

Glacial T, log ft²/day

- <2
- 2-3
- >3-4
- >4

Bedrock T, log ft²/day

- ▲ <1
- ▲ 1-2
- ▲ >2-3
- ▲ >3

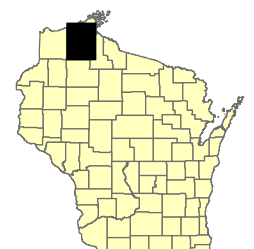
Pleistocene geology

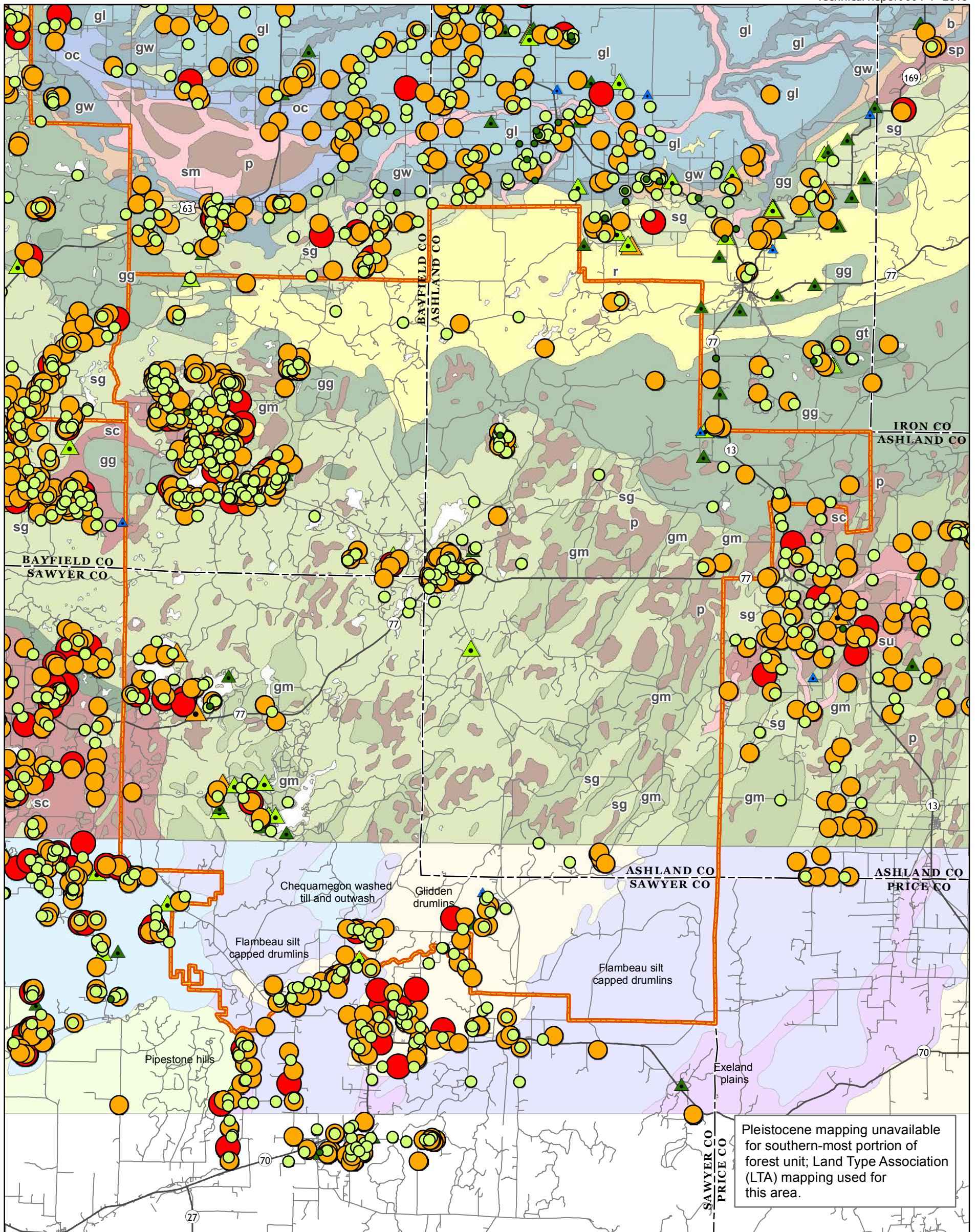
- | | | | |
|----|----|----|----|
| sm | gl | sc | gt |
| p | gw | sg | r |
| b | gh | gg | |
| oc | su | gm | |

Refer to Table 1 for unit descriptions.

Washburn/Great Divide Unit

0 4 Miles





Pleistocene mapping unavailable for southern-most portion of forest unit; Land Type Association (LTA) mapping used for this area.

Glacial T, log ft²/day

- <2
- 2-3
- >3-4
- >4

Bedrock T, log ft²/day

- ▲ <1
- ▲ 1-2
- ▲ >2-3
- ▲ >3

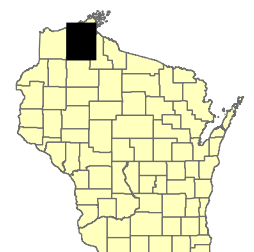
Pleistocene geology

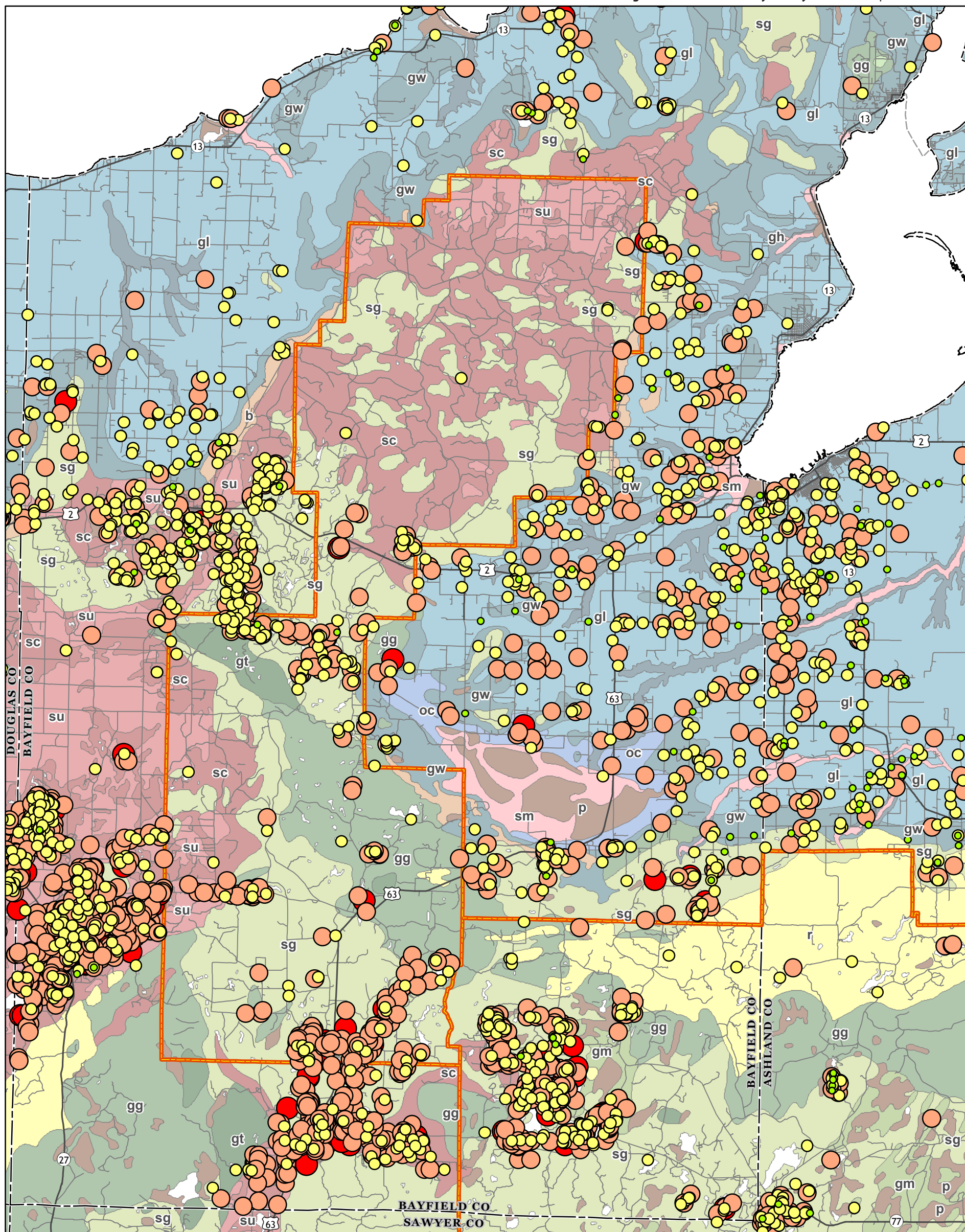
- | | | | | |
|----|----|----|----|---|
| sm | oc | su | gg | r |
| p | gl | sc | gm | |
| b | gw | sg | gt | |

Refer to Table 1 for unit descriptions.

Washburn/Great Divide Unit

0 4 Miles





Glacial hydraulic conductivity, log ft/day

- <0.5
- 0.5–1.5
- >1.5–2.5
- >2.5

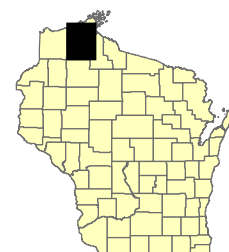
Pleistocene geology

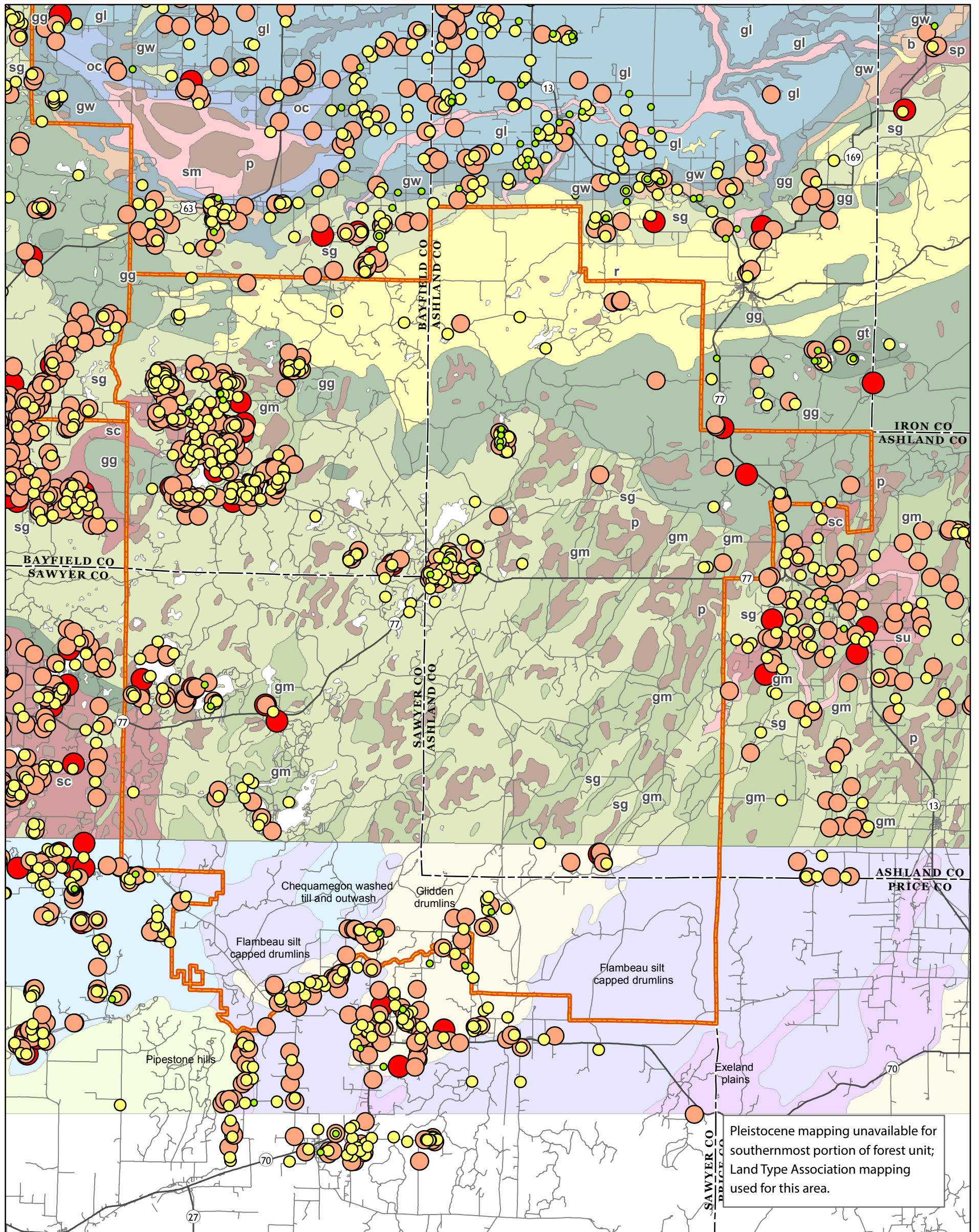
- | | | | |
|--|--|--|--|
| sm | gl | sc | gt |
| p | gw | sg | r |
| b | gh | gg | |
| oc | su | gm | |

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Washburn/Great Divide Unit

0 4 Miles





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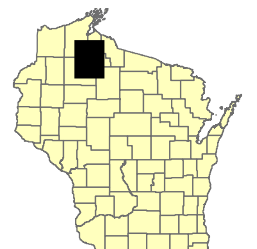
Pleistocene geology

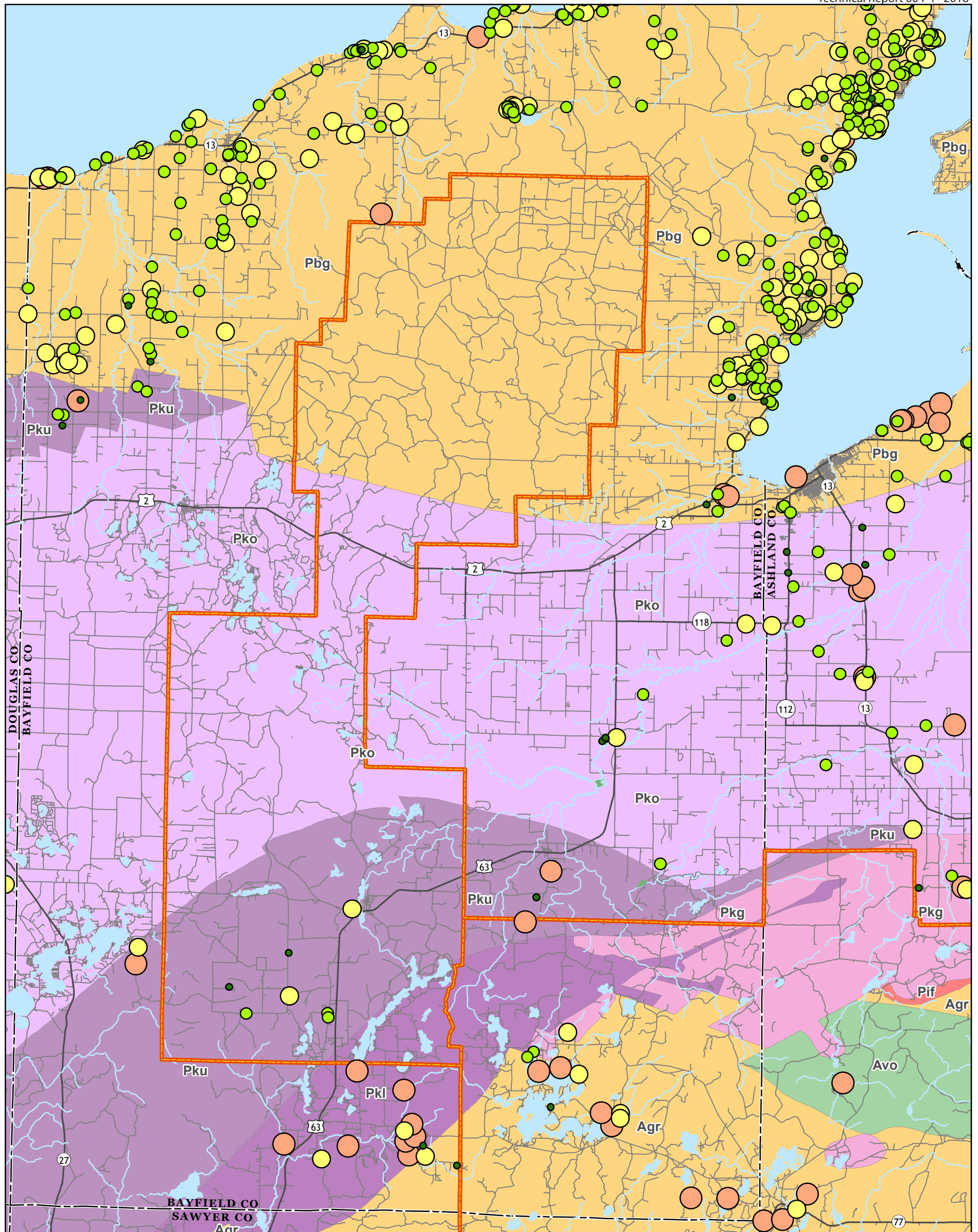
- | | | | |
|--|--|--|--|
| sm | oc | sc | gt |
| p | gl | sg | r |
| sp | gw | gg | |
| b | su | gm | |

Refer to Table 1 for unit descriptions.

Washburn/Great Divide Unit

0 4 Miles





Bedrock K, log ft/day

- <-0.5
- -0.5 to 0.5
- 0.5 to 1.5
- >1.5

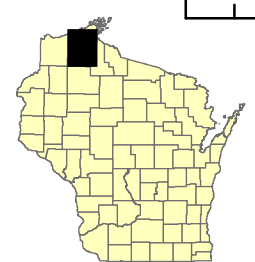
Washburn/Great Divide Unit

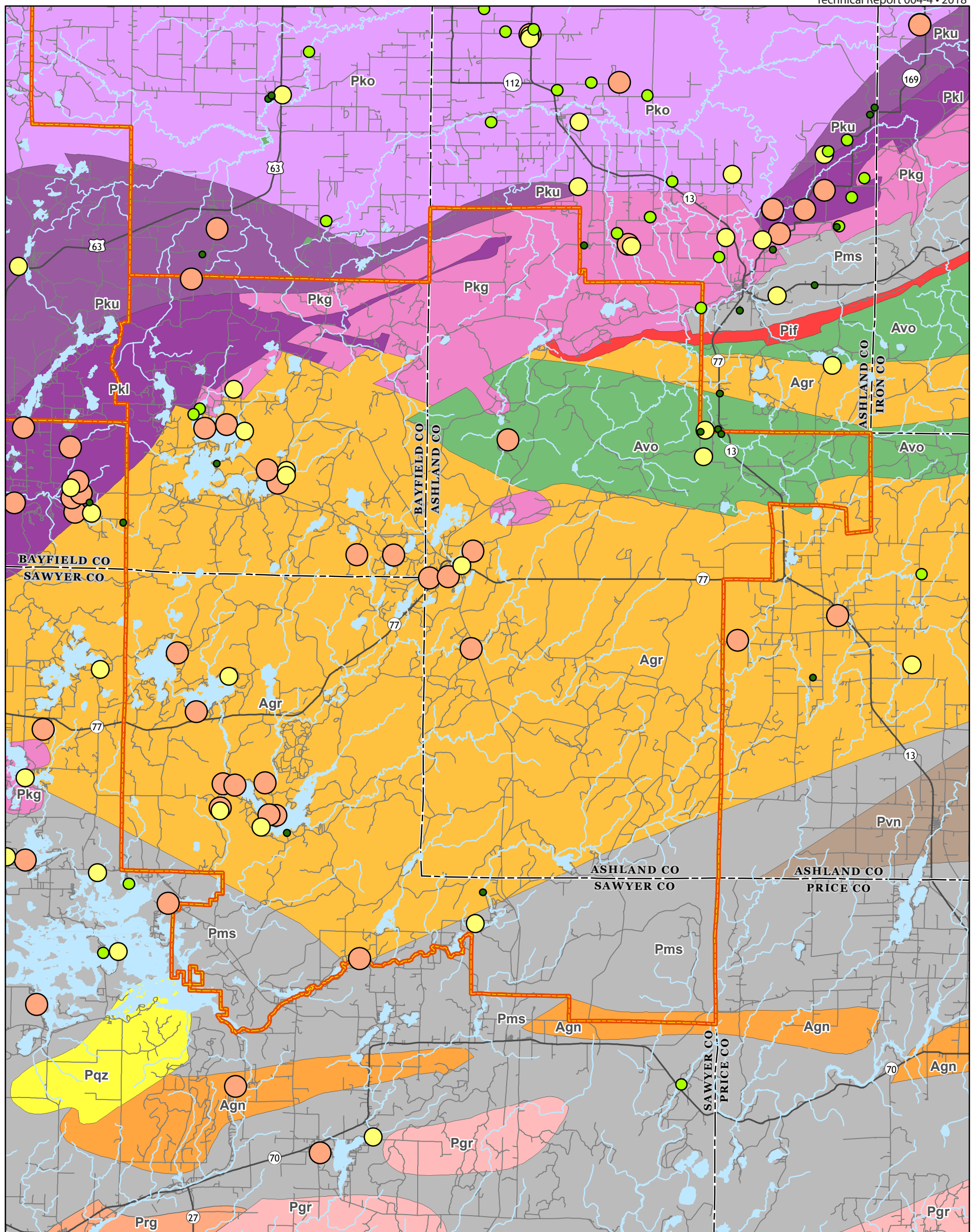
Bedrock geology

- | | | | |
|-----|-----|-----|-----|
| Pbg | Pku | Pkg | Agr |
| Pko | Pkl | Pif | Avo |

Refer to Table 2 for unit descriptions.

0 4 Miles





Bedrock K, log ft/day

- <-0.5
- -0.5 to 0.5
- 0.5 to 1.5
- >1.5

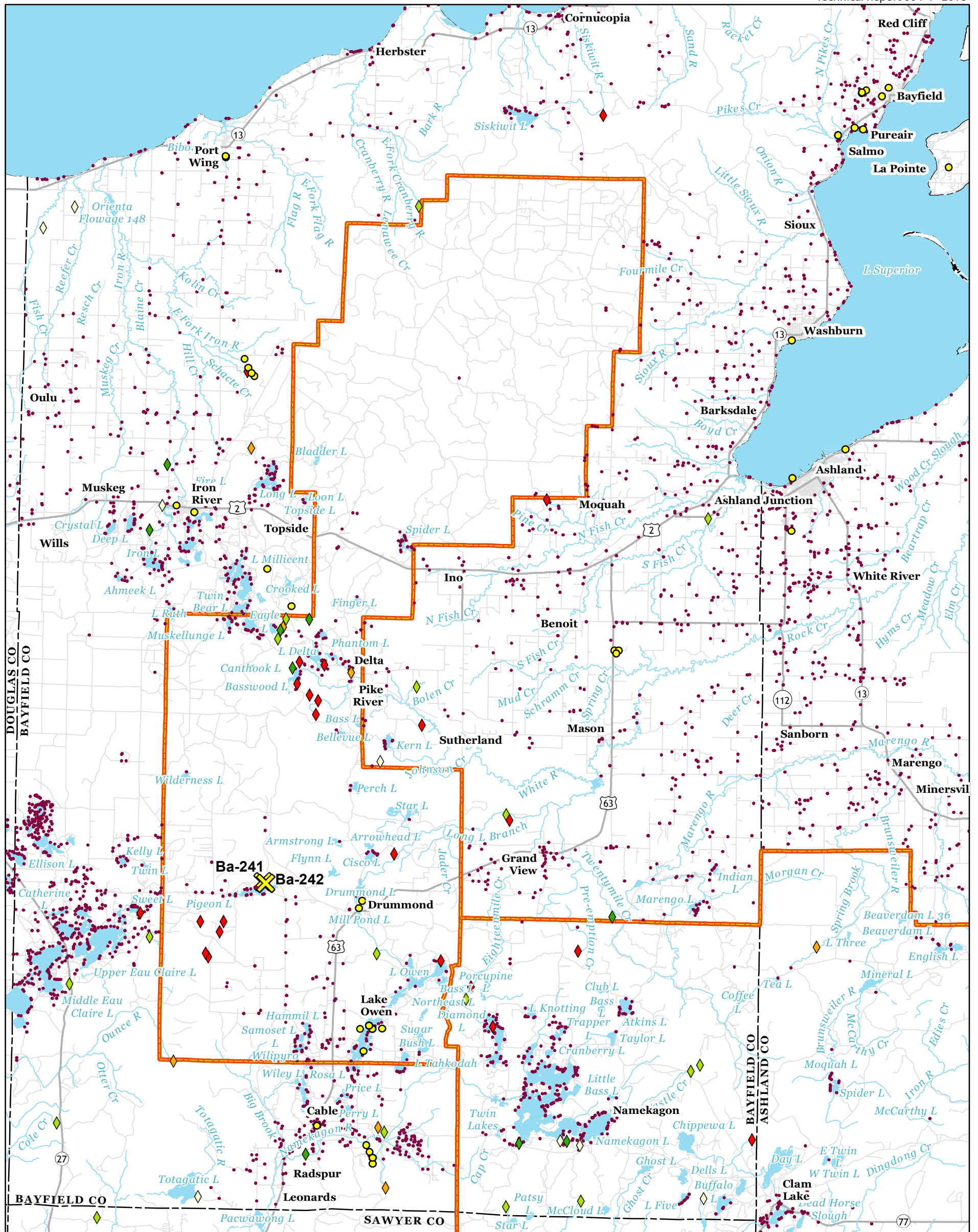
Washburn/Great Divide Unit

Bedrock geology

- | | | | |
|---|-----|-----|-----|
| Pko | Pkg | Pgr | Pvn |
| Pku | Pqz | Pms | Agr |
| Pkl | Prg | Pif | Avo |
| Refer to Table 2 for unit descriptions. | | | |
| | Agn | | |

0 4 Miles





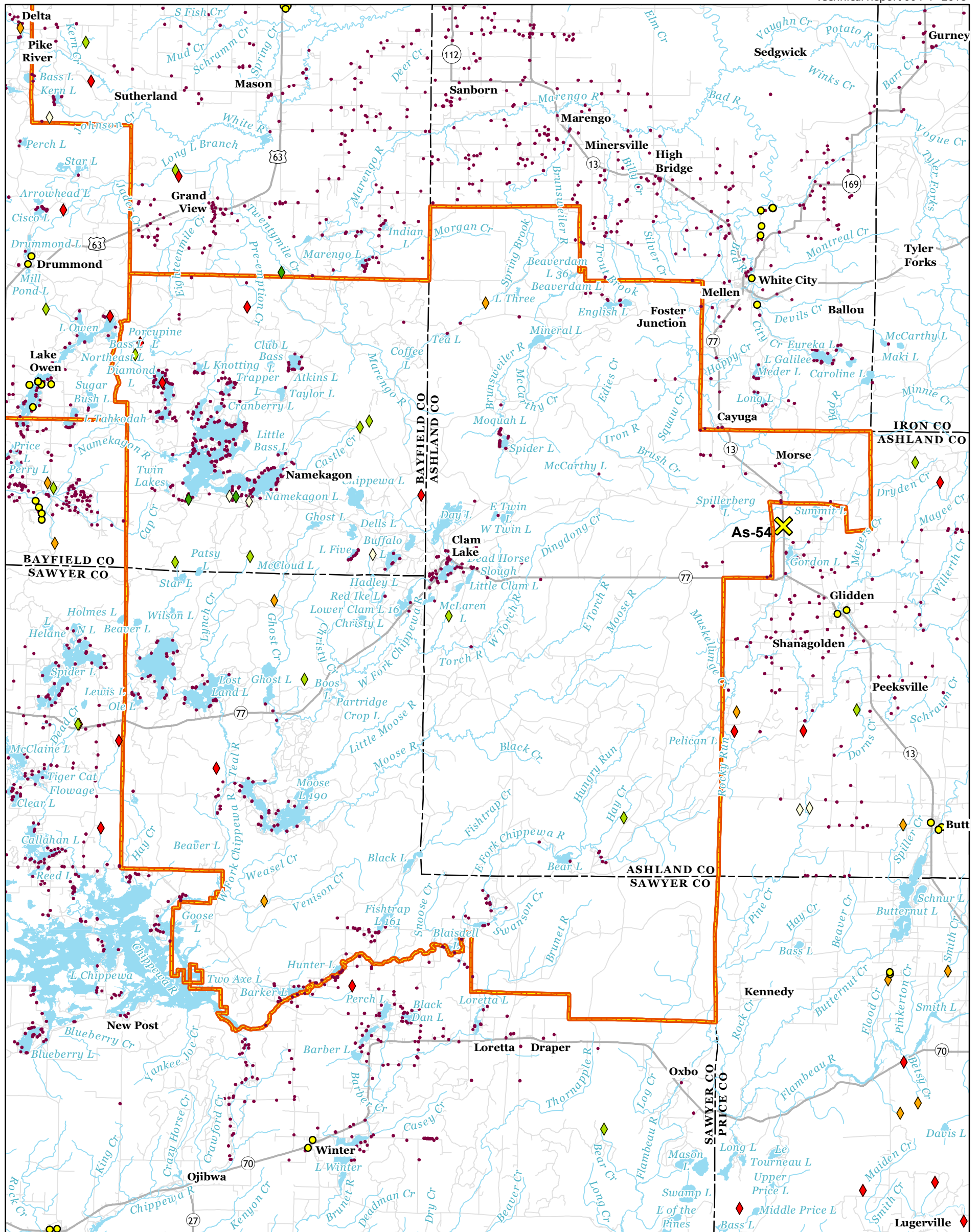
- Located wells
- High-capacity wells
- ✕ Ba-241 and Ba-242 monitoring wells
- ▭ Washburn/Great Divide Unit

**Mapped springs and spring ponds;
flow in cubic feet per second**

- ◇ No measurement
- ◆ <0.1
- ◆ 0.1–0.5
- ◆ 0.5–1.0
- ◆ >1.0

0 4 Miles



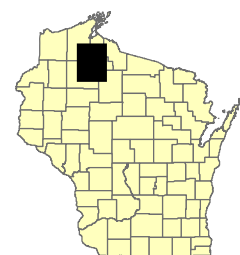


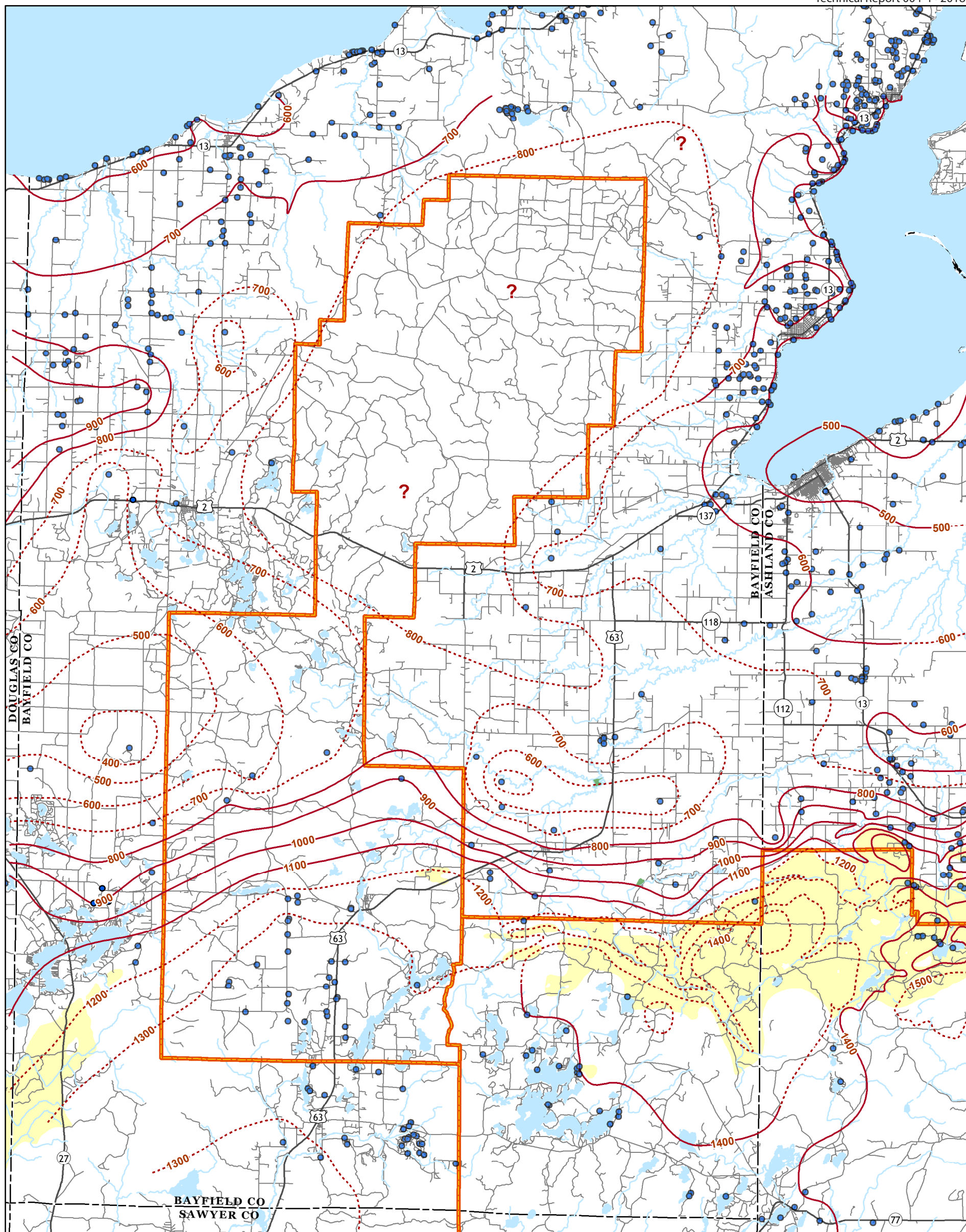
- Located wells
- ✕ AS-54 monitoring well
- High-capacity wells
- ▭ Washburn/Great Divide Unit

**Mapped springs and spring ponds;
flow in cubic feet per second**

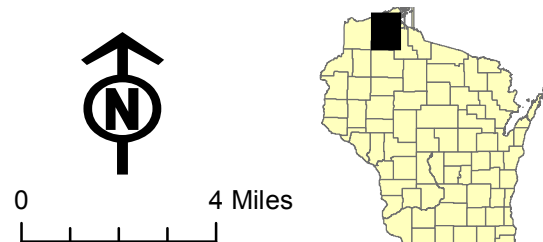
- ◇ No measurement
- ◇ <0.1
- ◇ 0.1–0.5
- ◇ 0.5–1.0
- ◇ >1.0

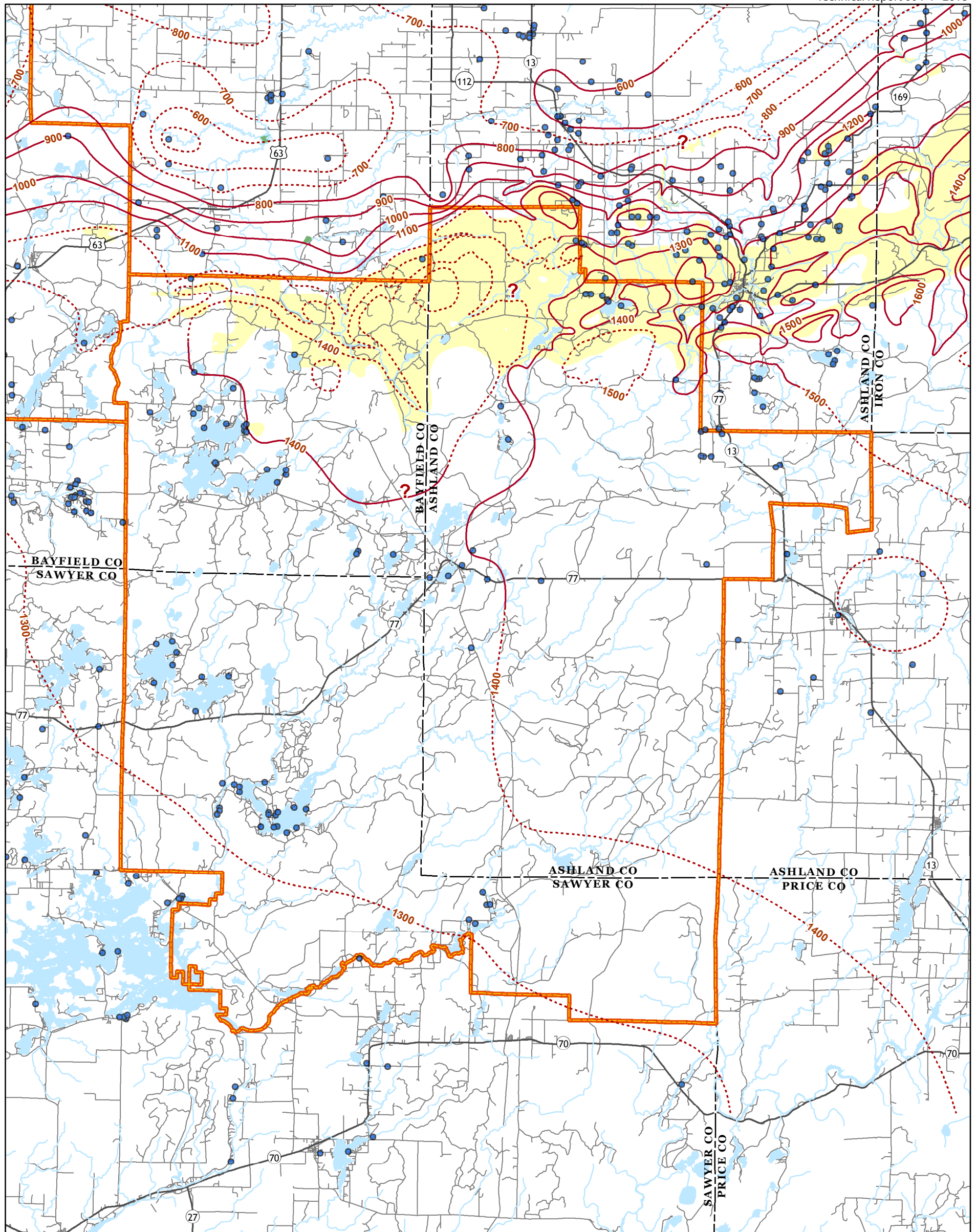
0 4 Miles



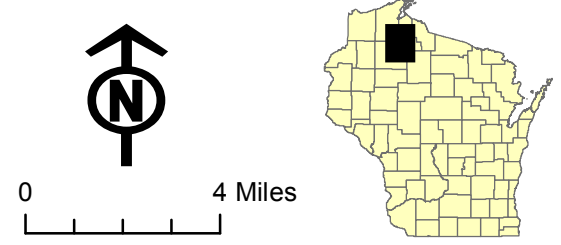


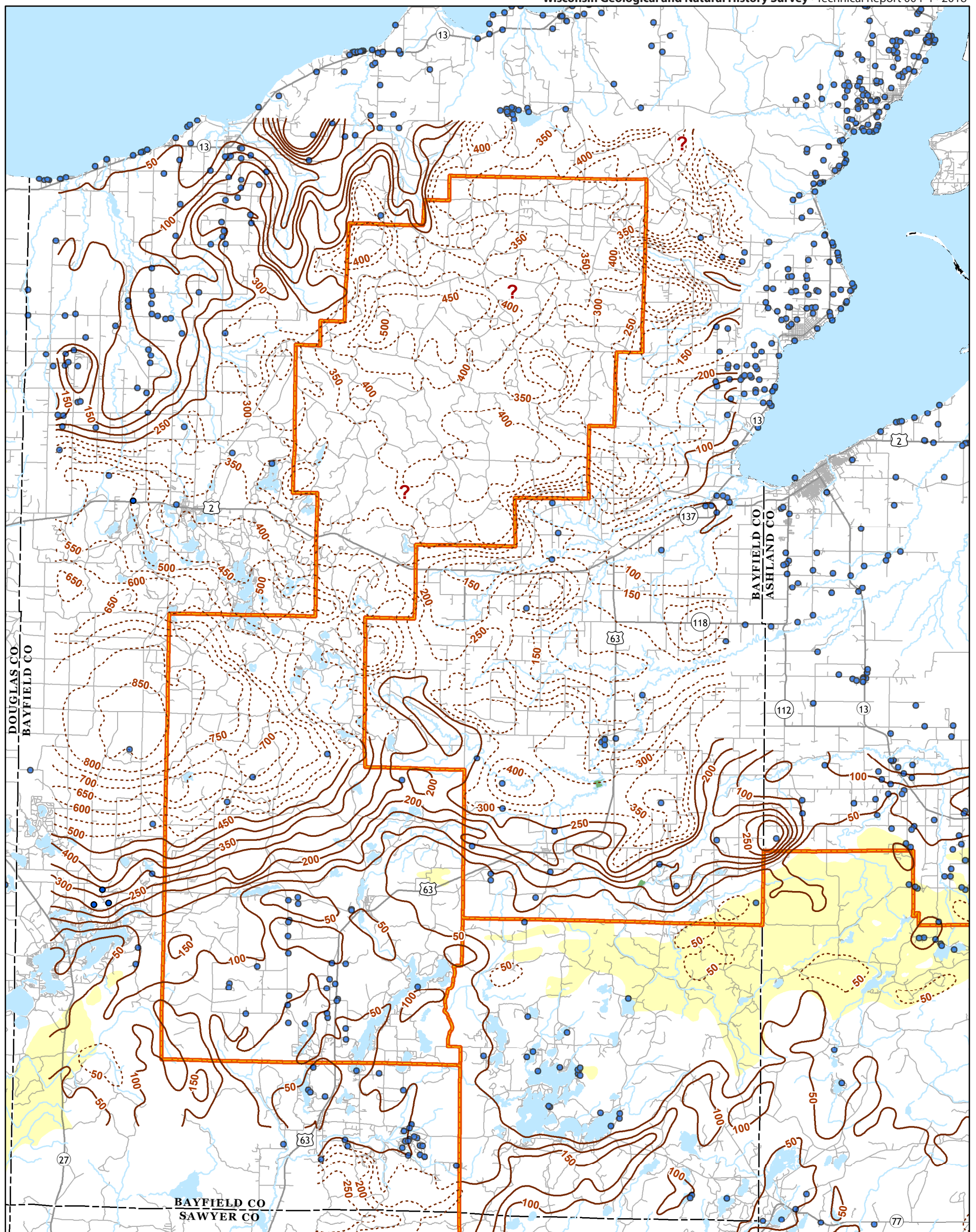
- Bedrock elevation, ft; contour interval 100 ft
- - - Bedrock elevation interpreted from poor information
- Well reaching bedrock
- ? No data, bedrock elevation uncertain
- shallow bedrock, generally within 50 ft of surface
- Washburn/Great Divide Unit





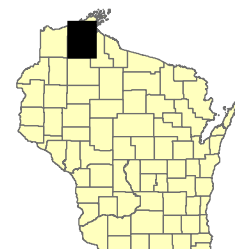
- Bedrock elevation, ft; contour interval 100 ft
- - - Bedrock elevation interpreted from poor information
- Well reaching bedrock
- ? No data, bedrock elevation uncertain
- shallow bedrock, generally within 50 ft of surface
- ▭ Washburn/Great Divide Unit

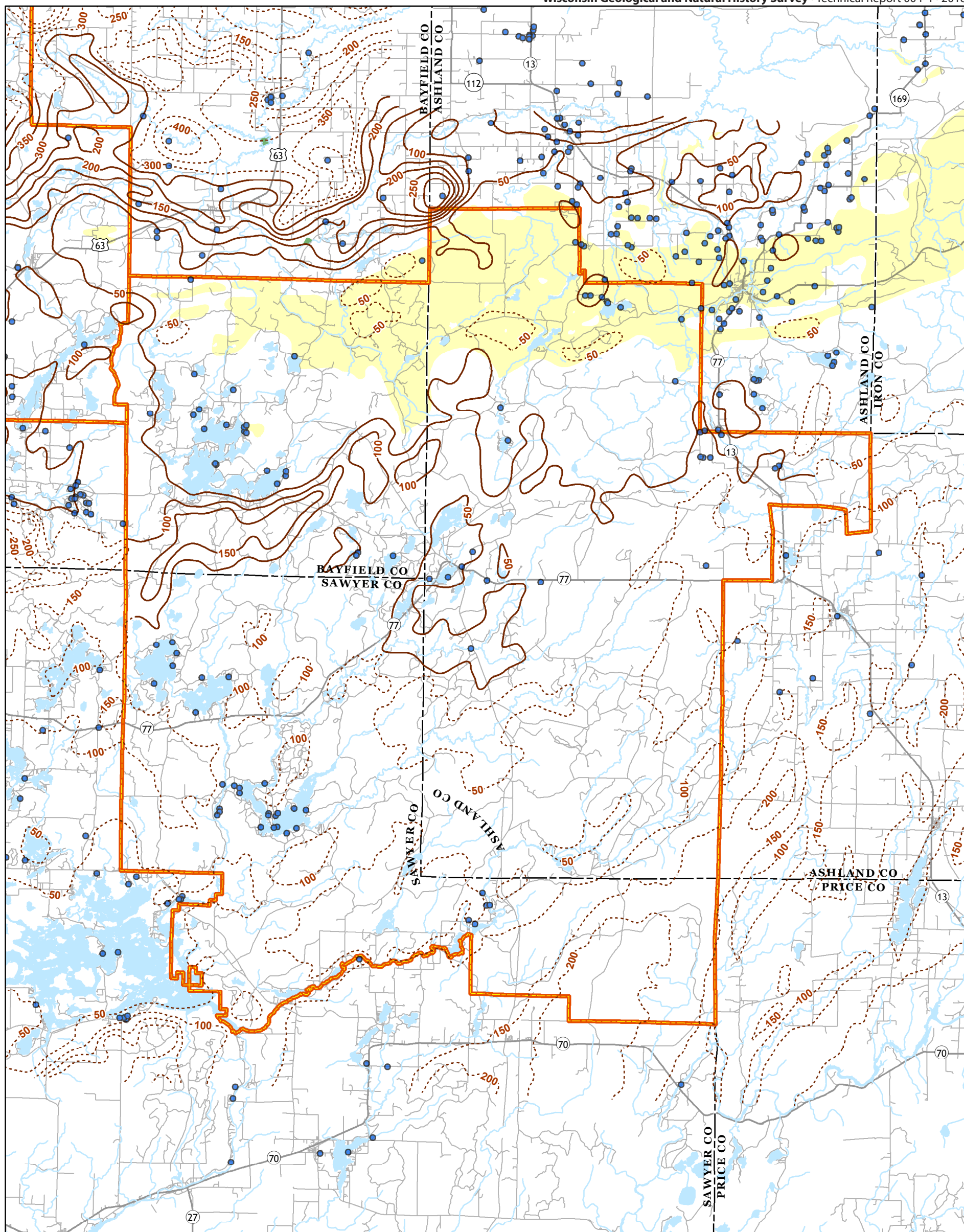




- Depth to bedrock, ft; contour interval 50 ft
- - - Depth to bedrock interpreted from poor information
- ▭ Washburn/Great Divide Unit
- ▭ Shallow bedrock, generally less than 50 ft below surface
- Well reaching bedrock
- ? No data, depth to bedrock uncertain

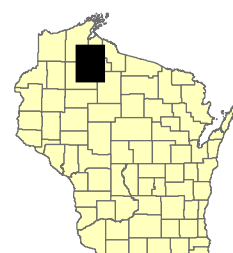
0 4 Miles

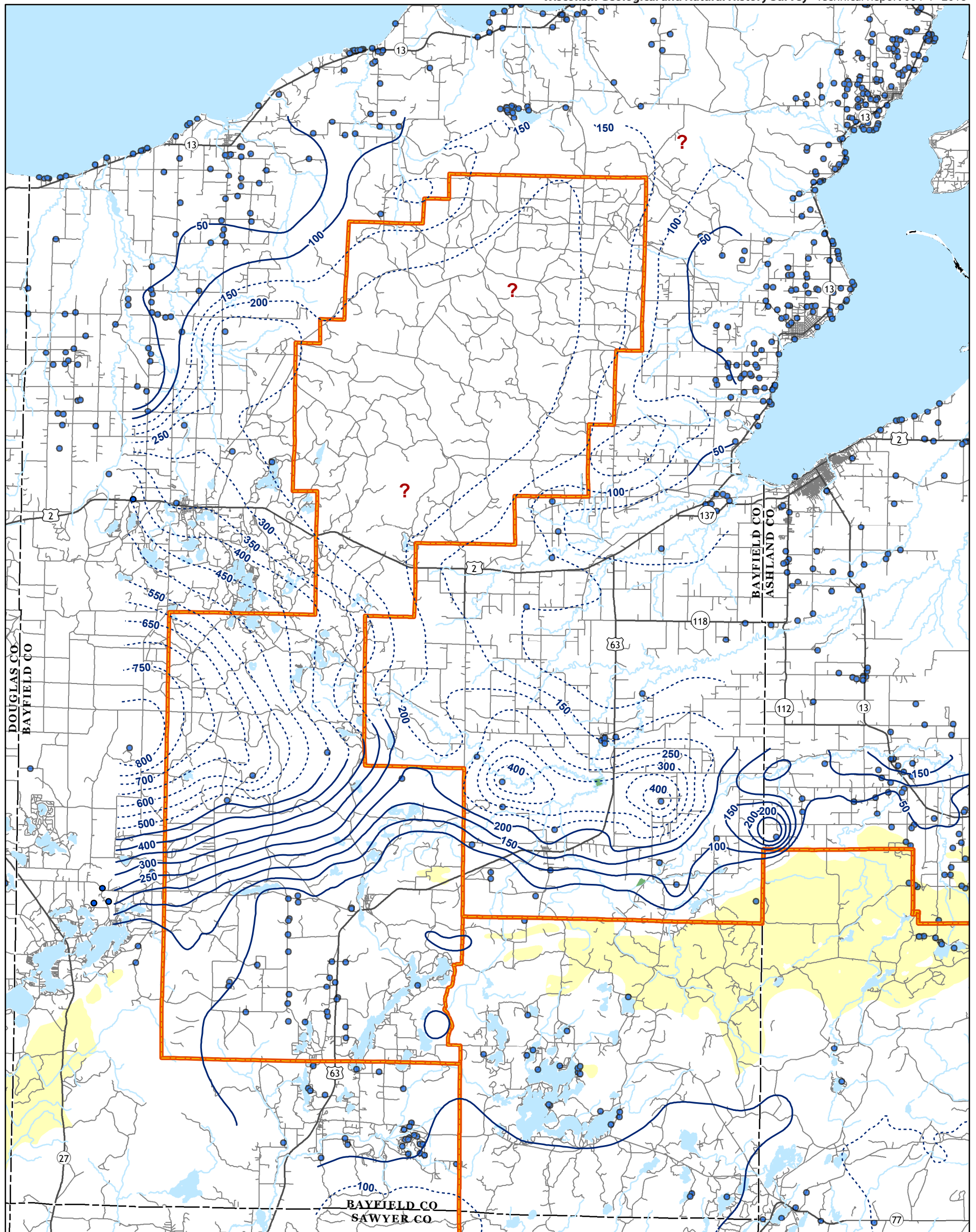




- Depth to bedrock, ft; contour interval 50 ft
- Depth to bedrock interpreted from poor information
- Washburn/Great Divide Unit
- Shallow bedrock, generally less than 50 ft below surface
- Well reaching bedrock

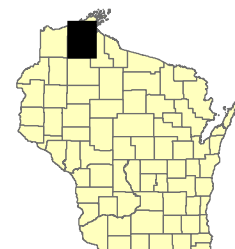
0 4 Miles



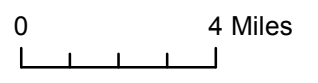
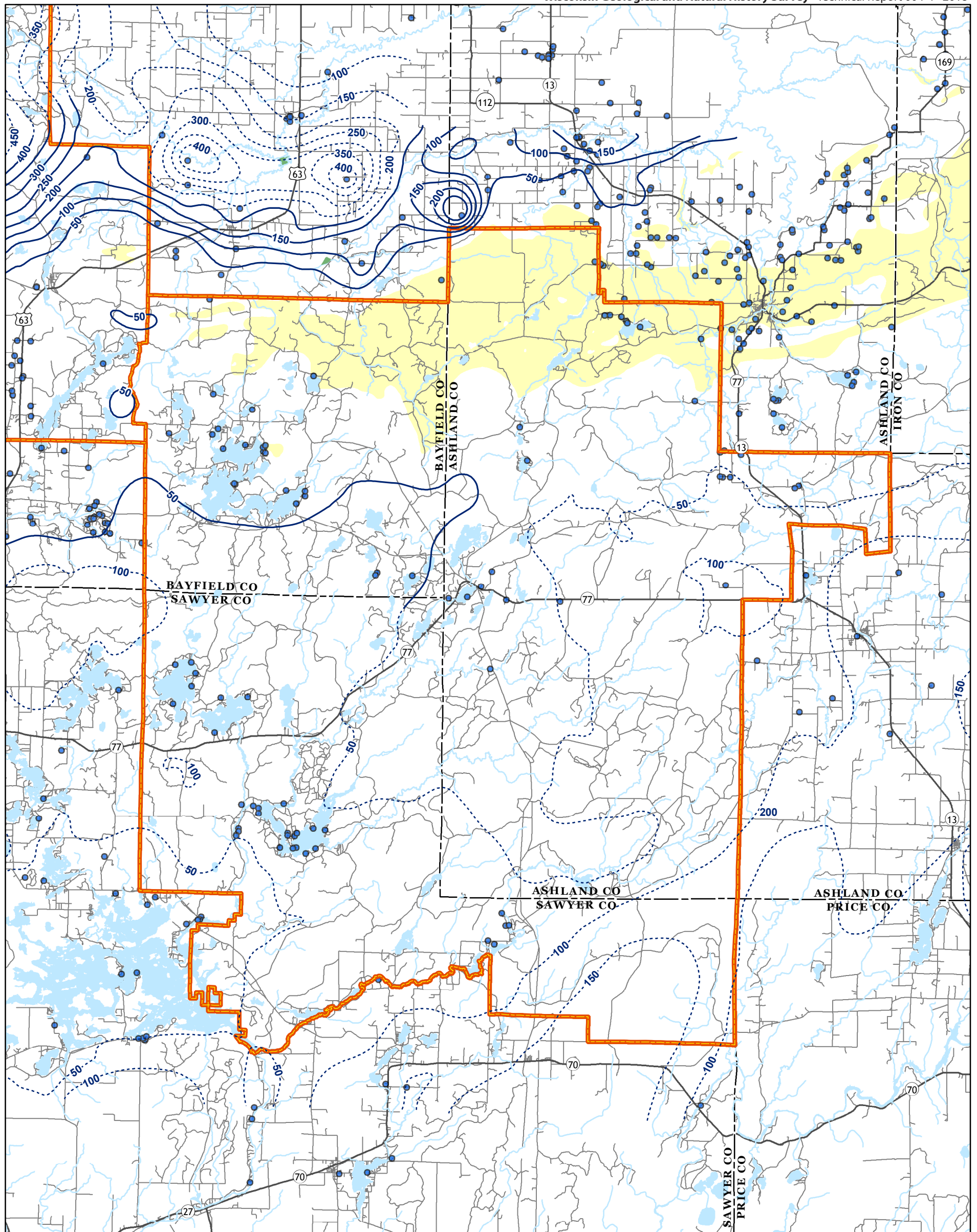


- Saturated thickness, ft; contour interval 50 ft
- Saturated thickness interpreted from poor information
- Washburn/Great Divide Unit
- Well reaching bedrock
- Shallow bedrock, generally within 50 ft of surface
- No data, saturated thickness uncertain

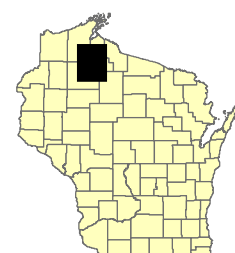
0 4 Miles



Shallow bedrock layer from areas mapped as pre-Pleistocene rock by Clayton, 1985. Bedrock lithographic records from wisLITH (WGNHS, 2012). Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Hydrography from National Hydrography Dataset, 2012.



- Saturated thickness, ft; contour interval 50 ft
- - - Saturated thickness interpreted from poor information
- Washburn/Great Divide Unit
- Well reaching bedrock
- shallow bedrock, generally within 50 ft of surface
- ? No data, saturated thickness uncertain



Shallow bedrock layer from areas mapped as pre-Pleistocene rock by Clayton, 1985. Bedrock lithographic records from wisLITH (WGNHS, 2012). Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Hydrography from National Hydrography Dataset, 2012.

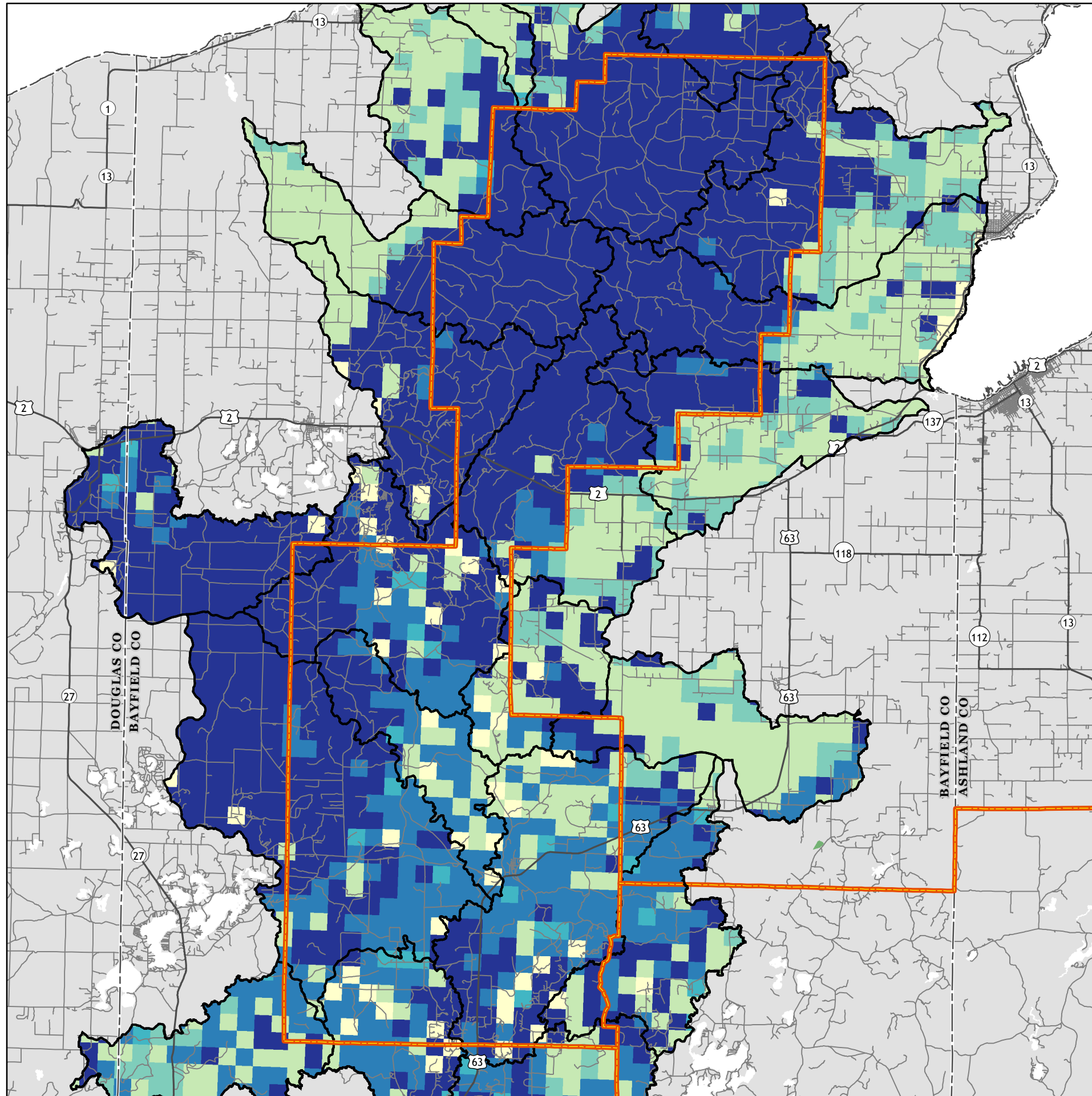


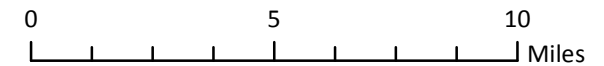


Plate 8a
Average annual groundwater recharge
(2000–2010)
 Watersheds of the Washburn District of the
 Chequamegon-Nicolet National Forest
 Wisconsin




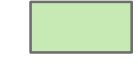




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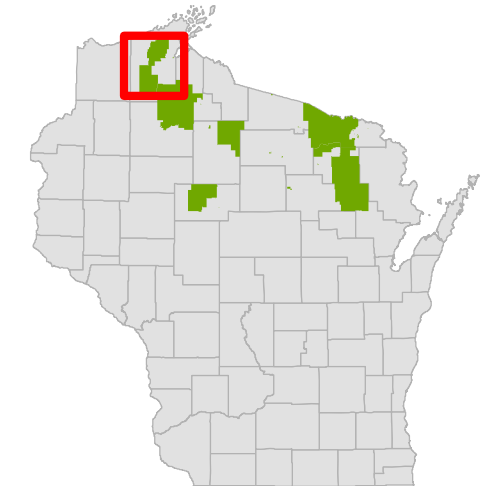
-  Washburn/Great Divide Unit
-  Watersheds



Mean annual recharge, 2000–2010

Inches

-  <3
-  3–6
-  >6–9
-  >9–12
-  >12–15
-  >15



Groundwater recharge was estimated through application of a soil-water balance (SWB) model and calibrated in a separate groundwater flow model. A brief description is provided here; see accompanying report for model setup, results, and data availability.

The SWB model estimates the distribution of deep drainage, approximately equal to groundwater recharge, through time using a modified Thornthwaite-Mather method to track soil moisture storage and flux on a spatially referenced grid at daily time increments. Inputs to the SWB model include map data layers for land surface topography and soil and land cover characteristics, as well as daily climate records. Model outputs included datasets of annual recharge from 2000 to 2010 and tabular summaries of daily and annual water balance calculations.

The 2000–2010 SWB annual recharge output was then used as initial input for a groundwater flow model. During flow model calibration, recharge was adjusted by using a multiplier to calibrate to groundwater conditions by adjusting the magnitude of recharge while maintaining the spatial distribution of SWB results. The SWB results were also downsampled for use in the flow model, resulting in a grid that is more generalized than the original SWB output. The results of this recharge calibration are shown here.

Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Watershed boundaries and hydrography from National Hydrography Dataset, 2011–12.

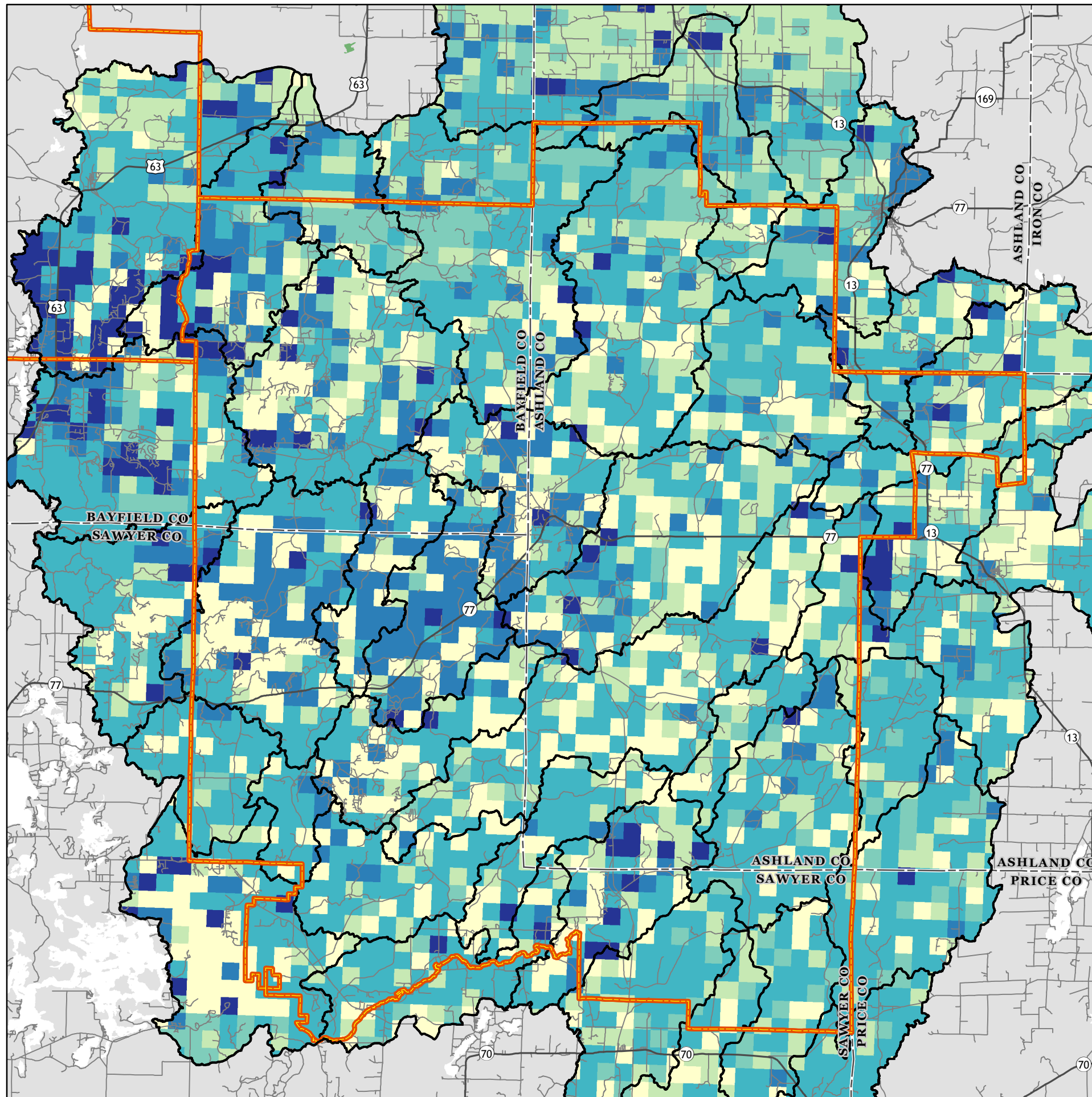
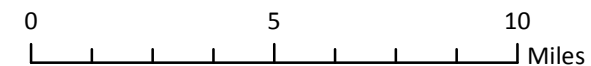




Plate 8b
Average annual groundwater recharge
(2000–2010)

Watersheds of the Great Divide District of the
 Chequamegon-Nicolet National Forest
 Wisconsin



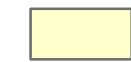
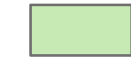




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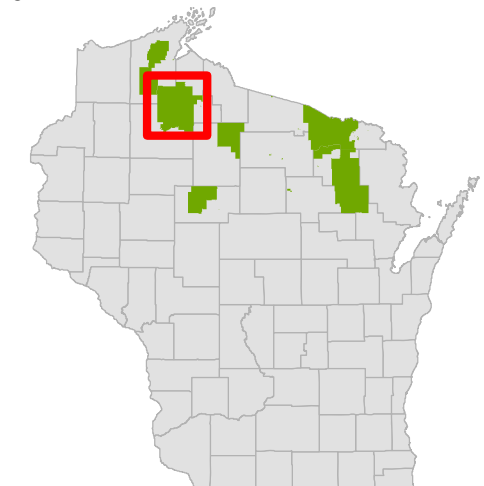


-  Washburn/Great Divide Unit
-  Watersheds

Mean annual recharge, 2000–2010

Inches

-  <3
-  3–6
-  >6–9
-  >9–12
-  >12–15
-  >15

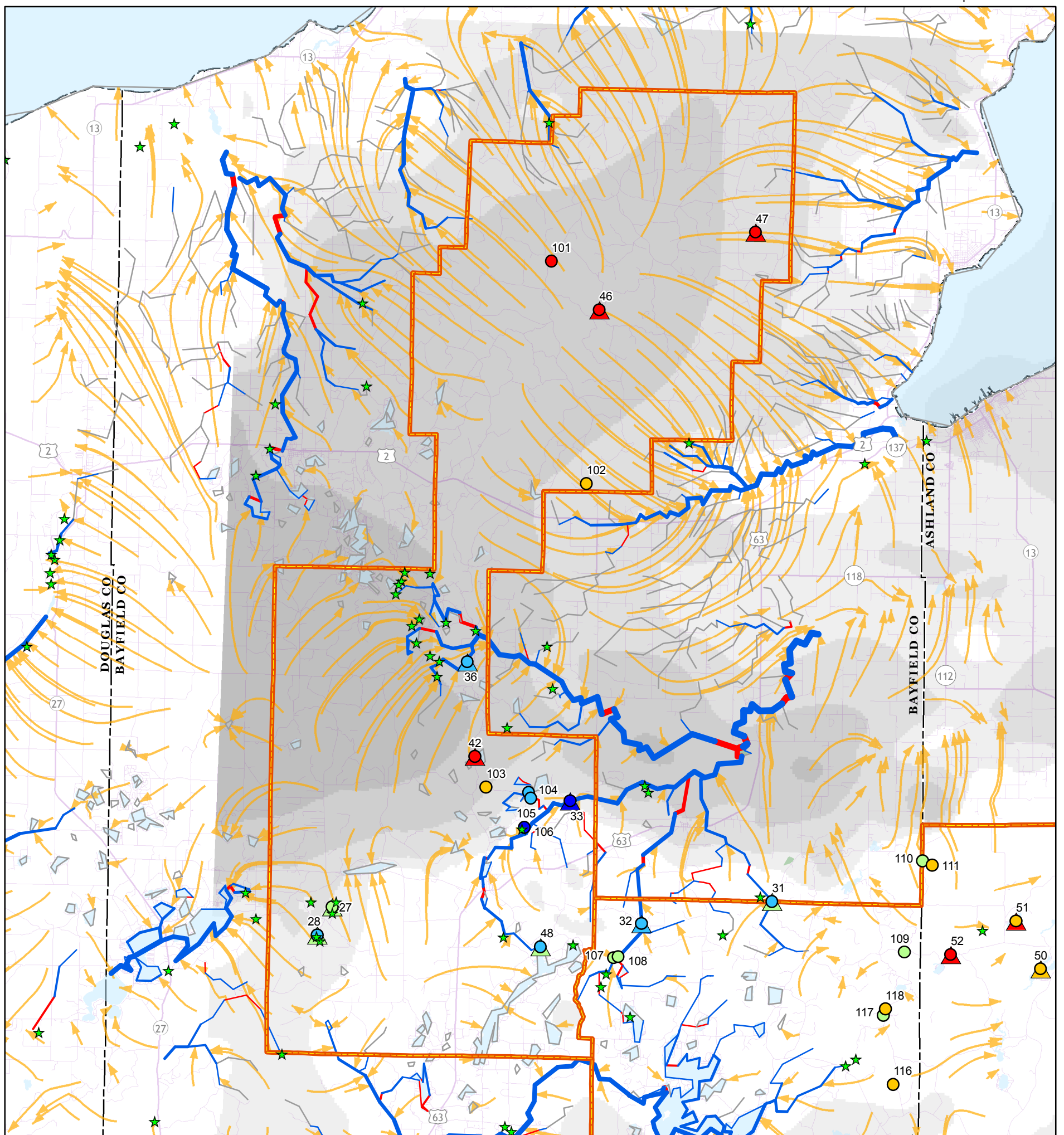


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The SWB model estimates the distribution of deep drainage, approximately equal to groundwater recharge, through time using a modified Thornthwaite-Mather method to track soil moisture storage and flux on a spatially referenced grid at daily time increments. Inputs to the SWB model include map data layers for land surface topography and soil and land cover characteristics, as well as daily climate records. Model outputs included datasets of annual recharge from 2000 to 2010 and tabular summaries of daily and annual water balance calculations.

The 2000–2010 SWB annual recharge output was then used as initial input for a groundwater flow model. During flow model calibration, recharge was adjusted by using a multiplier to calibrate to groundwater conditions by adjusting the magnitude of recharge while maintaining the spatial distribution of SWB results. The SWB results were also downsampled for use in the flow model, resulting in a grid that is more generalized than the original SWB output. The results of this recharge calibration are shown here.

Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Watershed boundaries and hydrography from National Hydrography Dataset, 2011–12.



Stream and lake samples¹

Conductivity, $\mu\text{s}/\text{cm}$	Alkalinity, mg/L
● 16–50	▲ 8–30
● >50–100	▲ >30–50
● >100–150	▲ >50–70
● >150–200	▲ >70–100
● >200–300	▲ >100–130

¹Label indicates site number. See report for further explanation.

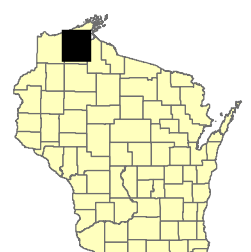
Simulated stream baseflow, by color and line weight²

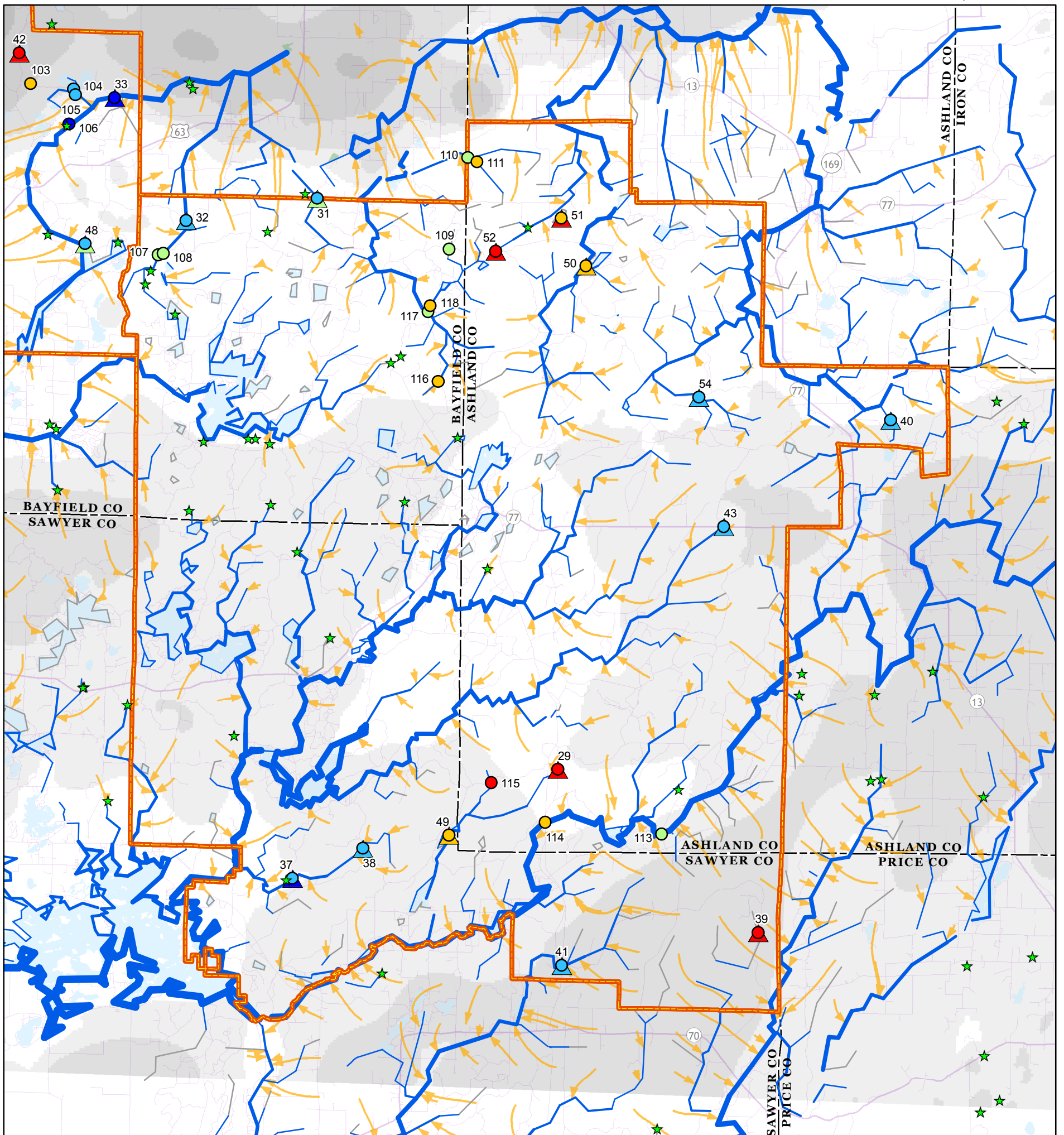
Aquifer interaction	Baseflow, cfs
— Dry	— 0–2
— Gaining from groundwater	— >2–6
— Losing to groundwater	— >6–12
	— >12–20
	— >20–30
	— >30–50
	— >50–90
	— >90–150
	— >150–230
	— >230–440

²Color indicates interaction with aquifer; line weight proportional to baseflow volume. Gray lines indicate streams that are represented in the flow model but have zero simulated baseflow. Far-field streams not shown.

	Washburn/Great Divide Unit
★	Springs and spring ponds
	Simulated groundwater flow path
Saturated aquifer thickness, ft	
	<50
	50–100
	>100–200
	>200–400
	>400

Springs and spring ponds from Macholl, 2007. Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Hydrography from National Hydrography Dataset, 2012.





Stream and lake samples¹

Conductivity, $\mu\text{s/cm}$	Alkalinity, mg/L
● 16–50	▲ 8–30
● >50–100	▲ >30–50
● >100–150	▲ >50–70
● >150–200	▲ >70–100
● >200–300	▲ >100–130

¹Label indicates site number. See report for further explanation.

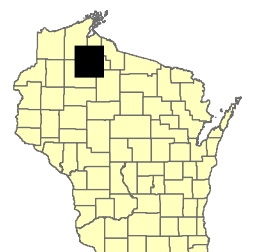
Simulated stream baseflow, by color and line weight²

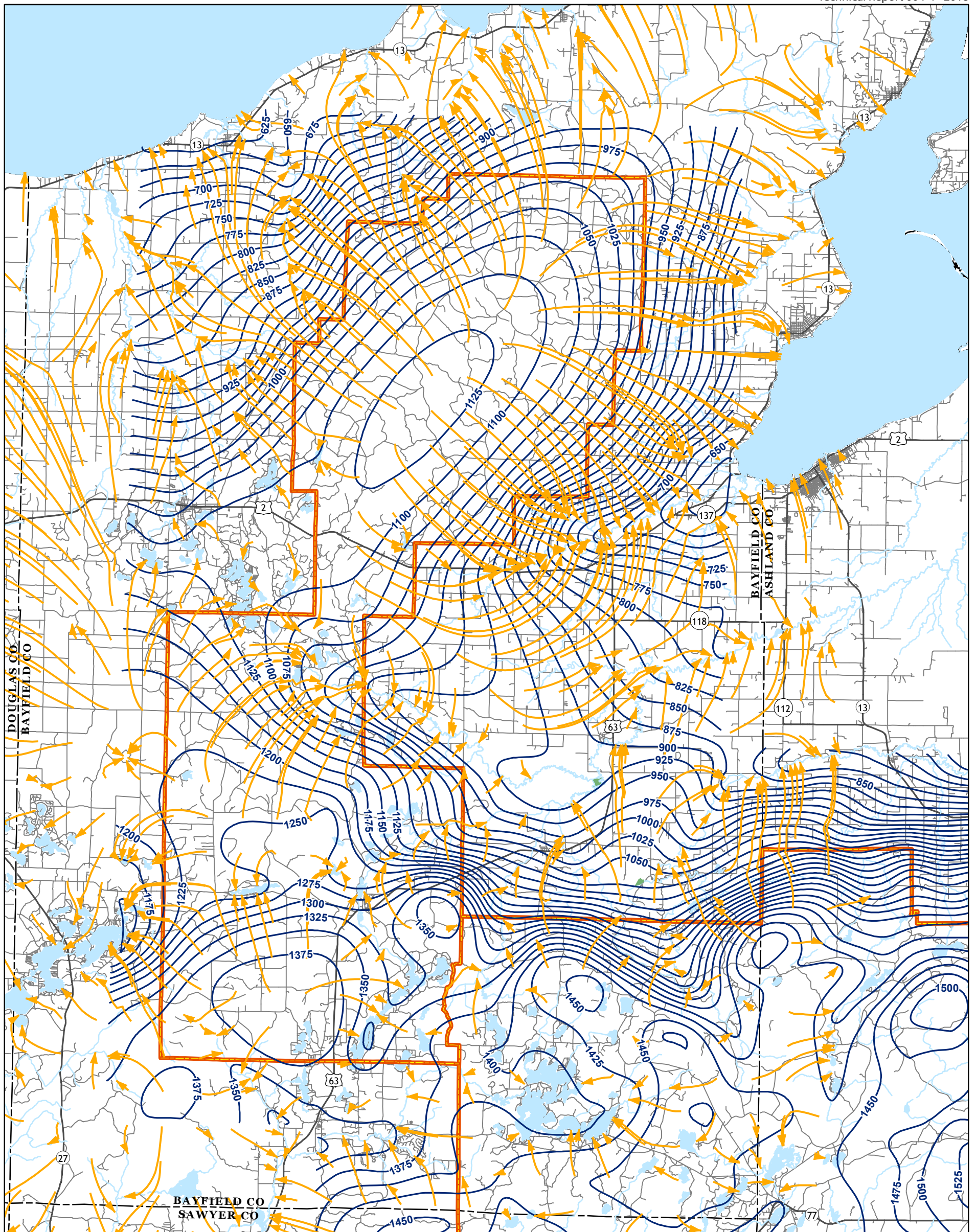
Aquifer interaction	Baseflow, cfs
— Dry	— 0–2
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	— >12–20
	— >20–30
	— >30–50
	— >50–90
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	— >230–440




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	Washburn/Great Divide Unit
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	Simulated groundwater flow path
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	50–100
	>100–200
	>200–400
	>400

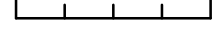
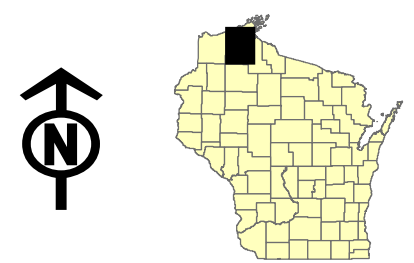
Springs and spring ponds from Macholl, 2007. Political boundaries from Wisconsin DNR, 2011. National Forest boundaries from the USDA Forest Service, 2011. Roads from U.S. Census Bureau, 2015. Hydrography from National Hydrography Dataset, 2012.

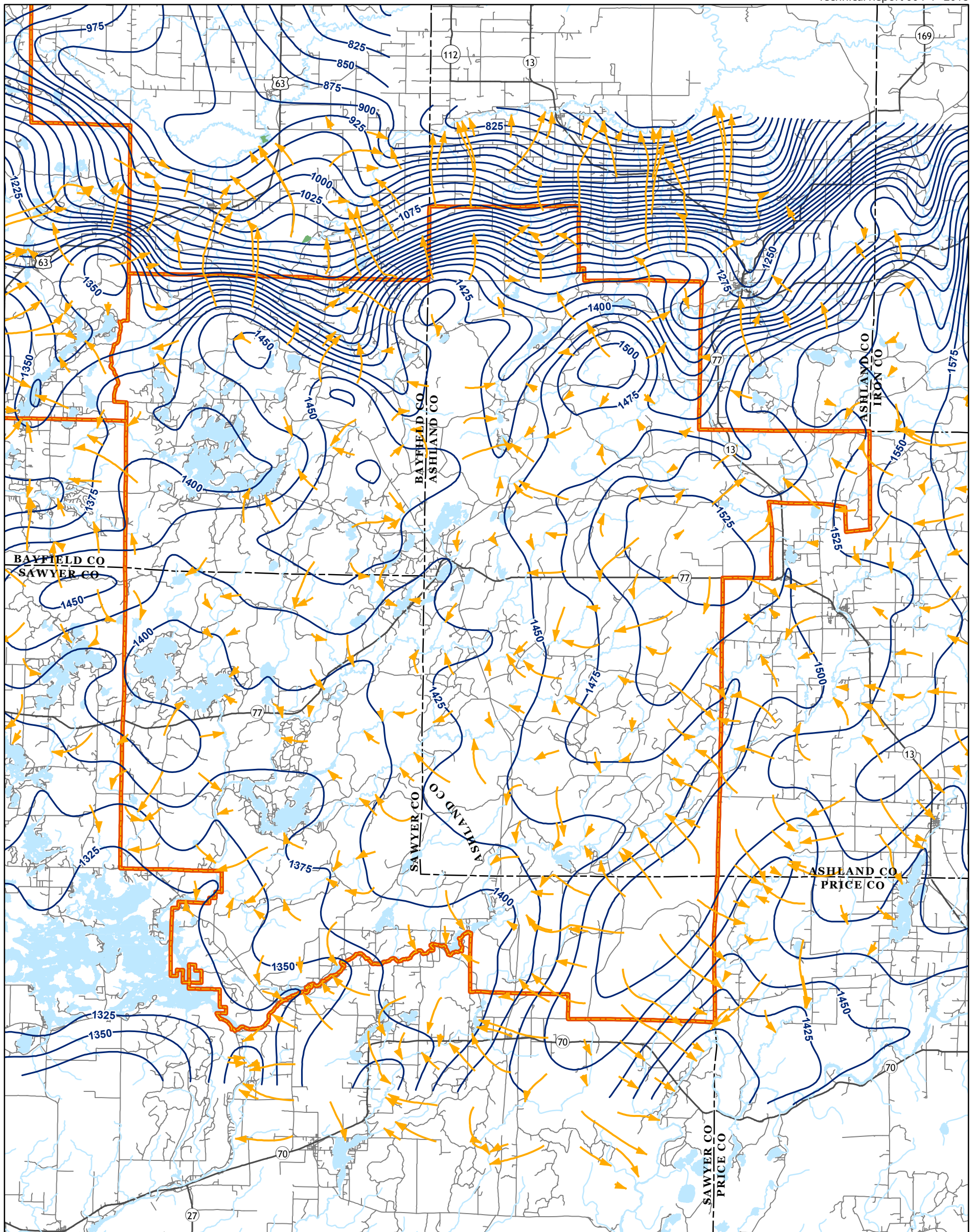







-  Simulated water table, ft; contour interval 25 ft
-  Simulated flow path
-  Washburn/Great Divide Unit

0 4 Miles



-  Simulated water table, ft; contour interval 25 ft
-  Simulated flow path
-  Washburn/Great Divide Unit

0 4 Miles

