METEOROLOGY

Rain

- Amount, Duration, Frequency and Intensity
  Rainfall directly impacts stream flow on Lake Superior's Clay plain. This is especially apparent once heavy clay soils are saturated or frozen with almost zero infiltration. Streams rise and fall in direct relation to the amount, duration and frequency/intensity of rainfall events.

  General 25-year, 24-hour precipitation is 4.66 inches (USGS, 2002)
  Annual Precipitation ranges from 30.02 – 33.46 in

- Mean annual Snowfall
  Great Variability in the Marengo Watershed as a portion of the pilot area is in the snow belt and a portion is not.
  Neighboring Watershed Comparisons
  Bad River 94.5 – 96 inches (USGS, 2002)
  Trout Brook tributary near Marengo 91.5 inches (USGS, 2002)
  White River near Ashland 66.1 inches (USGS, 2002)

Air Temperature

- Maximum & Minimum
  Maximum air temperature has big impacts during the peak runoff months from the end of March through the end of April.

Evaporation

Need information sources

Wind (spring)

Wind speeds and direction early in the spring contribute to both the amount and timing of flow in the Marengo Watershed.

Average Wind Speeds: 10 mph

SURFACE WATER

Quantity

- Streams
  - Drainage Area
    - Bad River drainage area (DA) at the stream gauge: 990 mi^2
    - White River DA at the stream gauge: 301 mi^2
    - Marengo River DA (no stream gauge):

- Average Annual (Mean) Flow
  - The main system, the Bad River has an average annual flow ranging from 615 ft^3/sec (1915) – 557 ft^3/sec (2004). A mean of 618 ft^3/sec for the water years 1914 – 2004 (USGS, 2006).
  - Neighboring stream, the White River, has gauge information that is not comparable because it is downstream of a hydroelectric dam, and it will therefore not be used.
  - Unknown in the Marengo River, no gauge present.

- Peak Runoff Months: end March to end April

- Impoundments – discussed in *Wetlands / Riparian Areas* section
  - Natural
  - Constructed

DRAINAGE BASIN CHARACTERISTICS

Watershed Morphometry

- Channel Geometry (cross section)

- Topography

  Marengo River Watershed _____ CGIS (awaiting data)

  Comparisons of USGS Gauging Stations:
  Bad River at Odanah 18.8 ft/mi (USGS, 2002)
  Bad River at Mellen 11.2 ft/mi (USGS, 2002)
  Trout Brook Tributary near Marengo 17.9 ft/mi (USGS, 2002)

Wetlands / Riparian Areas

Marengo Watershed (wetlands, forested wetlands/coniferous, deciduous & mixed):
18,136 ac (13.02%) (WISCLAND, 1992)

---Riparian Areas – Discuss Buffers and Importance/Relevance---

Soils (HSG)

Infiltration rates of the soils in the Marengo watershed vary widely and are affected by subsurface permeability as well as surface intake rates. Because there are well over 95 soil types in the Bayfield portion of the Marengo watershed alone, most comprised of complexes of 2-4 soils, we specifically looked at Hydrologic Soil Groups (HSG) in order to narrow the soils down into four groups – A, B, C and D. HSG ratings are based according to each soil's minimum infiltration rate, which is obtained for bare soil after prolonged wetting (USDA-SCS, 1986).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15- 0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

**Soil Transitional areas can be seen by looking at HSG.

Geology
All of the following information about geology has been adapted or quoted from the USGS Update Report: *Investigation of Erosion, Sedimentation, Channel Migration, and Streamflow Trends in the Bad River Basin, Wisconsin* (USGS, BRNR. Dec. 2005)

Areas of excessive lateral migration and channel instability exist at the confluence of the Marengo and Bad Rivers.

"Southern Tributaries flowing into the main stem of the Marengo River were identified as having substantial erosion and runoff problems because they flow directly down off the wave planed topography into the Marengo River."

Soil Transition Areas:
"Stream reaches in the Bad River watershed with the highest amount of erosion are located in steep reaches of the White, Marengo, Bad, and Potato River between altitudes of 750 to 1,050 feet above sea level. This altitude range corresponds to the north side of the Penokee range and to a post-glacial lake shoreline. **The abandoned shoreline has wave-planed topography developed in sandy unconsolidated deposits. The shoreline also marks the boundary between loamy glacial deposits in the southern, upper part of the watershed and clayey deposits in the northern, lower part of the watershed**. A combination of high local relief, clay over sand, and clearing or road development in this area leads to high erosion rates. The drainage networks above altitudes of about 1,200 ft, have loamy soils and poorly developed stream networks – streambanks for the most part are stable and high runoff rates are less of a problem than at altitudes below 1,200 feet."

Forest Age Class

- Using results from the Comparative Analysis of Hydrologic Units (CAHUs)(CGIS, 2004), identify the CAHUs where the combined amount of agricultural and forest land in 0-16 yr age class was greater than 60%.

In planning for snowmelt peak discharge, the locally accepted threshold of open land is about 40%; however there is actually a range between 40-60% where snowmelt peak discharge levels off or is slightly reduced. We chose to look at the maximum amount of open land/young forest using the 60% threshold, in order to specifically target areas in the watershed that were the most in need.

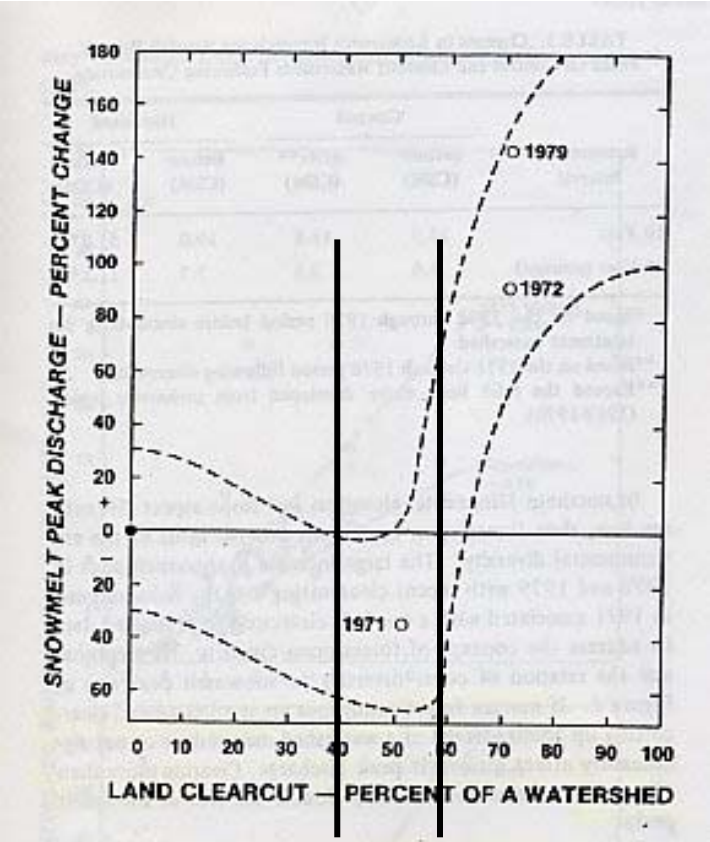

Figure 5. Relation Between the Portion of a Watershed Clearcut (with regrowth for at least nine years) and the Change in Snowmelt Peak Discharge Size Compared to Mature Aspen Forest Conditions. Circles are measured; lines hypothesize an envelope of response for northern Lake State conditions.

(AWRA-WRB, Verry et al. 1983)

Riparian Buffers – Discussion Needed

- Forested vs grassed buffers
- Composition of Forested Buffer
- Buffer Width
- Grazing

Human Influence

- Mining – we have the locations of nonmetallic mines from Bayfield County Zoning, but not from Ashland County Highway. We will include these locations on the maps soon and try to take a look at the impact of these nonmetallic mines on this watershed.

- Roads & Road Ditches
  Harr et al. (1975) showed that road ditches duplicate a stream system and road systems whose total right-of-way area makes up 15% of the basin will increase peak flow. We calculated the road ditch systems based on average size road ditches (no field-truthing) to get an idea of the road ditch area in both the HUC 6 and CAHU.

  USGS/BRNR December 2005 project update: "Road crossings on the southern tributaries to the Marengo River from County Line Rd to the confluence with the Bad River now function as grade control structures." (USGS and BRNR. 2005)

- Wetland Restoration
  Restorations generally don't have an impact on runoff the way they are constructed without drawdown capability.

- Agriculture
  - Livestock Grazing – impact on water quality in buffer areas
  - Nutrient Management – impact on water quality
  - Cropland (tillage, crop sequence, surface drainage, pasture, etc) – impact on spring runoff

- Groundwater Extraction – per USGS, groundwater data not available for this watershed. (3/06)

- Urban / Residential – not necessarily an issue in this watershed, but that does not mean there are not impacts that should be considered in Phase II of this project.

Reference levels: What should be the reference level for this watershed?

Discuss the reference levels for this watershed to be used for comparative purposes only. These levels do not imply that conditions can or should move to that level; nor are they necessarily the desired condition. They are simply the conditions expected if the watershed operated without significant human influence.