



# A Framework for Progress on “Altered Hydrology”: Getting to Solutions

Iowa Ag Water Alliance | December 22, 2016

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## OUR DISCUSSION



- **Hydrologic Alteration** as an emerging issue
- **Context** relative to the Clean Water Act
- Need for a **science-based** framework
- Illustration of a **science-based framework**
- **Vision** for success

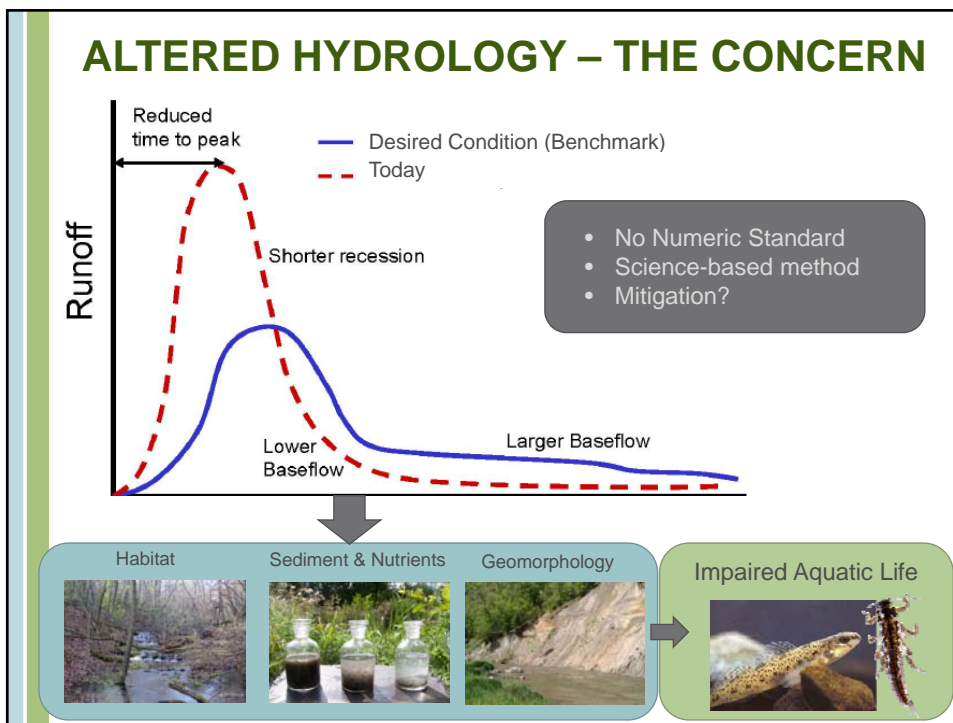
# EMERGENCE OF HYDROLOGIC ALTERATION



("Altered Hydrology")





## ANOTHER PERSPECTIVE

— 1980-2010  
 - - - 1945-1975

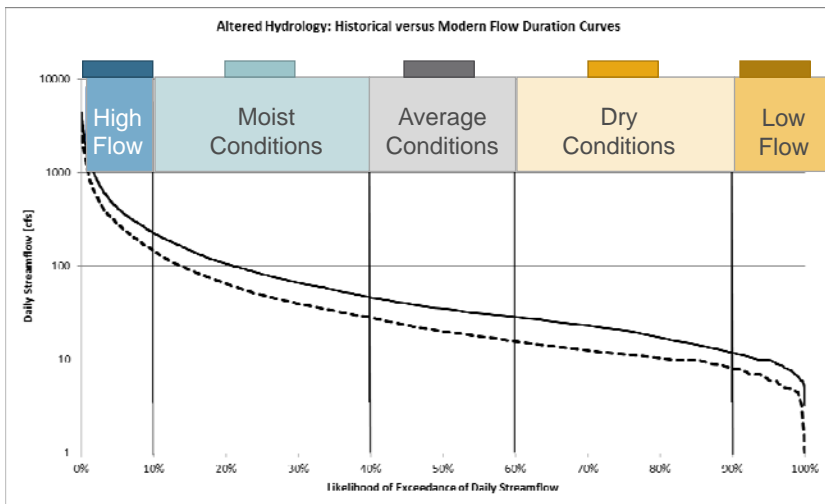
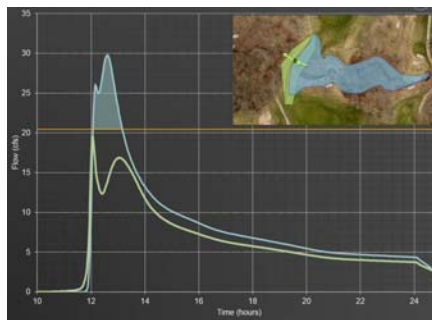
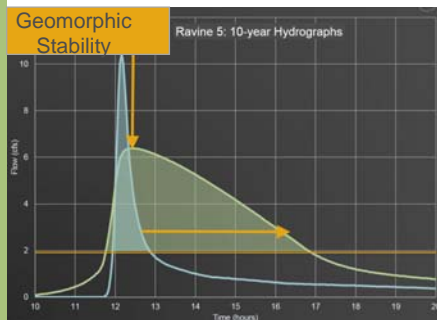
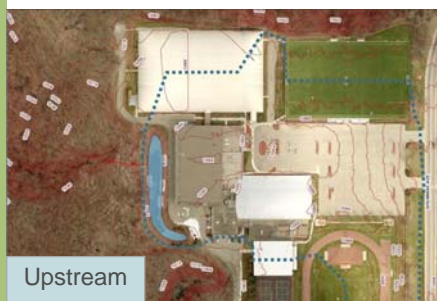
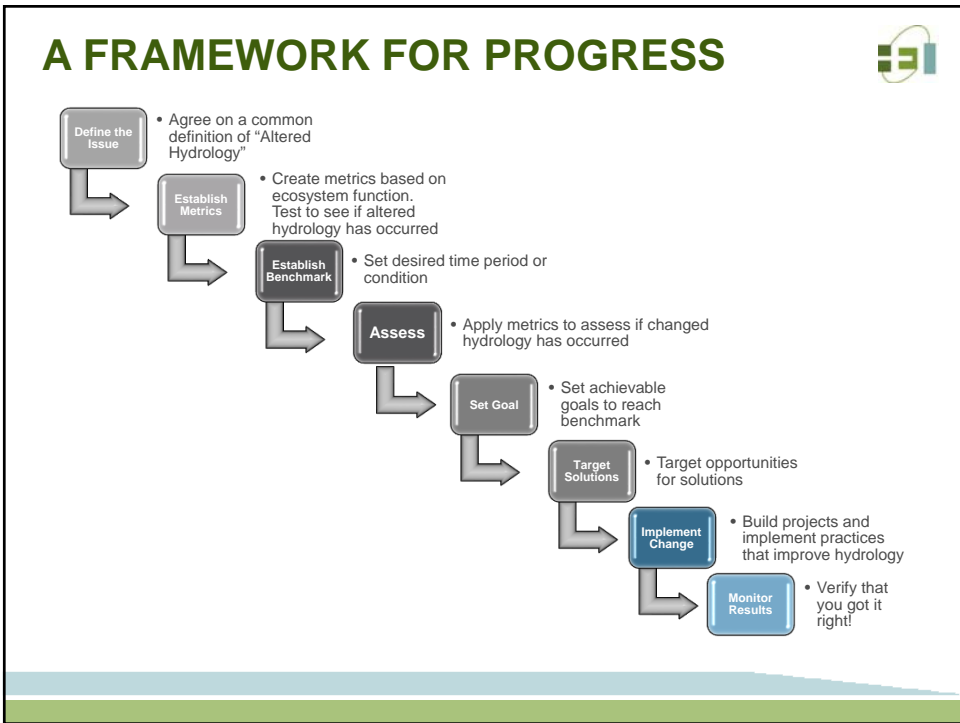
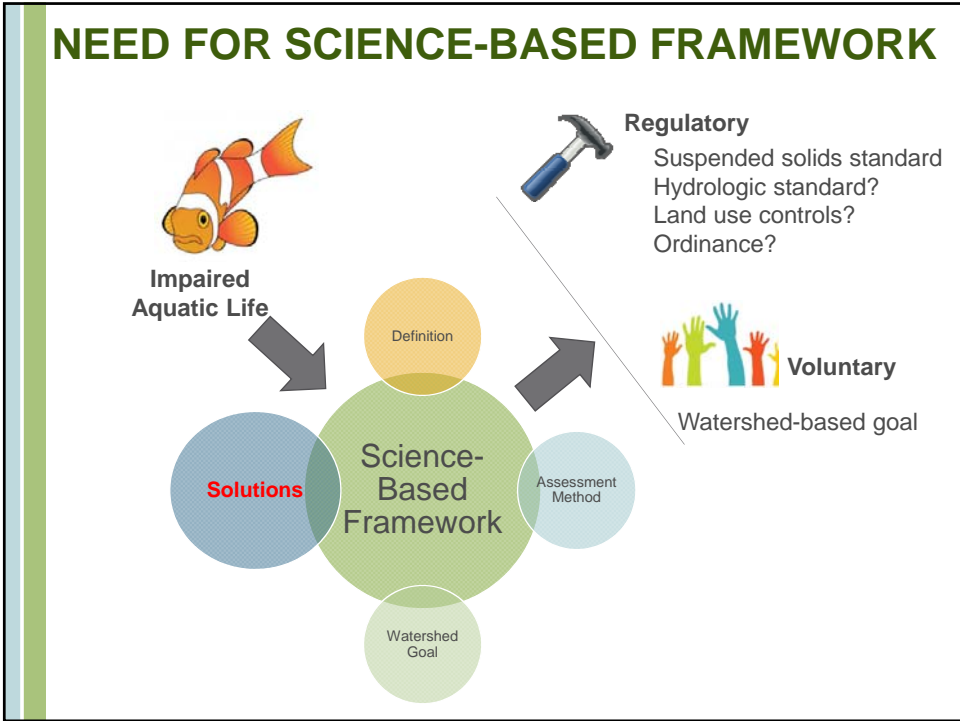


Figure 1. Flow duration curve for the Sand Hill River at Climax, Minnesota.

Note the increase in daily mean discharge since 1980!

## SHATTUCK: A CASE HISTORY





## A FRAMEWORK FOR PROGRESS

### Altered Hydrology


**Scientific Definition:**  
A *discernable* change in specific metrics derived from stream discharge, occurring through an entire annual hydrologic cycle compared to a benchmark condition, which exceed the measurement error.


**Practical Definition:**  
Change in the amount and timing of water throughout the year, which reaches a stream, river, or lake, compared to some previous time period.


## A FRAMEWORK FOR PROGRESS

Stream Flow  $m^3/s$   
Julian Day


## A FRAMEWORK FOR PROGRESS






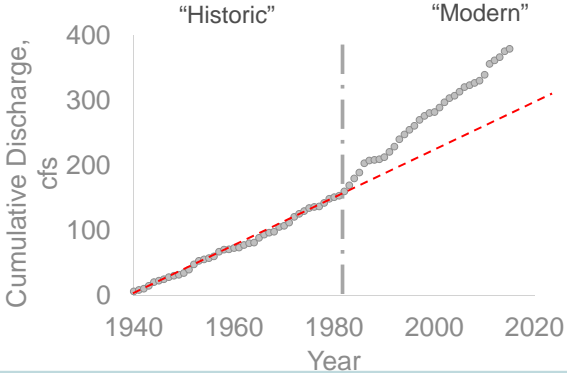
Relevance	Hydrograph Feature	Frequency	Duration	Metric	Ecological or Geomorphic Endpoint
<b>Condition of Aquatic Habitat</b> 	<b>Baseflow</b>	10-year	30-day	<ul style="list-style-type: none"> <li>Accurately measure streamflow discharge</li> <li>Accurate within 10% of true value.</li> <li>Some additional error from conversion of data to discharge.</li> <li>Minimum of 15% needed between "historic" and "modern" period.</li> </ul>	<b>Discharge= water flow for fish and aquatic life</b>
		Annual	30-day median		

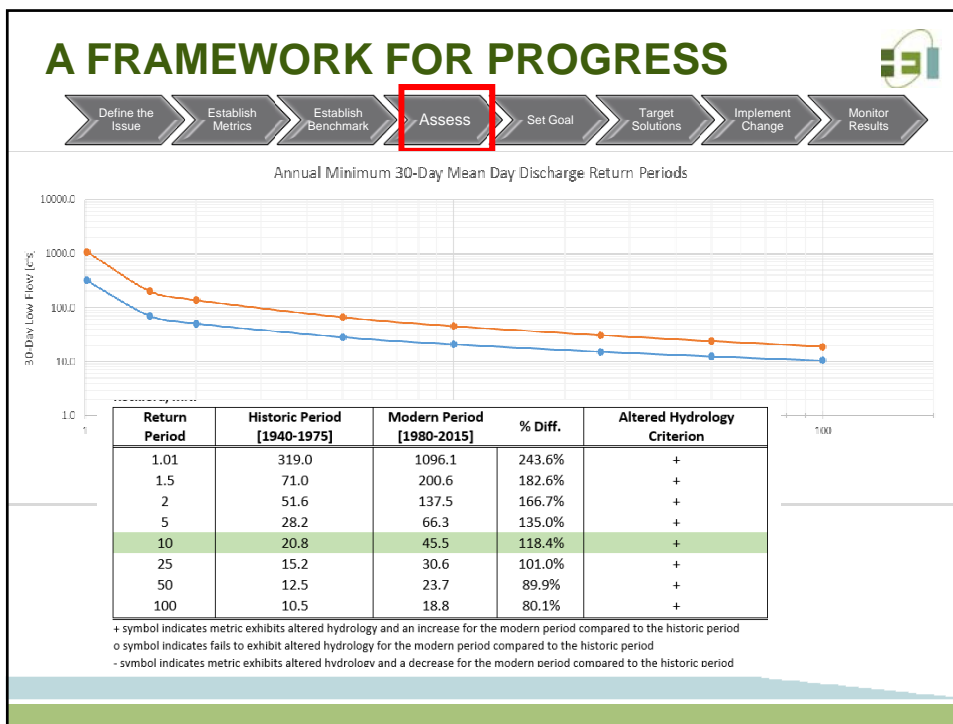
## A FRAMEWORK FOR PROGRESS





- **Benchmark** = *desired hydrologic condition*
- **Method** = *establish periods that represent "benchmark" and "altered" conditions*





## A FRAMEWORK FOR PROGRESS

Group	Metric	% Difference	Altered Hydrology Metric	Evidence of Altered Hydrology for Group
 Aquatic Habitat	• 10-year, 30-day Discharge	118.4%	+	<b>YES (Increase)</b>
	• 10-year, 7-day Discharge	121.6%	+	
	• Median November Flow	329.8%	+	
 Aquatic Organism Life Cycle	• Magnitude of Monthly Runoff	77.2%-207.8%	+	<b>MAYBE (Increase)</b>
	• Distribution of Monthly Runoff	-30.7%-71.5%	o	
	• Timing Annual Peak Discharge	10.7%	+	
	• Timing Annual Minimum Discharge	4.5%	o	

## A FRAMEWORK FOR PROGRESS



### Summary of altered hydrology metrics:

Category		Number (% of total)
Number of metrics used		20
Number of <b>positive</b> metrics exceeding altered hydrology criteria	+	12 (60%)
Number of <b>neutral</b> metrics	=	3 (15%)
Number of <b>negative</b> metrics exceeding altered hydrology criteria	-	5 (25%)
Number of metrics <b>exceeding</b> altered hydrology criteria	>	17 (85%)

## A FRAMEWORK FOR PROGRESS



Table 14. Estimated storage goal for the Crow watershed upstream of Rockford, MN using method 3.

Return Period (Years)	Change in flow (Q <sub>m</sub> -Q <sub>n</sub> ) (cfs)	Probability of Occurrence	Change in flow* Probability (cfs)	Probability weighted flow (AF/Day)	Change in the number of days above flow (days)	Storage Volume (AF)
1.5	1,498	0.67	1,004	1,991	28	55,757
2	1,834	0.5	917	1,819	17	30,928
5	1,722	0.2	344	683	0.2	137
10	819	0.1	82	162	0	0
					<b>Total Volume Goal</b>	<b>96,469 AF 0.69 inches</b>



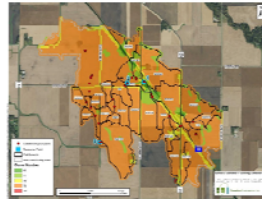
## A FRAMEWORK FOR PROGRESS



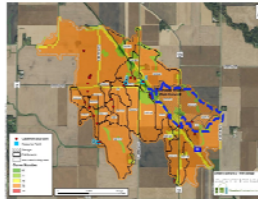
- Use technology to target opportunities for solutions

With BMP Implementation

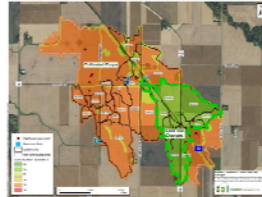
Scenario 1 - Existing Condition



Scenario 2 - with 32 ac-ft Pond



Scenario 3 - Cultivated Crops to Forest



Scenario 4 - C. crops to forest & 32 ac-ft Pond

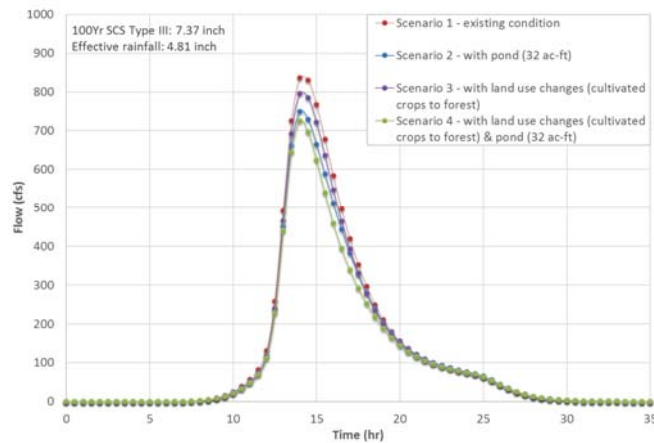


## A FRAMEWORK FOR PROGRESS



- Use technology to target opportunities for solutions

Simulated Hydrographs for Resource Point 3 - Scenarios 1 - 4

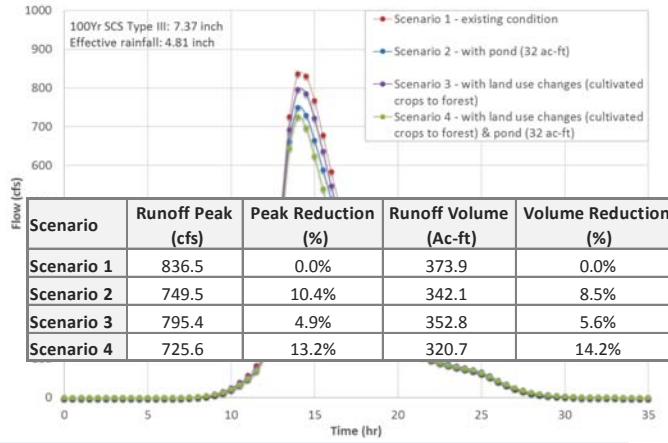


## A FRAMEWORK FOR PROGRESS



- Use technology to target opportunities for solutions

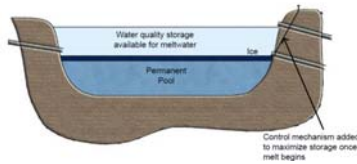
Simulated Hydrographs for Resource Point 3 - Scenarios 1 - 4



## A FRAMEWORK FOR PROGRESS





- Most important steps!!!!





## IMPLEMENTATION APPROACH

- Cost-share approach
- Use cash flow analysis to identify private land conservation opportunities
- Tillage management to encourage increasing organic matter content
- Cost-share storage practices at \$-per-acre-foot

## NEXT STEPS



- Framework is rolling out in Minnesota –  
**North Fork Crow One Watershed, One Plan**
- **2017:**  
Will likely be piloting in other watersheds