

Emmons & Olivier Resources, Inc.

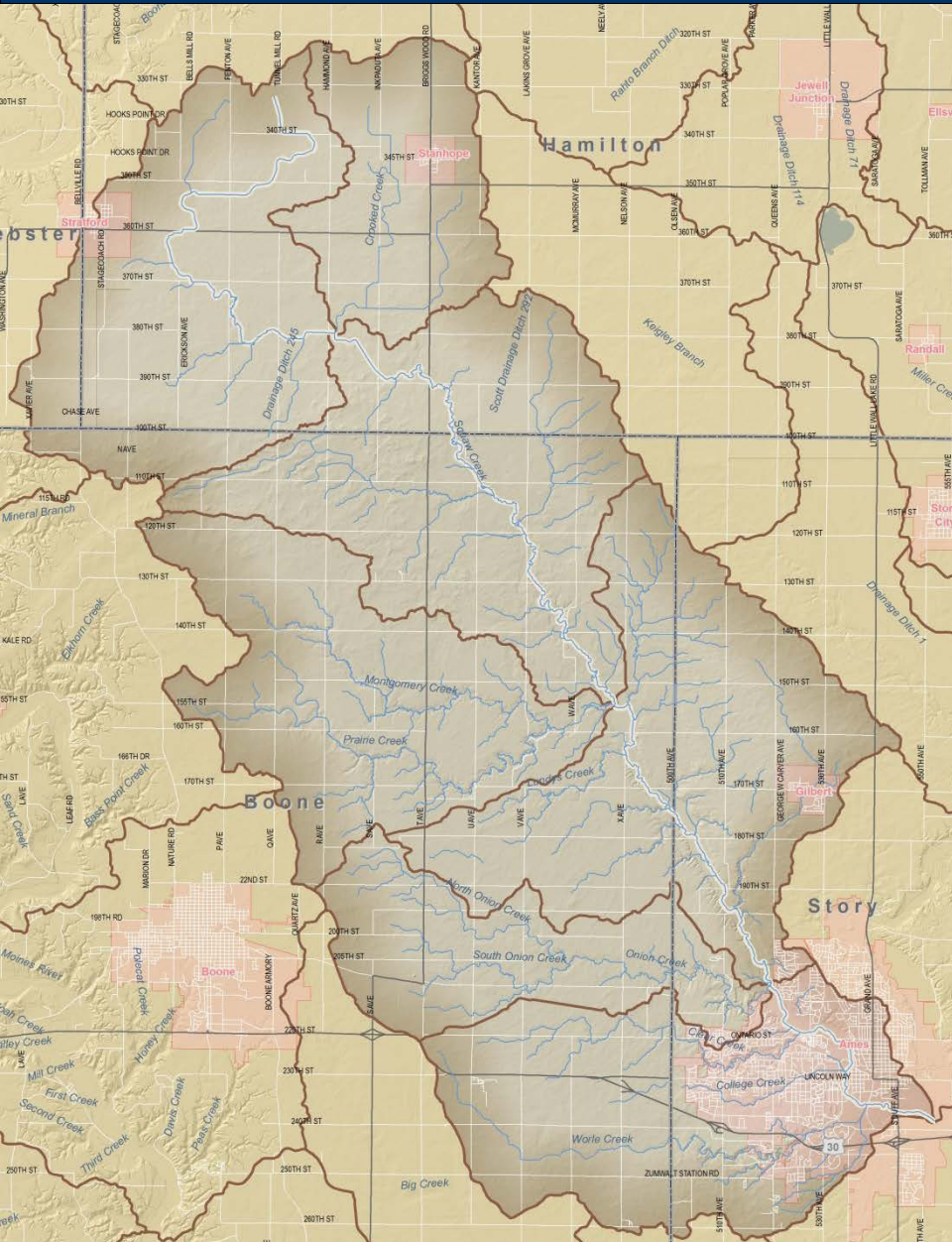
A young boy in a dark shirt and shorts is running away from the camera on a long wooden pier that stretches into a body of water. The pier has wooden railings on both sides. In the background, there are other wooden structures and a person standing on one of them. The water is calm with some ripples.

Squaw Creek WMA
Meeting Feb 6, 2014

Pat Conrad, EOR

water | ecology | community

Presentation Overview



Watershed Management Overview

Primary Issues

Management Alternatives

Approaches to Management

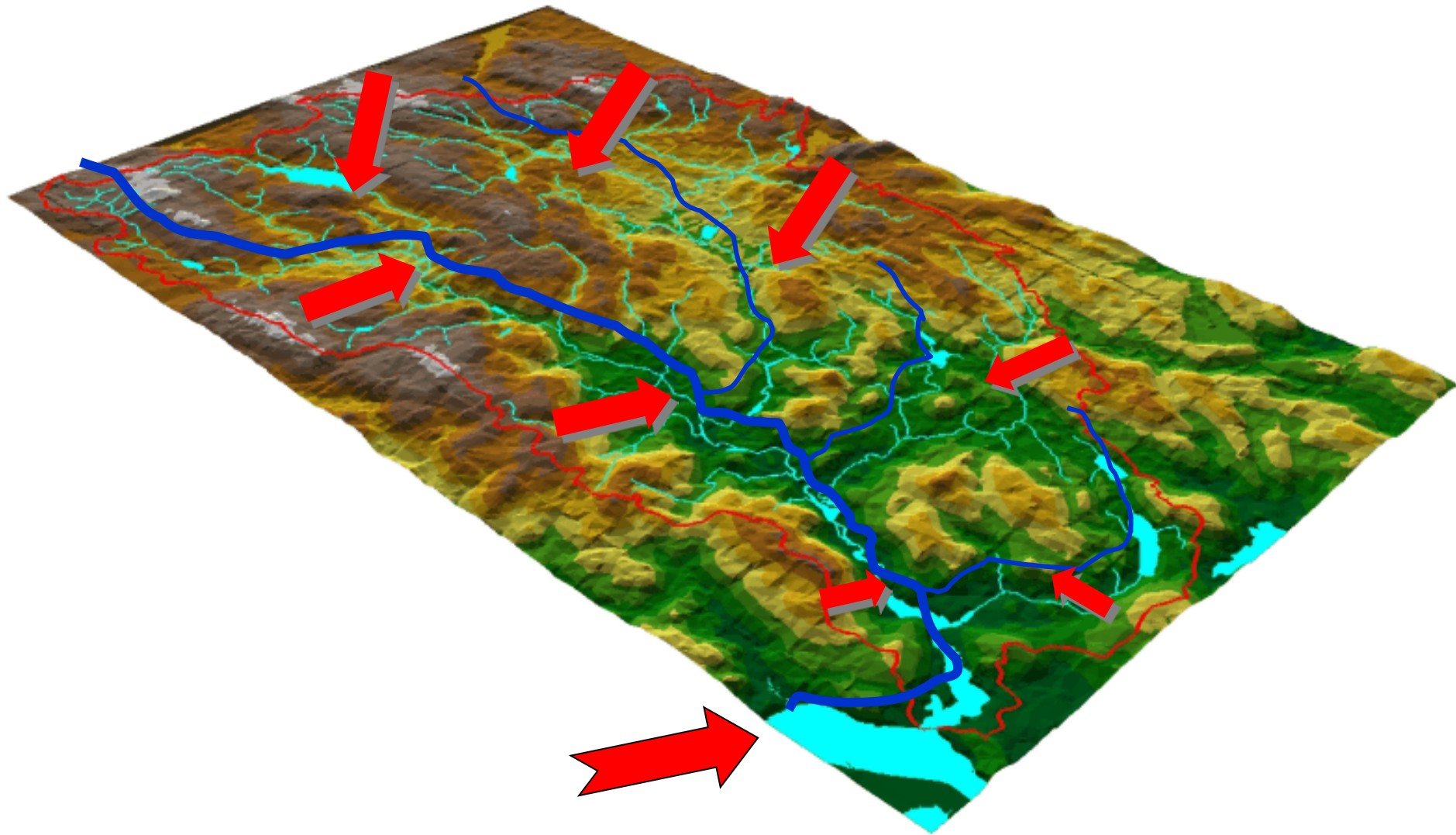
Watershed Assessment: Initial Findings

WQ Summary

Stream Assessment

Bacterial Source Assessment

What is a “watershed”?

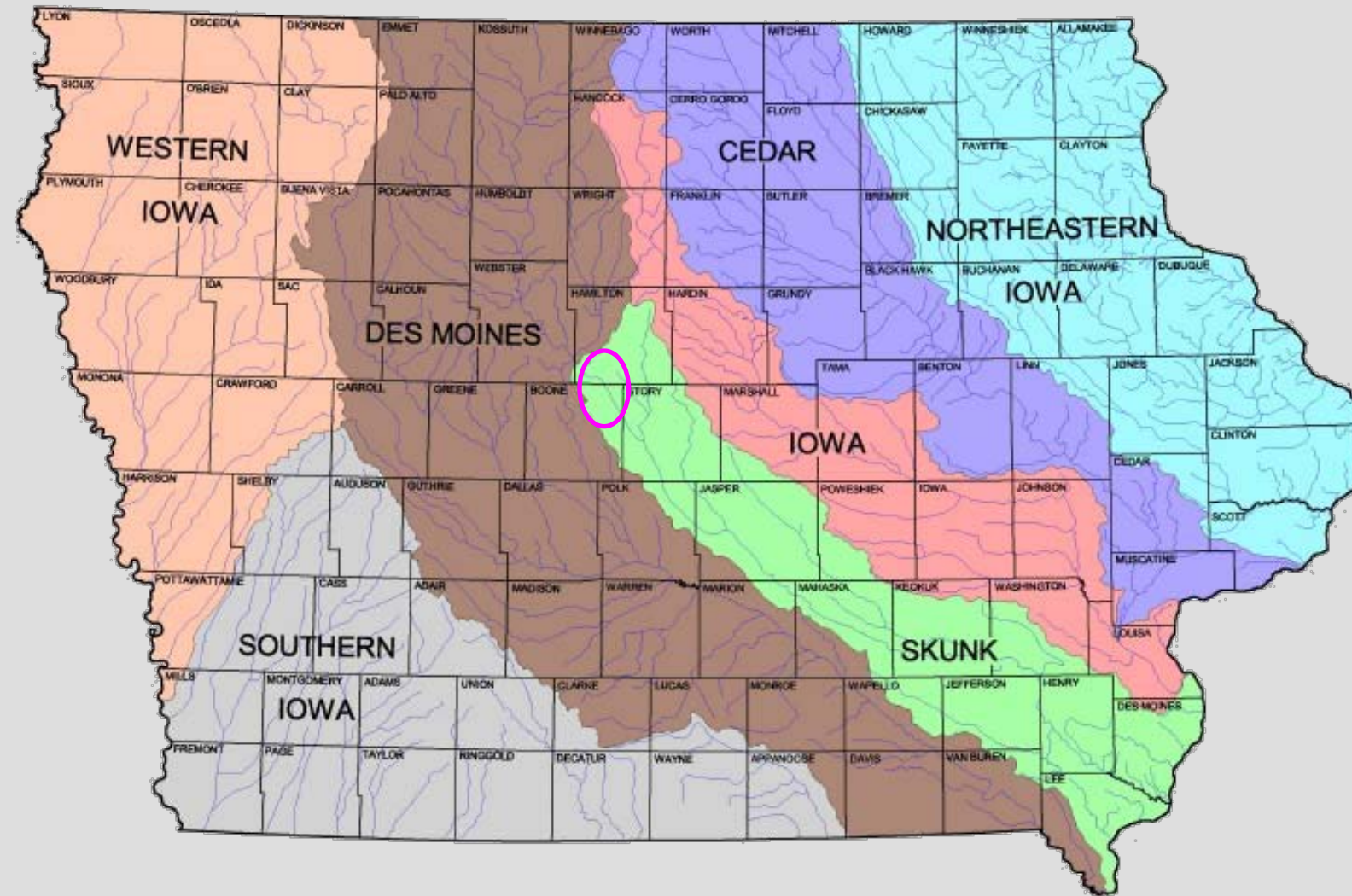


Upper Mississippi River



This map is not to scale.

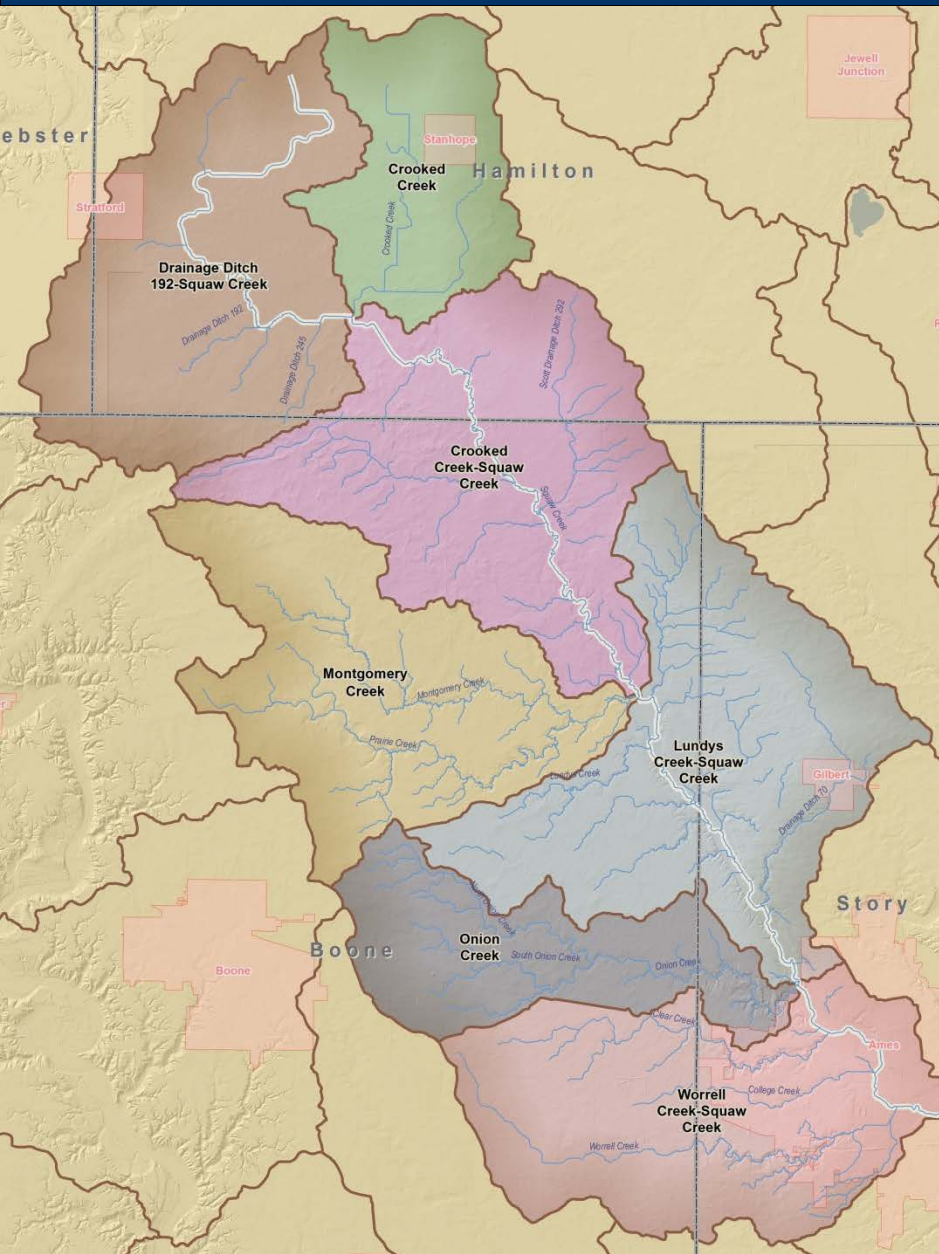
Skunk River



Upper Skunk Creek



Squaw Creek Subwatersheds





Primary Issue Areas

Water Quality

Water Quantity

Recreation & Aesthetics

Wildlife/Ecological Integrity

Related Issues

Management Approaches



Clean Water Act

Designated uses,

Pollutants

TMDLs

Gulf of Mexico Dead Zone

Iowa Nutrient Reduction Strategy



Drainage / Connectivity

Drain tiles

Stormsewer

Flooding

Streambank stability

Erosion



User Surveys

Kayaking, Canoeing

Wading - contact

Fisheries

Walking/Biking Corridors



Habitat

Wildlife / Bird Viewing

Aesthetics



Groundwater Recharge

Aquifer Pollution

Climate Change

Monitoring

**Contaminants of Emerging
Concern**

Funding Mechanisms

Education / Outreach

Socio-Economic



Urbanized Areas

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

Agricultural Areas

In-Field
Edge of Field
Land Use Changes



Regulation

**Capital Improvement
Expenditures**

Stewardship



MN Watershed Districts

Regulation, Taxing Authority

Iowa-Cedar

Interagency Coordination

Yahara Pride Farms

Stewardship/Certification

Watershed Assessment: Initial Findings



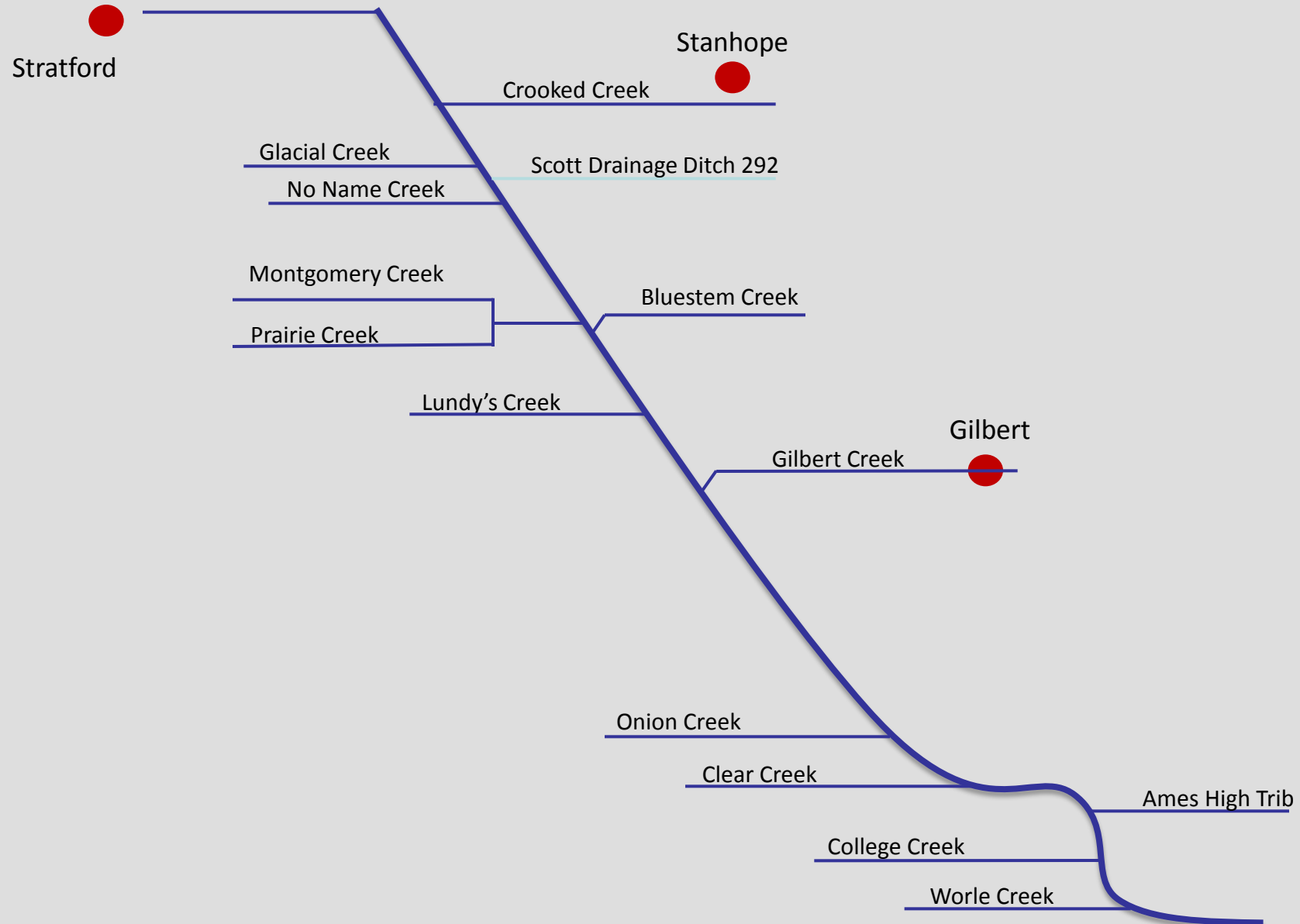
Water Quality Summary

Stream Assessment

Bacteria Source Inventory

Watershed Modeling

Watershed Stream Network



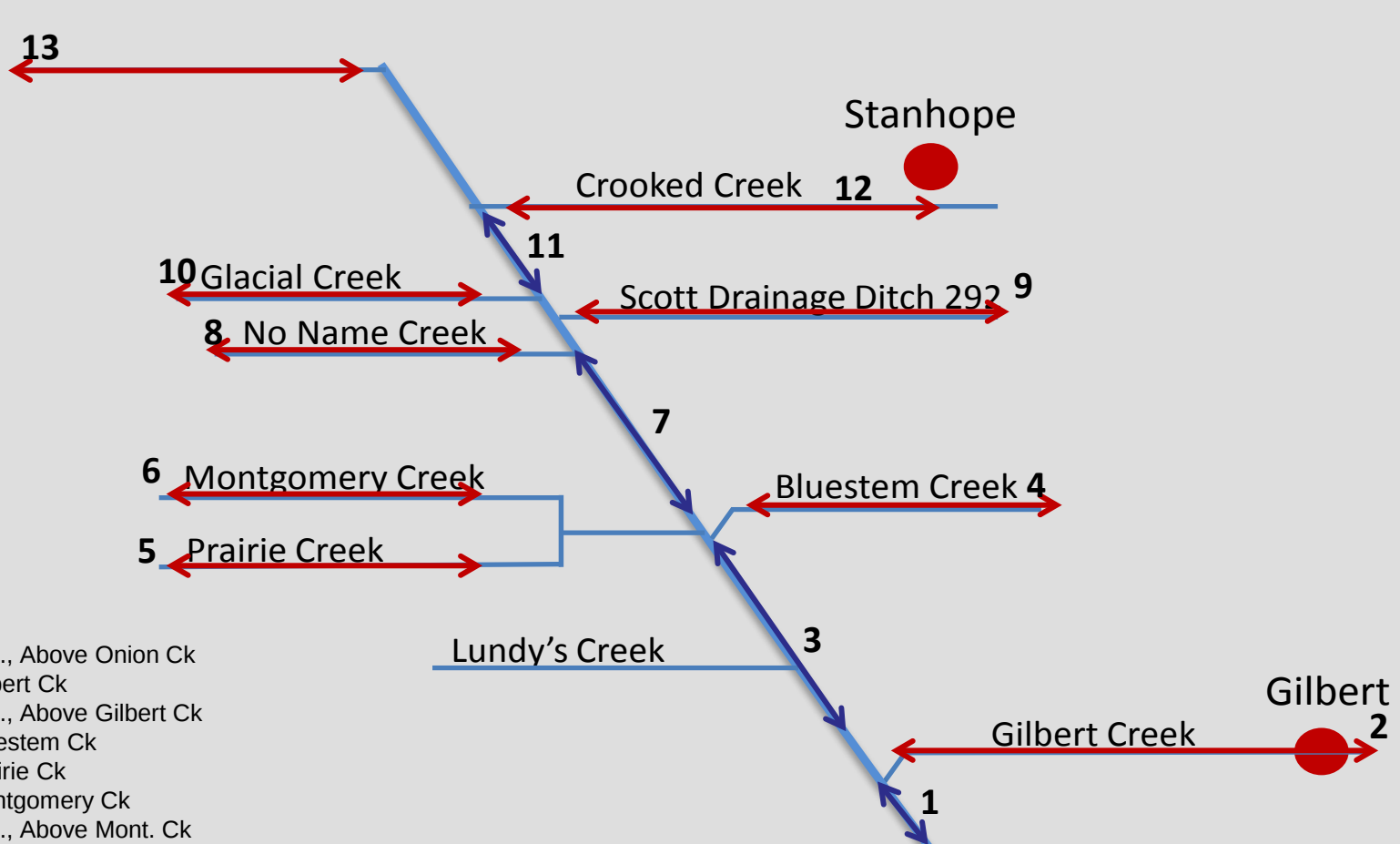
Upper Squaw Reaches

Stratford

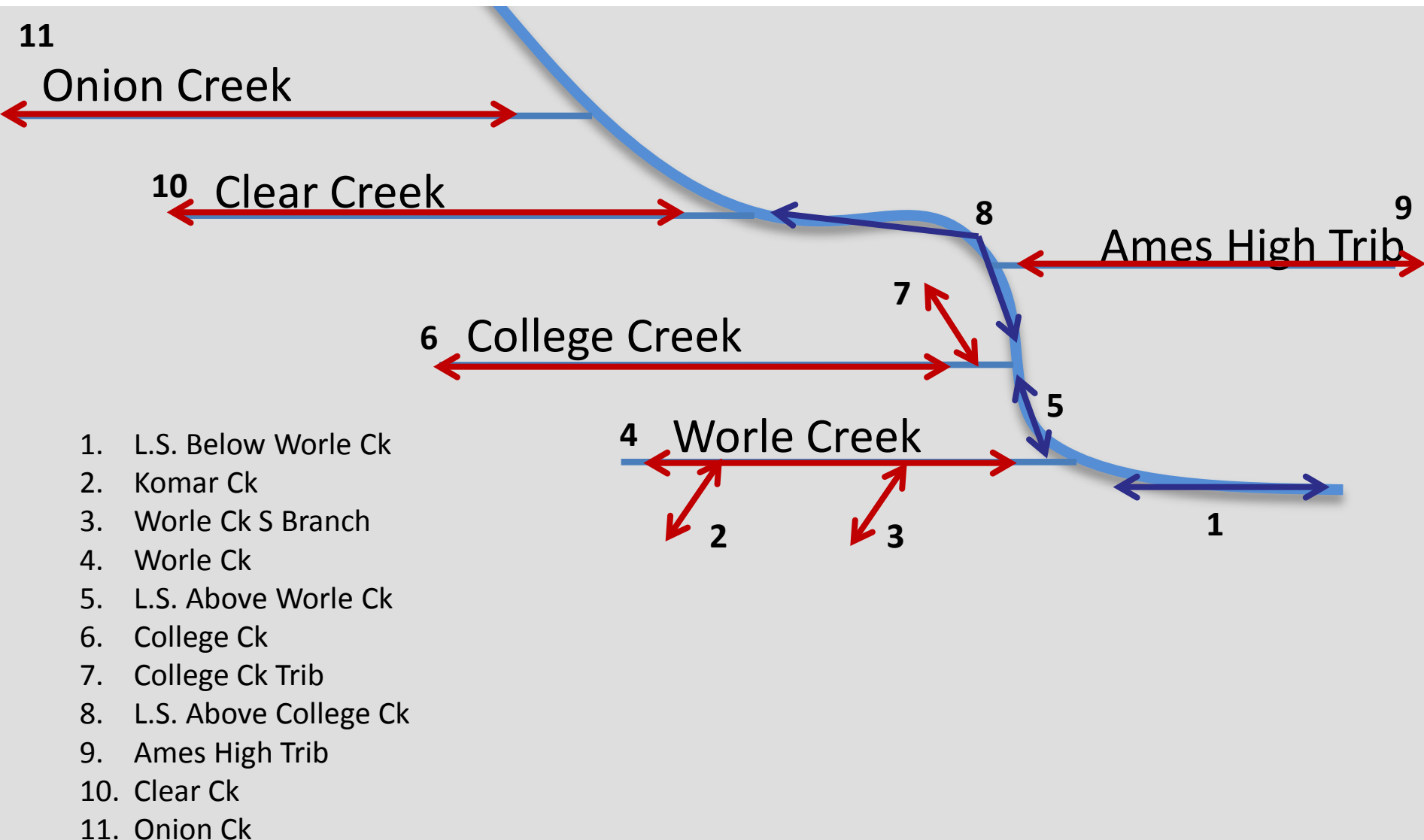
Stanhope

Gilbert

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



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

	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%

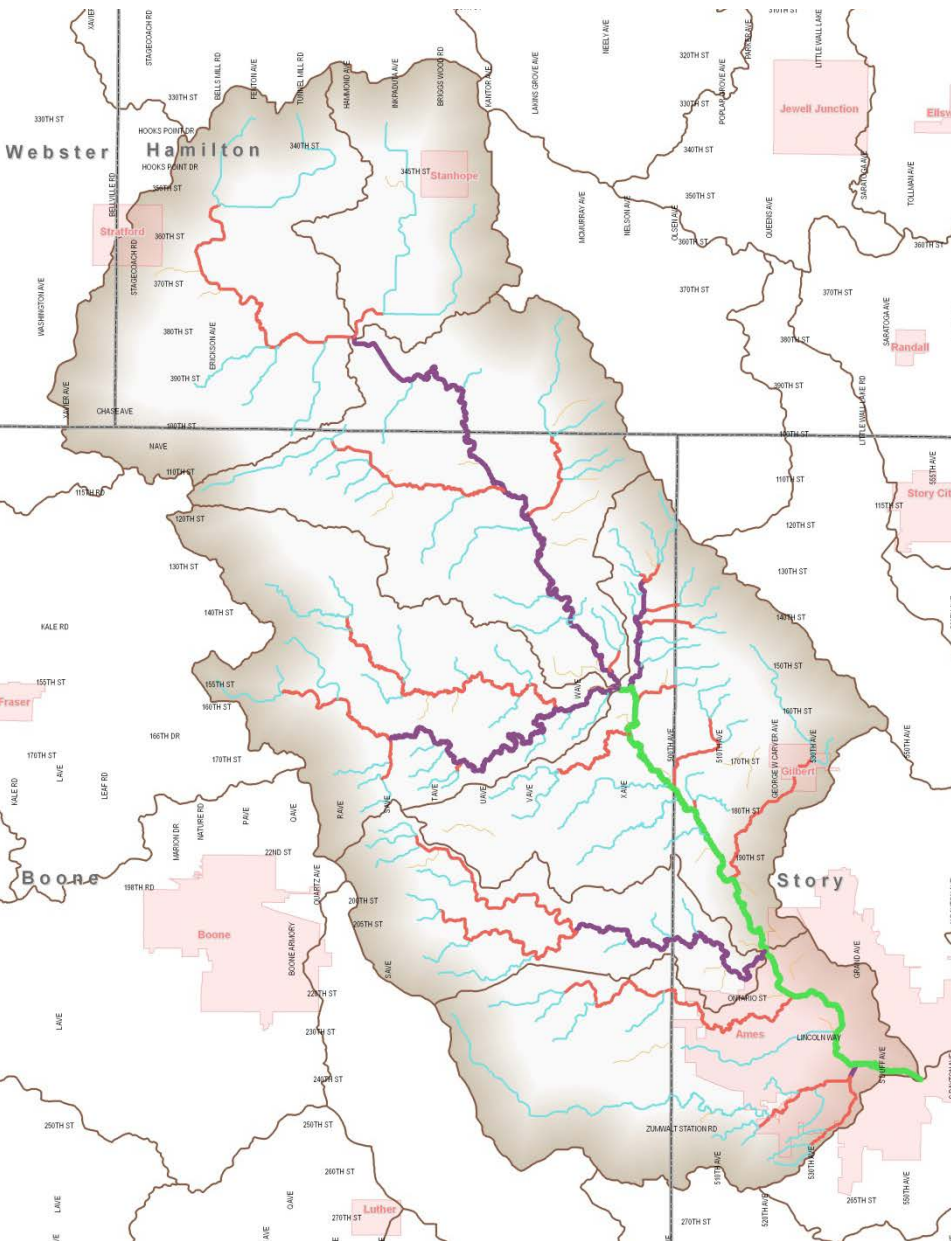
E. coli – All Sites

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

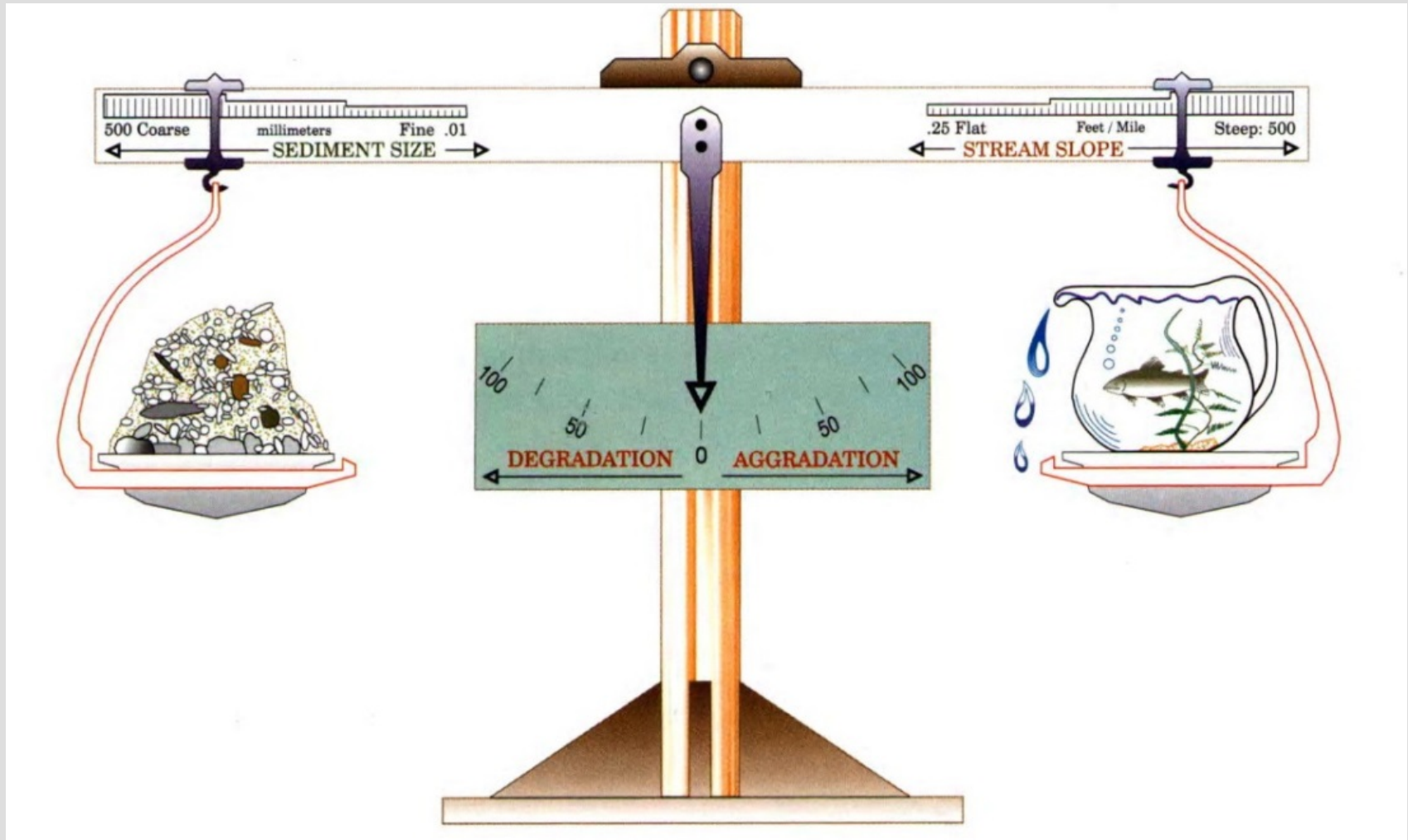
	DO (mg/L)
Standard (Min for at least 16 hours of every 24-hour period)	5
Squaw Creek (Downstream of Glacial to mouth)	9.2
Upper Squaw Creek (source to Onion)	9.7
Lower Squaw Creek (Onion to Mouth)	9
Worle Creek	9.9
Squaw Creek (Glacial Creek to Headwaters)	9.6
Glacial Creek	9.4
North Onion Creek	10
South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

Stream Assessment



Health

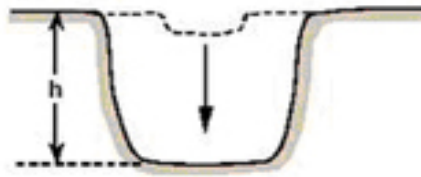
The integrity of surface waters can be affected by actions on the landscape that are directly adjacent to the waterbody, or at the farthest-most up-gradient point in a watershed



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

Stream Assessment

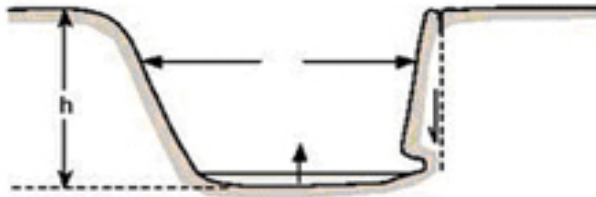
Stage I
Stable channel
Initial incision
 $h < h_{crit}$



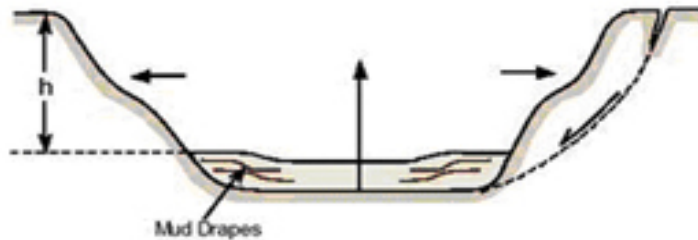
Stage II
Bed degrading
Banks stable
 $h > h_{crit}$



Stage III
Bed aggrading
Banks unstable
 $h > h_{crit}$



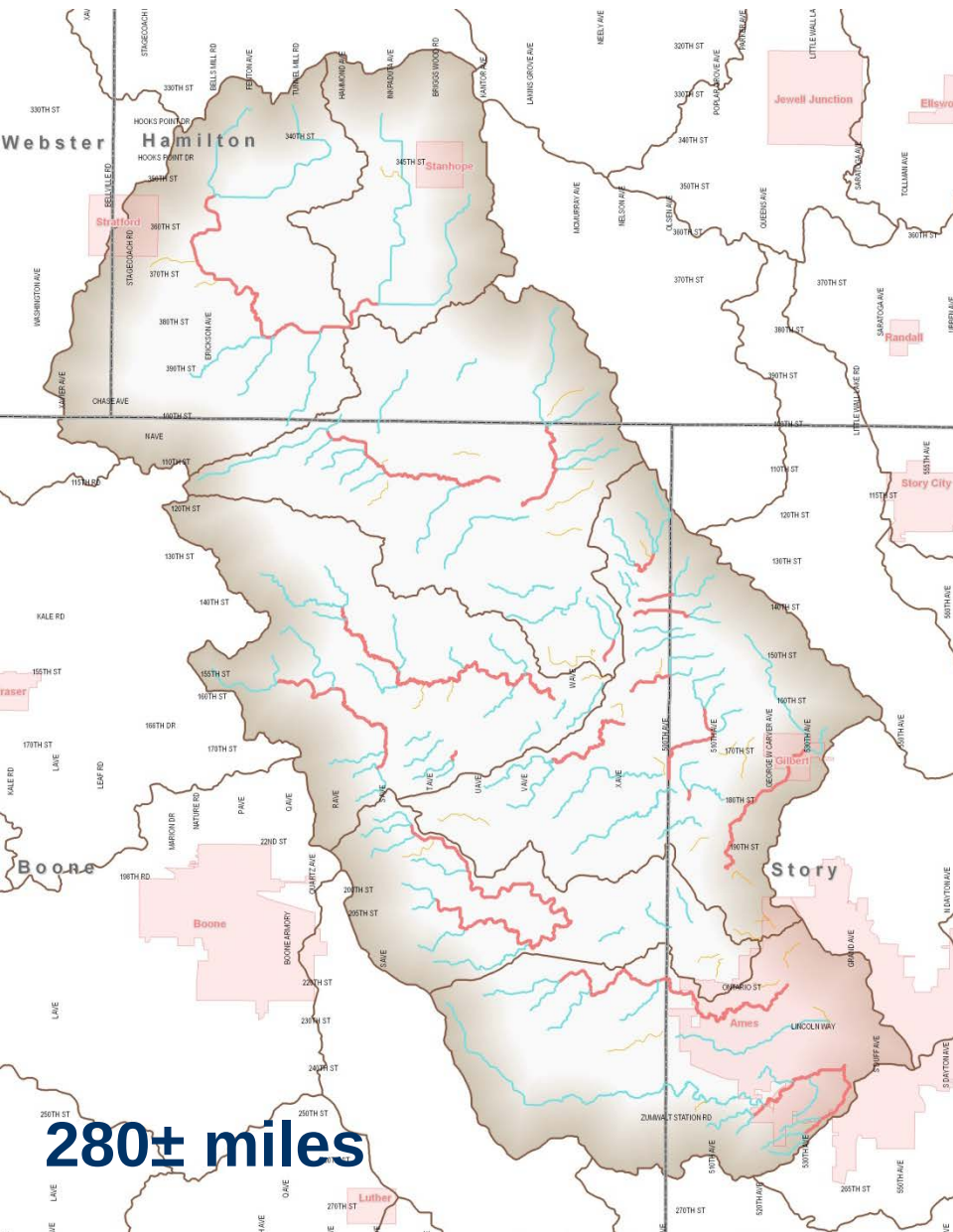
Stage IV
Bed aggrading
Banks unstable
 $h \approx h_{crit}$



Stage V
Slow aggradation
Banks stable
 $h < h_{crit}$



Stream Assessment



Tributaries: direct stresses

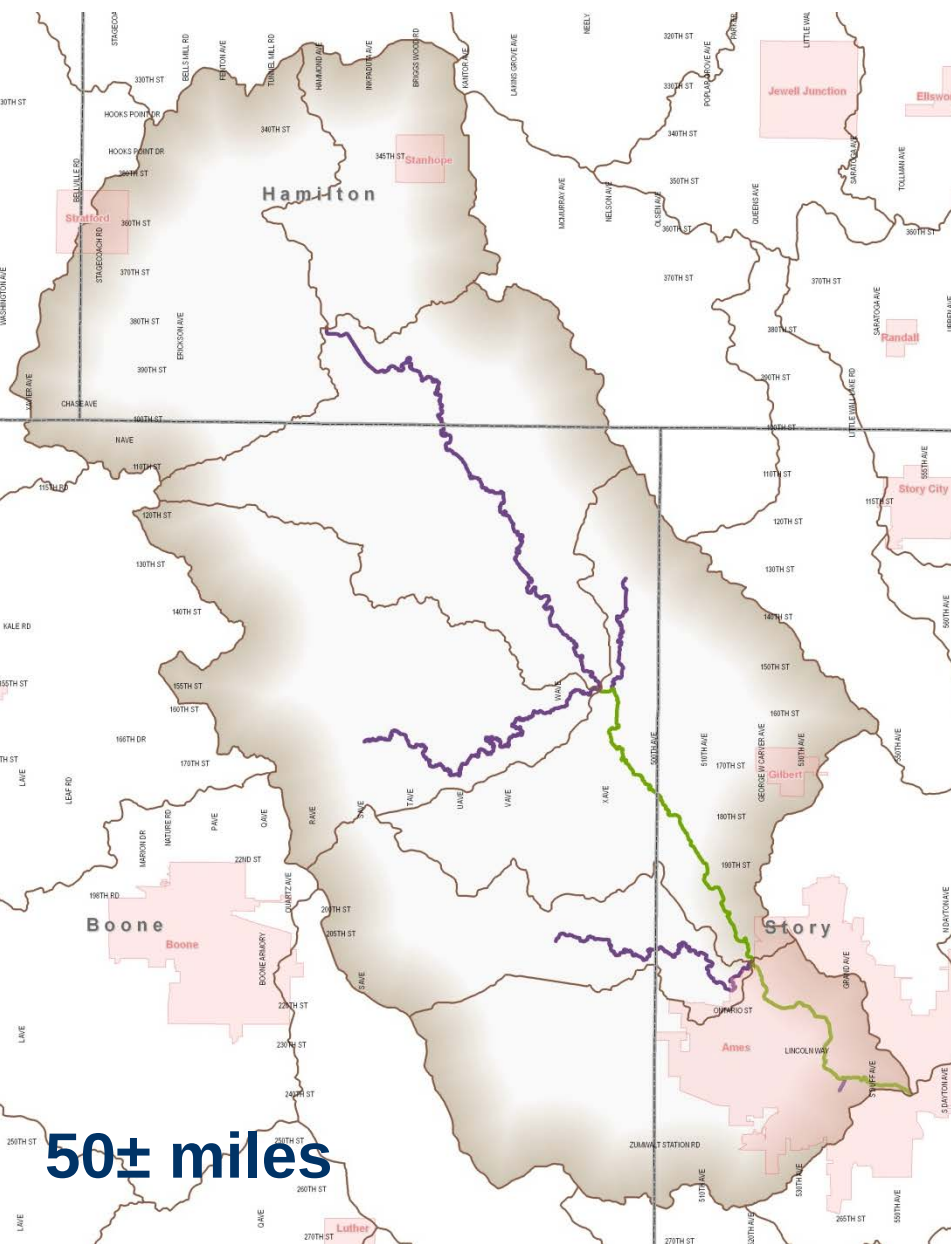
Stream Channel

- Straigtened (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**



Resulting Condition

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



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.



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

