

Montana Bureau of Mines and Geology
Final Technical Report for NGWMN Award G19AC00276:
National Groundwater Monitoring Network Persistent Data Services
2020–2021 Final Report

Miscellaneous Contribution 24

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Agency Name: Montana Bureau of Mines and Geology

Title: National Groundwater Monitoring Network Persistent Data Services
2020–2021 Final Report

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Background

The Montana Bureau of Mines and Geology (MBMG) maintains a statewide groundwater monitoring network to collect water-level and water-quality data from about 800 wells. Many of these wells are completed in Principal Aquifers, including the heavily developed intermontane basin aquifers in the west (S100NRMTIB), and the less intensively developed but widely used alluvial (N100ALLUVL), Lower Tertiary (N300LTRTRY), Upper Cretaceous (N300UPCTCS), Lower Cretaceous (N300LCRTCS), and Paleozoic aquifers (N500PLOZOC) in the east (Whitehead, 1996). The MBMG became a National Groundwater Monitoring Network (NGWMN) data provider in 2015, and at the start of this project provided water-level data for 224 sites, and water-quality data for 58 sites.

Description of work done to support the NGWMN as a data provider

The work performed for award G19AC00276 was under Objective 2: to maintain persistent data services between the MBMG and the NGWMN portal. Specific tasks related to ongoing web service maintenance included:

- Update registry with new or dropped sites.
- Maintain MBMG database tables for all NGWMN flagged wells.
- Review and revise MBMG structures to accommodate any NGWMN enhancements.
- Maintain software and provide updates as necessary.

The MBMG Ground Water Information Center databases are housed in Microsoft SQL Server, either 2012 Standard or 2016 Enterprise Edition. The databases store the data elements served to the NGWMN portal, including well construction details, lithologic descriptions, water levels, and inorganic water-quality data.

During the performance period, seven wells were dropped from the NGWMN because of difficult access, well damage, or the landowner no longer granting access. The sites may still be included in the registry, but the display function has been deactivated by the MBMG. The NGWMN site names for the deactivated sites are listed below:

Site_Name	National_Aquifer	Local_Aquifer	WL_Network	QW_Network	Aquifer_Type	Well_Depth (ft)
MBMG-140369	Alluvial aquifers	121FLXV FLAXVILLE GRAVELS (PLIOCENE-MIOCENE)	Yes	No	UNCONFINED	54
MBMG-1872	Lower Cretaceous aquifers	217KOTN, KOOTENAI FORMATION	Yes	Yes	CONFINED	705
MBMG-185284	Lower Tertiary aquifers	125TLCK, TULLOCK MEMBER (OF FT UNION FM.)	Yes	No	UNCONFINED	300
MBMG-4483	Northern Rocky Mountains Intermontane Basins aquifer systems	120SNGR, SAND AND GRAVEL (TERTIARY)	Yes	Yes	UNCONFINED	72
MBMG-77168	Northern Rocky Mountains Intermontane Basins aquifer systems	112LONE LONEPINE AQUIFER (LITTLE BITTERROOT VALLEY)	Yes	No	CONFINED	306
MBMG-90525	Northern Rocky Mountains Intermontane Basins aquifer systems	112SNGR SAND AND GRAVEL (PLEISTOCENE)	Yes	No	CONFINED	362
MBMG-108595	Northern Rocky Mountains Intermontane Basins aquifer systems	111SNGR, SAND AND GRAVEL (HOLOCENE)	Yes	Yes	UNCONFINED	43
MBMG-110196	Northern Rocky Mountains Intermontane Basins aquifer systems	120SDMS SEDIMENTS (TERTIARY)	Yes	No	UNCONFINED	70
MBMG-131018	Northern Rocky Mountains Intermontane Basins aquifer systems	110ALVM ALLUVIUM (QUATERNARY)	Yes	No	UNCONFINED	50
MBMG-132575	Northern Rocky Mountains Intermontane Basins aquifer systems	400BELT BELT SUPERGROUP	Yes	No	CONFINED	400
MBMG-132595	Northern Rocky Mountains Intermontane Basins aquifer systems	400BELT - BELT SUPERGROUP	Yes	No	CONFINED	120
MBMG-133045	Northern Rocky Mountains Intermontane Basins aquifer systems	112ALVM ALLUVIUM (PLEISTOCENE)	Yes	No	CONFINED	172
MBMG-133839	Northern Rocky Mountains Intermontane Basins aquifer systems	112LKML GLACIAL LAKE MISSOULA BEDS	Yes	No	CONFINED	305
MBMG-133842	Northern Rocky Mountains Intermontane Basins aquifer systems	112LKML GLACIAL LAKE MISSOULA BEDS	Yes	No	CONFINED	90
MBMG-133891	Northern Rocky Mountains Intermontane Basins aquifer systems	400RVLV RAVALLI GROUP	Yes	No	CONFINED	420
MBMG-133895	Northern Rocky Mountains Intermontane Basins aquifer systems	112ALVM ALLUVIUM (PLEISTOCENE)	Yes	No	CONFINED	500
MBMG-702934	Northern Rocky Mountains Intermontane Basins aquifer systems	112ALVM ALLUVIUM (PLEISTOCENE)	Yes	Yes	CONFINED	422
MBMG-155732	Sand and gravel aquifers (glaciated regions)	111SNGR, SAND AND GRAVEL (HOLOCENE)	Yes	No	UNCONFINED	114
MBMG-2333	Upper Cretaceous aquifers	211EGLE EAGLE SANDSTONE	Yes	Yes	CONFINED	1430
MBMG-27377	Upper Cretaceous aquifers	211HLCK HELL CREEK FORMATION	Yes	No	CONFINED	90
MBMG-136642	Upper Cretaceous aquifers	211COGT COLGATE SANDSTONE MEMBER (OF FOX HILLS FM.)	Yes	No	CONFINED	1467
MBMG-157936	Upper Cretaceous aquifers	211LNCE LANCE FORMATION	Yes	No	UNCONFINED	97
MBMG-164863	Upper Cretaceous aquifers	211EGLE EAGLE SANDSTONE	Yes	No	CONFINED	198

Table 1. Sites dropped from NGWMN during project period.

Also during the performance period, the MBMG monitored overall NGWMN service usage and availability, when necessary responding to questions from NGWMN portal staff. Specific items addressed included:

- MBMG Data Center worked with USGS to update passwords in response to an Oracle upgrade. This addressed software vulnerabilities in the Well Registry Management System in April 2020.
- MBMG addressed a broken web service link in February 2021.
- MBMG addressed precision issues and significant figures related to several of the connected services in July 2021.

Description of any updates made to web services during period of award

- MBMG developed a series of new APIs to deliver data to the NGWMN in June 2021, replacing the Geoserver.
- MBMG resolved API “endpoint” issues/errors to restore API links to the Network in July 2021.
- MBMG worked with USGS to update URL mapping to deliver daily average data to the Network.

Below are the API definitions for the National Network (NGWMN) URL:

Category: Water Levels

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevels/xml>

Variable: gwicid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevels/xml?gwicid=96983>

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevels/json>

Variable: gwicid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevels/json?gwicid=96983>

WaterLevels

gwicid*	integer(\$int32)
date_measured	string(\$date-time)
time_zone*	string
swl_ground	number(\$double)
method	string
nullable:	true
status*	string
data_source*	string
units*	string

Data Type: Averages (Daily)

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevelsDailyAverage/xml>

Variable: gwicid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevelsDailyAverage/xml?gwicid=96983>

Data Type: Averages (Daily)

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevelsDailyAverage/json>

Variable: gwicid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterLevelsDailyAverage/json?gwicid=96983>

WaterLevelsDailyAverage

gwicid*	integer(\$int32)
date_measured	string(\$date-time)
time_zone*	string
swl_ground	number(\$double)
method*	string
status*	string
data_source*	string
units*	string

Category: Construction—Casing

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Casing/xml>

Variable: gwicid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/Casing/xml?gwicid=96983>

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Casing/json>

Variable: gwicid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/Casing/json?gwicid=96983>

Casing

gwid*	integer(\$int32)
case_from	number(\$double)
case_from_unit*	string
case_to	number(\$double)
case_to_unit*	string
material*	string
diameter	number(\$double)
case_diameter_unit*	string
wall_thickness	string
nullable:	true
data_source*	string

Category: Construction—Completion

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Completion/xml>

Variable: gwid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/Completion/xml?gwid=96983>

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Completion/json>

Variable: gwid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/Completion/json?gwid=96983>

Completion

gwid*	integer(\$int32)
comp_from	number(\$double)
comp_from_unit*	string
comp_to	number(\$double)
comp_to_unit*	string
description*	string
diameter	number(\$double)
comp_diameter_unit*	string
data_source*	string

Category: Construction—Lithology

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Lithology/xml>

Variable: gwid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/Lithology/xml?gwid=96983>

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/Lithology/json>

Variable: gwid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/Lithology/json?gwid=96983>

Lithology

gwicid*	integer(\$int32)
lith_from	number(\$double)
lith_from_unit*	string
lith_to	number(\$double)
lith_to_unit*	string
description	string
nullable:	true
data_source*	string
total_depth	number(\$double)
well_log_available*	string

Category: Water Quality

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterQualityParameters/xml>

Variable: gwicid

Returns: XML

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterQualityParameters/xml?gwicid=96983>

Data Type: Raw

URI: <https://mbmgweb1a.mtech.edu:5001/national/WaterQualityParameters/json>

Variable: gwicid

Returns: JSON

Example: <https://mbmgweb1a.mtech.edu:5001/national/WaterQualityParameters/json?gwicid=96983>

WaterQualityParameters

sampleType*	string
gwicid*	integer(\$int32)
sampleIdentification	string
nullable:	true
sampleCollectionMethod*	string
samplingPointElevation	integer(\$int32)
nullable:	true
samplingPointElevationMeasurementMethod	integer(\$int32)
nullable:	true
samplingPointElevationAccuracy	integer(\$int32)
nullable:	true
siteUseAtTimeOfSampling	integer(\$int32)
nullable:	true
sampleCollectionDate	string(\$date-time)
nullable:	true
analyteName	string
nullable:	true
resultValue	string
nullable:	true
resultValueUnitOfMeasure	string
nullable:	true
detectionCondition	integer(\$int32)
nullable:	true
valueType*	string
sampleFraction	string
nullable:	true

analyticalMethodNumber	string
nullable:	true
analyticalMethodName	string
nullable:	true
analyticalMethodContext	integer(\$int32)
nullable:	true
chemicalIdentificationNumber	string
nullable:	true
chemicalSystematicContext	integer(\$int32)
nullable:	true
biologicalIdentificationNumber	integer(\$int32)
nullable:	true
biologicalSystematicContext	integer(\$int32)
nullable:	true
analysisDate	string(\$date-time)
nullable:	true

Notice of any changes in databases or web services that are being planned that would impact future integration of the web services with the NGWMN data portal

There are no planned changes to the MBMG web services.

References

Whitehead, R.L., 1996, Ground Water Atlas of the United States Segment 8-Montana, North Dakota, South Dakota, Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas 370-I, 24 p.