



Regional Water Supply Planning in Southeastern Wisconsin

Presentation to the
Waukesha County Board of Supervisors
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Background

A Cooperative Program...

SE Wisconsin
Water Utilities



Seven Southeastern
Wisconsin Counties





Background

Regional Water Supply Planning Program

Three Elements (Coordinated With And Designed To Complement Local Actions)

1. Conduct Basic Groundwater Inventories (Completed in 2001 With Partners—WGNHS and WDNR)
2. Collect Additional Inventory Data and Develop Regional Aquifer Simulation Model (Completed in 2005 with Partners—USGS, WGNHS, UW-Milwaukee, WDNR, and SE Wisconsin Water Utilities)
3. Prepare Regional Water Supply System Plan (Partners Include USGS, WGNHS, UW-Milwaukee, and WDNR)



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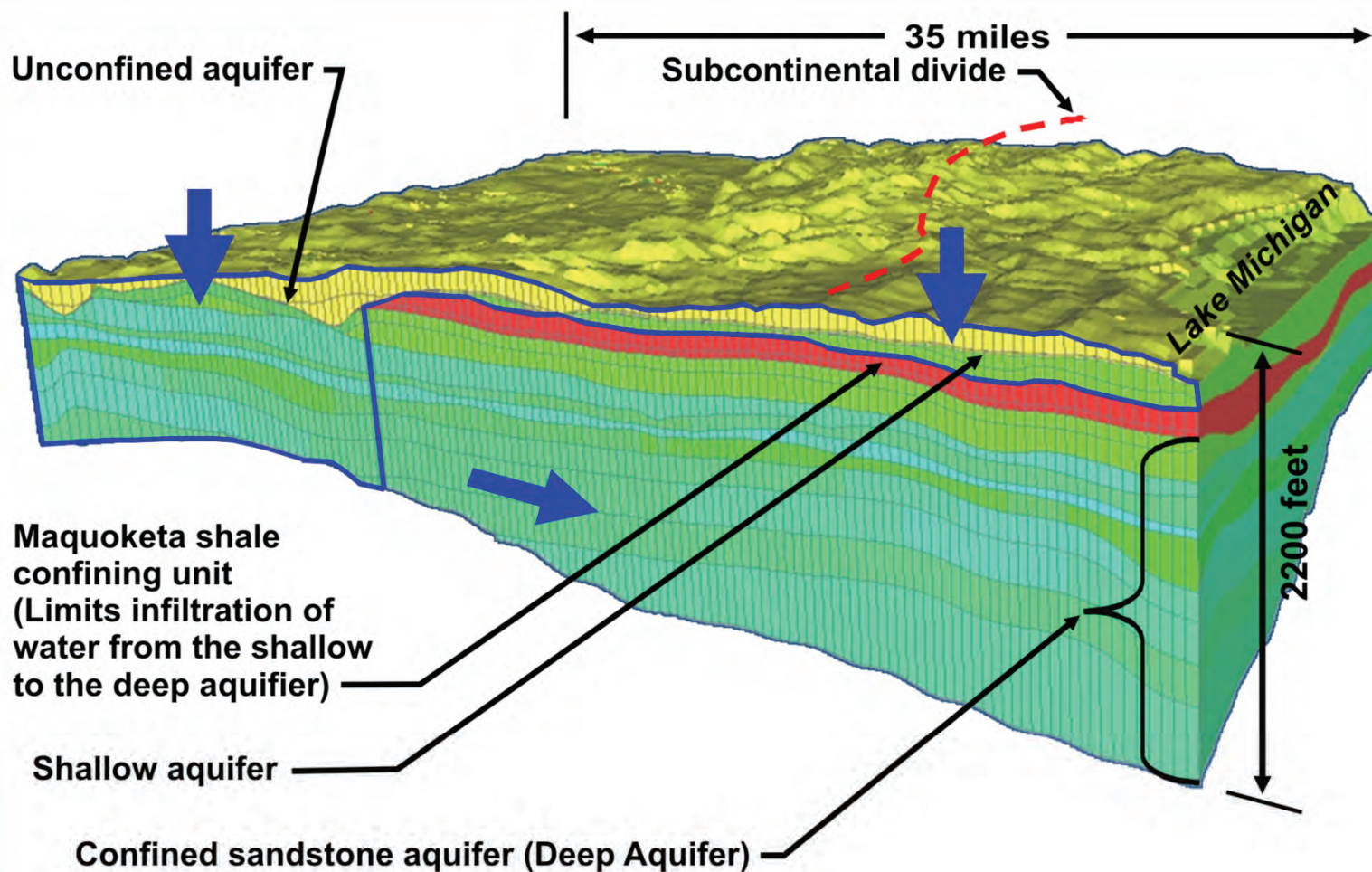
Daniel S. Winkler
Director of Public Works and Utilities, City of Lake Geneva

Steven N. Yttri
General Manager, Water and Sewer Utility, City of Oak Creek



Background

General Hydrogeology of Southeast Wisconsin



Private residential wells are generally in the shallow aquifer and 100 to 300 feet deep. Most municipal wells are 200 to 800 feet deep with some up to 2,200 feet deep, and are in both the shallow and deep aquifer.

Source: USGS.

Background

Objective – To assess whether the water supply for this Region can sustain existing and planned population and development.

Experience to Date

➤ Current water supply (290 mgd)




- Lake Michigan – 9 plants (28 systems) serving 1.2 million people (210 mgd-72%)
- Groundwater – 50 systems serving 400,000 people (55 mgd-19%)
- Groundwater – individual wells serving 350,000 people (25 mgd-9%)

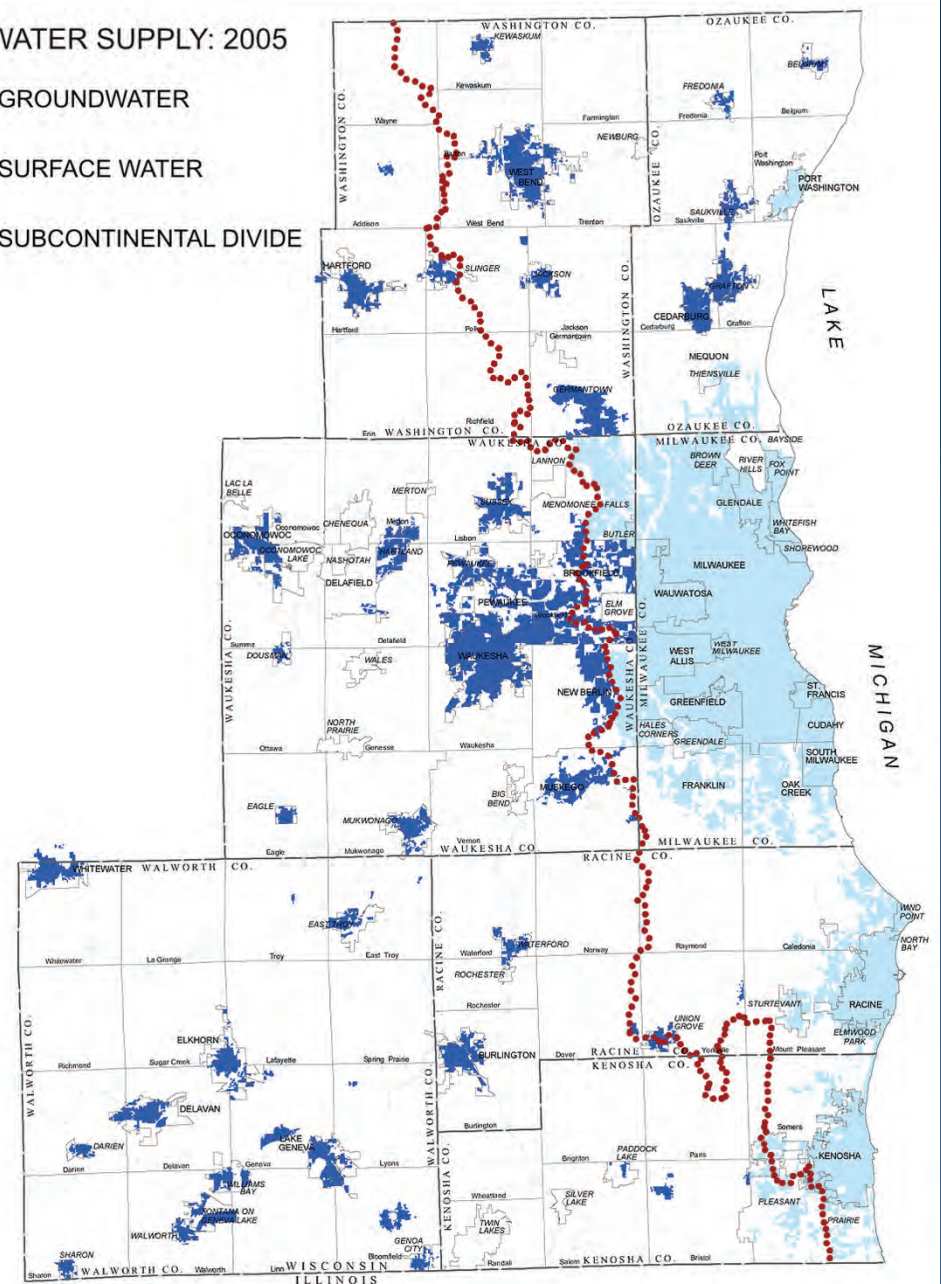
➤ Groundwater deep aquifer – historic 4 to 5 feet annual drawdown and some radium and dissolved solids problems.

➤ Groundwater shallow aquifer – some isolated seasonal supply problems and quality issues.

➤ Lake Michigan water – existing treatment plants operating at less than 50 percent of capacity.

PUBLIC WATER SUPPLY: 2005

-  GROUNDWATER
-  SURFACE WATER
-  SUBCONTINENTAL DIVIDE






Background

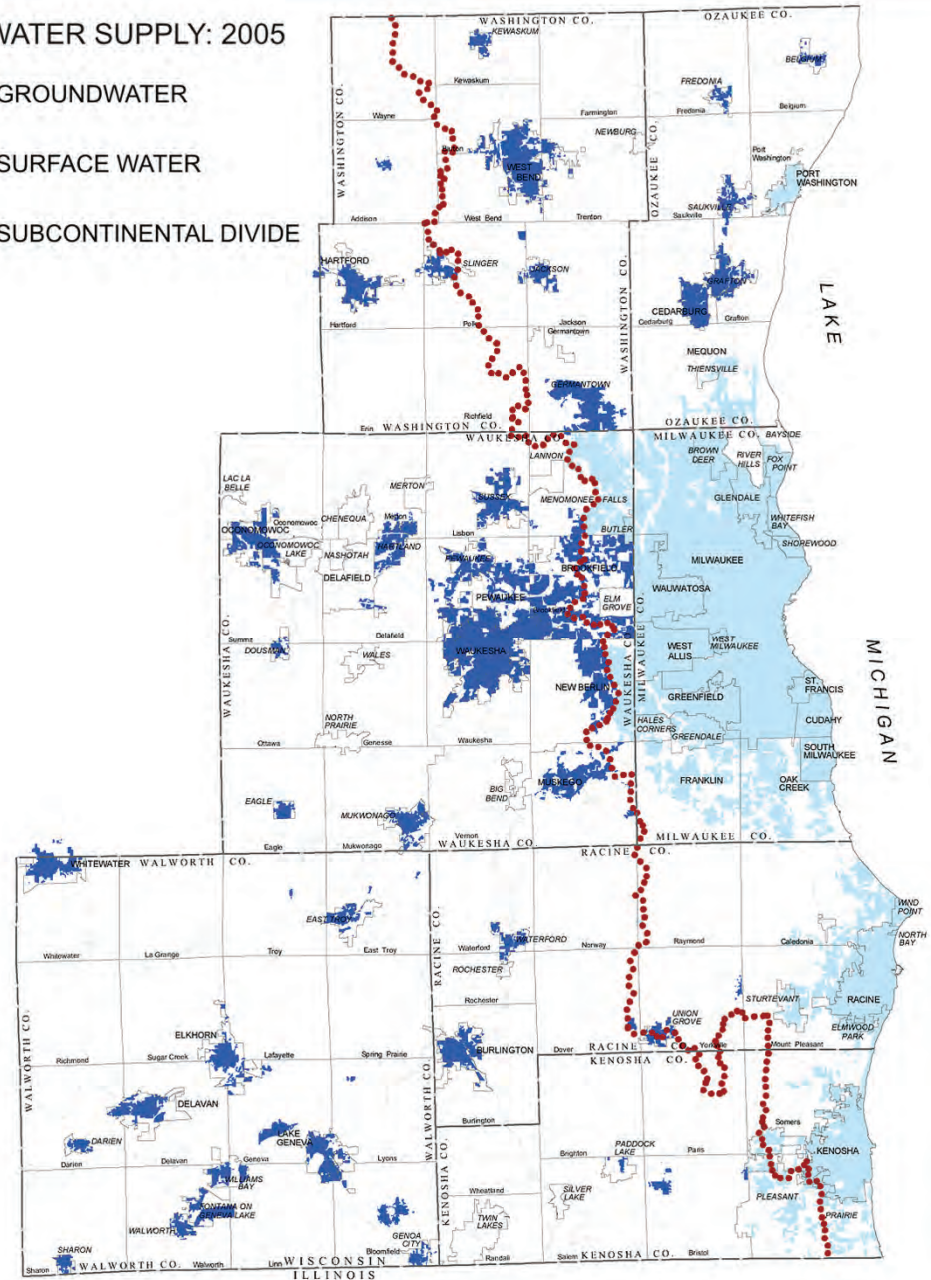
Existing Municipal Water Supply Systems in Waukesha County

All groundwater-supply utilities have a combination of shallow and deep aquifer wells except for:

- Delafield (deep aquifer)
- Hartland (shallow aquifer)
- Town of Brookfield SD No. 4 (shallow aquifer)

PUBLIC WATER SUPPLY: 2005

-  GROUNDWATER
-  SURFACE WATER
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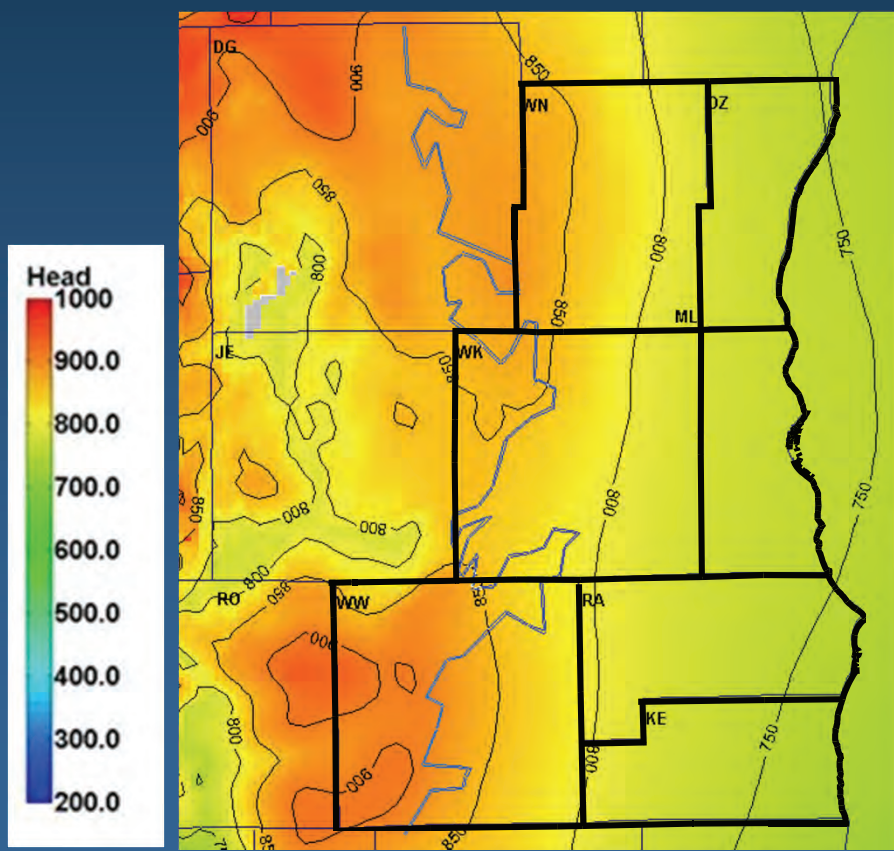


Background

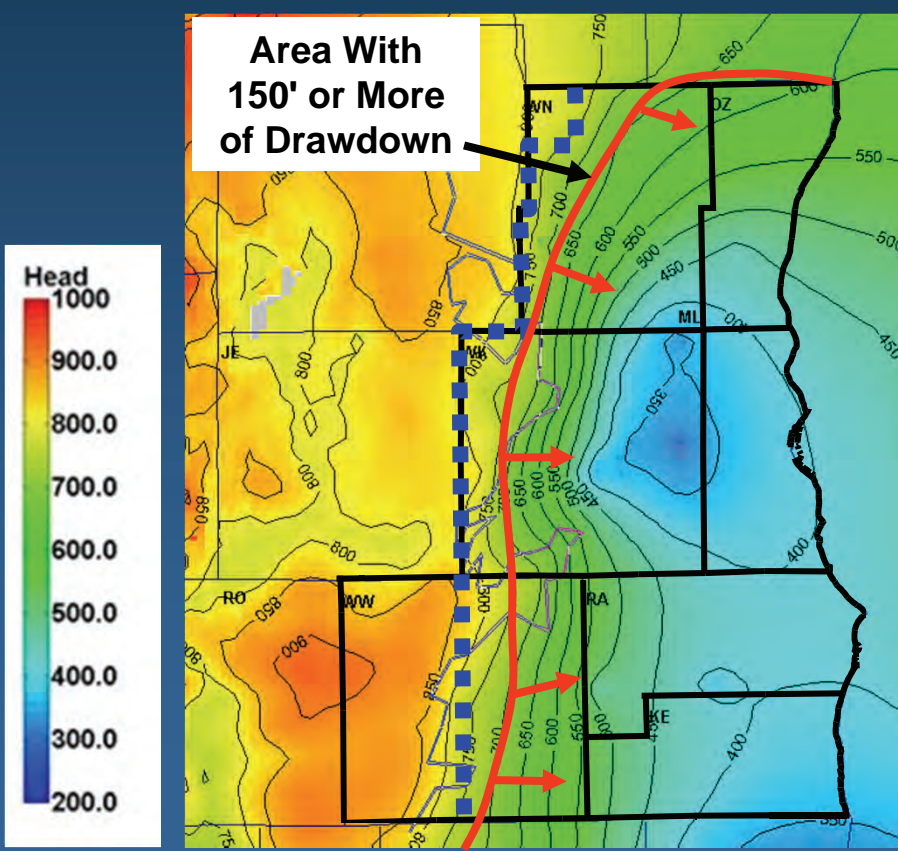
Deep Sandstone Aquifer Drawdown

Pre-1864

2000

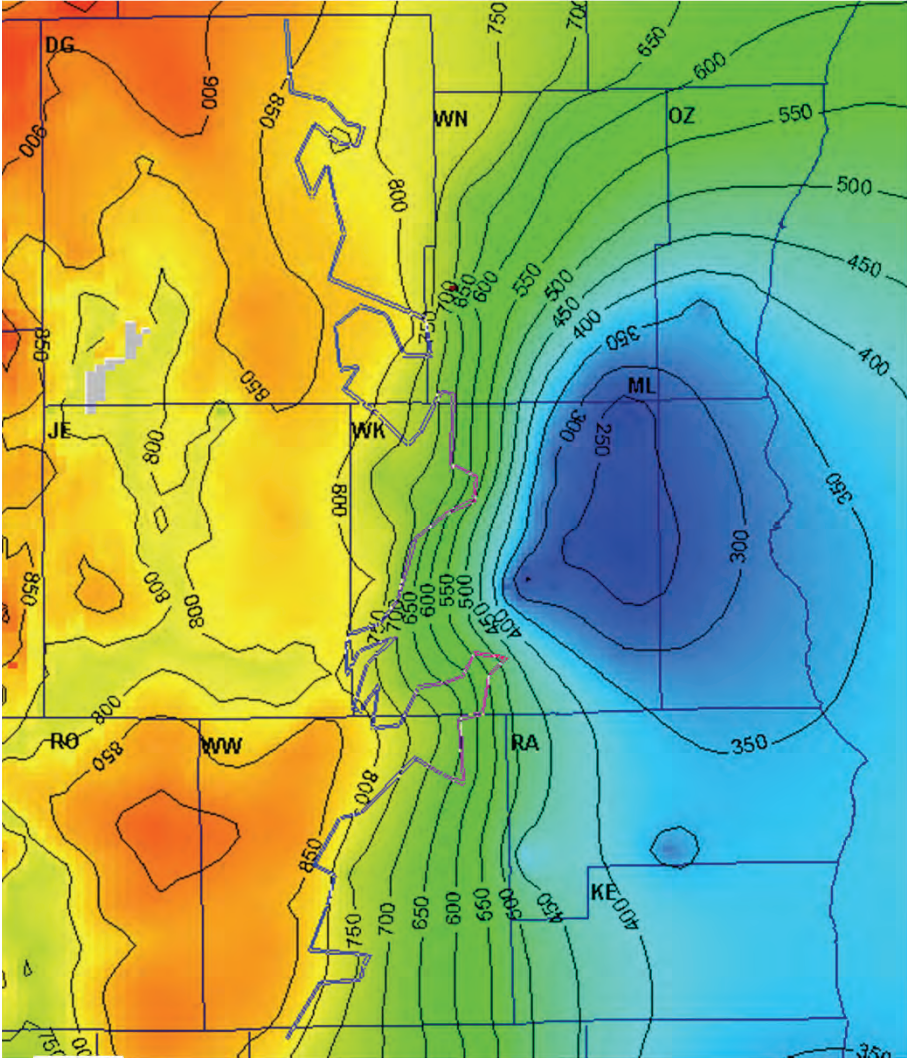


Water Levels in the Sandstone Aquifer
(feet above sea level)

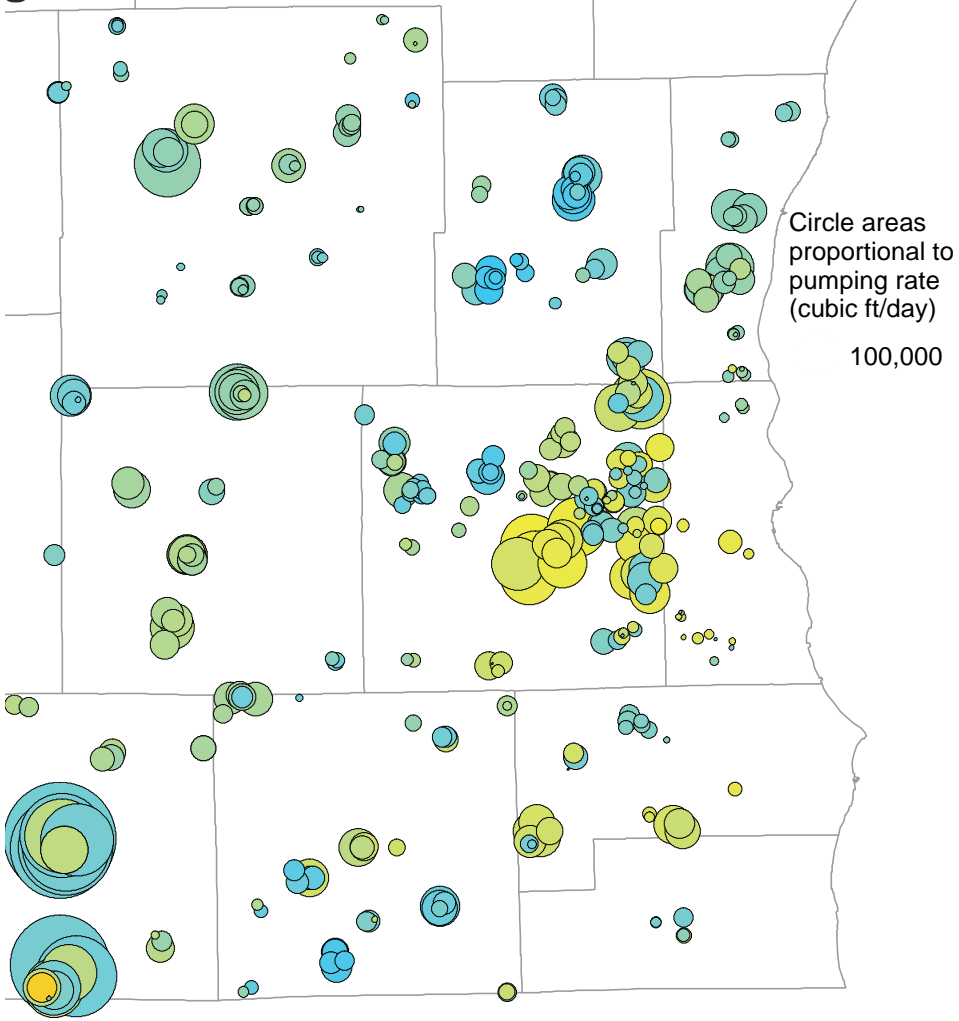
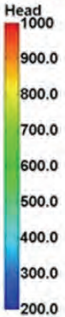


Water Levels in the Sandstone Aquifer
(feet above sea level)

Background



Water Levels in the Sandstone Aquifer
(feet above sea level)



Well Locations and Pumping Rates

- Shallow
- Mixed or Intermediate Depth
- Deep

2010-2020



Alternative Plans: Year 2035

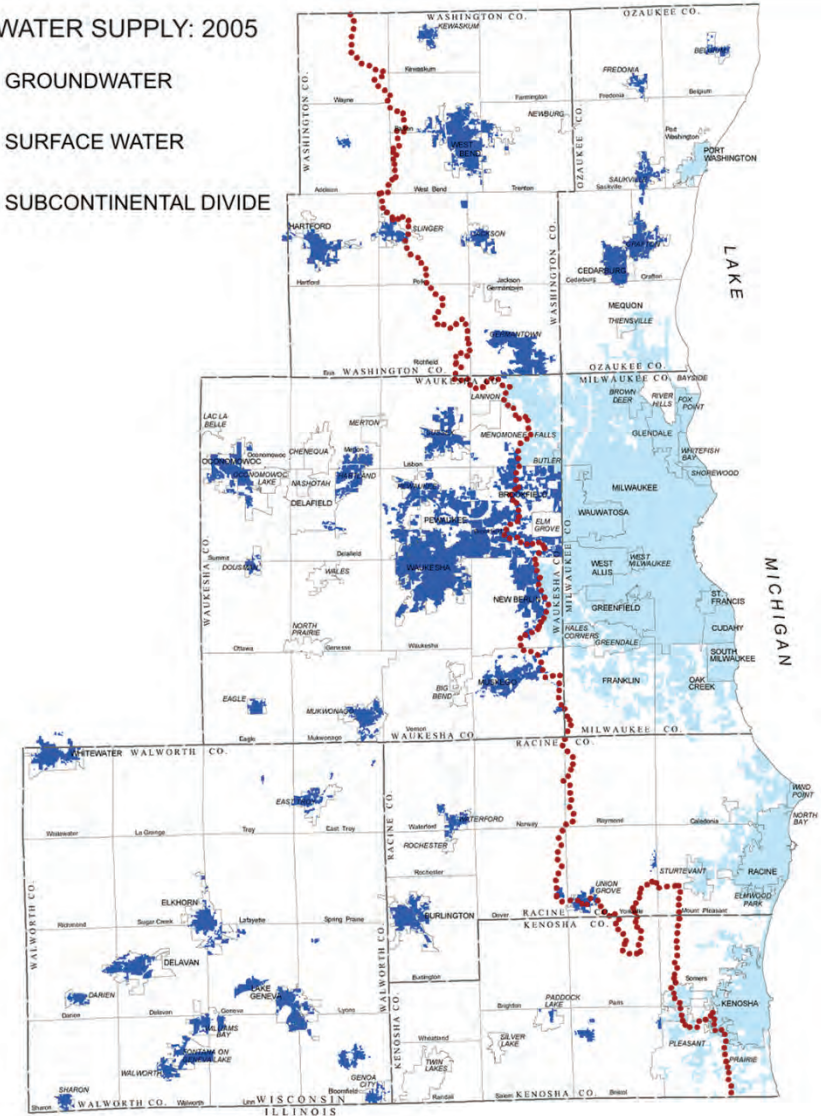
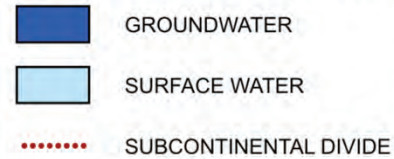
- Alternative Plan No. 1: Existing Trends and Committed Actions
- Alternative Plan No. 2: Limited Expansion of Lake Michigan and Shallow Groundwater Aquifer Supplies
- Alternative Plan No. 3: Limited Expansion of Lake Michigan and Shallow Groundwater Aquifer Supplies with Groundwater Recharge
- Alternative Plan No. 4: Alternative Plan No. 2 with Further Expansion of Lake Michigan Supply

Background

Scope of Study

- Forecast future water use demand in the Region.
- Consider potential of water conservation to reduce future demand.
- Identify groundwater recharge areas which should be protected from development.
- Assess potential for shallow groundwater recharge through infiltration of stormwater runoff and treatment plant effluent.
- Consider potential alternative sources of supply
 - Shallow groundwater
 - Lake Michigan water replacing groundwater east of the subcontinental divide.
 - Lake Michigan water replacing groundwater in “straddling communities” which already have “return flow”
 - Lake Michigan water replacing groundwater in “straddling communities” and “communities in straddling counties” and providing for “return flow”.
- Estimate costs and impacts of alternatives
 - Groundwater-Surface Water Interdependence and Impacts
- Identify any development constraints necessary to assure water supply sustainability; consider amending regional land use plan if necessary

PUBLIC WATER SUPPLY: 2005





Elements Considered in Alternative Plans and Included in the Final Recommended Plan

ELEMENTS IN FINAL RECOMMENDED PLAN

- Water conservation.
- Groundwater recharge area protection.
- Enhanced recharge of shallow aquifer by stormwater management practices.
- Continued reliance on deep aquifer water with treatment as needed.
- Continued and increased reliance on shallow aquifer water.
- Extension of Lake Michigan supply to selected communities east of the divide.
- Extension of Lake Michigan supply to selected communities straddling the divide with current return flow.
- Extension of Lake Michigan supply to the City of Waukesha.



Elements Considered in Alternative Plans but Not Included in the Final Recommended Plan

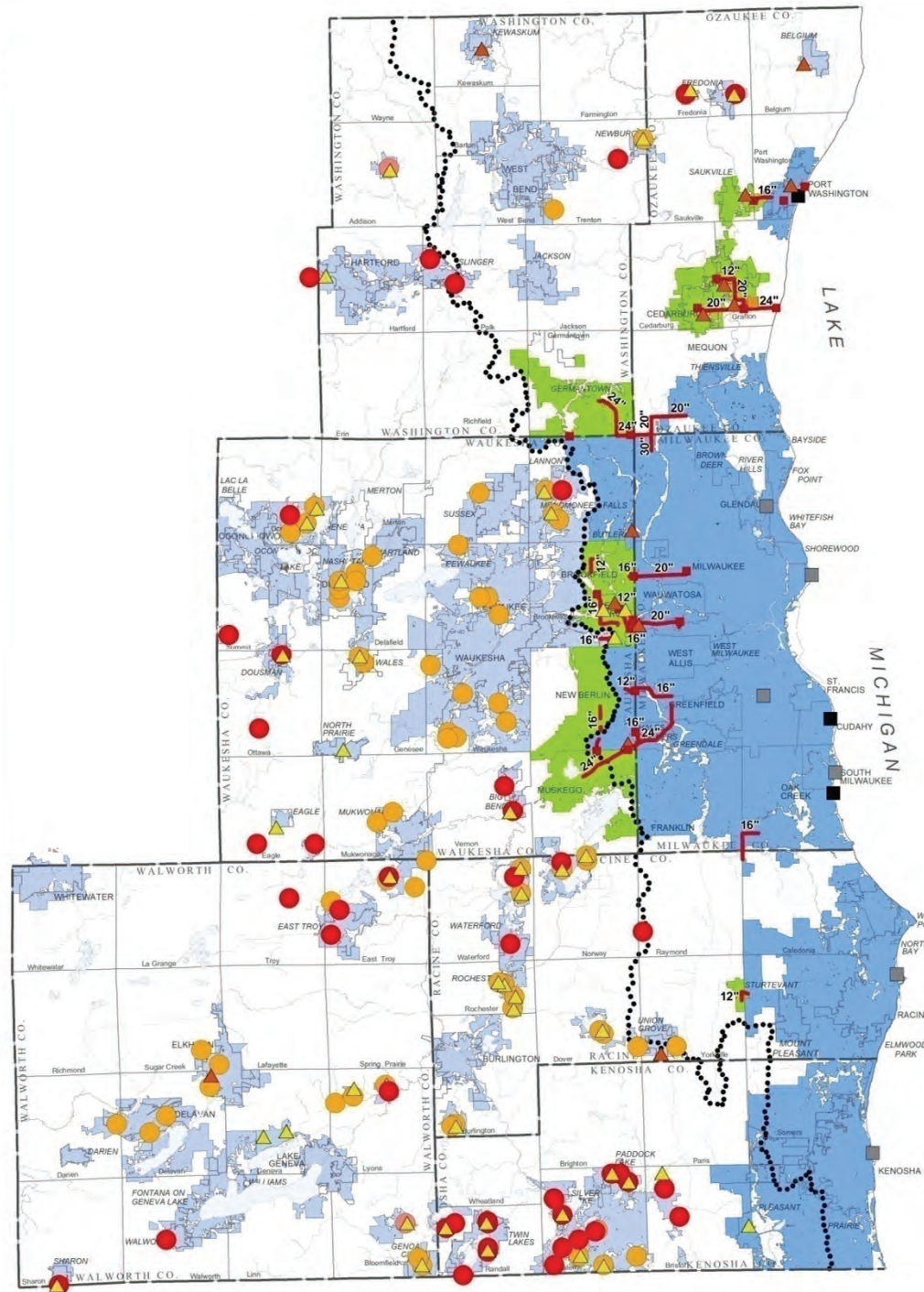
ELEMENTS NOT INCLUDED IN FINAL RECOMMENDED PLAN

- Enhanced recharge of shallow aquifer by injection of highly treated sewage treatment plant effluent.
- Recharge of the deep aquifer by injection of treated Lake Michigan surface water
- Extension of Lake Michigan supply to areas west of the divide other than the City of Waukesha.

Regional Water Supply Plan Subalternative 1 to the Composite Plan



- Enhanced local conservation programs
- Conversion of selected areas with current return flow to Lake Michigan supply
- Conversion of selected groundwater supply from deep to shallow aquifer supply
- Enhancement of rainfall infiltration over 2.0 square miles of open space through bioengineering
- Continued reliance on private wells for selected residential areas (about 180,000 persons plus selected agricultural, irrigation, and industrial uses)

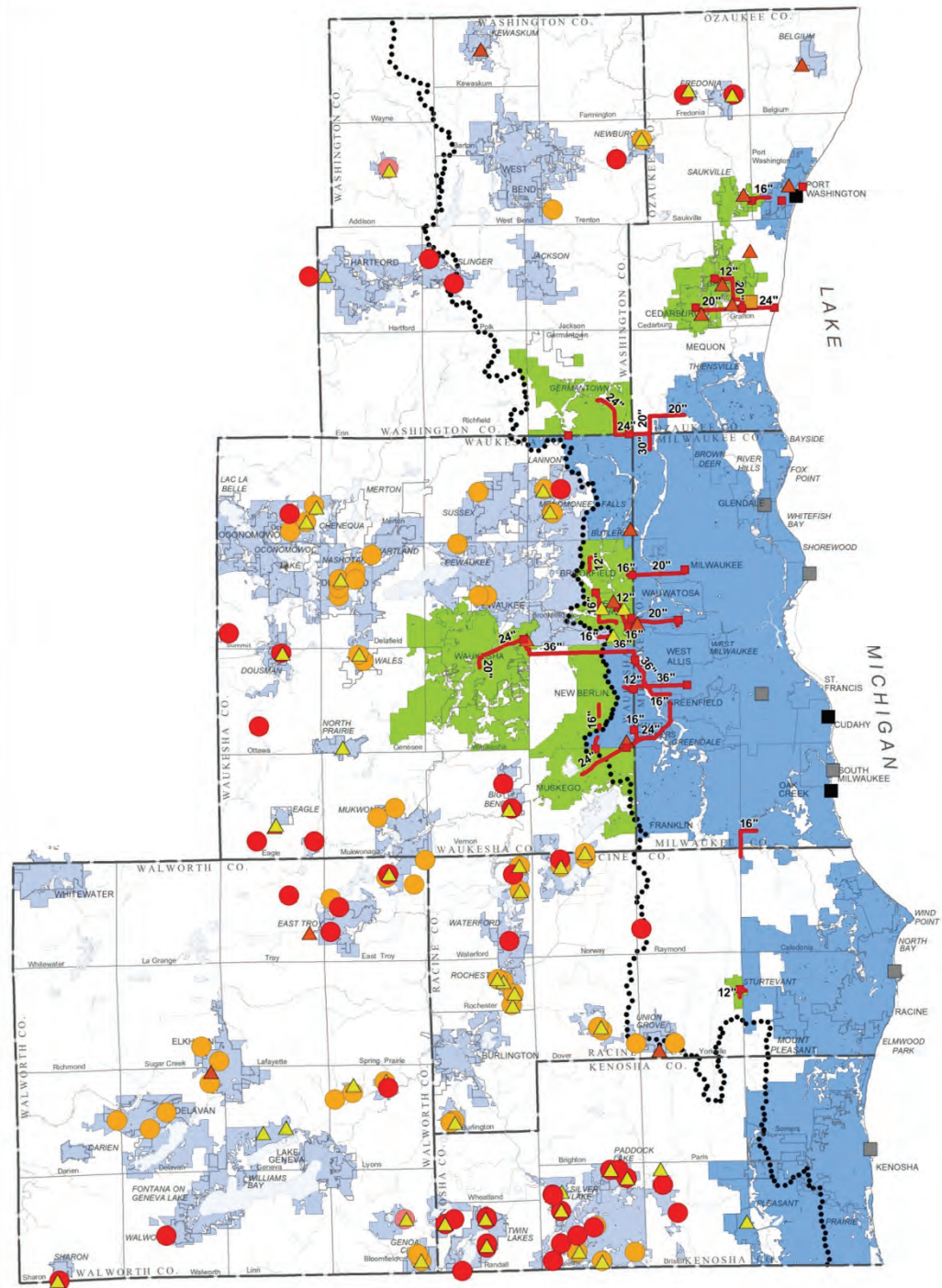


Regional Water Supply Plan Subalternative 2 to the Composite Plan: (Recommended Water Supply Plan)















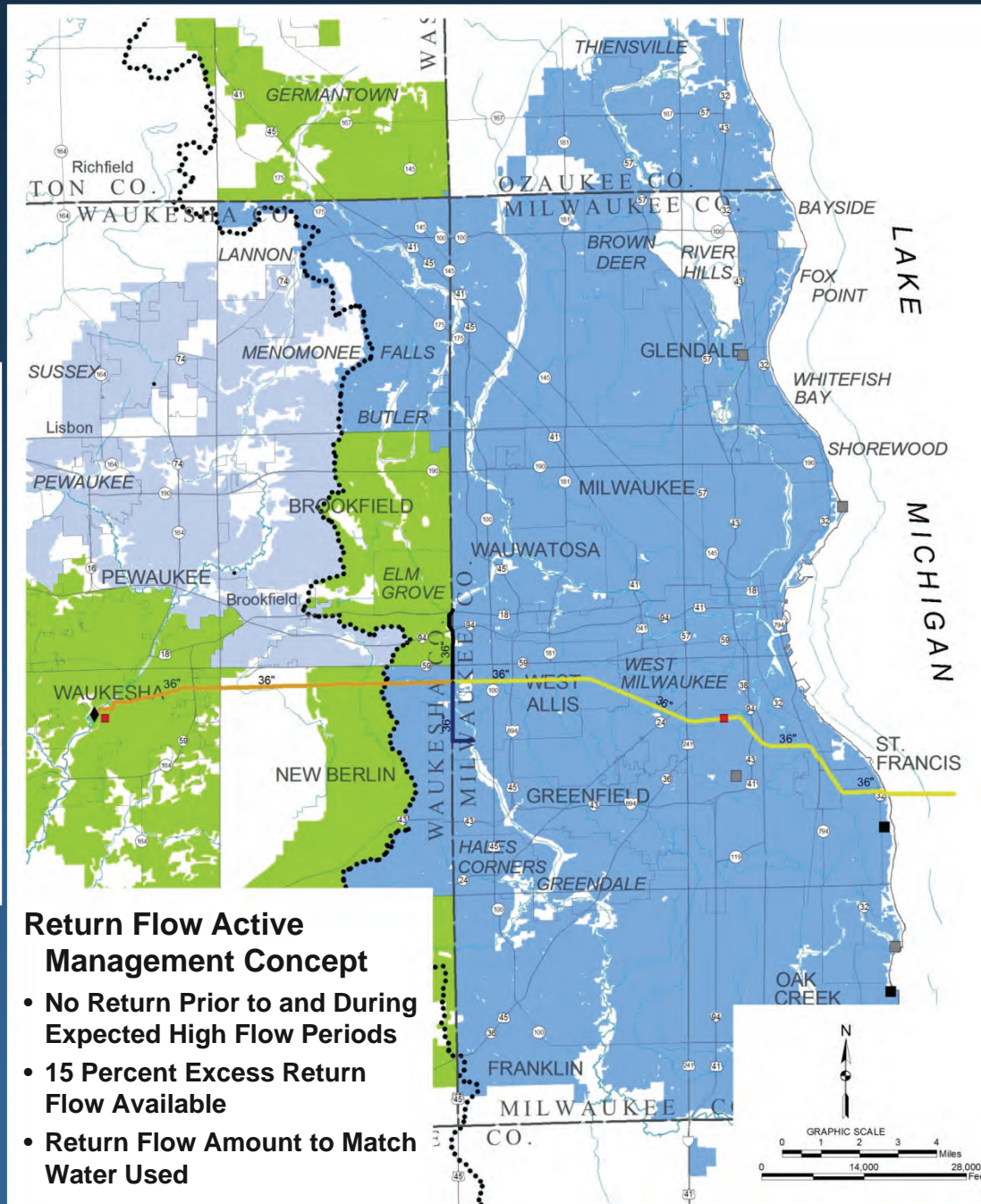
➤ Includes all aspects of subalternative 1 to the composite plan except:

- The City of Waukesha water utility is converted to a Lake Michigan supply with a return flow component
- The enhanced rainfall infiltration acreage is reduced from 2.0 to 1.7 square miles



Options 1 – 4 for Return Flow for Subalternative 2 to the Composite Plan: Return Flow Pipelines to Lake Michigan, Underwood Creek, and Root River

-  AREAS SERVED BY PUBLIC WATER UTILITIES PROVIDING WATER FROM LAKE MICHIGAN UNDER ALTERNATIVE PLAN 1: 2035
-  AREAS CONVERTED FROM GROUNDWATER TO SURFACE WATER UNDER THE PRELIMINARY RECOMMENDED PLAN: 2035
-  AREAS SERVED BY PUBLIC WATER UTILITIES PROVIDING GROUNDWATER: 2035
-  EXISTING MUNICIPAL WATER TREATMENT PLANT NEEDING NO EXPANSION
-  EXISTING MUNICIPAL WATER TREATMENT PLANT TO BE EXPANDED OR UPGRADED
-  EXISTING MUNICIPAL WASTEWATER TREATMENT PLANT
-  PLANNED NEW PUMPING STATION
-  PLANNED WATER RETURN FLOW PIPELINE: OPTIONS 1, 2, 3, AND 4
-  PLANNED WATER RETURN FLOW PIPELINE: OPTION 1
-  PLANNED WATER RETURN FLOW PIPELINE: OPTION 2 AND 4
-  PLANNED WATER RETURN FLOW PIPELINE: OPTION 3 AND 4
-  SUBCONTINENTAL DIVIDE



Return Flow Active Management Concept

- No Return Prior to and During Expected High Flow Periods
- 15 Percent Excess Return Flow Available
- Return Flow Amount to Match Water Used

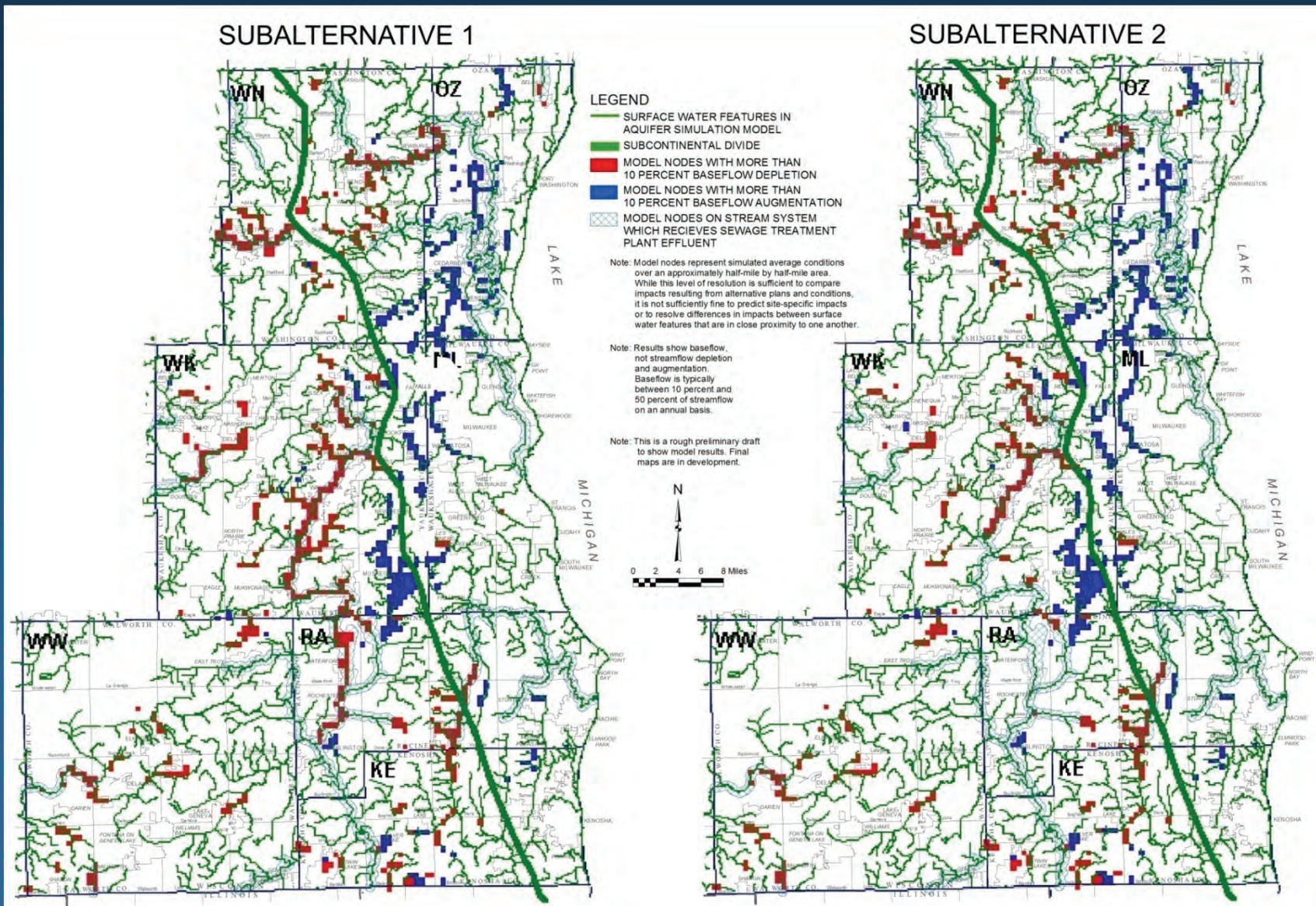


Subalternative New Cost Comparison (2005) and Recommended Plan New Costs (2010)

- Subalternative No. 1-Intermediate Expansion of Lake Michigan Supply with City of Waukesha on a Groundwater Supply (Year 2005)
 - Capital Cost: \$296.6 million
 - Annual O&M: -\$1.4 million
 - Present Worth: \$206.2 million
 - Equivalent Annual Cost: \$13.1 million
- Subalternative No. 2-Intermediate Expansion of Lake Michigan Supply with City of Waukesha on a Lake Michigan Supply (Year 2005)
 - Capital Cost: \$328.7 to \$356.3 million
 - Annual O&M: -\$8.2 to -\$8.7million
 - Present Worth: \$134.2 to \$169.8 million
 - Equivalent Annual Cost: \$8.5 to 10.8 million
- Recommended Plan (Year 2010)
 - Capital Cost: \$388.8 to \$421.1 million
 - Annual O&M: -\$5.8 to -6.4 million

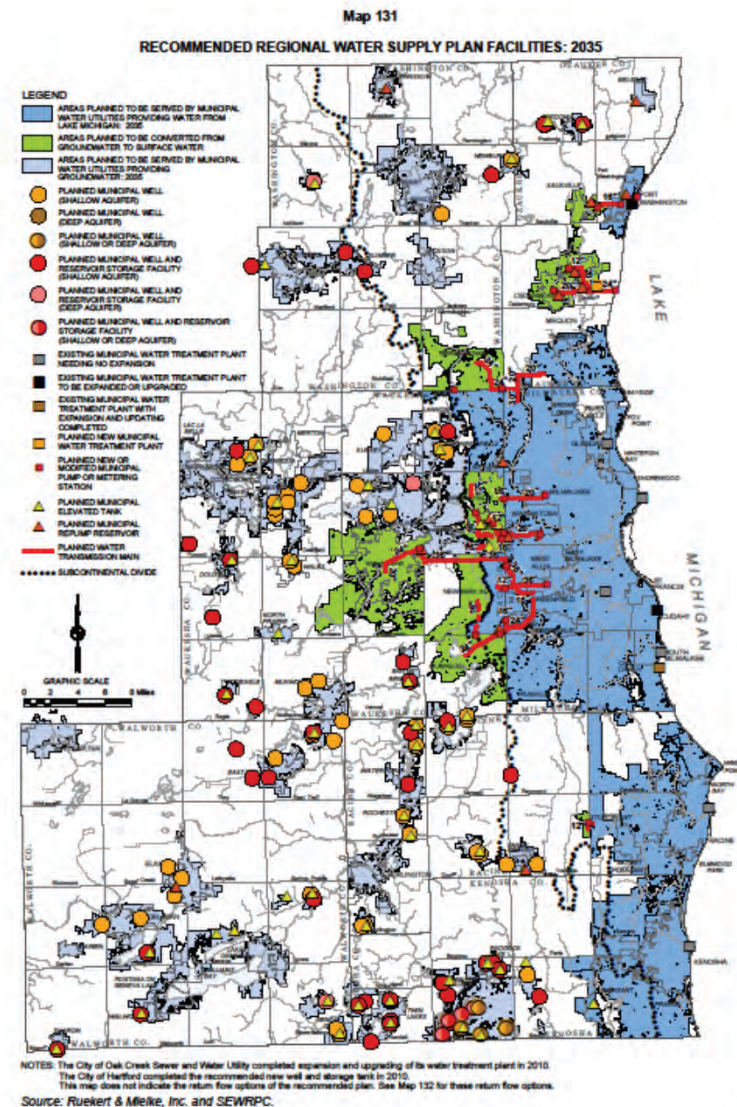
Evaluation of Subalternative Composite Plans

Surface Water Impacts Associated with Subalternatives of the Composite Plan



Summary of Recommended Plan

- Sources of supply
- Water conservation programs
- Groundwater recharge area protection
- Stormwater management practices
- Regulation of high capacity wells
- Enhanced rainfall infiltration systems in strategic locations



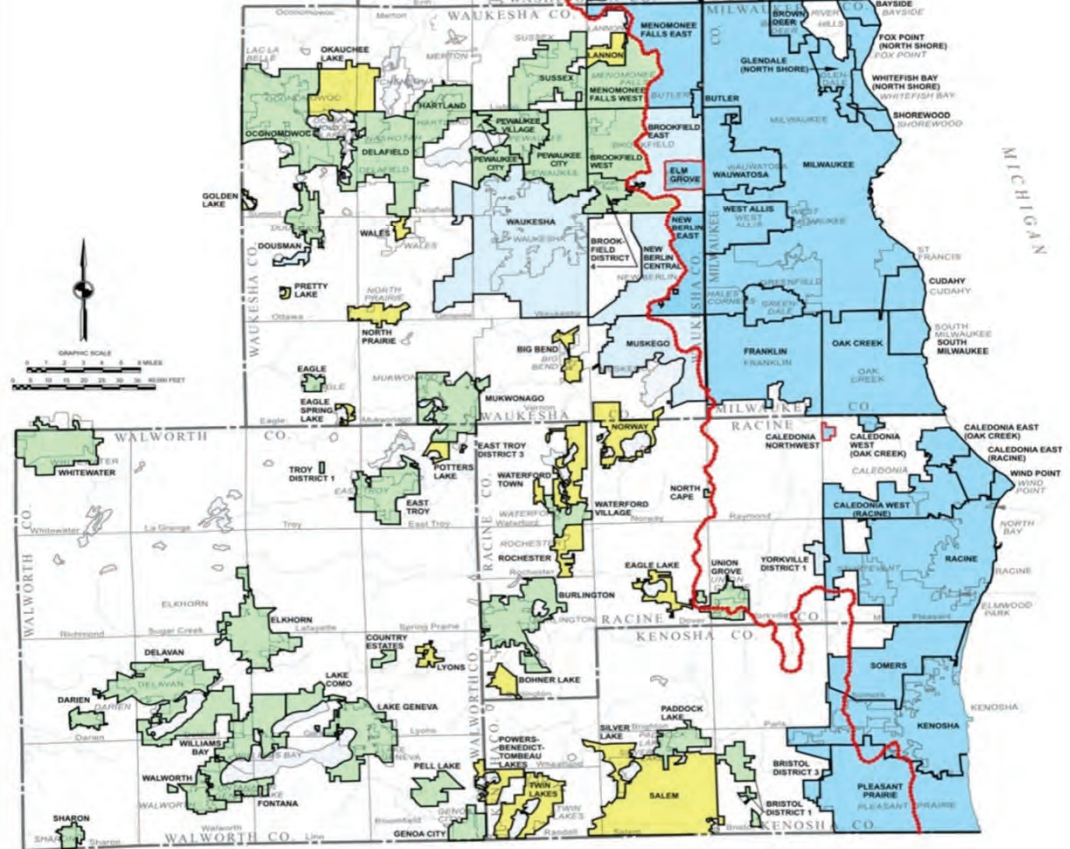
Sources of Supply Plan Component

Most Waukesha County utilities (10 utilities plus portions of 2 utilities) would continue to utilize groundwater as a long term source of supply.

- Brookfield West (portion)
- Town of Brookfield SD No. 4
- Delafield
- Dousman
- Eagle
- Hartland
- Mukwonago
- Oconomowoc
- Menomonee Falls West (portion)
- City of Pewaukee
- Village of Pewaukee
- Sussex

AREAS PROPOSED TO BE SERVED BY PUBLIC WATER UTILITIES IN SOUTHEASTERN WISCONSIN: 2035

- EXISTING UTILITY TO REMAIN ON LAKE MICHIGAN SUPPLY (27)
- NEW UTILITY SERVICE AREAS TO UTILIZE LAKE MICHIGAN SUPPLY (2)
- EXISTING UTILITY TO REMAIN ON GROUNDWATER SUPPLY (42)
- EXISTING UTILITY TO BE CONVERTED FROM GROUNDWATER SUPPLY TO LAKE MICHIGAN SUPPLY(9)
- POTENTIAL FUTURE UTILITY SERVICE AREAS TO UTILIZE GROUNDWATER SUPPLIES DEPENDING UPON LOCAL NEEDS AND DETERMINATIONS (21)
- SUBCONTINENTAL DIVIDE



Source: SEWRPC.

Sources of Supply Plan Component

Utility areas expected to continue to use Lake Michigan as a source of supply include:

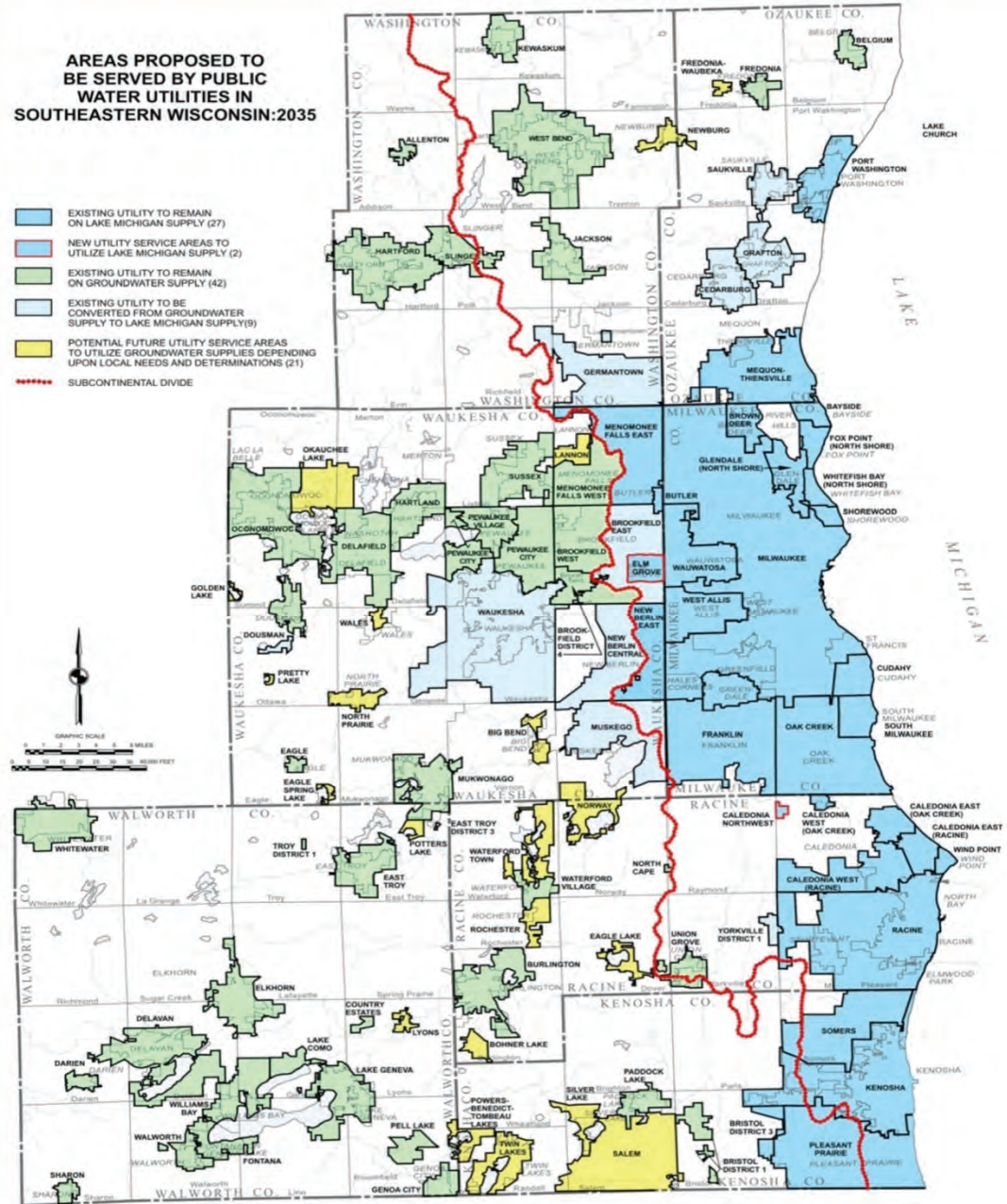
- Eastern Menomonee Falls
- Eastern New Berlin
- Butler

Utility areas expected to change to a Lake Michigan supply over the planning period (to 2035) include:

- Eastern Brookfield (east of divide)
- Central New Berlin (straddling community, return flow system already in place)
- Elm Grove (east of divide)
- Muskego (straddling community, return flow system already in place)
- Waukesha (west of divide in straddling county, new return flow system required, subject to approval under Great Lakes compact)

AREAS PROPOSED TO BE SERVED BY PUBLIC WATER UTILITIES IN SOUTHEASTERN WISCONSIN: 2035

- EXISTING UTILITY TO REMAIN ON LAKE MICHIGAN SUPPLY (27)
- NEW UTILITY SERVICE AREAS TO UTILIZE LAKE MICHIGAN SUPPLY (2)
- EXISTING UTILITY TO REMAIN ON GROUNDWATER SUPPLY (42)
- EXISTING UTILITY TO BE CONVERTED FROM GROUNDWATER SUPPLY TO LAKE MICHIGAN SUPPLY(9)
- POTENTIAL FUTURE UTILITY SERVICE AREAS TO UTILIZE GROUNDWATER SUPPLIES DEPENDING UPON LOCAL NEEDS AND DETERMINATIONS (21)
- SUBCONTINENTAL DIVIDE



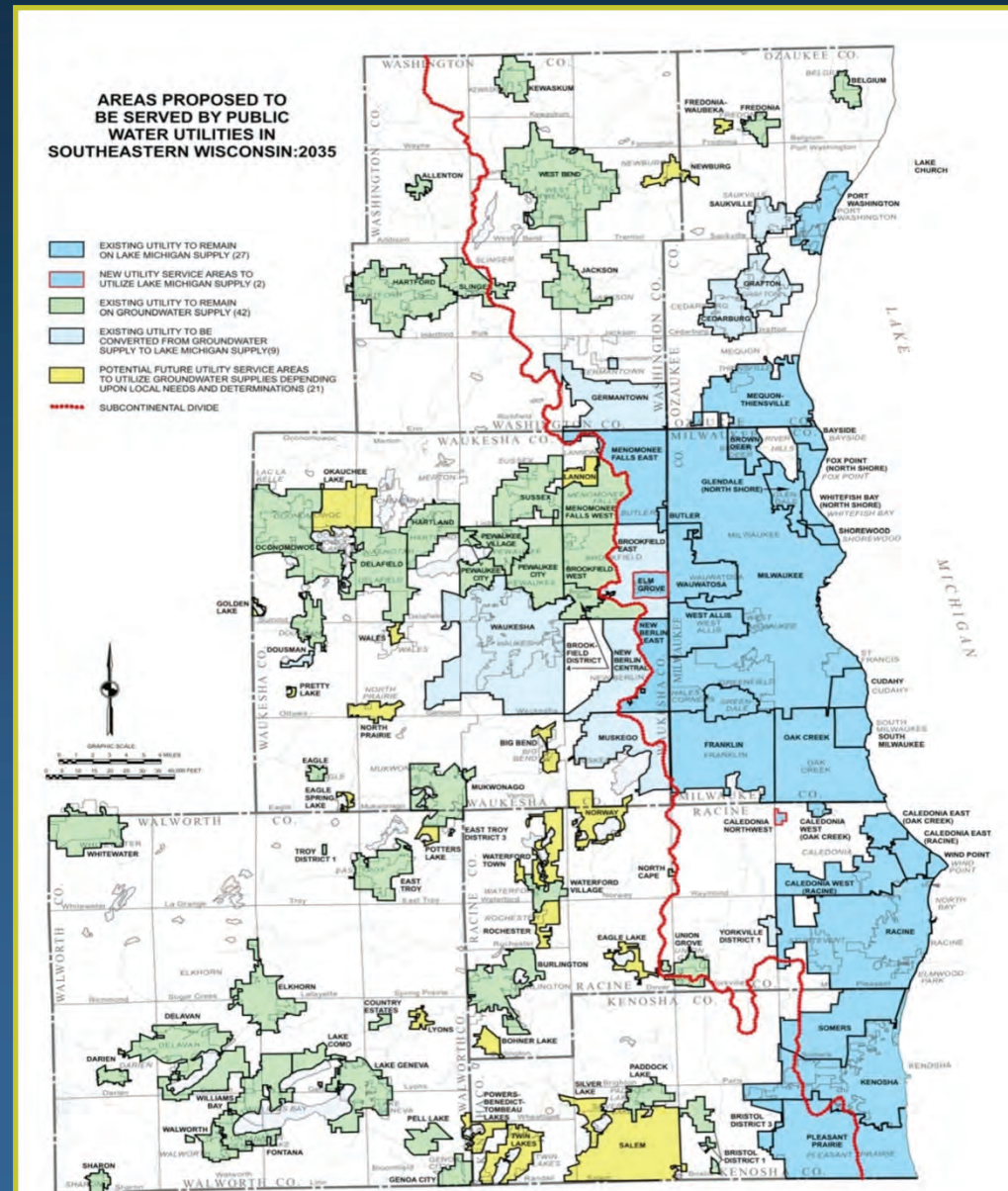
Source: SEWRPC.

Sources of Supply Plan Component

- Selected Waukesha County areas currently served by individual wells were identified as having the potential to be served by long-term municipal water supply service

- Big Bend
- Elm Grove
- Lannon
- Muskego (Norway-Wind Lake Service Area)
- North Prairie (Prairie Village Water Trust)
- Portion of Village of Summit
- Portion of the Village of Wales
- Eagle Spring Lake
- Okauchee Lake
- Golden Lake
- Pretty Lake
- Portion of Town of Delafield
- Portion of Town of Genesee
- Portion of Town of Lisbon
- Portion of Town of Oconomowoc
- Portion of Town of Waukesha

These utilities would be created only if local conditions and initiatives warrant such creation. Absent a demonstrated need, residents and businesses of these areas would remain on individual wells indefinitely.



Source: SEWRPC.



Sources of Supply Plan Component

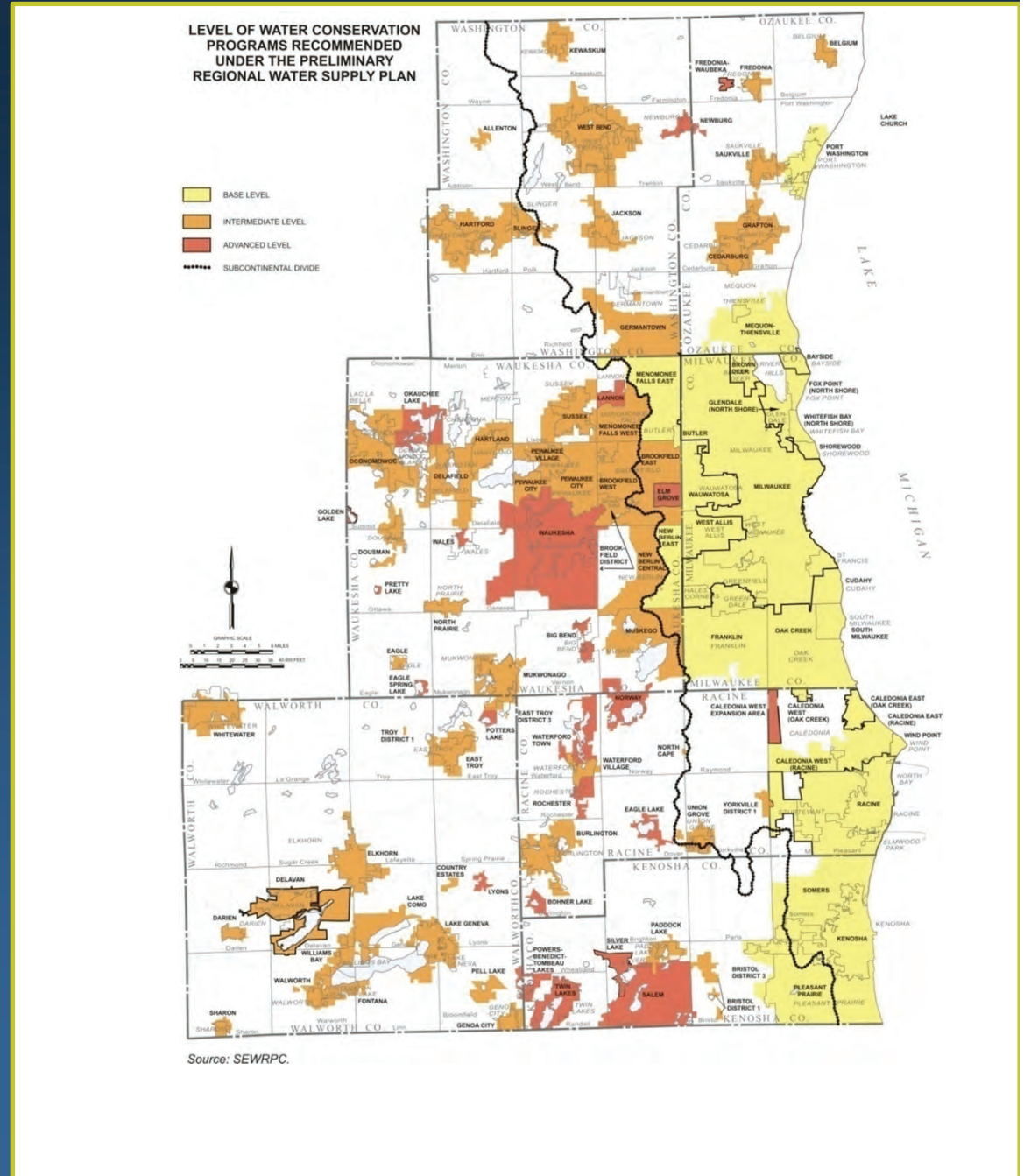
Regional Water Supply Plan Lake Michigan Diversion Element

Fundamental reasons for recommending the additional areas be supplied with Lake Michigan waters.

- Reduction in chloride discharge.
- Favorable impacts on recovery of deep aquifer.
- Favorable environmental impacts on baseflows to surface waters.
- Ability to preserve groundwater for other uses, i.e., agriculture.
- Opportunity to use excess water production capacity at potential supplying water utilities.

Water Conservation Plan Component

- Base Level:
 - Butler
 - Menomonee Falls East
 - New Berlin East
- Intermediate Level
 - Brookfield East & West
 - Delafield
 - Dousman
 - Eagle
 - Hartland
 - Menomonee Falls West
 - Mukwonago
 - Muskego
 - New Berlin Central
 - North Prairie
 - Oconomowoc
 - City & Village of Pewaukee
 - Sussex
- Advanced Level
 - Big Bend
 - Eagle Spring Lake
 - Elm Grove
 - Golden Lake
 - Lannon
 - Norway/Wind Lake
 - Okauchee Lake
 - Pretty Lake
 - Wales
 - Waukesha





Water Conservation Program Plan Component for Waukesha County

Base-Level Program: 3 Utilities

- Water supply system efficiency
- Information and education programming
- Outdoor watering reduction measures

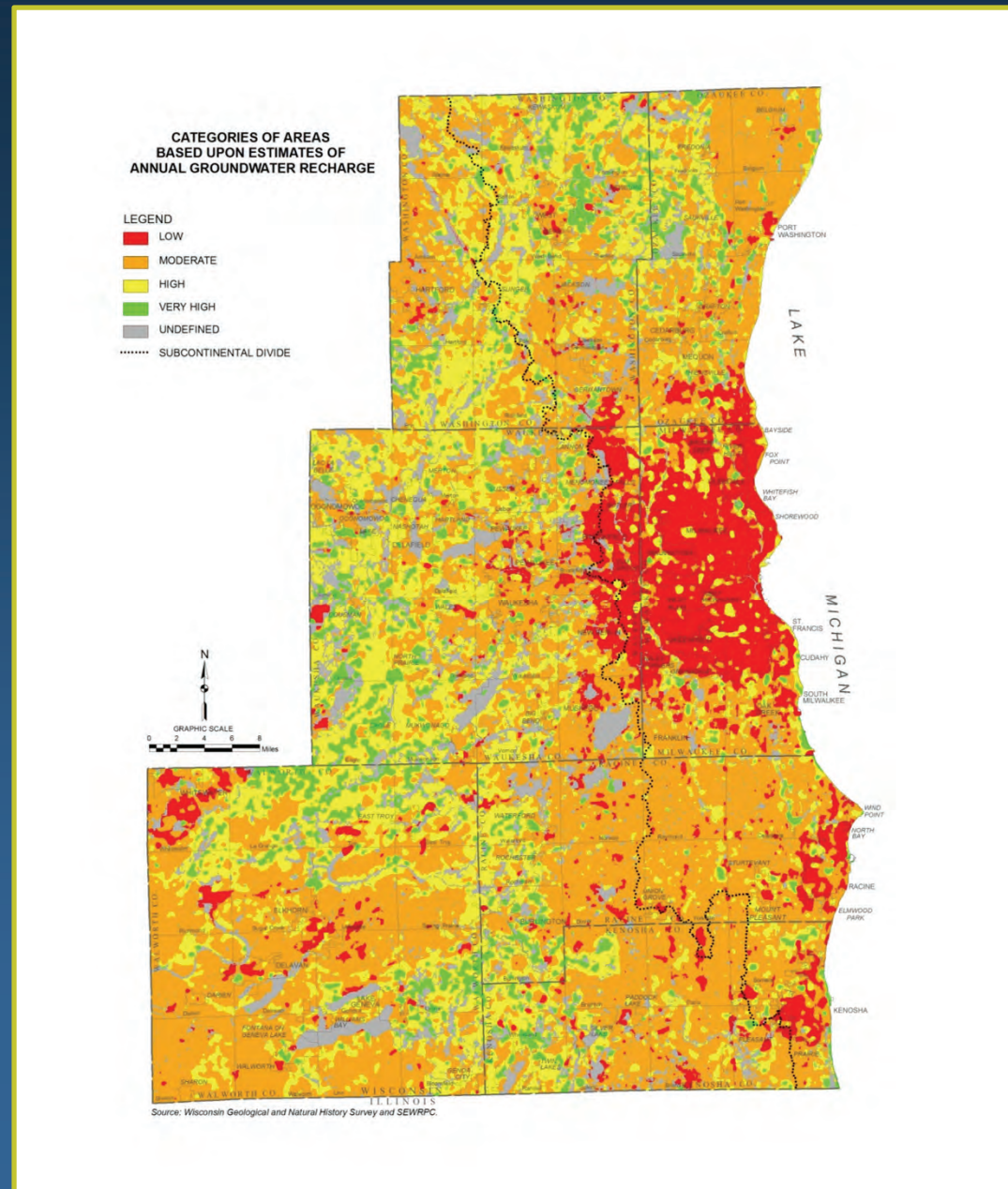
Intermediate-Level Program: 13 Utilities

- Base Level plus:
 - Higher level of information and education programming
 - Plumbing system retrofits
 - Water conservation rate structures
 - More aggressive outdoor watering restrictions

Advanced-Level Program: 10 Utilities and Potential New Utilities

- Intermediate Level plus:
 - Fixture replacement rebate programs
 - More aggressive water conservation rate structures and outdoor watering restrictions

Groundwater Recharge Area Protection Plan Component





Groundwater Recharge Area Protection Plan Component

- The preservation of groundwater recharge areas found to have a high or very high recharge potential.
- About 74 percent of the highly rated and very highly rated recharge areas located in environmental corridors, isolated natural areas, and prime and other agricultural areas identified for preservation in the regional land use plan.
- Additional areas can be protected in medium or low density development areas by utilizing stormwater management practices designed to maintain the natural hydrology.
- Over time, consider expansion of environmental corridors to include selected areas with very high or high groundwater recharge potential.



Stormwater Management Practices Plan Component

- **Widespread implementation of state-of-the-art stormwater management practices, including application of treatment and infiltration systems.**
 - **Will largely be implemented through NR 151 stormwater performance standards**
- **To the extent practicable maintain the natural recharge of areas committed to residential and selected nonresidential land use developments.**



Enhanced Rainfall Infiltration Systems Plan Component

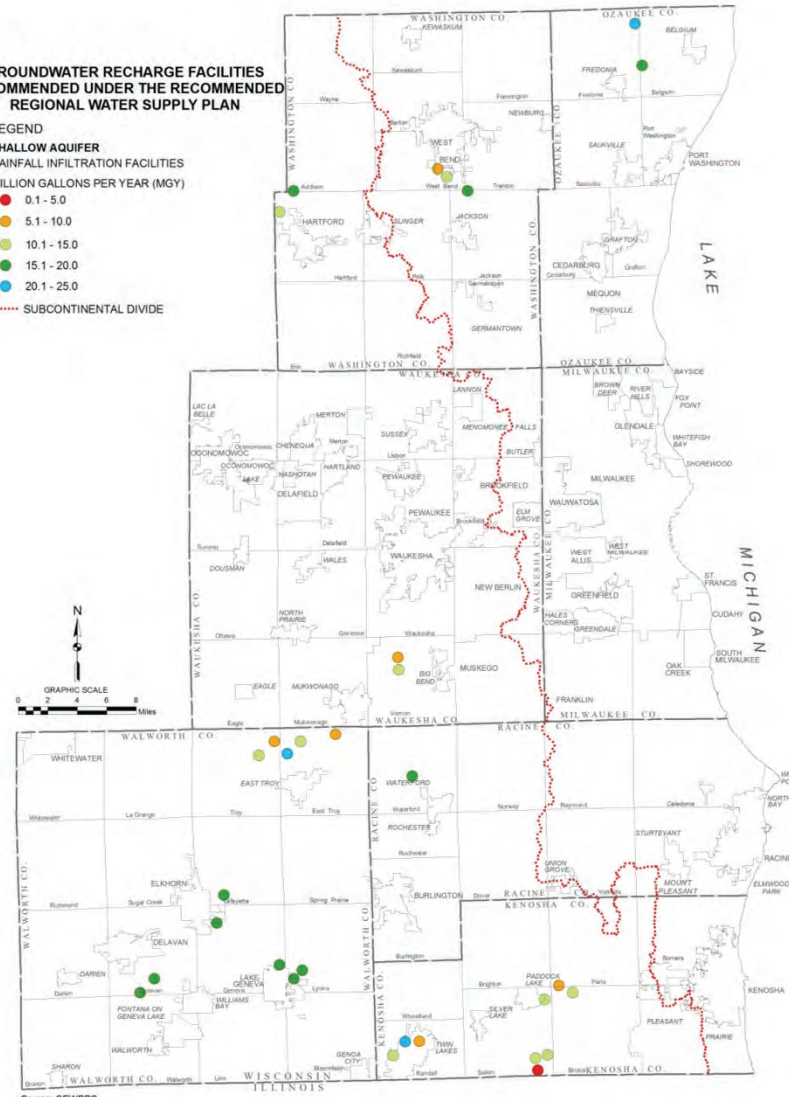
- Installation of enhanced rainfall infiltration systems in areas where evaluations conducted in conjunction with siting of high-capacity wells in the shallow aquifer indicate probable reductions in base flow to nearby surface waterbodies or water levels in lakes or wetlands.
 - A variety of designs and methods are possible.
 - Rain gardens, larger bioretention basins, infiltration ponds, infiltration ditches, and other systems.
 - 32 rainfall infiltration systems under the recommended plan.



Enhanced Rainfall Infiltration Plan Component

GROUNDWATER RECHARGE FACILITIES RECOMMENDED UNDER THE RECOMMENDED REGIONAL WATER SUPPLY PLAN

- LEGEND
- SHALLOW AQUIFER
RAINFALL INFILTRATION FACILITIES
- MILLION GALLONS PER YEAR (MGY)
- 0.1 - 5.0
 - 5.1 - 10.0
 - 10.1 - 15.0
 - 15.1 - 20.0
 - 20.1 - 25.0
- SUBCONTINENTAL DIVIDE





High Capacity Well Regulation Plan Component

- **Recommends analyses and monitoring of the impacts of potential new wells on the shallow aquifer, existing wells, and surface waters.**
 - **Develop the necessary understanding of the hydrogeological system associated with each candidate well site.**
 - **Monitoring of water levels in the vicinity of potential new high-capacity wells in the shallow aquifer, to establish a baseline, including levels in private wells expected to be maintained.**
 - **Monitoring to continue during the test well phase of evaluation and during the operation of the well.**