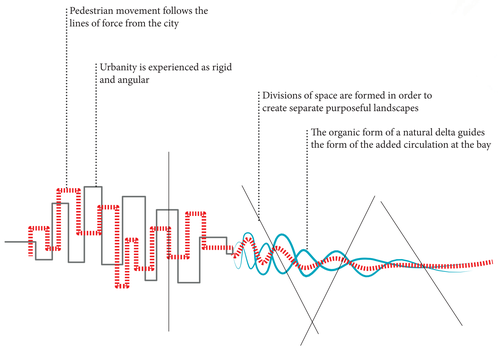
The URBAN Delta

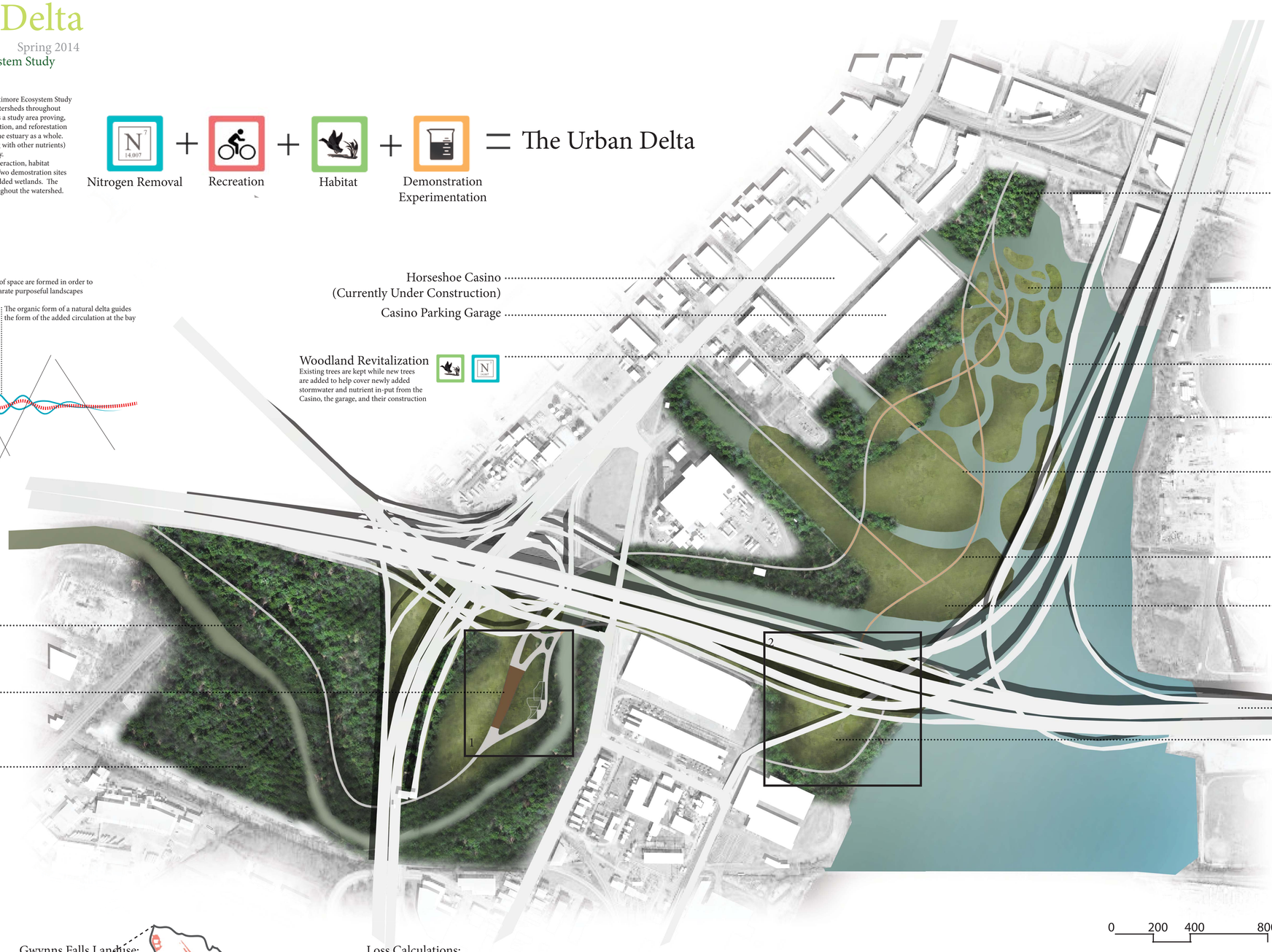
Jennie Ryan
Spring 2014
In collaboration with the Baltimore Ecosystem Study

Concept

The Urban Delta ecosystem design is based directly from findings in Baltimore Ecosystem Study data showing a high influx of nitrogen into the Chesapeake Bay from watersheds throughout the estuary. The Gwynns Falls Watershed in Baltimore, Maryland acts as a study area proving, through concious landscape decisions, that wetland construction, protection, and reforestation of underutilized land within a region can positively effect the health of the estuary as a whole. Nitrogen is used as an indicator of positive change, since nitrogen (along with other nutrients) has been found to cause issues such as algal blooms and anoxia in the bay. Through mitigating the nitrogen loss issues, opportunities for human interaction, habitat creation, and water quality testing were designed into the master plan. Two demostration sites were considered at the site level in order to test the effectiveness of the added wetlands. The processes and management pactices at these sites can be replicated throughout the watershed.

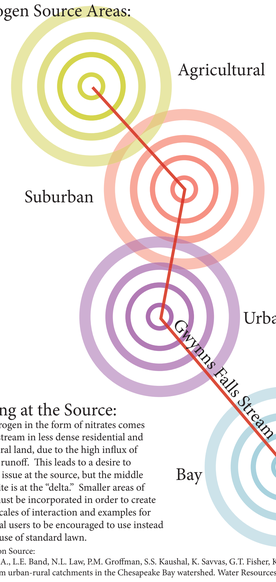
Nitrogen Removal + Recreation + Habitat + Demonstration Experimentation = The Urban Delta



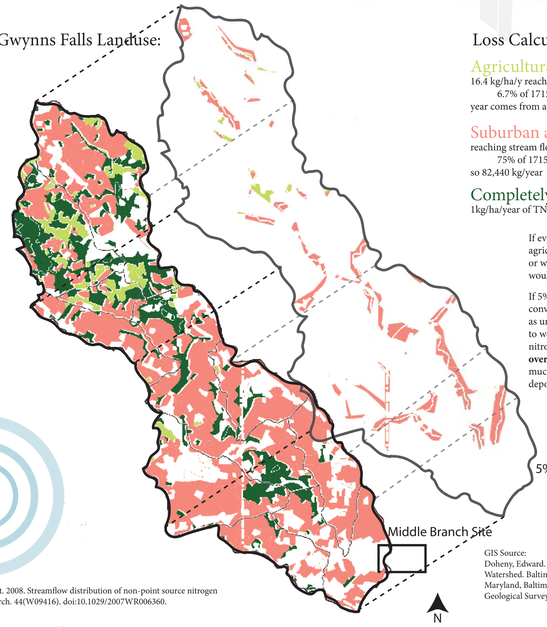


Nitrogen Loss to Streams

Nitrogen Source Areas:



Gwynns Falls Landuse:



Solving at the Source:

Most nitrogen in the form of nitrates comes from upstream in less dense residential and agricultural land, due to the high influx of fertilizer runoff. This leads to a desire to solve the issue at the source, but the middle branch site is at the "delta." Smaller areas of design must be incorporated in order to create human scales of interaction and examples for residential users to be encouraged to use instead of 100% use of standard lawn.

Information Source:
Shields, C.A., L.E. Band, N.L. Law, P.M. Groffman, S.S. Kaushal, K. Savvas, G.T. Fisher, K.T. Belt. 2008. Streamflow distribution of non-point source nitrogen export from urban-rural catchments in the Chesapeake Bay watershed. Water Resources Research. 44(W09416). doi:10.1029/2007WR006360.

Loss Calculations:

Agricultural runoff for Gwynn's Falls Watershed 16.4 kg/ha/y reaches stream flow:
6.7% of 17150 ha is ag. Or 1150 ha so 18,860 kg/ year comes from agriculture

Losses: 18,860kg/year

Suburban and Urban at 6.5kg/ha/year reaching stream flow:
75% of 17150 ha is suburban and urban or 12,863 so 82,440 kg/year

82,440kg/y

Completely forested areas have less that 1kg/ha/year of TN loss

Less Loss With 5% Conversion to Forest: 5,065kg/y

If even only 5% of lawn or underutilized agricultural land was converted to forest or wetland buffers 5,065kg less of nitrogen would enter the stream flow system.

If 5% (a reasonable number for land conversion of yards near streams as well as underutilized agriculture) is converted to wetlands, 5,866,743 MAXIMUM total nitrogen removal can occur which **covers over 100% nitrogen lost in streams**, and much of the nitrogen lost in other forms of deposition.

Possible Removal Through Wetlands: 5,866,743kg/y

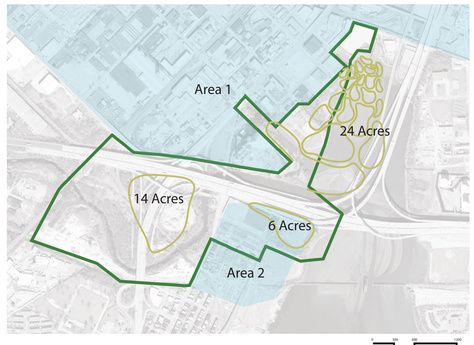
Source of nitrogen loss rates:
Groffman, P.M., N.L. Law, K.T. Belt, L.E. Band, G.T. Fisher. 2004. Nitrogen fluxes and retention in urban watershed ecosystems. Ecosystems. 7(4):393-403. doi:10.1007/s10021-003-0039-x.

5% Changed

GIS Source:
Doheny, Edward. 1999. Index of Hydrologic Characteristics and Data Resources for the Gwynns Falls Watershed. Baltimore County and Baltimore City, Maryland.In cooperation with the. University of Maryland, Baltimore County and the Institute of Ecosystem Studies U.S. Department of the Interior U.S. Geological Survey

The Middle Branch Site

The Middle Branch Nitrogen Removal



Nitrogen Removal Rate For Construucted Wetlands: 0.37kg/TN/year

Removal Rate Source:
Kenimer, Anne. Constructed Wetlands for Animal Waste Management. Second National Workshop on Constructed Wetlands for Animal Waste Management Fort Worth, Texas, 15-18 May, 1996

Area 1
Total Drainage Area: 650 acres
Max TN Loss: 20 kg/acre/year
Loss per Year: 13000 kg Nitrogen loss per year

Area 2
Total Drainage Area: 37 acres
Max TN Loss: 20 kg/acre/year
Loss per Year: 740 kg Nitrogen loss per year

Total Added Wetland Nitrogen Filters: 38 acres
TN MAXIMUM Taken Up by Biomass: 56,887 kg/year

Total Added Wetland Nitrogen Filters: 6 acres
TN MAXIMUM Taken up by Biomass: 8,802 kg/year

Nitrogen Removal Plants

Selected Riparian/Wetland:

Selected Suburban:

Selected Agricultural:

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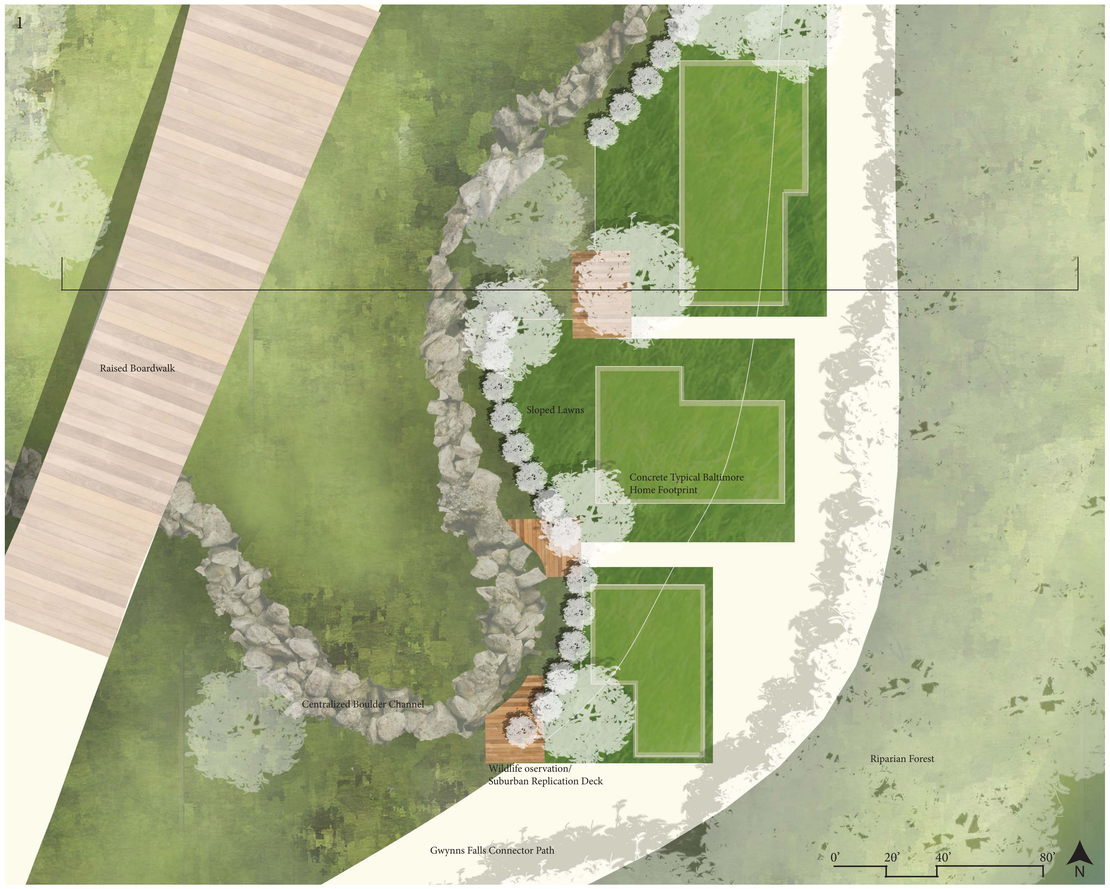
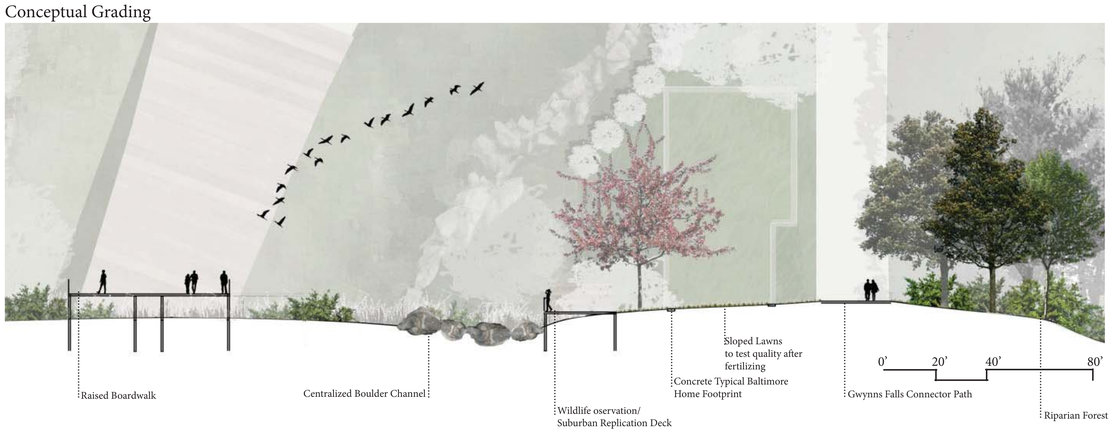
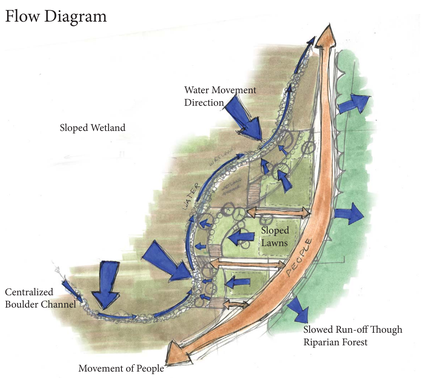
Suburban Replication



Conceptual Grading

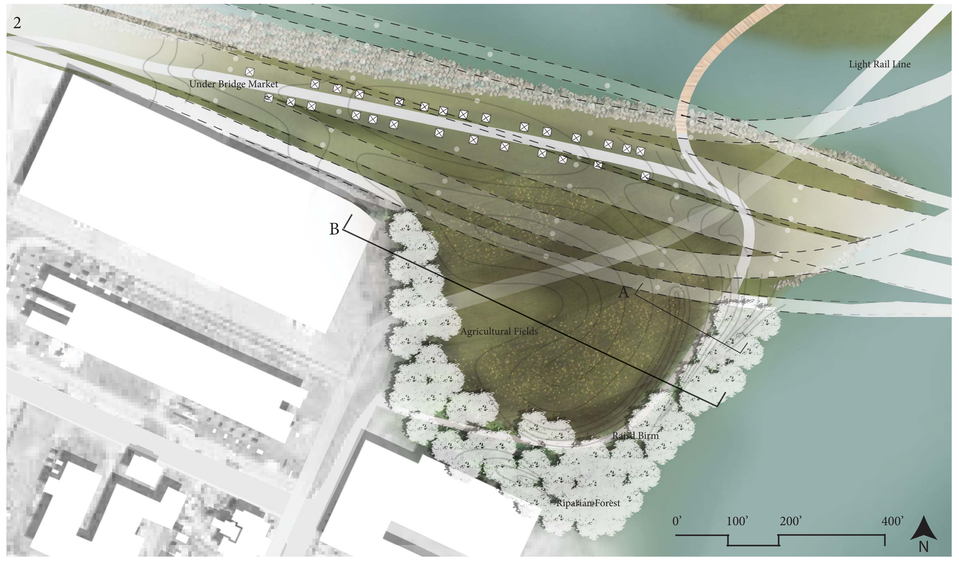


Flow Diagram

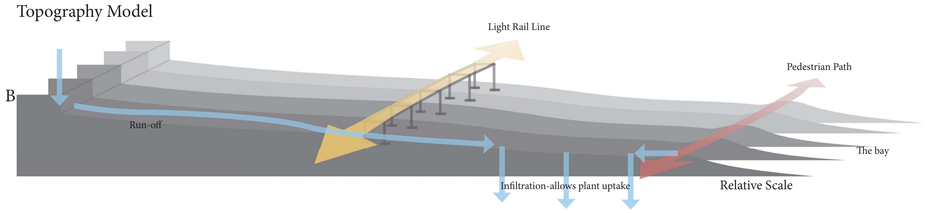


Suburban Replication Decks

Managed Agricultural Wetland



Topography Model



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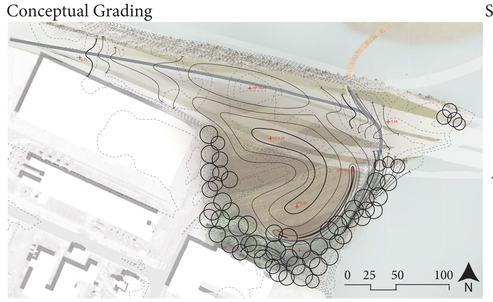
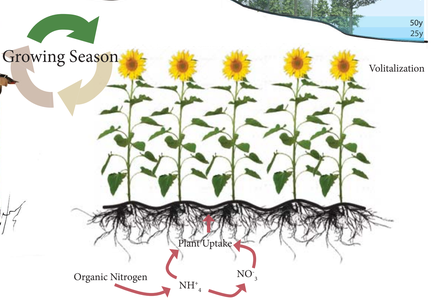
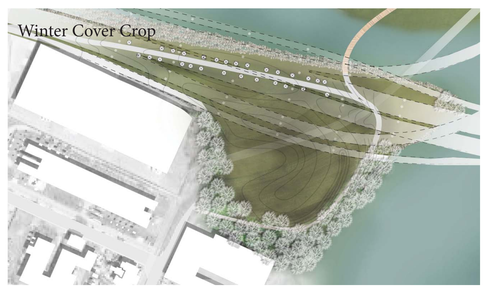
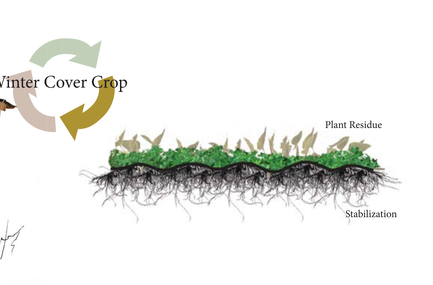


Seasonal Management

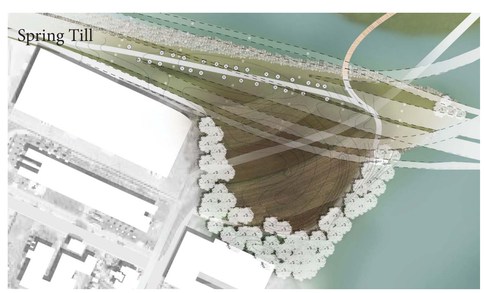


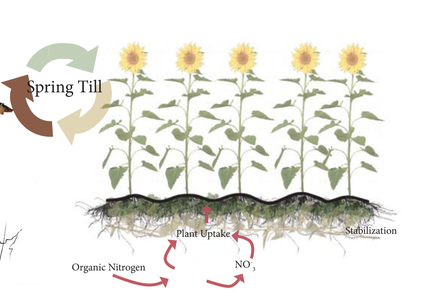
Winter Cover Crop





Spring Till





Flood Projections