Assessment of the Functional Capacity of Wetlands within the Coon Creek Watershed

Tim Kelly & Justin Hawley March

Goals

1. To assess wetland functional capacity within the watershed

2. To use a tool based on HGM classification where time and cost prohibit establishing reference wetlands.

Objectives

1. To augment field determinations
2. Functional Indices serve to identify level of function provided (High, Medium, Low)
3. To compare other wetlands in same HGM class
4. Impacts to functions can be reevaluated under impact scenarios of variable conditions
5. Mitigation goals can be defined by examining the combination of conditions that yield a high functional index

Approach

The approach for assessing wetland functional capacity draws from Magee, D.W. & G.G. Hollands. 1998. <u>A Rapid Procedure for Assessing Wetland Functional Capacity based on Hydrogeomorphic (HGM) Classification</u>. Normandeau Associates Incorp. ENSR. This approach was selected in part because it was developed specifically to assess functional capacity in the glaciated northeast and Midwest (p. 11). It was also selected because of its ability to analyze functional capacity at multiple geographic scales and is therefore conducive to integration and consistency within and between programs.

Other advantages to this approach, as it applies to the Coon Creek Watershed were:
<u>Its portability</u>: the method can be used in any area accounted for in with the HGM classification (North America).
<u>Its Modularity</u>: More accurate data can easily be adapted into the inputs for greater localized assessment.

Process

1. Describe the Anoka Sand Plain/Anoka Lake Plain
2. Hydrogeomorphic Classes of Wetlands within the Watershed
3. Develop a List of Functions
4. Develop a Functional Profile for each HGM class
5. List Relevant & Appropriate Variable for Each Function
6. Document each Variable & Model Rationale
7. Use GIS Soils, NWI, Land Use, etc to apply model

8. Fine Tune Procedure

Definitions

Direct indicators of function Are variables which by themselves provide strong evidence that the potential functional capacity is high, obviating the need to further evaluating the wetland.

Functional capacity index (FCI) An index generated for each function, which indicates the potential degree (capacity) to which the wetland performs the function.

Indicators of Dysfunction Variables that obviate the need to further evaluate the wetland for a function.

Applications and Limitations of the Approach

This procedure is for use by trained wetland specialists who are competent and field experienced in discerning the landscape, soils, hydrology and plant identification and ecological indicators involving wetlands.

The functional indices generate by the models serve to identify the level of function provided by a given HGM classification based upon the magnitude of the score derived by the model. Comparison with other wetlands in the HGM class can be made based on the relationship between the functional index for the wetland being evaluated and the functional assessment data from other wetlands. Impacts to functions can be assessed by reevaluating the wetland under the impact scenario based on changes to less favorable variable conditions. Mitigation goals can be identified by examining the combination of variable conditions that yield high functional index; these variable conditions may serve as the design standards for a wetland restoration or creation.

Because of time and budget constraints, there was no opportunity to perform case studies on the reference wetland system within the watershed. As such, conditions and ranges were based on professional experience of Watershed and Conservation District staff and data from several thousand wetland delineations and assessments conducted between 1992 and 2010.

Use of Reference Wetland Data in Refining the Procedure

To refine this procedure, monitoring data from reference wetlands was used to verify or gain insight in to wetland processes and functions, and to clarify the variables and range of conditions which give rise to functional capacity.

In the past, most wetland assessment procedures have been based upon a combination of wetland functions and societal values, established by statutes which were written by legislators, environmentalists and informed lay persons (eg. MnRAM, WET & WEM). These earlier procedures have been based on existing literature and basic concepts of engineering, hydrology and ecology rather than upon research directed towards developing a reference data base in order to establish functions, variable and variable condition ranges. However, the Hydrogeomorphic Method (Brinson, 1993) is designed to be based on reference data and to transcend site and regional scales. The process for establishing and monitoring the reference wetlands within the around the Coon Creek watershed is best described in the Water Atlases published annually be the Anoka Conservation District.

Description of the Anoka Sand Plain/Anoka Lake Plain

The ecological setting of the watershed within the Anoka Sand Plain is addressed in detail in Appendix A (Tab 17, pages 2-6). To address ecosystem hierarchy we will use the National Framework of Ecological Units based on terms defined by Bailey (1995). The Ecological Classification System (ECS) is a method to identify, describe and map units of land with different capabilities to support natural resources. This is done by integrating climatic, geologic, hydrologic, topographic, soil and vegetation data.

ECS divides the landscape into a series of ecosystems that are nestled within one another in a hierarchy of spatial sizes. In Minnesota, the classification and mapping is divided into six levels of detail. These levels are:

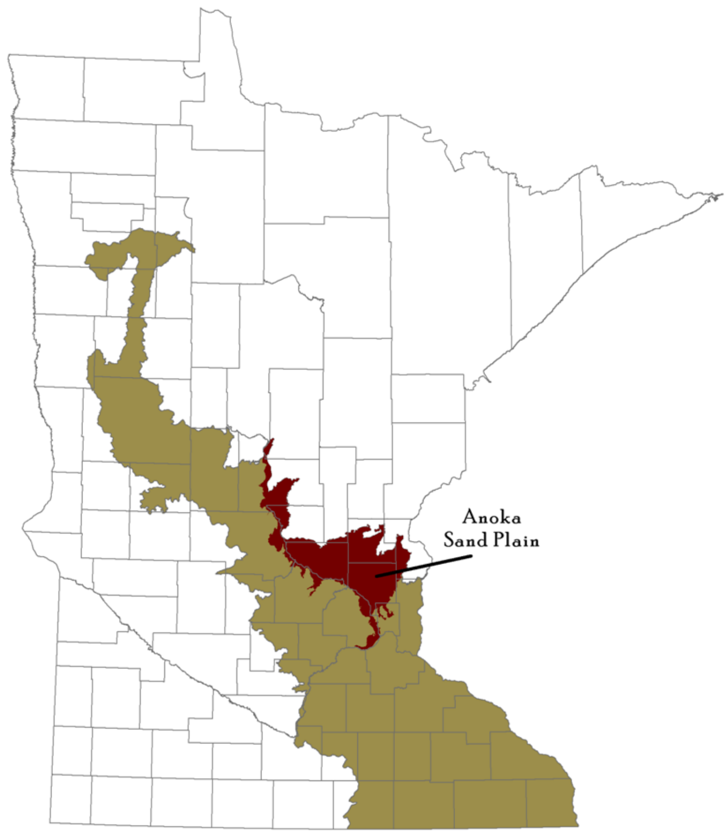
Level	Name
Province	Midwest Broadleaf Forest
Section	Minnesota and NE Iowa Moraine
Subsection	Anoka Sand Plain
Land type association	Anoka Lake Plain
Land types	Glacial Lake Hugo Lake Plain Glacial Lake Fridley Lake Plain Mississippi Sand Plain

Subsection - Anoka Sand Plain

The Anoka Sand Plain is approximately 1,960 square miles in size. It is a sand outwash plain formed by the retreat of the Superior Lobe of the Grantsburg Sub-lobe of the Late Wisconsin glaciers.

Outwash plains consist mainly of sandy and coarsely textured material of glaciofluvial origin; generally smooth, and where pitted is of generally low topographic relief.

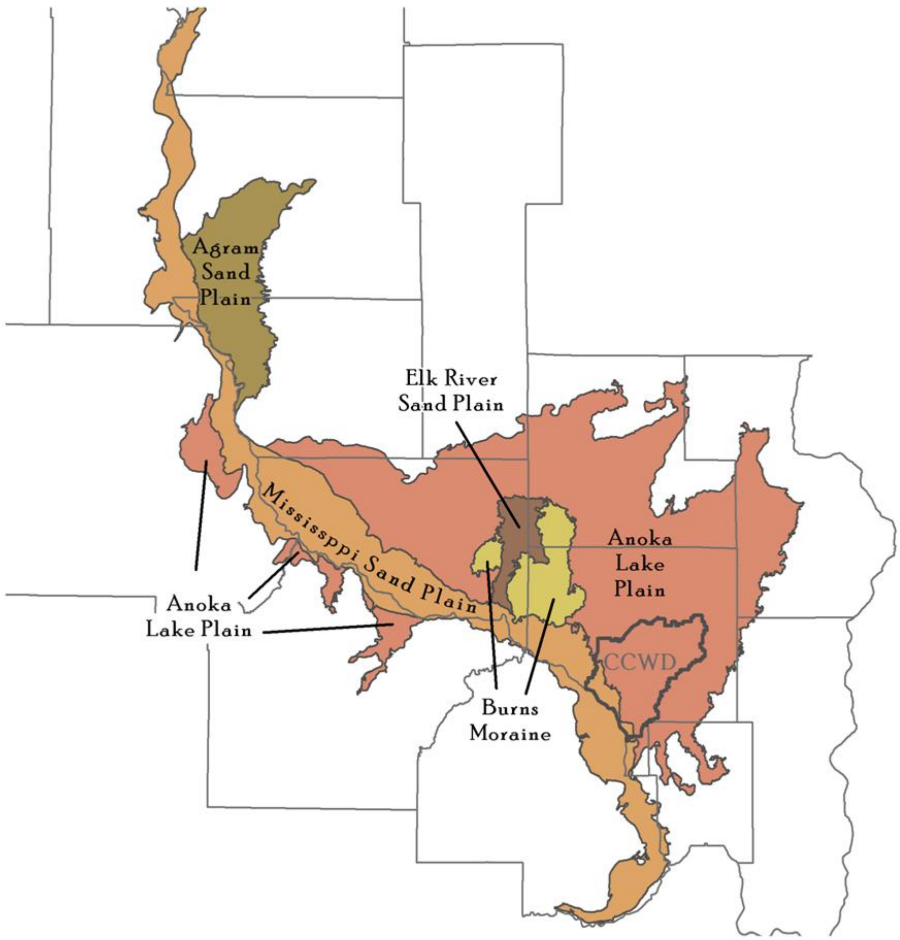
The Anoka Sand Plain consists of a flat, sandy lake plain along the Mississippi River.



Land Type Association: Anoka Lake Plain

Coon Creek Watershed is included in a portion of the Anoka Sand Plain known as the Anoka Lake Plain. The Anoka Lake Plain is a nearly level to gently rolling lake plain formed by melt water from the Grantsburg Sublobe. Some areas of the lake plain have been reworked by wind to form dunes.

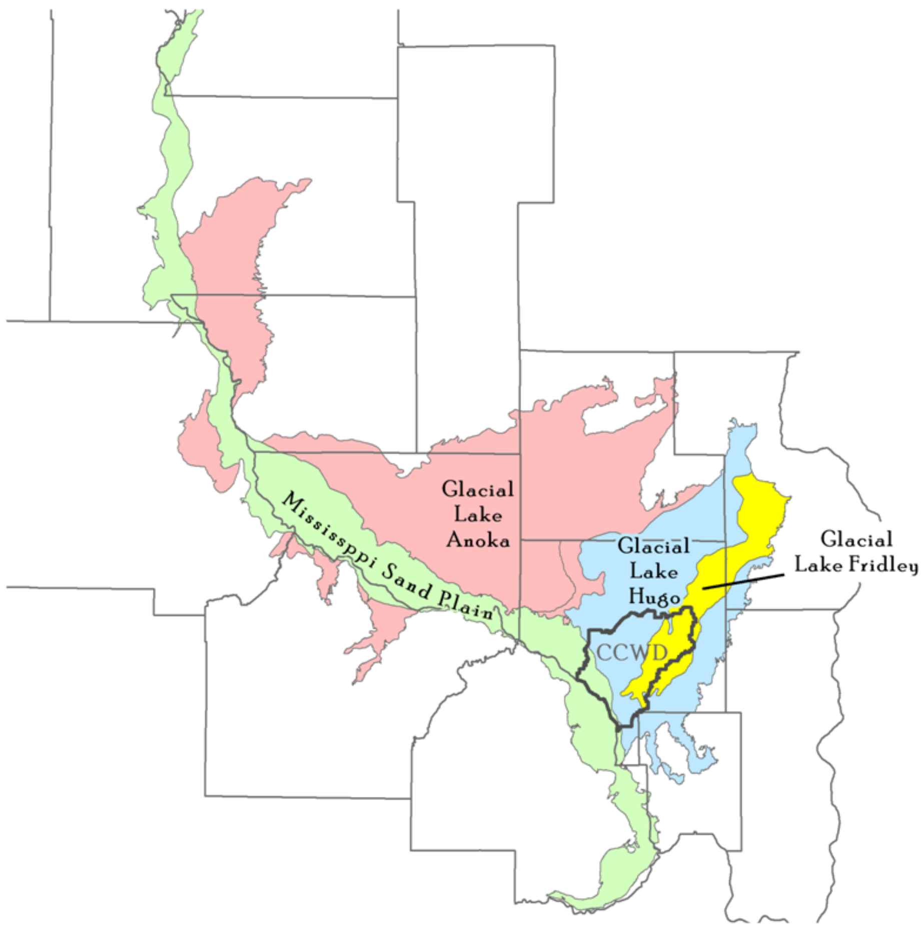
The soils are primarily fine sands with organic and loamy and hemic hydric soils in depressions. The regional water table is very shallow, usually less than 15 feet below the surface with much of it exposed in the form of wetlands, lakes and streams.



Land Types The basic character of the watershed landscape occurs in three geomorphic land types that contain distinctive landforms and landscape patterns (Glacial Lake Hugo, Glacial Lake Fridley and the Mississippi River Terrace).

Glacial Lakes Hugo & Fridley These land types were formed from glacial melt water as the Grantsburg sublobe melted between 16,000 and 13,000 years ago. The melt waters formed a large outwash and lake plain. The outwash plain is mainly sandy or coarsely textured material of glaciofluvial material. An outwash plain is commonly smooth, and where pitted or contains depressions, generally is low in relief. The lake deposited sands across much of eastern part of the Anoka Sand Plain (Meyer, 1993).

Mississippi Sand Plain A third land type, The Mississippi River Terraces provides a distinctive landscape formed by the Mississippi River. Here the erosion and down cutting created by the river is steep in some places in contrast to the smooth and flat landscape of the lake plains.



Hydrogeomorphic Classes of Wetlands within the Watershed

The descriptions below are based upon Brinson (1993). The classifications have three component parts:

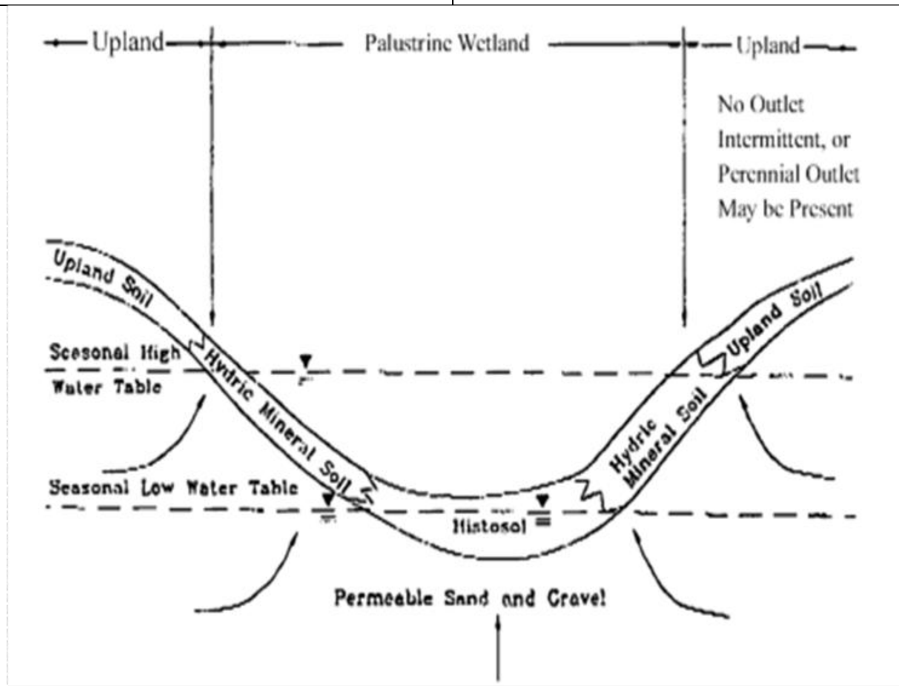
1. Geomorphic setting
2. Water Source
3. Transport and hydrodynamics

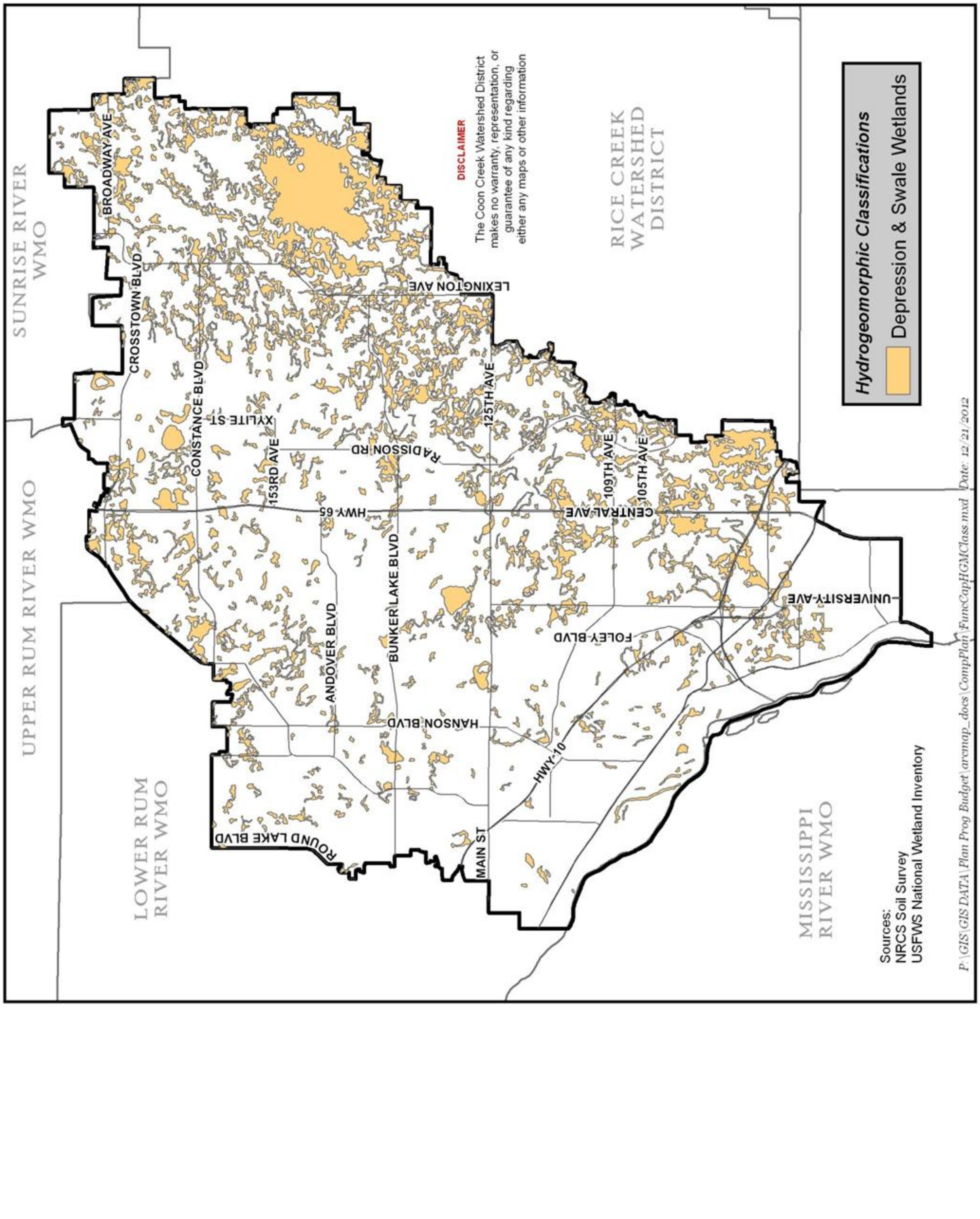
There are six Hydrogeomorphic classes of wetland within the Coon Creek watershed. They are:

1. Depression and Swale Wetlands
2. Lacustrine Fringe Wetlands
3. Floodplain/Riverine Wetlands
4. Flats
    a. Mineral Soil Flats
    b. Organic Soil Flats
    c. Slope Wetlands

Depression & Swale Wetlands

Characteristic	Description
Landscape Position	Depressions
Soils	Blomford Isan Isanti Marsh
Primary Water Source	Groundwater
Hydroperiod	Permanently flooded Seasonally flooded Semi-permanently flooded




Hydrogeomorphic Classifications
Depression & Swale Wetlands
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UNIVERSITY AVE
FOLEY BLVD
HANSON BLVD
HWY 10
ROUND LAKE BLVD
MAIN ST
Sources:
NRCS Soil Survey
USFWS National Wetland Inventory
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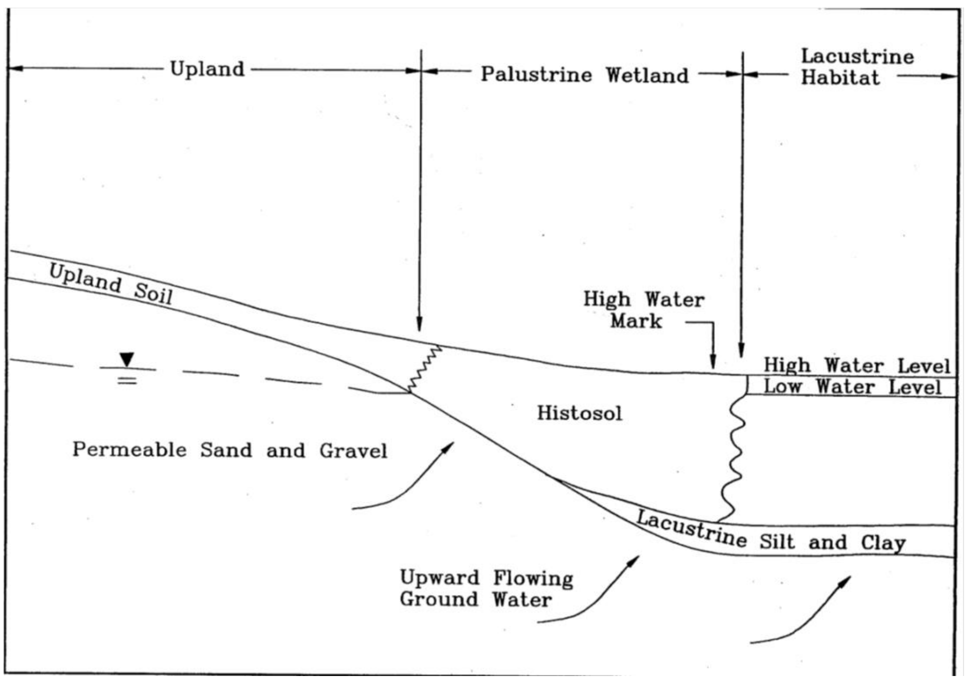
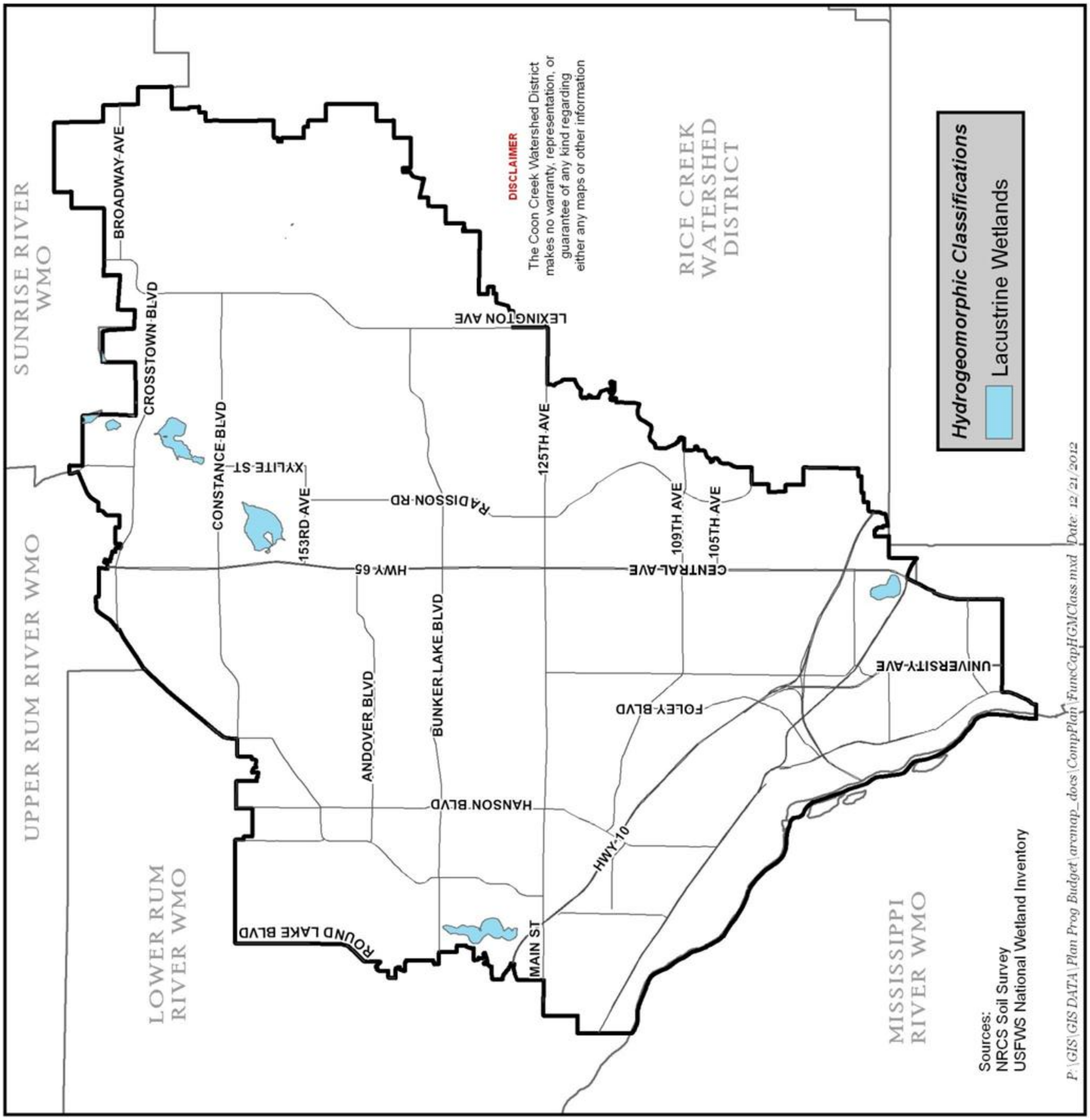
Lacustrine Wetlands

Characteristic	Description
Landscape Position	Lake Marsh Shrub Swamp Fringe
Soils	Unconsolidated Bottom Adjacent to Lakes
Primary Water Source	Lateral flow from Lake
Hydroperiod	Permanent Semi-Permanently Flooded





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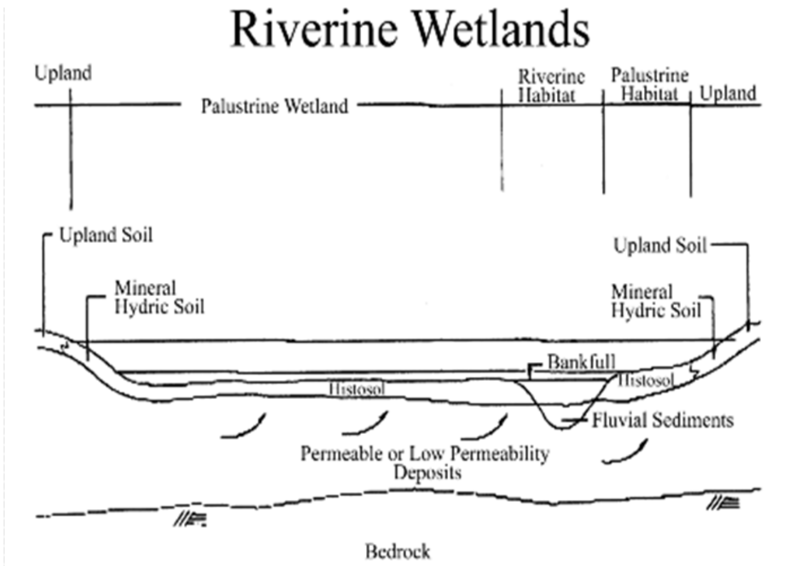
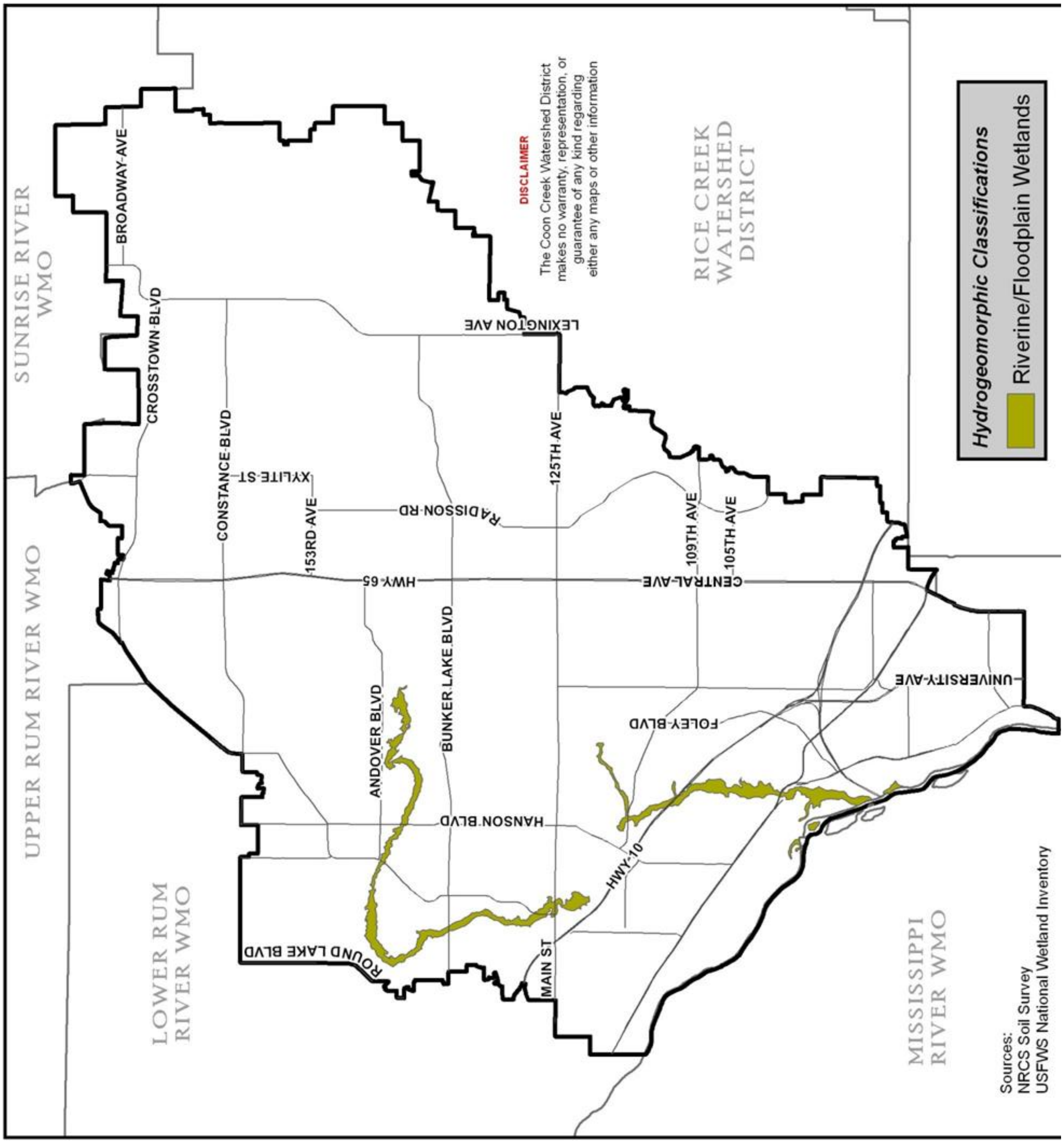
Riverine/ Floodplain Wetlands

Characteristic	Description
Landscape Position	Floodplains
Soils	Alluvial
Primary Water Source	Overbank Flow
Hydroperiod	Permanent Semi-Permanently Flooded




Hydrogeomorphic Classifications
Riverine/Floodplain Wetlands
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Sources:
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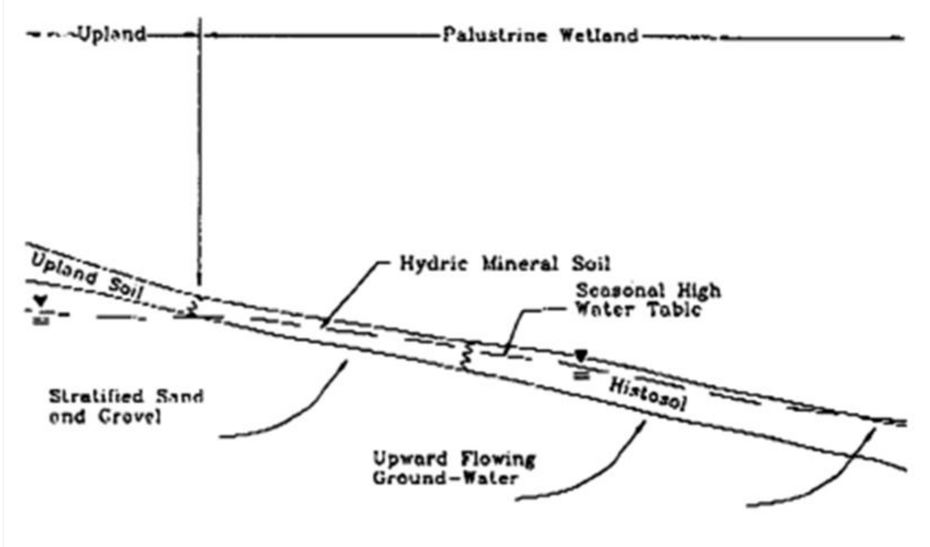
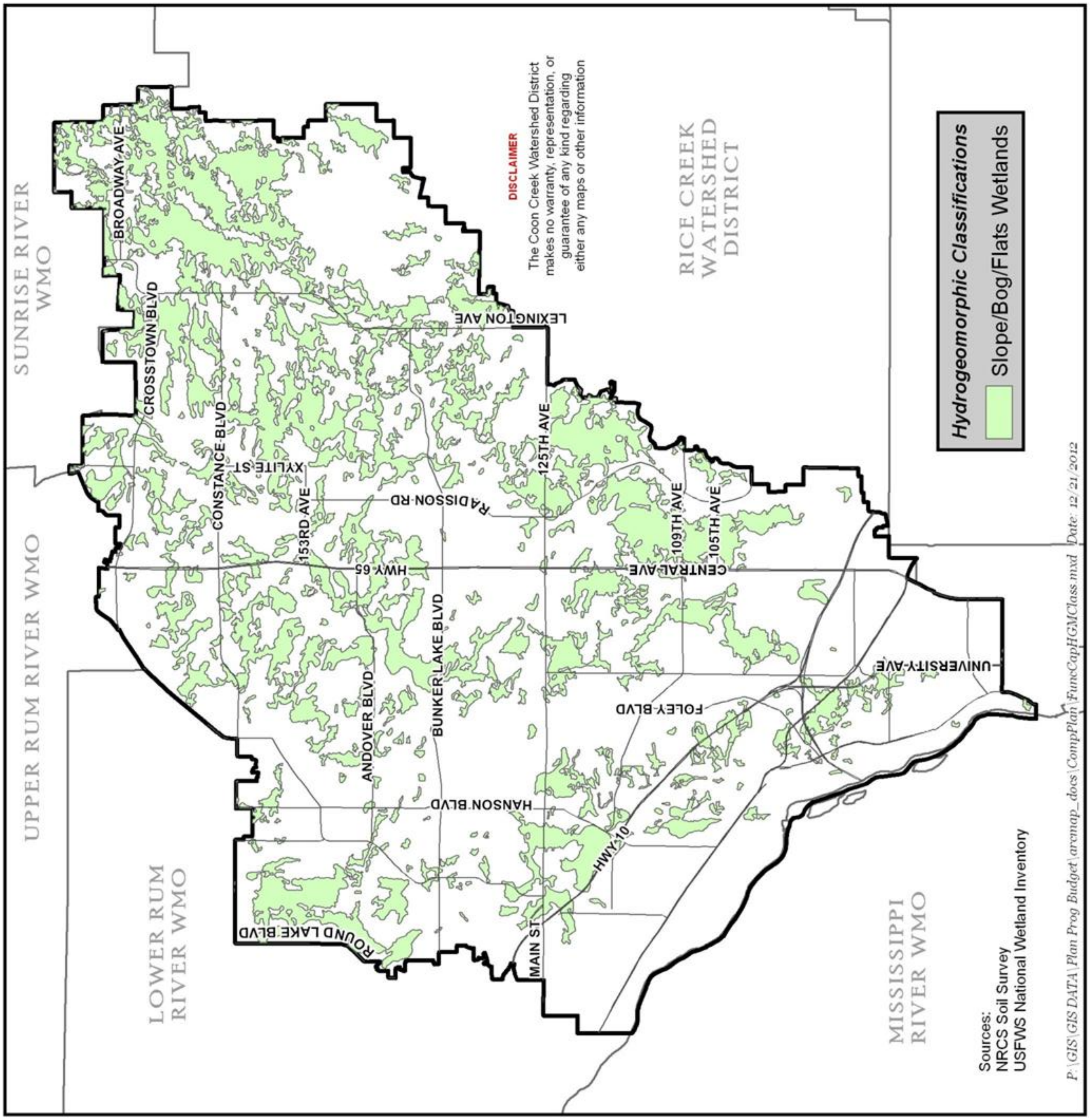
USFWS National Wetland Inventory

Slope/Bog/Flats Wetlands

Characteristic	Description
Landscape Position	Glacio-Lacustrine Sequences
Soils	Cathro Kratka Markey Millerville Rifle Rondeau Seelyville
Primary Water Source	Groundwater, Precipitation Overland Flow
Hydroperiod	Seasonally flooded Saturated Seasonally Saturated





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Functions Performed by Hydrogeomorphic Classes

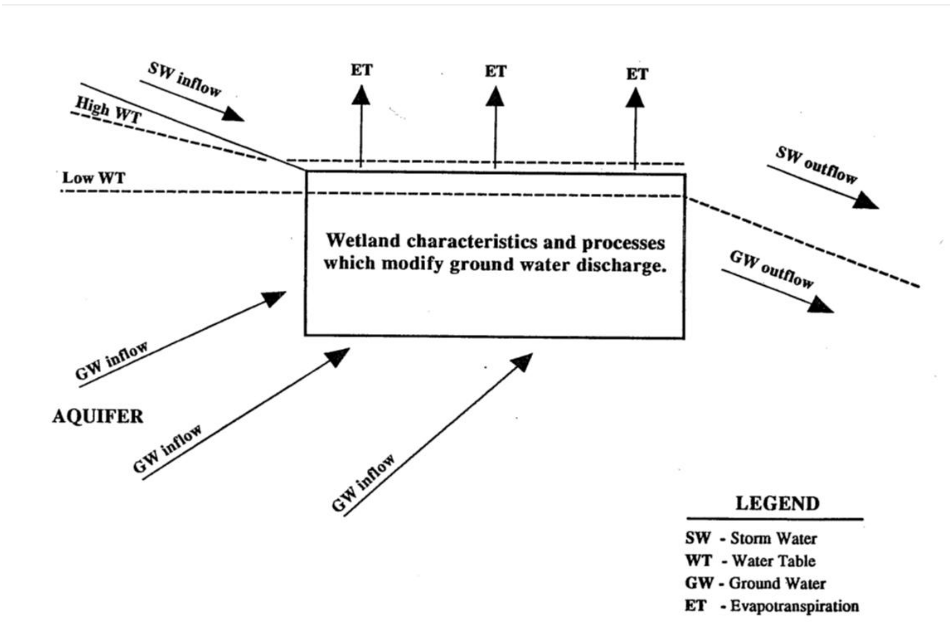
The functions that the Hydrogeomorphic classes of wetlands have the potential to perform are listed and described below. Direct measurement and quantification of most of these functions is possible but would be costly and time consuming and/or require long term monitoring. The models developed for each function, however, are based on variables having high predictive value, and therefore provide a means for assessing functional capacity.

1. Modification of Ground Water Discharge
2. Modification of Ground Water Recharge
3. Storm and Flood Water Storage
4. Modification of Stream Flow
5. Modification of Water Quality
6. Contribution to Abundance & Diversity of Wetland Vegetation
7. Contribution to Abundance & Diversity of Wetland Fauna

It is noted that many of these functions may at times detract from as well as contribute to societal values. This analysis is to assess the public benefits of wetland functions rather than those aspects that detract from public benefits.

Modification of Ground Water Discharge

Is the capacity of a wetland to influence the amount of water moving from ground to surface water.

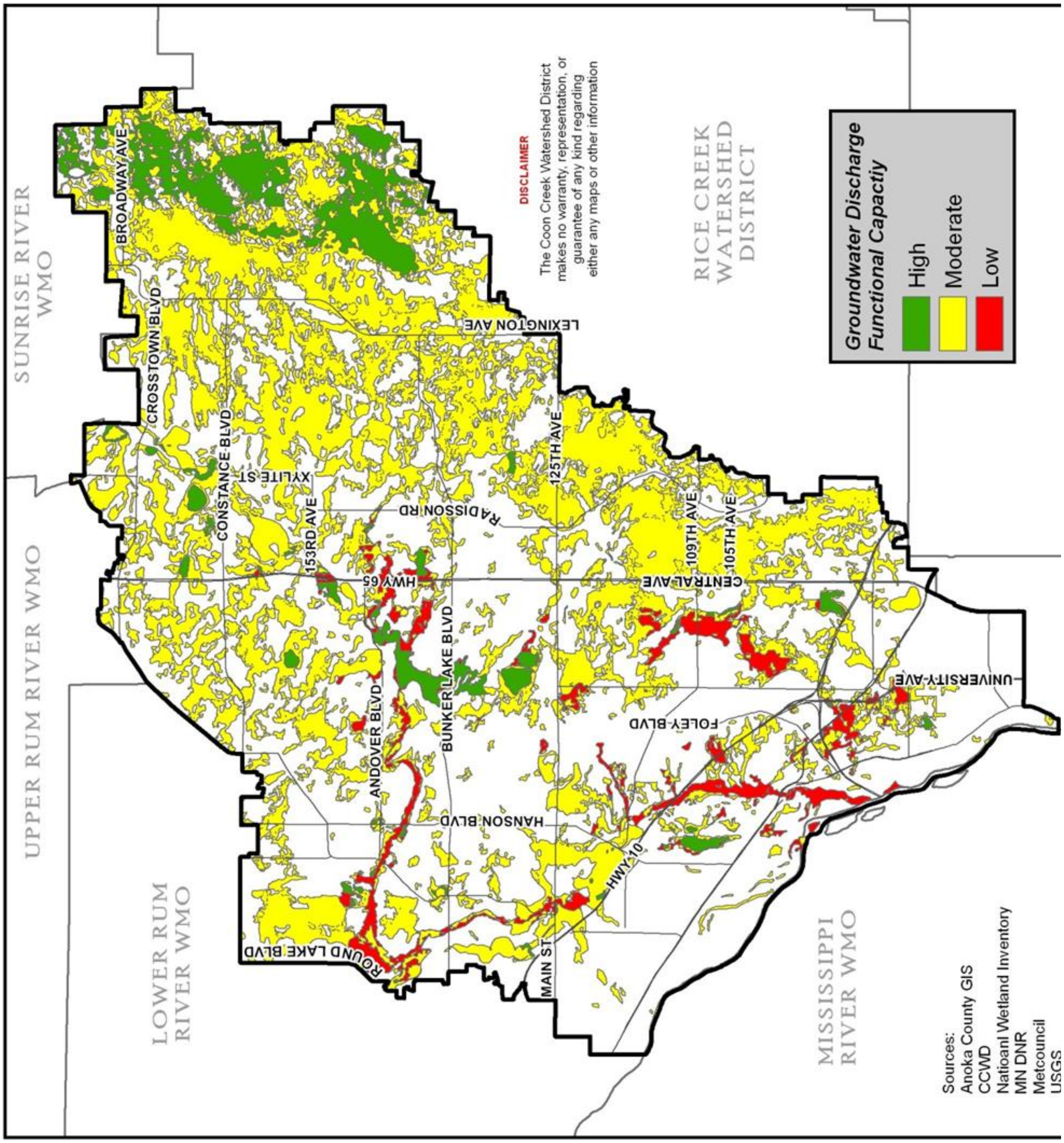


<u>Wetland Characteristics & Processes Modifying Ground Water Discharge</u>:

- Inlet/Outlet Class

- pH
- Surficial Geological Deposits of Wetland
- Wetland Water Regime
- Soil Type

Variable	**Depression/ Swale**	**Lacustrine**	**Bogs/ Peatlands**	**Floodplain**
Inlet/Outlet Class	X		X	X
pH	X		X	X
Surface Geology	X		X	X
Water Regime	X		X	X
Soil Type	X		X	X


Groundwater Discharge
Functional Capactiy
High
Moderate
Low
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RICE CREEK
WATERSHED
DISTRICT
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ROUND LAKE BLVD
MAIN ST
Sources:
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CCWD
Natioanl Wetland Inventory
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Metcouncil
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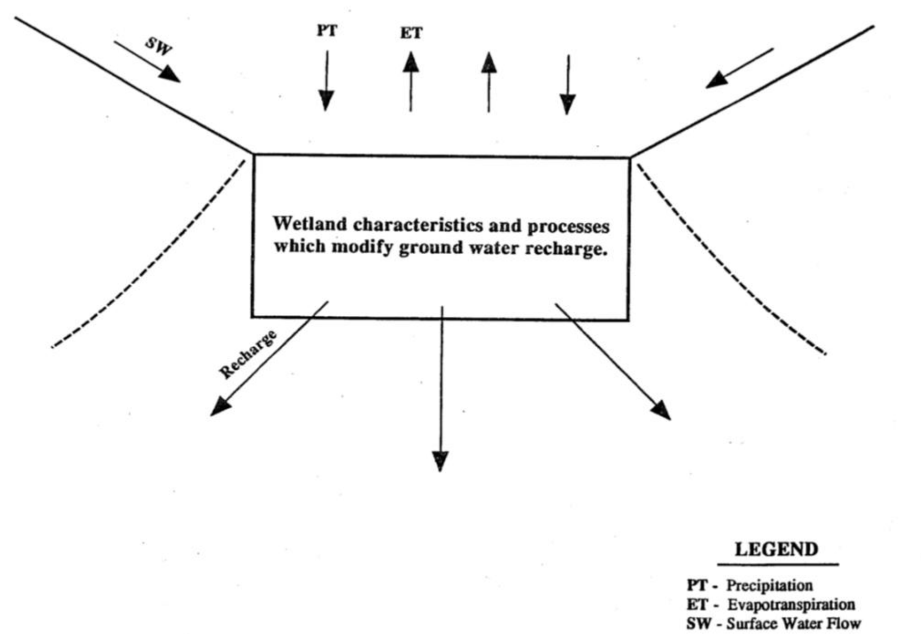
Modification of Ground Water Recharge

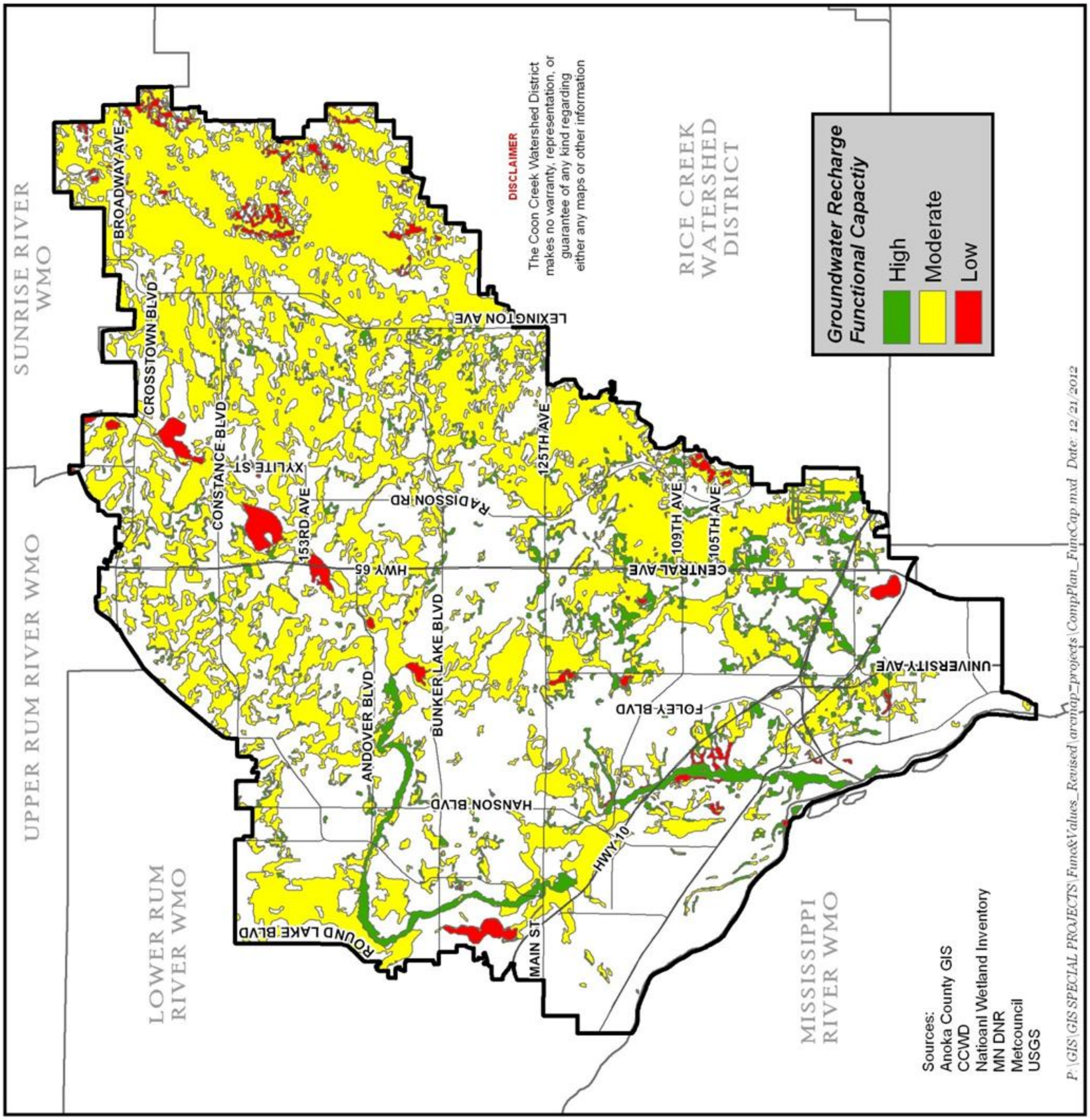
Is the capacity of a wetland to influence the amount of water moving from surface water to ground water



<u>Characteristics & Processes Modifying Ground Water Recharge</u>:

- Inlet/Outlet Classification
- pH
- Surficial Geological Deposits of Wetland
- Wetland Water Regime
- Soil Type

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Inlet/Outlet Class	X	X	X	X
pH	X	X	X	X
Surface Geology	X	X	X	X
Water Regime	X	X	X	X
Soil Type	X	X	X	X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RICE CREEK WATERSHED DISTRICT
MISSISSIPPI RIVER WMO
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Groundwater Recharge Functional Capactiy
High
Moderate
Low
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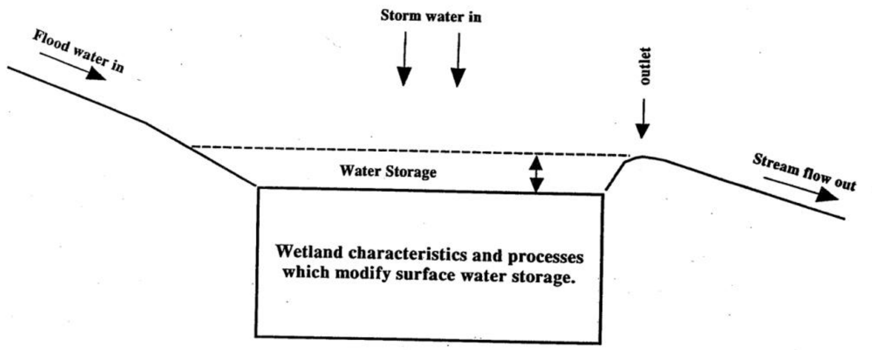
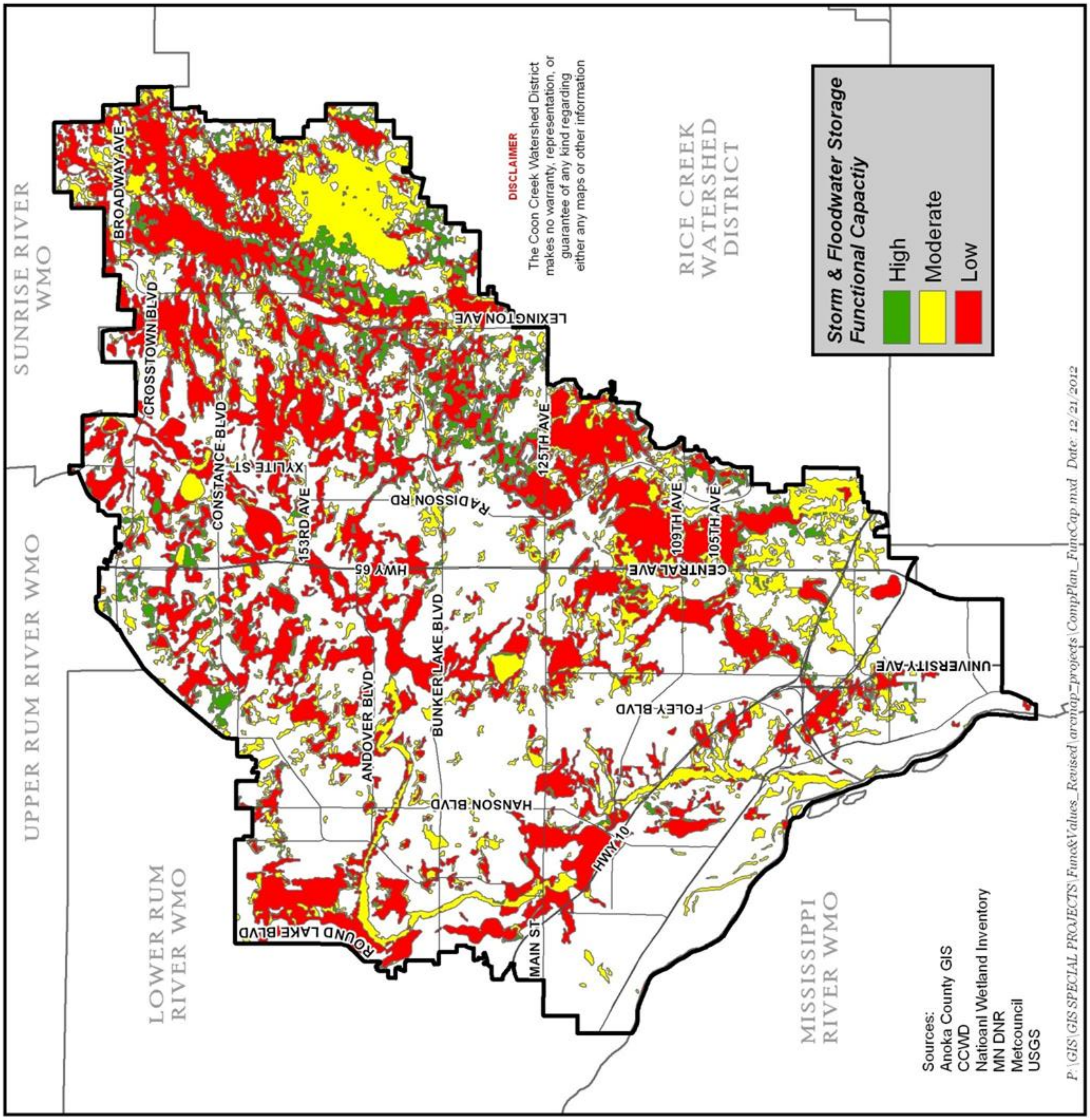
Storm and Flood Water Storage The storage of inflowing water from storm events, resulting in detention and retention of water on the wetland surface.



<u>Characteristics & Processes Modifying Storm & Flood Storage:</u>

- Inlet/Outlet Classification
- Degree of Outlet Restriction
- Basin Topographic Gradient
- Water Regime
- Surface Water Fluctuations
- Wetland to Watershed Areas Ratio
- Vegetation Density & Dominance

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Inlet/Outlet Class	X		X	X
Outlet Restriction				
Topographic Gradient	X		X	X
Water Regime	X		X	X
Water Fluctuation	X	X	X	X
Wetland/ Watershed Ratio	X	X		X
Veg Density & Dom	X	X	X	X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Storm & Floodwater Storage Functional Capactiy
High
Moderate
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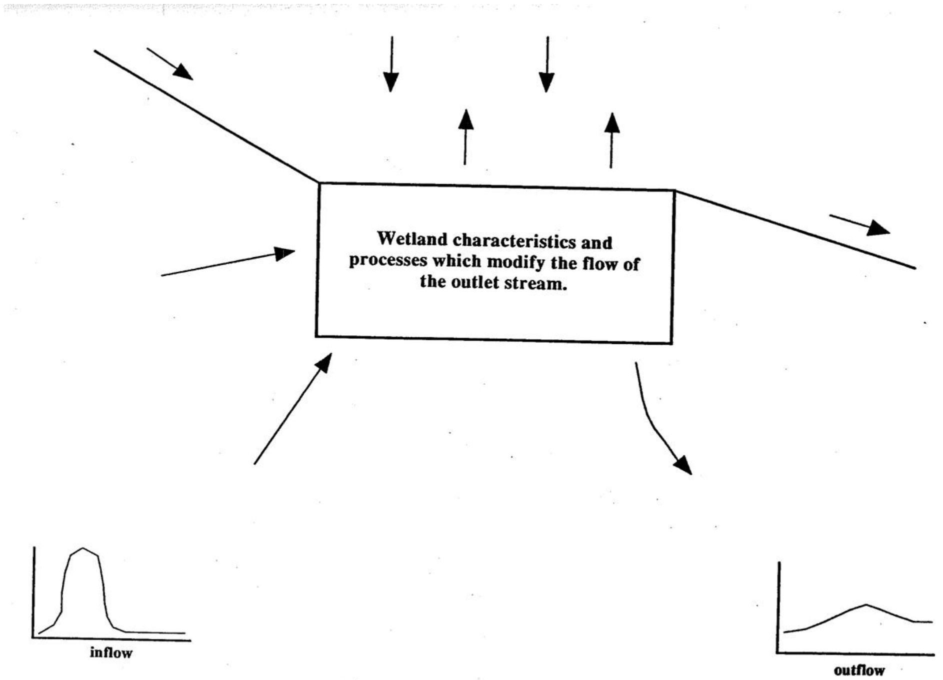
Modification of Stream Flow The modification of inflow hydrology by the wetland to produce the outlet stream's hydrology.

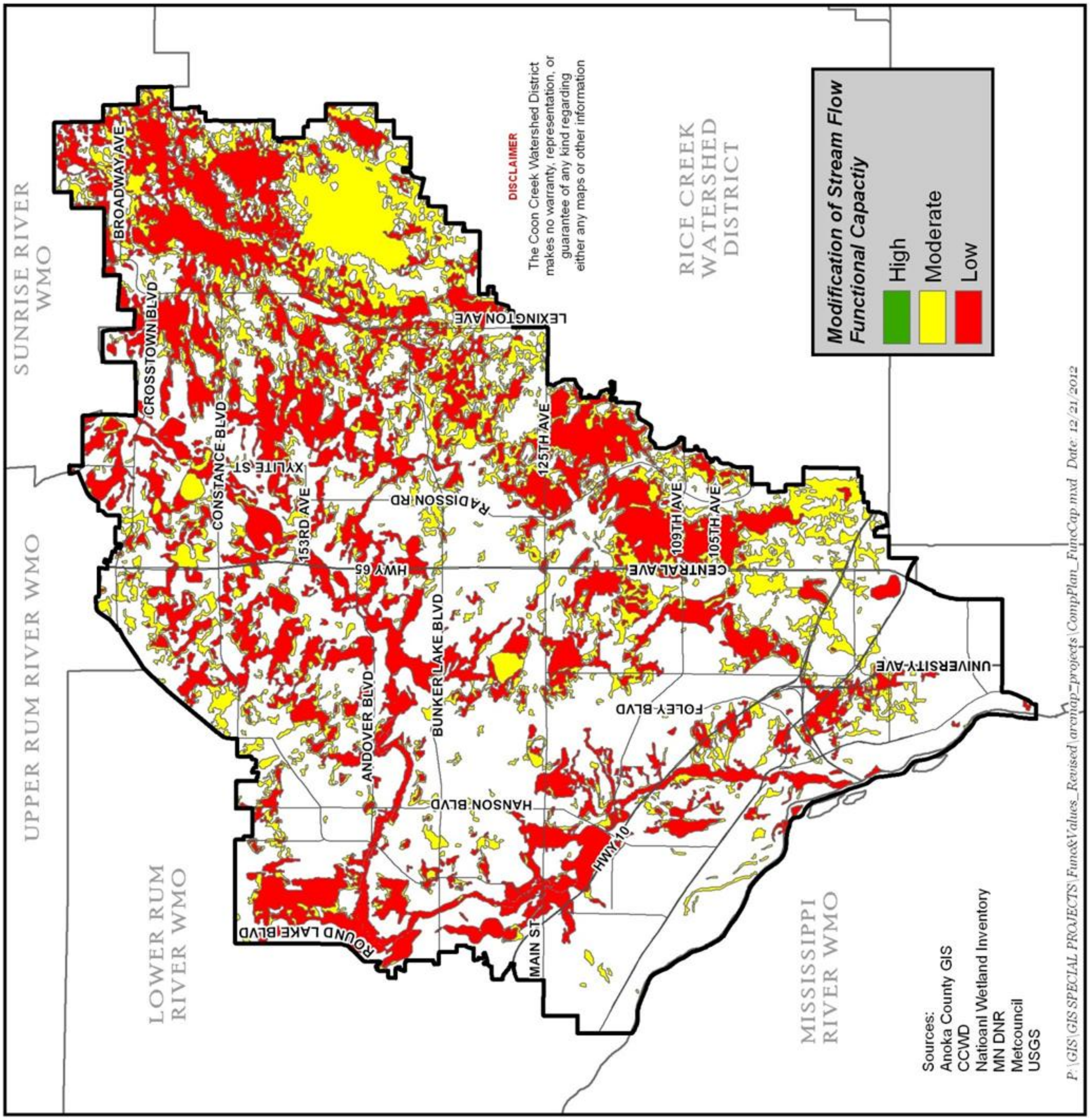


<u>Characteristics & Processes Modifying Stream Flow</u>:

- Inlet/Outlet Classification
- Degree of Outlet Restriction
- Basin Topographic Gradient
- Water Regime
- Surface Water Fluctuations
- Wetland to Watershed Areas Ratio
- Vegetation Density & Dominance
- Frequency of Overbank Flooding
- Soil Type
- pH
- Surficial Geological Deposits of Wetland

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Inlet/Outlet Class	X		X	X
Outlet Restriction	X		X	
Topographic. Gradient	X		X	X
Water Regime	X	X	X	X
Water Fluctuation	X	X	X	X
Wetland/	X	X	X	X

Watershed Ratio				
Veg Density & Dom	X	X	X	X
Frequency of Overbank Flooding				X
Soil Type	X		X	X
pH	X		X	X
Surficial Geological Deposits	X		X	X


Modification of Stream Flow Functional Capactiy
High
Moderate
Low
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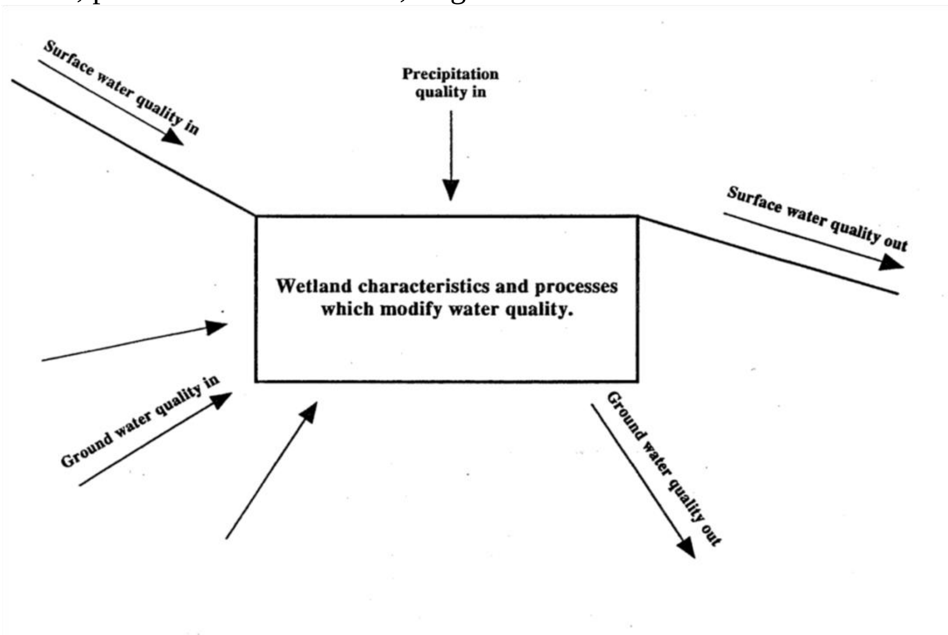
Modification of Water Quality

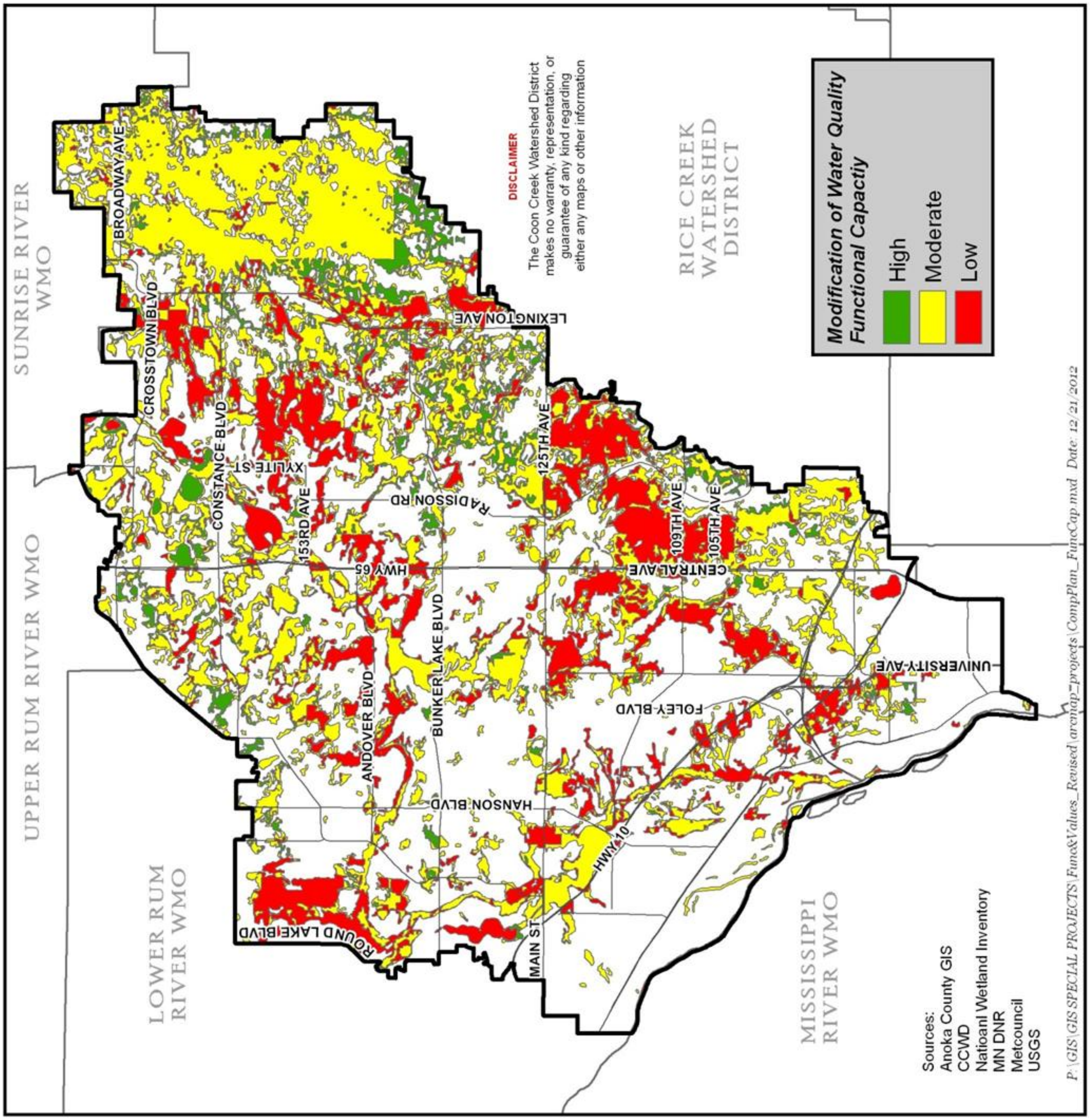
Removal of suspended and dissolved solids from surface water and dissolved solids from surface and groundwater, and conversion into other forms, plant or animal biomass, or gases.



Characteristics & Processes Modifying Water Quality:

- Wetland Land Use
- Degree of Outlet Restriction
- Inlet/Outlet Type
- Cover Distribution
- Soil Type

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Wetland Land Use	X	X	X	X
Degree of Outlet Restriction	X		-	
Inlet/Outlet Class	X		-	
Cover Distribution	X	X	X	X
Soil Type	X	X	X	X


Modification of Water Quality Functional Capactiy
High
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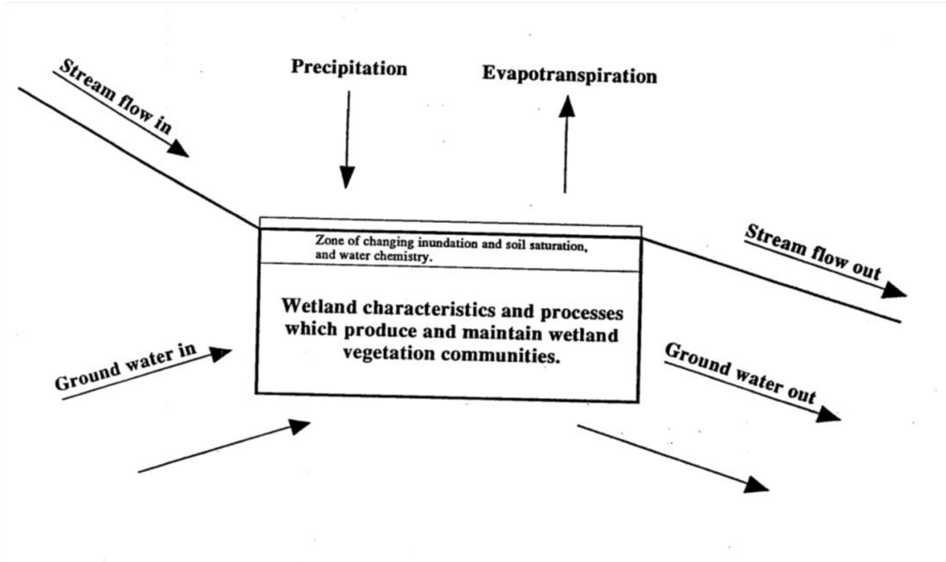
105TH AVE
CENTRAL AVE
HWY 65
BUNKER LAKE BLVD
ANDOVER BLVD
UNIVERSITY AVE
FOLEY BLVD
HANSON BLVD
HWY 10
MAIN ST
ROUND LAKE BLVD
Sources:
Anoka County GIS
CCWD
Natioanl Wetland Inventory
MN DNR
Metcouncil
USGS
P:\GIS\GIS SPECIAL PROJECTS\Func&Values_Revised\arcmap_projects\CompPlan_FuncCap.mxd Date: 12/21/2012

Contribution to Abundance & Diversity of Wetland Vegetation

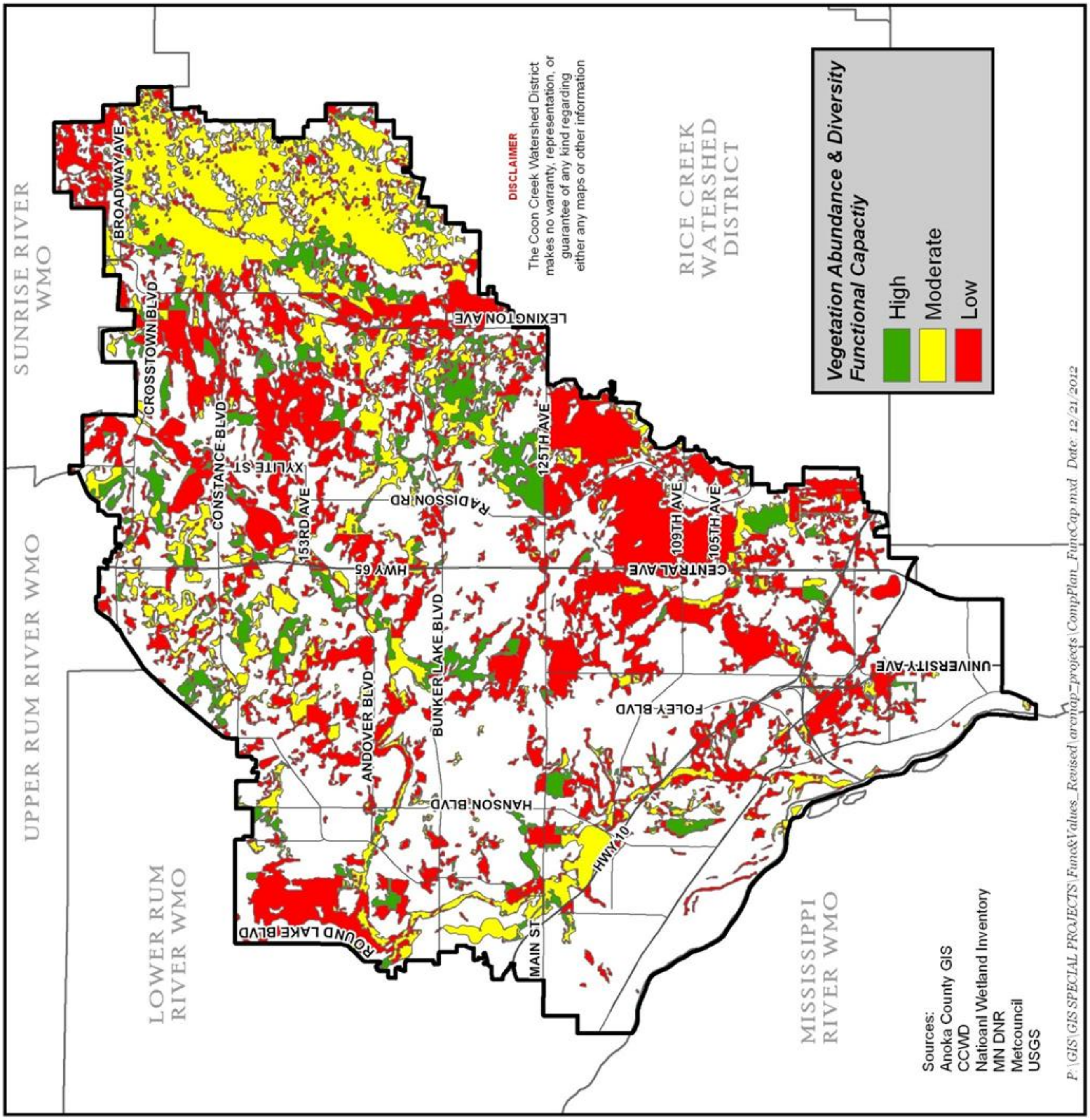
The capacity of a wetland to produce an abundance and diversity of hydrophytic plant species individually or as part of a group of wetlands in a local landscape.



<u>Characteristics & Processes Producing & Maintaining Wetland Vegetation</u>:

- Plant Species Diversity
- Vegetation Density/Dominance
- Wetland Juxtaposition

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Plant Species Diversity	X	X	X	X
Vegetation Density/ Dominance	X	X	X	X
Wetland Juxtaposition	X	X	X	X



Vegetation Abundance & Diversity
Functional Capactiy
High
Moderate
Low
DISCLAIMER
The Coon Creek Watershed District makes no warranty, representation, or guarantee of any kind regarding either any maps or other information
SUNRISE RIVER WMO
UPPER RUM RIVER WMO
LOWER RUM RIVER WMO
RICE CREEK WATERSHED DISTRICT
MISSISSIPPI RIVER WMO
BROADWAY AVE
CROSSTOWN BLVD
CONSTANCE BLVD
XYLITE ST
153RD AVE
HWY 65
LEXINGTON AVE
125TH AVE
RADISSON RD
109TH AVE
105TH AVE
CENTRAL AVE
UNIVERSITY AVE
FOLEY BLVD
BUNKER LAKE BLVD
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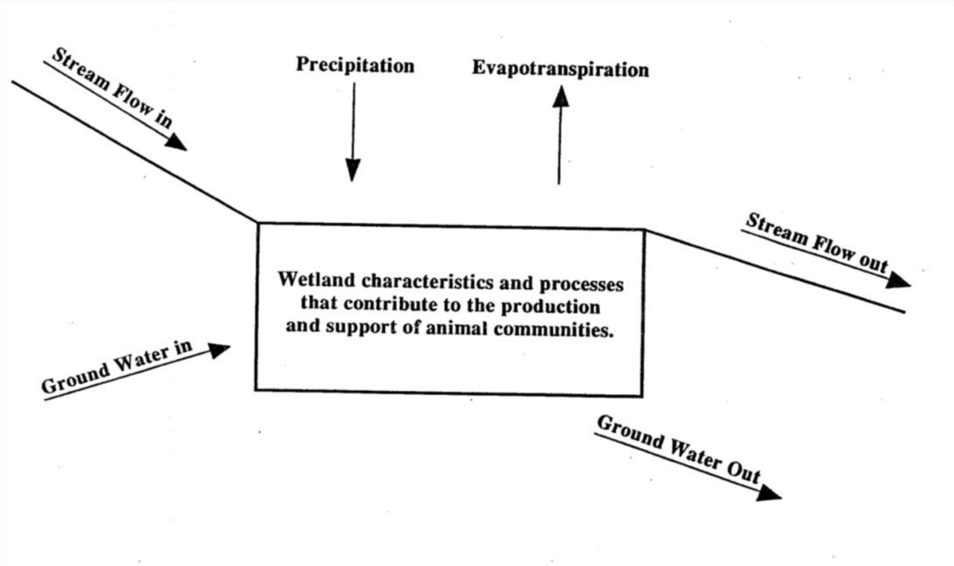
P:\GIS\GIS SPECIAL PROJECTS\Func&Values_Revised\arcmap_projects\CompPlan_FuncCap.mxd Date: 12/21/2012

Contribution to Abundance & Diversity of Wetland Fauna

The capacity of a wetland to support large and/or diverse populations of animal species that spend part or all of their life cycle in wetlands, individually, r as part of a mosaic of wetlands within a local landscape.

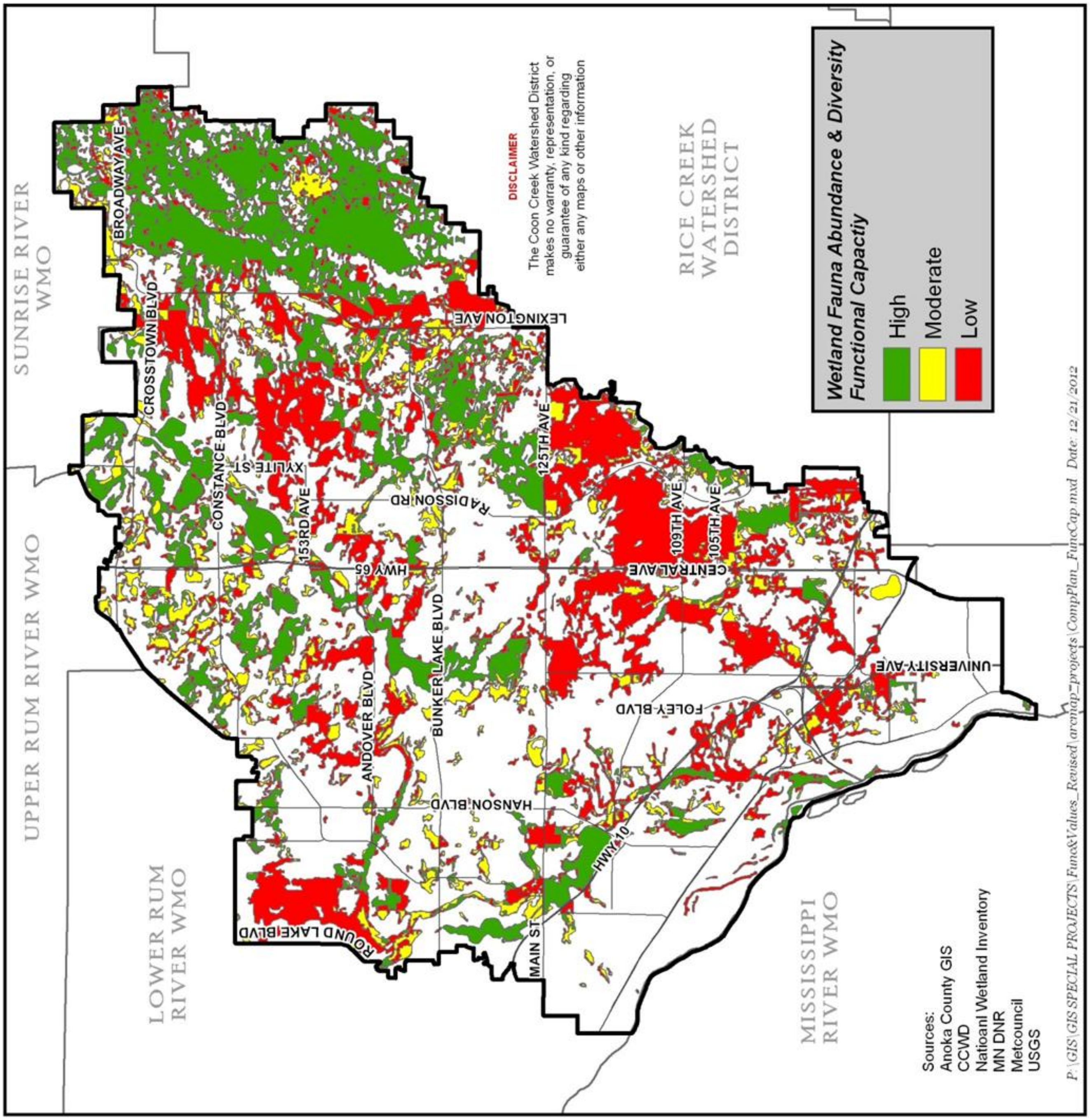


<u>Characteristics & Processes Producing & Supporting Wetland Fauna</u>:

- Watershed Land Use
- Wetland Land Use
- Wetland Water Regime
- Number of Wetland Types & Relative Proportions
- Vegetative Interspersion
- Number of Layers
- Percent Cover
- Interspersion of Vegetative Cover & Open Water
- Size
- Wetland Juxtaposition

Variable	Depression/ Swale	Lacustrine	Bogs/ Peatlands	Floodplain
Watershed Land Use	X	X	X	X
Wetland Land Use	X	X	X	X
Wetland Water Regime	X	X	X	X
Number of Wetland Types & Relative Proportions	X	X	X	X
Vegetative Interspersion	X	X	X	X

Number of Layers	X	X	X	X
Percent Cover	X	X	X	X
Interspersion of Vegetative Cover & Open Water	X	X	X	X
Size	X	X	X	X
Wetland Juxtaposition	X	X	X	X


Wetland Fauna Abundance & Diversity
Functional Capactiy
High
Moderate
Low
DISCLAIMER
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RICE CREEK WATERSHED DISTRICT
SUNRISE RIVER WMO
UPPER RUM RIVER WMO
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P:\GIS\GIS SPECIAL PROJECTS\Func&Values_Revised arcmap_projects\CompPlan_FuncCap.mxd Date: 12/21/2012

FINDINGS

The functional assessment has found the following:

Augmenting Field Work

The functional capacity assessment presented in this report has been of moderate assistance in augmenting field work during the 2011 and 2012 field seasons. The majority of field work remains in the determination of "Jurisdictional Wetland" using the Federal Manual. Under the current policy framework of the Wetland Conservation Act, the issues of sustainability, or relative value/importance of any given wetland basin, are trumped by the regulatory issue of the determining the presence and extent of jurisdictional wetland and the quantity of direct or indirect impact on that basin.

Determination of the Level of Function

The determination of the level of function has been most helpful at the watershed and subwatershed scale in discerning patterns, needs and the geographic aspect of demand and need.

Comparing Wetlands

The Coon Creek Watershed District has, as of yet, encountered a situation where comparison of the functional capacity of wetlands, let alone wetlands within the same HGM Class, has been a factor in a wetland regulatory or management decision.

The Wetland Conservation Act program emphasizes the quantity or acreage of wetland impacted and required to be replaced. Functional Capacity is a concept that has more bearing in discussions of sustainability or a management framework that emphasizes the utility of the resource in providing benefits, goods and services.

Evaluating Impacts to Functional Capacity

At present, the Wetland Conservation Act does not regulate the "degree" of impact, impacts to functional capacity, or impacts to the beneficial services that may be provided by the given wetland. The Wetland Conservation Act regulates filling and draining, both direct, easily measurable impacts. This is a strength of the wetland law and regulations. The legal and regulatory criteria are easy to measure and easy to administer and defend. They are conducive to a set of yes or no findings that can be supported by measurable findings and data that can be verified in the field.

However, as landscapes and landscape processes evolve and the biological, geological and chemical factors which combine to create what we identify as wetlands change, the question of sustainability and degree of service will surface and the question of whether it is "worth" avoiding all areas which meet the technical criteria will be raised. It is in this context that the degree to which a wetland is capable of performing certain tasks which provide benefits will be most helpful.

Defining Management and

The Coon Creek Watershed District has found the HGM method extremely beneficial in defining management and mitigation goals. The CCWD began

Mitigations Goals

using the HGM method to classify and discuss wetlands in 2004. The framework has proven extremely beneficial in evaluating problem and disturbed wetlands and providing a framework for evaluating the probable success of proposed wetland mitigation sites and in describing why older mitigation sites have failed or been less successful.

Management Challenges

1. Setting standards on acceptable impact levels for wetlands while taking other factors, such as long term goals, into account.

2. Providing adequate information about how resources function so that management can make informed choices.

3. Managing and monitoring activities and impacts to ensure that situations don't change in a manner that may adversely affect the quality of the area.

Potential Approach to Setting Standards

The approach, consistent with the functional capacity analysis, would specify three wetland categories. These categories would correspond to wetland of low, medium and high quality and/or function. In addition, there is an implied fourth category in the middle of the continuum of wetlands that are degraded but restorable (modified category 2). These potentially restorable wetlands are category 2 wetlands and receive the same level of regulatory protection as other category 2 wetlands

Category 1 Wetlands

These wetlands support minimal wildlife habitat, and minimal hydrologic and recreational functions. They also do not provide critical habitat for endangered or threatened species or contain rare, threatened or endangered species.

These wetlands are often hydrologically isolated, and have low species diversity, no significant habitat or wildlife use, little or no upland buffers, limited potential to achieve beneficial wetland values, and/or have a predominance of non-native species. Category 1 wetlands should be considered ‘Limited Value Resources Waters’ (Class 7) under the MPCA Rule 7050.

These wetlands should be considered to be a resource that has been so degraded or with such limited potential for restoration or of such low functionality that no social or economic justification can be made and lower standards of avoidance and minimization should be made.

Category 2 (Modified) Wetlands

These wetlands constitute a broad middle category that supports moderate wildlife habitat or hydrologic or recreational functions, but also includes wetlands which, while degraded, have a reasonable potential for reestablishing compromised wetland functions.

Category 2 Wetlands These wetlands support moderate wildlife habitat or hydrological or recreational functions and as wetlands are dominated by native species but generally without the presence of, or habitat for, rare, threatened or endangered species. Category 2 wetlands constitute a broad middle category of "good" quality wetlands. These wetlands can be considered "warm water habitat" streams (Class 2D, 3D, 4C, 5 and 6 waters) and therefore can be considered a functioning, diverse, healthy water resource that has ecological integrity and human value. Some Category 2 wetlands may be relatively lacking in human disturbance and can be considered to be naturally or moderate quality; others may have been Category 3 wetlands in the past but have been disturbed "down to" Category 2 status.

Category 3 Wetlands These wetlands provide superior habitat, or superior hydrologic or recreational functions. They are typified by high levels of diversity, a high proportion of native species, and/or high functional capacity. Category 3 wetlands include wetlands which contain, or provide habitat for, threatened or endangered species, are high quality mature forested wetlands, vernal pools, bogs, fens or which are scarce regionally and/or statewide.

Wetland Tiered Aquatic Life Uses

Minnesota is working to revise its water quality standards (MN Rule Chapter 7050) to incorporate a tiered aquatic life use (TALU) framework for rivers and streams. It does not appear that that MPCA plans to develop separate 'Wetland Aquatic Life Use' standards. The Watershed District will follow the MPCA development of TALU standards and evaluate the 3 categories identified here while the District works through the Watershed Restoration and Assessment Project (WRAP).

Special Wetland Uses

Subscript	Special Use	Description
A	Recreation	Wetlands available to the public with known recreational uses.
B	Education	Wetlands with known educational uses such as nature center, schools
C	Bird Habitat	Wetlands that provide important breeding and nonbreeding habitat for birds (wildlife management areas, parks, nature centers)
D	T & E Habitat	Wetlands that provide habitat for endangered and threatened species.
E	Flood Storage	Wetlands located in landscape positions such that they have flood retention functions.
F	Water quality Improvement	Wetlands located in landscape positions such that they can perform water quality improvement functions for lakes, streams, other wetlands or the Mississippi River

Potential Wetland Tiered Aquatic Life Uses for specific landscape positions and plant communities

<table>
<tr><th>HGM class</th><th>HGM Subclass</th><th>Plant community</th><th>Category 1</th><th>Category 2 (modified)</th><th>Category 2</th><th>Category 3</th></tr>
<tr><td>Depressions & Swales</td><td>All</td><td></td><td colspan="4" rowspan="6">To Be Developed</td></tr>
<tr><td>Lacustrine</td><td>All</td><td></td></tr>
<tr><td>Floodplain/ Riverine</td><td>All</td><td></td></tr>
<tr><td>Flats</td><td>Mineral</td><td></td></tr>
<tr><td></td><td>Organic</td><td></td></tr>
<tr><td></td><td>Slope</td><td></td></tr>
</table>

Potential Hydrologic Stressors for Consideration:

1. Ditching
2. Dike/Ditch Plug
3. Weir
4. Stormwater
5. Point Source
6. Fill
7. Road or Rail Road Bed
8. Dredge disposal
9. Dewatering/Shallow Wells
10. Other

Potential Habitat Alteration Stressors for consideration:

1. Mowing
2. Grazing
3. Clear Cutting
4. Selective Cutting
5. Woody & Brush Removal
6. Sedimentation
7. Toxic Pollution
8. Aquatic Bed/Emergent Removal
9. Dredging
10. Nutrient Enrichment