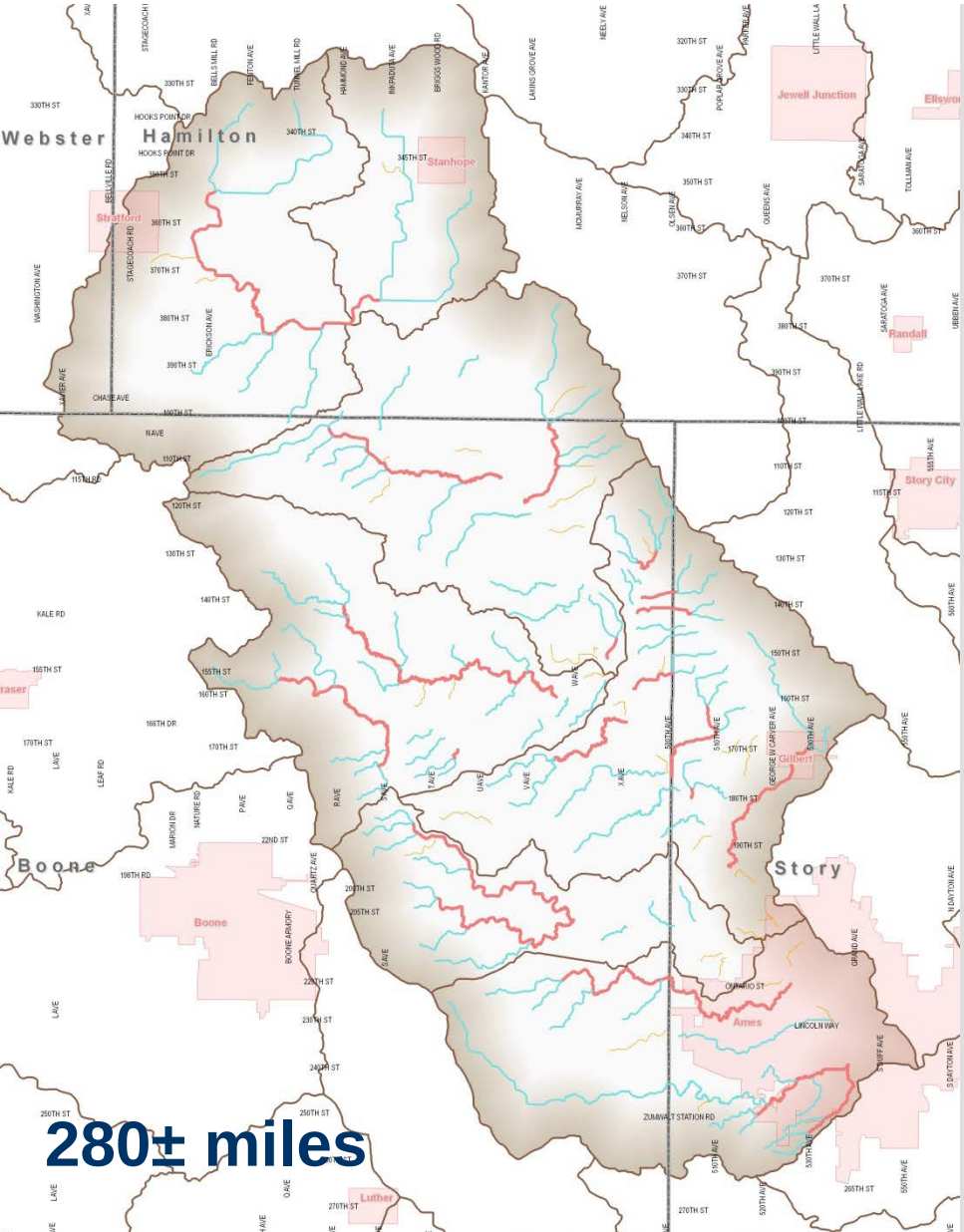


The condition of a stream is a reflection of the level of combined human-induced stresses acting upon it

Stream Assessment



Stream Assessment



Tributaries: direct stresses

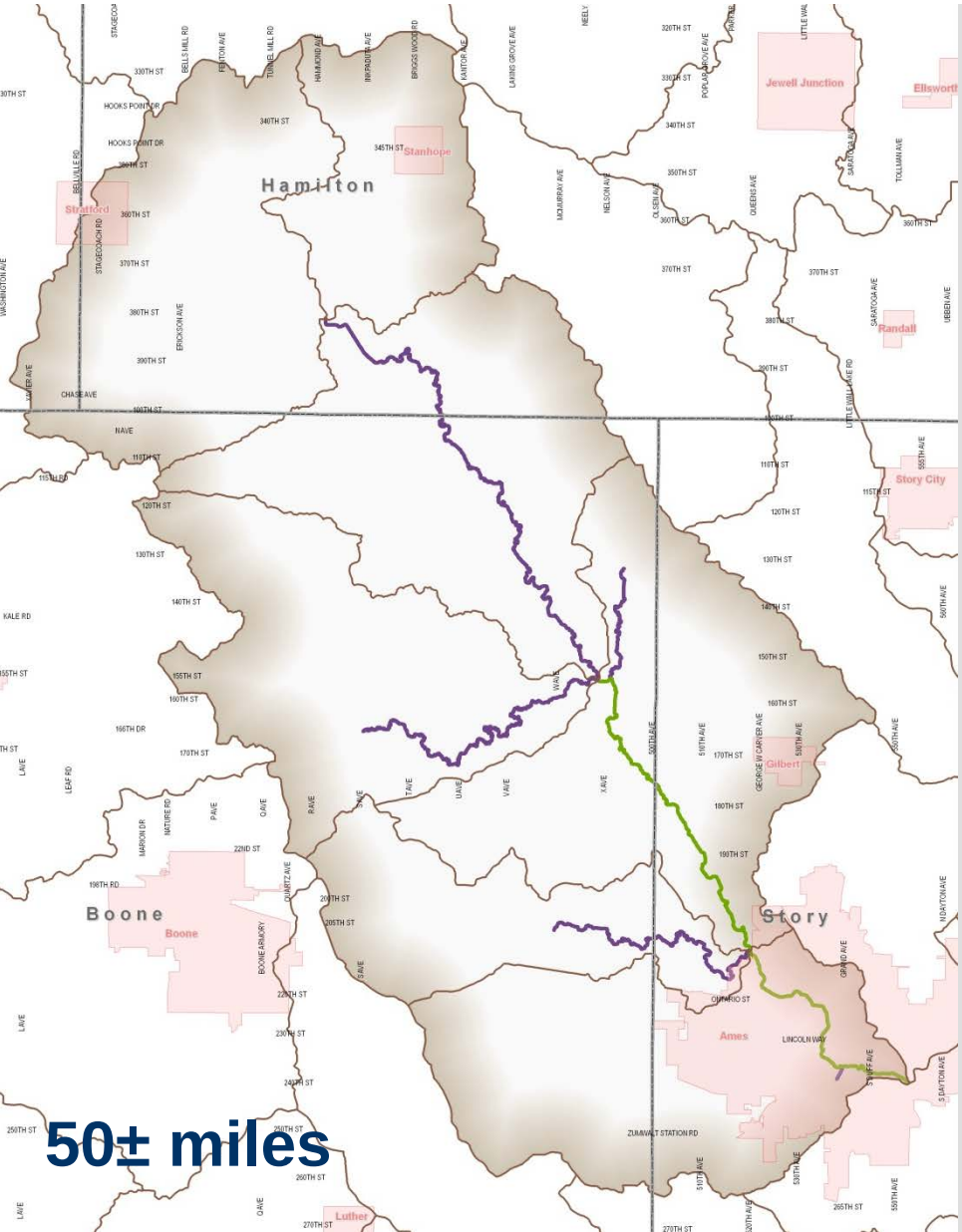
Stream Channel

- Straightened (loss of K and increase in slope)
- Loss of floodplain
- Entrenchment
- Encroachment (crop & cattle)

Hydrology

- Loss of storage (wetland)
- Runoff coefficient (landcover)
- direct connectivity (drainage)

Stream Assessment



Primary Stream Reaches

Indirectly impacted via compounding upstream stresses

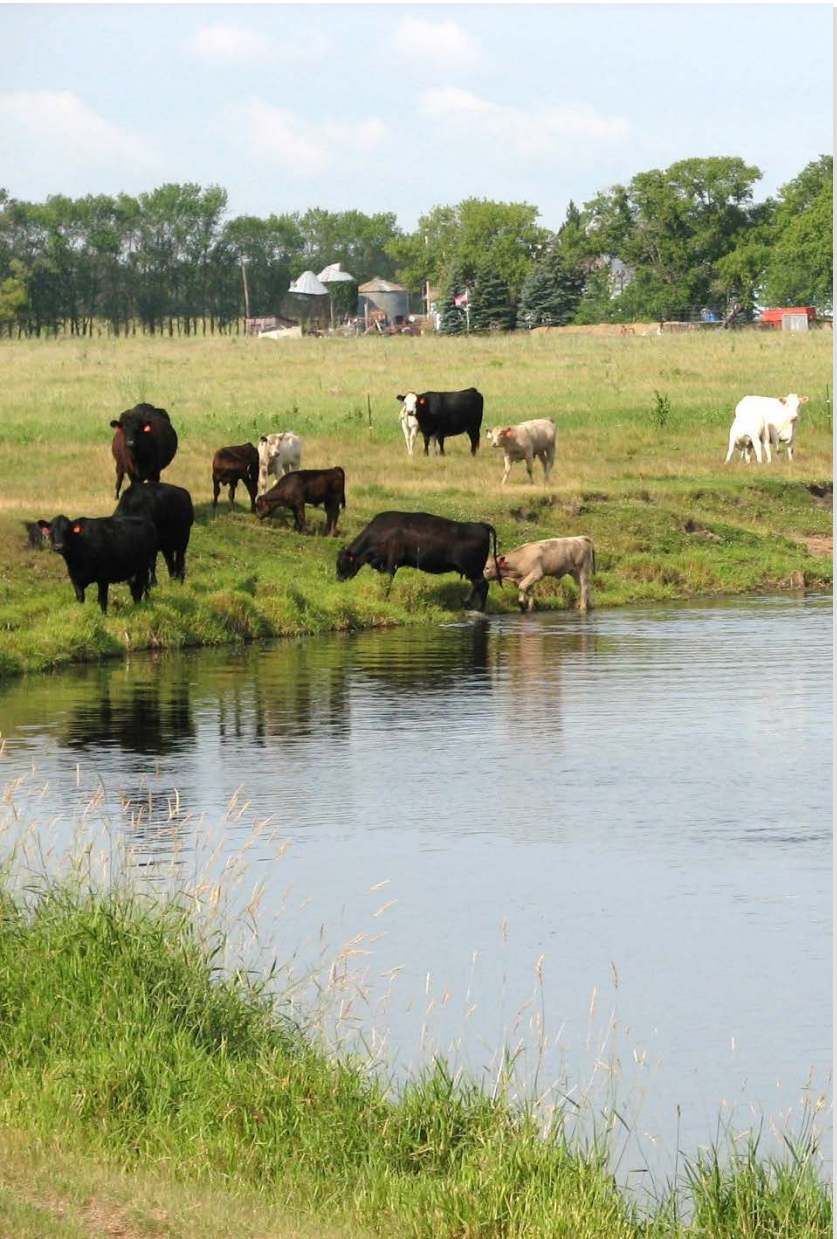
Directly impacted via similar upstream stresses along with urban stormwater

Stream Assessment

Resulting Condition

- Increase water temp
- Degradation
- Increased flooding (frequency and severity)
- Decreased water quality
- Increased infrastructure threats

Bacterial Source Assessment



BSA Steps:

1. Identify Potential Sources of Bacteria in the watershed

2. Bacteria Production Estimates based on bacteria content in feces and an average excrement rate which varies by animal type

3. Estimate Delivery of Bacteria to surface waters

4. BSA Results reported in relative terms: low, medium-low, medium, medium-high, high

Estimates of Potential Bacteria Sources: Humans

Bacteria Sources			Data Sources and Assumptions
Sewered Community	**WWTF**	WWTF Effluent	Based on WWTF design flow and NPDES permit limits.
		Land Application of Biosolids	Delivery assumed to be low based on regulation.
	Collection System	Illicit Connections or Leakage of Raw Sewage from Sanitary Sewer into Stormsewer	Not an issue in project area.
Unsewered Community	**Compliant WWTS**	WWTS Discharge to Groundwater	Groundwater sources of E. coli excluded from analysis because there is not enough information available to adequately evaluate the magnitude of groundwater sources of E. coli to surface waters.
		Land Application of Septage	There is a lot of uncertainty as to the level of implementation: delivery assumed to be low.
	Non-Compliant WWTS	ITPHS WWTS including Illicit Discharges	The population in unsewered communities estimated based on 2010 Census block groups (US Census Bureau 2011) for those areas outside of the WWTF service area. SSTS flow estimated to be 265 L/person-day (Metcalf and Eddy 1991). The estimated fraction of flow from unsewered communities that is classified as failing to be determined. Raw sewage E. coli concentration estimated at 3.15×10^6 org/100ml based on an approximate 2:1 relationship between fecal coliform and E. coli in waste [Doyle and Erikson (2006)] provided in Overcash and Davidson (1980) as referenced in USEPA (2011).

Estimates of Potential Bacteria Sources: Livestock

Data Sources and Assumptions

Grazing

Grazing populations est. for cattle, goats, and sheep based on the USDA 2007 Census of Agriculture (USDA NASS 2009).

Animal Feeding Operations (AFO) estimated for:

- **Cattle**
- **Poultry**
- **Goats**
- **Sheep**
- **Hogs**

Based on the USDA 2007 Census of Agriculture (USDA NASS 2009).

Partially Housed or Open Lot without Runoff Controls

The proportion of AFO animals that are partially housed or in open lots without runoff controls was based on Mulla et al. (2001):

- Cattle 50%
- Poultry 8%
- Goats 42%
- Sheep 42%
- Hogs 15%

Land Application of Manure Mulla et al. (2001):

- Cattle 50%
- Poultry 92%
- Goats 58%
- Sheep 58%
- Hogs 85%

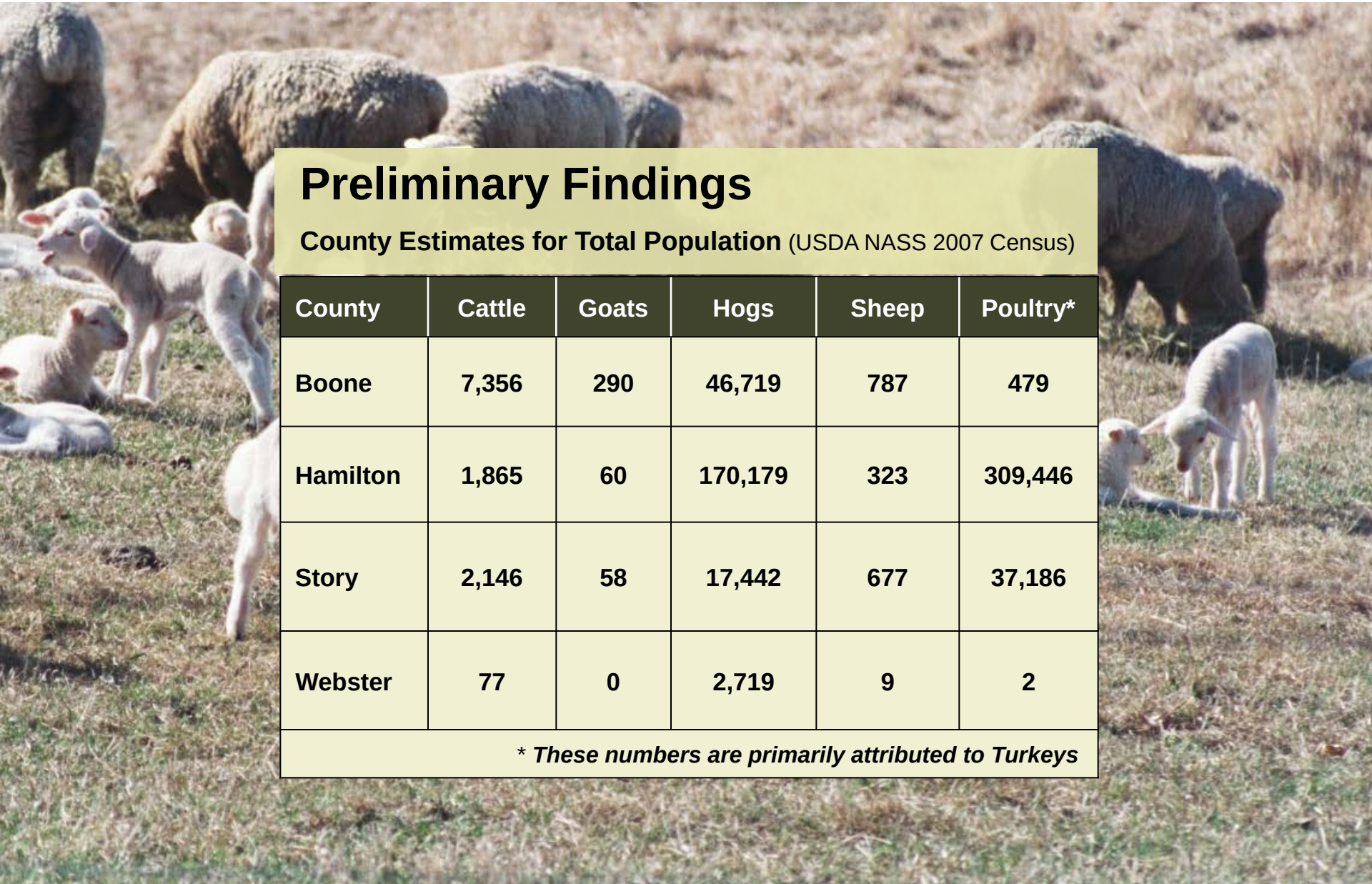
Surface Application without Incorporation Mulla et al. (2001):

- Cattle 86%
- Poultry 91%
- Goats 89%
- Sheep 89%
- Hogs 65%

Incorporated or Injected Mulla et al. (2001):

- Cattle 14%
- Poultry 9%
- Goats 11%
- Sheep 11%
- Hogs 35%

Estimates of Potential Bacteria Sources: Livestock



Preliminary Findings

County Estimates for Total Population (USDA NASS 2007 Census)

County	Cattle	Goats	Hogs	Sheep	Poultry*
Boone	7,356	290	46,719	787	479
Hamilton	1,865	60	170,179	323	309,446
Story	2,146	58	17,442	677	37,186
Webster	77	0	2,719	9	2

** These numbers are primarily attributed to Turkeys*

Estimates of Potential Bacteria Sources: Companion Animals

Animal	Basis for Estimates of Animal Population
Dogs	American Veterinary Medical Association's (AVMA) 34% own dogs 1.4 dogs per household 2010 Census block group data
Cats	American Veterinary Medical Association's (AVMA) 32% own cats 2.3 cats per household 2010 Census block group data

Estimates of Potential Bacteria Sources: Wildlife

Animal	Basis for Estimates of Animal Population
Raccoons, Beavers, Muskrats	Information to be provided by Iowa DNR and evaluated for inclusion.
Breeding Ducks	Fall estimates based on weekly surveys conducted by Iowa DNR in refuge areas to be provided.
Deer	County-wide annual population estimates to be provided by the Iowa DNR, Division of Wildlife.
Geese	Fall estimates based on weekly surveys conducted by Iowa DNR in refuge areas to be provided.
Raccoons	Insufficient data to include in Bacteria Source Assessment.

Watershed Modeling Status

LiDAR Derived Stream Power Index

SWAT Water Quality Model

- Demonstrate connection between landscape and water quality
- Prioritize conservation actions
- Demonstrate benefit of conservation actions

Coordinate with past efforts of Iowa State & Ames Flood modeling.

Questions?

Thank you