

Background

It should be evident that quality management of water resources is only possible with quality information about water resources. This program and the statutes that created it were based off of predicting the impacts of large quantity water withdrawals on water-dependent natural resources, giving water users access to water when they will not cause adverse resource impacts defined in the law, and preventing adverse resource impacts from occurring due to water withdrawals. The benefits of the program and support for it among all citizen stakeholders affected by it, are only derived when these predictions do a reasonably accurate job of reflecting real world conditions. Data about Michigan's waters under lie this accuracy, and when they are called into question, all of the merits of the program are called into question. When our data is inaccurate or limited, it can lead to both situations where water users may be unnecessarily restricted from water use and also lead to unlawful adverse resource impacts. This program started by using the data available at the time as reasonably as possible, but all stakeholders of the program expected that data would continuously improve through time and would lead to more and more accurate predictions of real-world conditions. Investments in the acquisition of improved data to support this program have been minimal and insufficient over the past ~11 years of this program. Michigan cannot well manage its water unless it well understands it, and new data acquisition is essential to this.

When we refer to new data acquisition needs for this program, we are primarily addressing three general types of data; streamflow, groundwater and geology data. Within each category, there are numerous types of data for each and numerous methods or techniques for the collection of each. Each subtype can provide unique information, and the techniques for collection of it can span spectrums of cost-efficiency to collect versus the reliability and quality of that information. A full discussion of all of the pros and cons of different types of data acquisition and how to create an optimal strategy to gain the maximum amount of information needed from a particular amount of financial resources is beyond the scope of this brief report, but is the focus of the work of the WUAC Data Committee and the agencies that participate in it.

Past and current reviews of the existing streamflow, groundwater and geology data currently available in Michigan repeatedly find that in all categories it is limited, and significantly limits the development of better water-management strategies for our state. Michigan's past geological history resulted in our state having an incredible amount of spatial variability of conditions. Key determinants of how groundwater and surface water function in any specific location in Michigan, vary considerably over very small distances. Limited data statewide therefore greatly affects the reliability of our understanding and predictions of how water systems and uses of it will play out in reality. Previous WUAC recommendations have called for the acquisition of each type of data, in both areas of high current and emerging water use as well as filling critical gaps of each statewide.

Findings and Recommendations

Getting us from where we are currently at with water-management data to where we need to be in order to ideally manage these assets will require a long-term data acquisition plan and ongoing dedicated investments to implement it. We find that water, all of its uses and benefits, is one of Michigan's strongest assets and that we should invest in understanding it better so that we might fully

realize those benefits in the future. We however, recognize that this report comes at a time of significant financial strain and limitations for the State of Michigan. We therefore are recommending a combination of actions on water-data acquisition that represent modest progress on the long-term needs, while also recommending minimal short-term investments in new data acquisition.

Long-term planning. The WUAC recommends that it coordinate development of an overall long-term plan for the acquisition of water management data needs. This entails formal analysis and communication of all forms of existing streamflow, groundwater and geological data by type and locations within Michigan, identification of critical data gaps and needs, and development of priority needs and cost-efficient strategies for data collection. The WUAC Data Committee is able to coordinate this and support its development, but additional financial resources are also required to engage necessary technical resources required to support this project. While participants in the WUAC will contribute significantly to this effort, we are requesting an investment of \$100,000 to support acquisition of appropriate technical resources contracting to accomplish this project. These funds would be appropriated to EGLE, with the WUAC assisting the department in contracting and management of the work.

Investment Proposed: \$100,000 one time.

Implementing Organizations: WUAC, EGLE, USGS, MGS

Timeframe: 12- 18 months

Streamflow. It has been recently estimated that Michigan contains over 70,000 miles of rivers and streams. For the purpose of this program, these miles are grouped into approximately 5,600 distinct watershed management areas (WMA's). Each of these has a prediction of the long-term median summer baseflow, referred to as the "index flow", which the assessment process and regulatory framework is dependent on. Currently, in Michigan, there are approximately 208 active stream gages maintained by the USGS that are supported by Federal, State, and local partners. Since 2011, the USGS in cooperation with EGLE has collected miscellaneous flow measurements at 66 additional sites (no gage installed). Additional miscellaneous flow data has been collected by non-agency entities in recent years as well, in efforts to augment the sparse network of agency collected data. EGLE has been contracting with the USGS annually, to collect some additional streamflow data each year. The pace of that, while minimal, is still important progress, and the funds previously used for that expire and will need replacement by 2022 (previous fund source ends). Many of the streamflow gages have been funded by different sources, however, the cost to replace this program's existing level of investment in streamflow data is approximately \$350,000 per year. The cost of USGS streamflow gages, per gage, is approximately \$18,500 (+/- \$1,000) for the equipment and installation; and \$15,700 for annual operation and maintenance. Average cost for the USGS to collect sufficient repeated flow measurements at a miscellaneous site ranges between \$3,000 – \$4,000. This existing level of data acquisition, while minimal, is critical to replace funding for in the FY2022 budget.

Investment Proposed: \$350,000 per year, starting in the FY2020 state budget

Implementing Organization: EGLE, with USGS

Timeframe: annual, starting in FY2020

Groundwater

Groundwater #1.

The State's ability to monitor groundwater levels is limited by an inadequate network of groundwater monitoring wells. The proposal here is to implement a plan for a more comprehensive groundwater

network throughout Michigan. This will be accomplished in a four-task approach of initial evaluation, field evaluation, network implementation, and operation and maintenance. For the full network implementation across the State of Michigan, the first year of establishing the network is roughly estimated to cost approximately \$259,000 with subsequent years costing approximately \$226,000. We project increases in project costs of five to ten percent each year thereafter to account for operation and maintenance of ten additional wells per year and adjustments for inflation.

Unknown in this proposal is the number of new wells necessary to complete the monitoring network; however, initial discussions have focused on having at least two wells per county. This will presumably be determined in the initial and field evaluation portion of the proposal. Approximate costs of new wells are as follows, per USGS.

- Estimated cost for drilling a new observation well: Average is about \$5,500 but depends on depth. Estimate about \$25-\$50 per foot depending on difficulty
- Estimated cost for equipment for non real-time / transducer and data logger only observation well: \$1,800
- Estimated cost for equipment for real-time observation well: \$7,500
- Annual operation and maintenance for non real-time / transducer and data logger only observation well: \$2,400
- Annual operation and maintenance for real-time observation well: \$4,840

Additionally, WUAC recommends that EGLE join the National Groundwater Monitoring Network (<https://cida.usgs.gov/ngwmn/>) to increase awareness among various divisions in EGLE on existing groundwater monitoring wells and data to allow for interdepartmental efficiencies. USGS has outlined several requirements of each state for data to be accepted into the network. By meeting USGS requirements for the network, EGLE will improve the organization and accessibility of existing groundwater monitoring data within the Department. For example, groundwater data is currently housed in multiple databases across EGLE but the inclusion in the NGWMN will provide translators to restructure files into common data formats. Additionally, inclusion in the NGWMN makes Michigan eligible for additional funding that can cover costs associated with rehabilitating existing, and installing new monitoring wells during future rounds of funding.

Investment Proposed: \$259,000 during the first year; \$226,000 in subsequent years subject to cost increases due to inflation. USGS will consider up to 25 percent match through its' Cooperative Matching Funds program (subject to availability).

Implementing Organization: USGS

Timeframe: Program could start immediately, and annual costs would continue for the life of the program.

Geology

Geology #1. 3D Glacial Aquifer Mapping in Four Michigan Counties

3D glacial aquifer data, currently unavailable in most of Michigan, would enable EGLE, Water Use Program staff, as well as private contractors, to predict via modelling whether or not proposed large quantity withdrawals are likely to cause adverse resource impacts. One of most robust methods of mapping the 3D aquifer properties of an area is the use of transition probability (TP), a geostatistical approach based on the premise that the probability that a given geologic material type is present at another location depends only upon the material type at the current location. The lithologic descriptions for given depth intervals in the Wellogig lithology file are pre-classified into four different geologic

material types: aquifer material (AQ); marginal aquifer material (MAQ); partially confining material (PCM); and confining material (CM). These lithologic classifications can be analyzed to create a transition probability matrix of auto- and cross-correlations between the material types and geostatistical models can be fit to the data using Markov chain analysis. The result is a 3D leggo block-like geologic model of aquifer material types throughout an area of interest.

The WUAC strongly recommends that the legislature allocates \$120,000 to the EGLE, Water Use Program to be expended across two fiscal years by an external contractor who will map the 3D aquifer properties of four counties using the transition probability geostatistical approach. The EGLE, Water Use Program will select Cass County and three other counties where the contractor will develop a 3-D realization of the glacial aquifer materials that extends from the land surface to the top of the bedrock surface (in counties where both glacial and bedrock aquifers are used) or to the bottom of the screened interval in all the wells in counties where the bedrock is not an aquifer. Only counties where the locations of Wellogic well records have been verified shall be selected. The geologic model cells should have a vertical height of not more than 4 m and a horizontal extent of 500 x 500 m or less. Each cell will be categorized as one of the four material types (AQ, MAQ, PCM, or CM) for each model realization. At least 1000 realizations must be executed to produce an ensemble mean geologic model by assigning the most frequently occurring validated geologic material at each grid cell. The contractor will derive the average effective hydraulic conductivity of each layer in the output model from the validated well location in Wellogic data base. The final 3D aquifer properties model must be in a format compatible with the most recent version of the USGS ModFlow software.

Investment Proposed: \$120,000 across two fiscal years.

Implementing Organization: The EGLE, Water Use Program will work through the DTMB to solicit bids from qualified contractors to map the 3D aquifer properties of four counties and will be the point of contact for the State of Michigan to manage the subsequent contract. Water Use Program staff will engage with the WUAC Models Committee as they develop the Request for Proposals for DTMB. The contractor's quarterly reports submitted to the Water Use Program should also be shared with the WUAC Models Committee.

Timeframe: This recommendation is for funds to be expended across two fiscal years by an external contractor who will map the 3D aquifer properties of four counties in Michigan.

Geology #2. Expanding Geologic Mapping in targeted areas of Michigan

Improved geologic data are needed to fine tune and verify predictions that large quantity withdrawals will not cause adverse resource impacts, and to determine whether an ARI has occurred. The best available surface geology maps in Michigan are compiled at a scale of 1:24,000 within 7.5' quadrangles. Currently, only 33 such high-quality maps exist, collectively covering less than three standard (576 mi²) counties. Expanding state funding to the Michigan Geological Survey (MGS) in support of the STATEMAP program will dramatically improve the ability of EGLE to manage the groundwater resources of Michigan under Part 327 and will support numerous other programs in EGLE (e.g., supporting the Michigan PFAS Action Response Team (MPART), MDNR and MDARD for years to come. These MGS mapping projects would expand existing geologic information with data from drilling, soil sampling, passive seismic, and gamma-ray logging to produce composite surficial geology maps that include bedrock topography, thickness of glacial deposits and static groundwater elevations.

The WUAC strongly recommends that the legislature allocates at least \$3,000,000 of recurring, operating funds. This allocation would be consistent with 2019 proposed legislation in SB-403 and HB-4745 to support geologic mapping for PFAS impacted areas by the Michigan Geological Survey (MGS) to specifically conduct the geological mapping of EGLE-designated counties in order to derive geologic and aquifer data useful to the EGLE, Water Use Program and MPART geologic subsurface data requirements.



Such funding is necessary so that MGS can secure matching funds from the Federal USGS National Cooperative Geological Mapping Program (NCGMP). Attached is a summary of the counties recommended for mapping to the Legislature in October 2019 by EGLE WRD and MPART with an estimated 20 Counties completed in 10 years at that allocation. The WUAC strongly urges that such an appropriation also require that the MGS-sponsored geologic mapping projects continue to collect and analyze the glacial core samples in order to estimate the hydraulic conductivity of the glacial deposits and that MGS enter these data into the appropriate, publicly-available database that will be part of the Michigan Hydrologic Framework (the Hydrologic-Geologic Data Set).

Investment Proposed: \$3,000,000, recurring

Implementing Organization: Michigan Geological Survey at Western Michigan University

Timeframe: This recommendation is for recurring, operating funds for the Michigan Geological Survey for a ten year period.

Recommended Counties for mapping

		MICHIGAN GEOLOGICAL SURVEY SUMMARY OF COUNTY MAPPING PRIORITIES RESULTING IN VALIDATED GEOLOGIC MAPPING PRODUCTS		
	Priority Counties (Mapping data needed)	EGLE WRD Water Use Priority list	EGLE MPART PFAS Areas	
1	Montcalm	Branch	Kalamazoo	
2	Ottawa	Cass	Muskegon	
3	Allegan	St. Joseph	Oakland	
4	Calhoun	Calhoun	Kent	
5	Berrien	Van Buren	Montcalm	
6	Jackson	Ottawa	Ottawa	
7	Branch	Berrien	Allegan	
8	Cass	Allegan	Calhoun	
9	St. Joseph	Montcalm	Ionia	
10	Washtenaw	Hillsdale	Monroe	
11	Kent	Jackson	Livingston	
12	Barry	Gratiot	Lenawee	
13	Oakland	Isabella	Marquette	
14	Ionia		Washtenaw	
15			Barry	
16			Berrien	
17			Charlevoix	
18			Delta	
19	Top Priority		Jackson	
20	Second Priority		Newaygo	
21	Third Priority			
<p>NOTE: MGS has received specific priority county designations from WRD and MPART, when asked. The United Tribes of Michigan endorsement was for mapping of water resources where needed in the State.</p>				

Total New Data Acquisition Investment Proposed:

Relevant Previous WUAC (2014) Recommendations: 1.1, 1.2, 2.3, 1.6