State of Alaska Department of Natural Resources
New Data Provider to the National Groundwater Monitoring Network, South-central Alaska Water Level and Water Quality Networks

Final Project Technical Report

award #G16AC00368

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Disclaimer

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1. Contents

2. Introduction

The Alaska Department of Natural Resources (ADNR), Alaska Hydrologic Survey (AHS), is a water-level data provider to the National Groundwater Monitoring Network (NGWMN). The ADNR collects groundwater data to evaluate changes in groundwater availability, the interaction between groundwater and surface-water, the response of groundwater systems to climate variability, and the effects of natural disturbances on groundwater levels.

The Alaska Hydrologic Survey (AHS) within the Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW), Water Resources Section, is mandated by Alaska Statute (AS) 41.08.017, AS 41.08.020 and Department Order 115 (Noah, 1994) to collect, record and require filing of data on the quantity, location and quality of water in the subsurface, surface, or along the coasts. Our program elements under AS 41.08 include, but are not limited to: systematic hydrologic data collection and analysis, database management, archival of water well logs, coordination of water-data collection activities by state agencies, and establishment of cooperative agreements with individuals, public or private agencies, communities, private industry, and state or federal agencies. The purpose for monitoring and collection of hydrologic data is to provide the scientific data necessary to support management of Alaska’s natural resources.

The principal aquifers monitored by ADNR and its cooperators include the Alaska Unconsolidated – deposit aquifers (Miller et al., 1999) and the Cook Inlet Aquifer System in parts of Anchorage, Palmer, Wasilla and the Kenai Peninsula. The Unconsolidated – deposit aquifers (Alaska) are important locally and at the national-scale for multiple purposes, including, but not limited to: sources for water supply, economic development, sources for upwelling to anadromous streams and other surface water bodies, for tracking/quantifying climatic changes, and for responding to natural disasters resulting from fires, earthquakes, and volcanic eruptions.

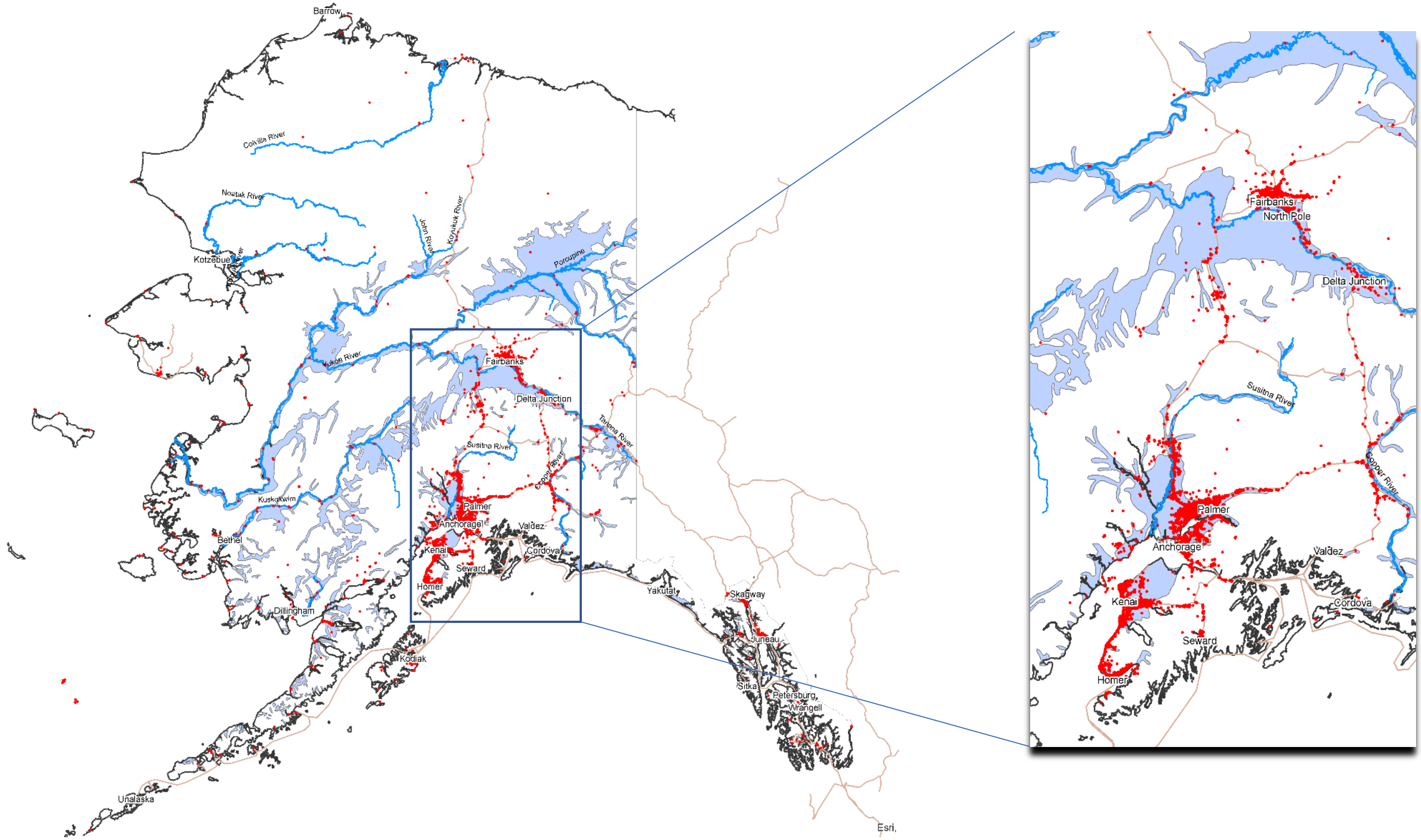


Figure 1. Location of all groundwater wells in the Well Log Tracking System (WELTS) database, and the areal extent of Alaska major unconsolidated-deposit aquifers (Miller et al. 1997, data source: https://www.usgs.gov/media/images/unconsolidated-deposit-aquifers-alaska).

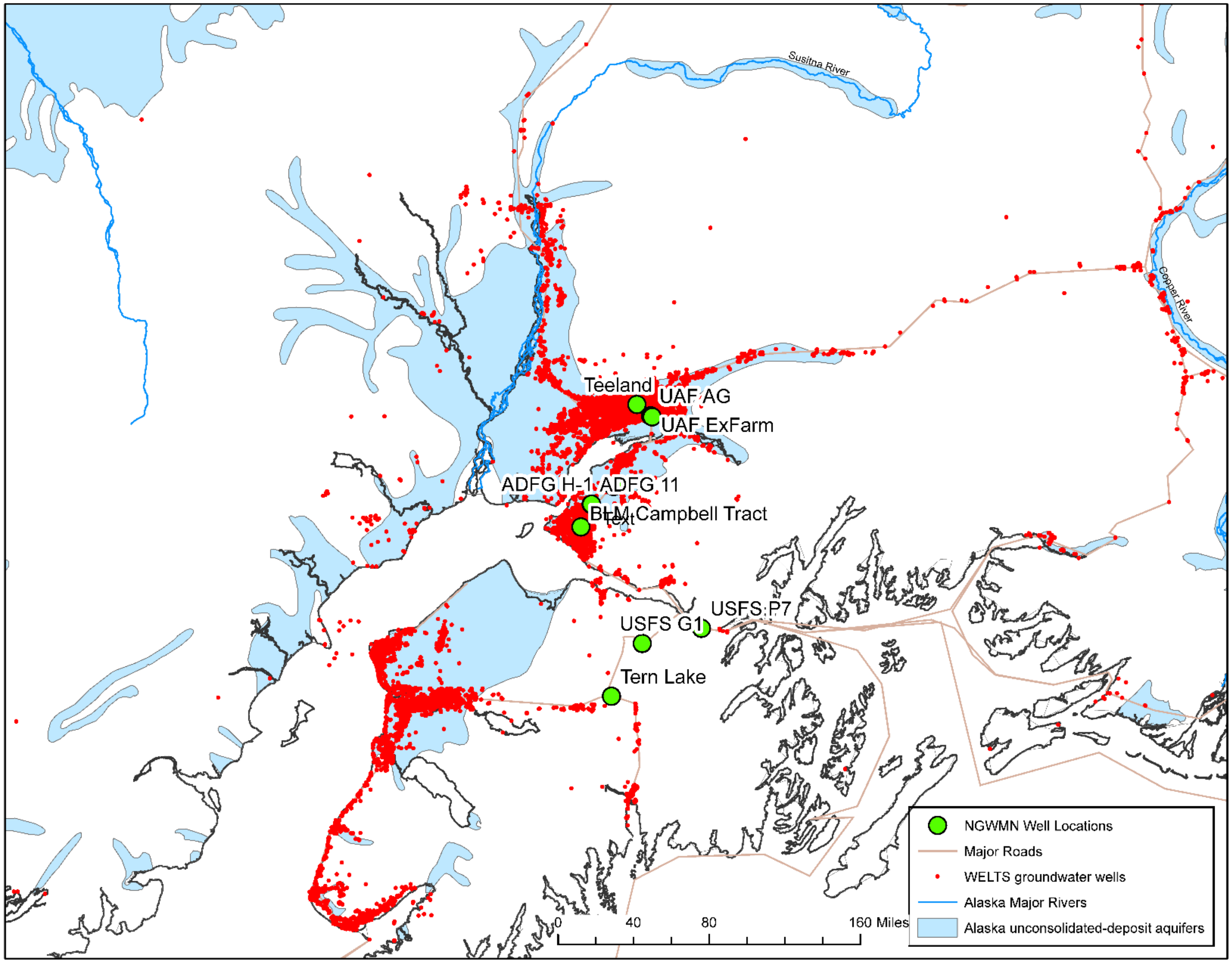


Figure 2. Location of all monitoring well in the NGMN and major unconsolidated-deposit aquifers (Miller et al. 1999)).

3. Major Aquifers and Groundwater Use in Alaska

Unconsolidated deposits created from alluvial processes or glacial outwash and consisting of sand, gravel, boulders, silt and clay, are the most productive aquifers in Alaska. Groundwater is an important source of water supply in Alaska's major cities as well as numerous smaller villages where unconsolidated deposits were deposited by glaciers and alluvial and colluvial processes (Miller 1999).

Patrick et al. 1990 outlined the water use from major aquifer systems. These include the alluvium and glacial outwash aquifers, from greatest to smallest water use, - the Cook Inlet, Yukon-Tanana, Copper River-Valdez, Yukon-Tanana, Juneau, and Bristol Bay Aquifers. Major alluvial aquifers are found on major river systems, serving larger cities such as Fairbanks and numerous smaller villages, especially along the Yukon-Kuskokwim river systems. Glacial deposit aquifers supply the major cities such as Anchorage and Juneau.

The aquifer systems underlying Fairbanks and Anchorage are high-yielding and supply drinking water as well as cooling water for some major commercial buildings. In Anchorage, unconfined aquifers are present near the surface, but confined aquifers below a confining layer of silt and clay provide the majority of drinking water to water utility and household wells. While Anchorage relied primarily on groundwater wells for city water demand from statehood to the early 1980s, surface water from Eklutna has contributed the majority of Anchorage Water and Wastewater Utility (AWWU) supply in the last twenty years. Nevertheless, groundwater still supplies more than 4 Mgal/d for Anchorage AWWU supply and a similar volume is estimated to be supplied from private domestic wells (Moran 2006, AKWUDS 2021).

Groundwater resources are plentiful in many regions of Alaska, but groundwater with adequate yield and quality is not always available where and when it is needed. Groundwater depletion has previously occurred in Anchorage due to high pumping rates from confined aquifers (Miller et al. 1999). Salt-water intrusion in Auke Bay near Juneau has also resulted in limitation on groundwater use (Barnwell and Boning 1968, Motyka 1988). Extensive development in the Matanuska Valley has on occasion led to depletion of local aquifer systems. The Anchorage Bowl and Matanuska-Susitna Valleys have the greatest density of domestic and community wells. Groundwater wells are typically finished in confined aquifers with water-bearing sand and gravel but can be limited in supply, especially when if the water-bearing formation is shallow and numerous wells are finished or screened in the same confining layer (Dearborn and Munter 1987, Kikuchi 2013).

4. History of Groundwater Monitoring and Assessment in Alaska

Groundwater resources were evaluated by the USGS and the State of Alaska pre- and post-statehood in numerous reports focused on population centers and major villages throughout Alaska. The earliest Alaska territory-wide water use assessment in was conducted by the USGS (Cederstrom 1952). USGS water resource studies continued after statehood in 1959 with groundwater assessment in Anchorage (Cederstrom et al. 1964). Anchorage groundwater supply was further evaluated in numerous USGS (Cederstrom 1964, Patrick et al. 1990) and Alaska Division of Geological and Geophysical Surveys (DGGS) reports (Dearborn and Munter 1995, Munter and Allely 1993). Geology and groundwater resources in the Matanuska-Susitna valley north of Anchorage, the history of glacial advance and retreat, and the complexity of the unconsolidated-deposit aquifers were evaluated by USGS (Trainer 1960) and DGGS (Jokela et al. 1990). Most recently, a State of Alaska capital improvement project awarded to the USGS compiled groundwater data and developed a modflow groundwater model for the Matanuska-Susitna valley (Kikuchi 2013).

Groundwater resources are widely used throughout Alaska where public water supply is not available. The density of groundwater wells can be found using in the Well Log Tracking System (WELTS) database available to the general public, https://dnr.alaska.gov/welts/ (see Fig 1).

The value of a long-term groundwater monitoring network was recognized when Alaska was still a U.S. territory. By the early 1970's, 80 groundwater stations (27 instrumented) and one spring were maintained by the USGS. Recommendations in the Alaska 10-year Comprehensive Plan included expansion of the existing groundwater stations over a 10-year period (IHCA 1974). Despite much research conducted by the State of Alaska DGGS and the U.S. Geologic Survey (USGS) from statehood and through the 1990's, current USGS groundwater monitoring is limited to just four wells in Alaska

5. Selection and Classification for NGWMN

The NGWMN framework is built around subnetworks with specified level or frequency of monitoring. Monitoring categories indicated by the NGWMN include trends wells (high frequency to determine changes in groundwater levels over time) and surveillance monitoring (periodic "census" of groundwater conditions at lower frequency of monitoring). All wells maintained by ADNR hydrologists in the NGWMN network have continuous monitoring by pressure transducer and therefore are considered "trend" monitoring wells.

Alaska has a sparse network of groundwater monitoring network that we have been working to expand. Recently added wells were selected based on prior monitoring record, available well construction and lithology, and accessibility by ADNR hydrologists. Wells are located on borough, municipality, federal (BLM, USFS), and state-owned lands. Currently, the well network is concentrated in southcentral Alaska, but expansion is planned for other regions of Alaska as suitable wells become available.

NGWMN wells are further classified into well classification subnetworks defined in NGWMN framework document:

- *Background subnetwork*
  Monitoring points that provide data from aquifers or parts of aquifers with no (or minimal) anthropogenic effects.

- *Suspected Changes subnetwork*
  Monitoring points that provide data from aquifers or parts of aquifers that may have been affected by man's activity, but that is not documented or conclusive.

- *Documented Changes subnetwork*

Monitoring points that provide data from aquifers that have documented anthropogenic effects.

Based on this classification, the AK NGWMN wells located in the Anchorage Bowl and Matanuska-Susitna Valleys may be affected by groundwater pumping. Drawdown in some wells has already been established and coincides with known pumping events, falling into the "Documented" subnetwork. Other wells near population centers are in the "Suspected" subnetwork until further baseline data can be collected to determine if water levels are affected by pumping.

Three wells on the Kenai Peninsula in unconfined surficial aquifers within the U.S. National Forest are located far from population centers and local pumping and are considered "background" sub-network wells. The Tern Lake well is co-located with streamflow at Daves Creek (Alaska Department of Fish and Game gage for instream flow) at the outlet of Tern Lake (see Fig 9).

6. Project Objectives and Achievements

Eight objectives were outlined in the original ADNR/NGWMN grant proposal, including

<u>Objective 1</u> *Work with NGWMN and USGS personnel at the Alaska Science Center to determine the appropriate density of monitoring locations in each principle aquifer using the Framework document.*

<u>Objective 2</u>: *Required data elements for water-level and water quality networks listed in NGWMN.*

<u>Objective 3</u>: *Monitoring stations will be classified into the Subnetworks and Monitoring Categories*

<u>Objective 4</u>: *Establish a user account to access the Well Registry using Google Chrome and populate the NGWMN Well Registry with sites and network information.*

<u>Objective 5</u>: *The Information Resource Management (IRM) section in the state's Support Services Division (IRM) will be contracted to establish connections using Web Services between the state's databases and the NGWMN Data Portal. Separate services will be established for water levels, water quality, lithology, and well construction. The approach will comply with the requirements provided in the National Groundwater Monitoring Network Tip Sheet on Developing Web Services for the Network.*

<u>Objective 6</u>: *Document and provide field and data management procedures/practices.*

<u>Objective 7</u>: *A report describing the outcome of the: 1) selection process and well classification criteria and 2) web services used to supply data to the NGWMN will be provided.*

<u>Objective 8</u>: *Conduct ongoing maintenance during year two with the purpose of: 1) ensuring that the NGWMN portal connections are operational, 2) that sites in the network are current, and 3) data elements for new sites are added to the NGWMN.*

In the process of utilizing the NGWMN network with steps of establishing user account and entering new wells on the network (Obj 4); populating data elements (Obj 2), and programming the web services to upload and manage data (Obj 5). In this report, we outline the field and data management procedures/practices (Obj 6). This report also outlines the selection process and well classification (Obj 3). We are continuing to upload groundwater data from 10 wells, visiting wells on a quarterly basis, and uploading data through a data uploader GUI written by the state's DOA programmers (Obj 5).

7. Data Logger Installation and Data Collection Techniques

The SOA ADNR has an established protocol for long-term well records and establishment of wells and recording water-level measurements in the field, the value measured is compared to prior values to assure the value is continuous with the range of previous values. Water-level measurements that are anomalously high or low should be checked to verify that the reading is correct. Anomalous values should also be noted in the field notebook/data sheet with an explanation, if known. Water-level measurements are recorded in a dedicated field notebook, field datasheet, or electronic equivalent and maintained to preserve historical measurements as an archive. When water levels of all the wells within the National Groundwater Monitoring Network have been measured (typically every three months), the data are compiled and uploaded through the uploader developed by DNR programmers. The development of this software interface allows a hydrologist to upload data directly, saving time and effort by the SOA programming team.

Well inserts were created in collaboration with a local fabrication shop. The design is based on existing well inserts designed and constructed in-house by the USGS's Anchorage Field Office. Slight modifications to the original design were made to streamline CNC production as well and loosen tolerances for ease of use in the field. Some dimensions were also changed to simplify the math of adding the insert into water level calculations. The well inserts are made of steel with a primer basecoat to protect against corrosion.

Fig 3. Location photos of monitoring wells on the Kenai Peninsula and in the Matanuska-Susitna Valley. USFS G1 (Granite Creek), P7 (Portage Creek) in top panel. Term Lake middle-left; the long-term UAF Mat Exp Ag Farm well (middle right) and in bottom panel the recently added ‘UAF ExFarm’, also at UAF Mat Exp Ag Farm in Palmer, and the Teeland well in Wasilla (see Fig 2 for well locations).

ADFG 11

ADFG H-1

Eagle River TW#5

BLM Campbell Tract

Fig 4. Location photos of monitoring wells ADFG-11 and ADFG H-1 at former ADFG hatchery within the Fort Richardson military base. The recently rehabilitated and re-instrumented monitoring well in Eagle River (lower left), and the newly drilled well at the BLM Campbell Tract (lower right) in the Anchorage Bowl.

8. Data Management

Data are collected from each well by data download using datalogger-specific software (e.g. in-situ and solinst dataloggers and software). Data are downloaded in csv format, and transferred to spreadsheets in the office. Barometric pressure corrections are performed in spreadsheets, and daily average water level are calculated. Data are uploaded to the state groundwater database with an uploader template and software interface created by SOA programmers. ADNR hydrologists collaborated with SOA Department of Administration (DOA) programmers to develop a secure uploader to enable hydrologists to enter data directly into the NGWMN. This enables hydrologists to upload, edit, and delete water level data to the NGWMN rather than relying on programmers to utilize oracle to upload. These data are then harvested by the USGS/NGWMN network.

9. Well Rehabilitation and Well Drilling

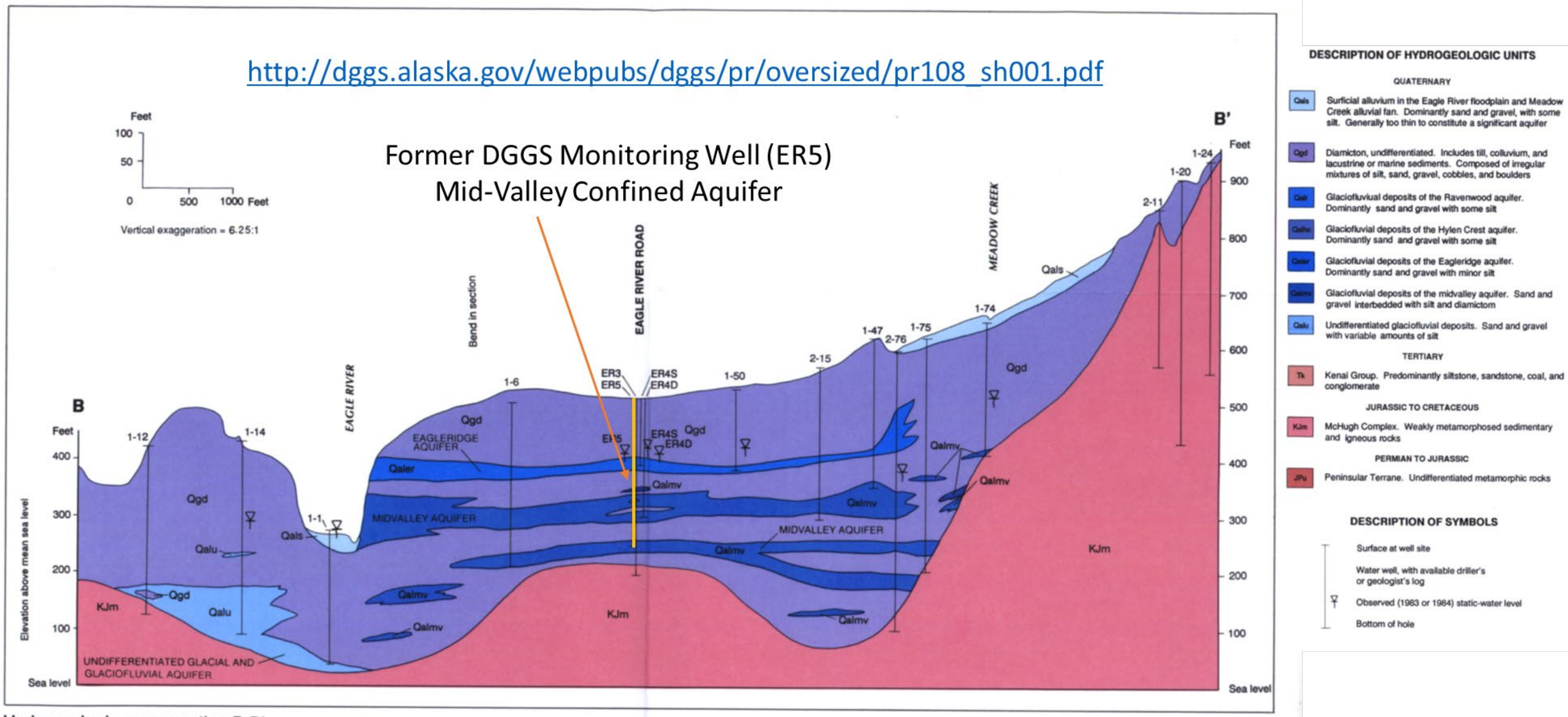
In order to expand the Alaska NGWMN monitoring network, we proposed to rehabilitate an existing well and drill a new well monitoring well (USGS grant #G16AC0036).

After closer inspection, it was determined that the original well proposed for rehabilitation (H-1 in former ADFG fish hatchery) was not suitable for a driller rig due to the proximity of local power lines. A suitable well was found, a former DGGS well, ER-5 in confined, mid-valley aquifer, that was previously monitored by Alaska Department of Geological and Geophysical Survey (DGGS) from 1983–1991 (see Fig 7). Several steps were taken to complete the rehabilitation project - a driller (M-W Drilling) was contracted, and ADNR obtained the necessary Right of Way permits and Lane Closure permits from the Alaska Department of Transportation. M-W Drilling completed the well rehabilitation in February 2020, including removal of incrustation and scale of the well screen. The down-hole video logging and cleaned screen are shown in Fig 5.

A new monitoring well was drilled within the U.S. Bureau of Land Management Campbell Tract in September 2020. ADNR collaborated with BLM to find a suitable site for drilling, and submitted a DOI Right of Way permit for the well drilling operation. Once the DOI Right of Way permit was approved, a well driller, Denali Drilling, was contracted. Although the contract was for up to 300 ft well depth, we decided with the driller to finish drilling at 92 ft after a high-yielding aquifer (50 gpm) was encountered below a dense confining layer of clay (Fig 6). The well was instrumented in December 2020 and the full period of record is shown in Fig 7.

Fig. 5 Eagle River, Alaska - Monitoring Well Rehabilitation (USGS grant #G16AC0036) conducted in February 2020, Well ER-5 confined, mid-valley aquifer, previously monitored by Alaska Department of Geological and Geophysical Survey (DGGS) from 1983–1991. Upper left: M-W Drilling boom on Eagle River Rd; upper right: sweep/brush unit used to clean well screen, middle left: pump used to purge well; middle right: cleaned well screen at 296 ft depth; bottom left: custom fabricated well hanger plate; bottom right: ER-5 well logger installation with pressure transducer and barometer anchored in well hanger plate set in well casing.

Fig 6. Drilling new monitoring well BLM Campbell tract (USGS grant #G16AC0036), air rotary drilling method, developed with air surge at Open End casing to 92ft; confined aquifer (dense clay aquitard from 18-26 ft, clay and gravel from 26 to 56 ft, flow rate during air lift development = 30 gpm. period of record 12/7/2020 to present. Top panel: well drilling rig and casing; middle panel: drill bit and finished well; bottom panel: well hanger plate with barometer and pressure transducer during installation in December 2020.



Hydrogeologic cross section B-B'

Fig 7. Location of re-instrumented Eagle River Well (former DGGS well "ER5"), screened casing from xx to xx ft. in the mid-valley aquifer represented in the conceptual profile Monitoring Well Rehabilitation (USGS grant #G16AC0036) conducted in February 2020, Well ER-5 confined, mid-valley aquifer, previously monitored by Alaska Department of Geological and Geophysical Survey (DGGS) from 1983–1991. Figure modified from Munter and Allely 1993.

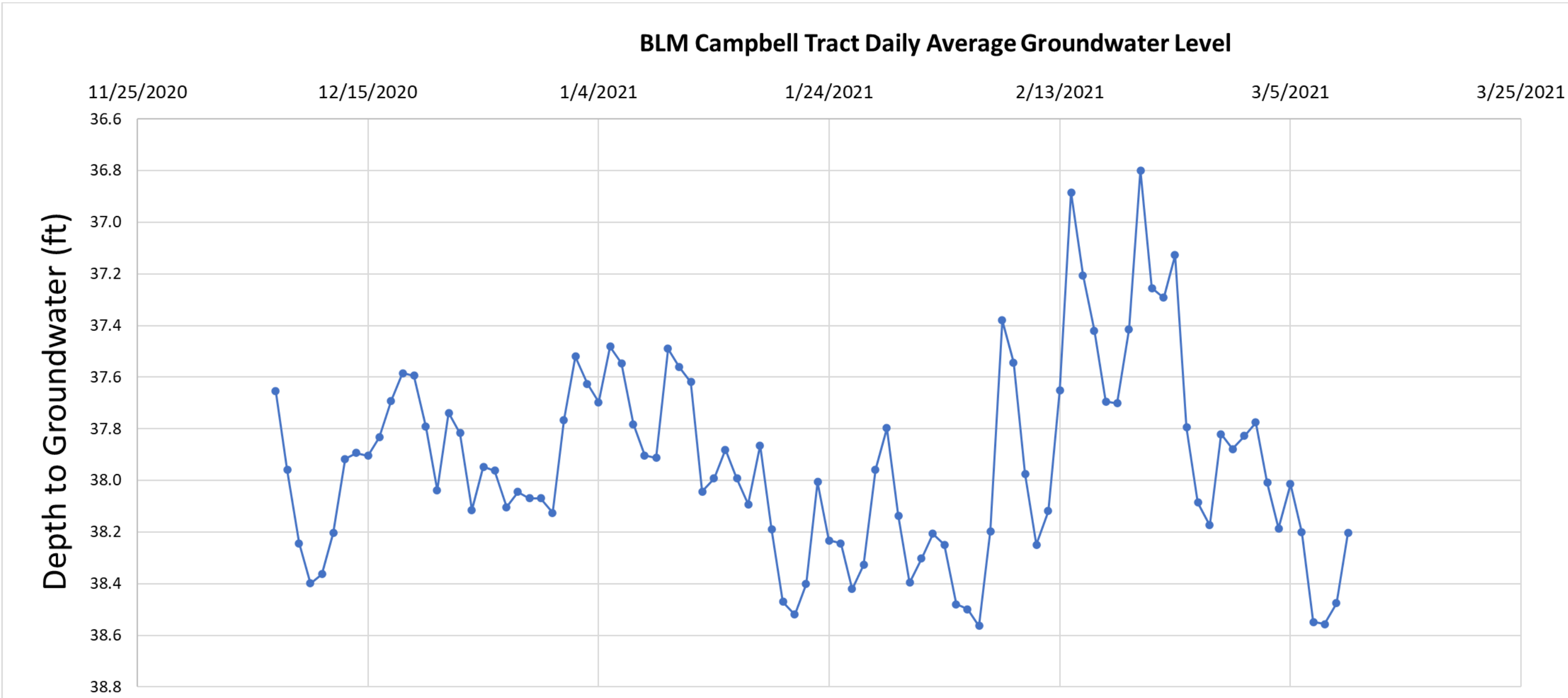


Fig 8 Average daily groundwater level in the BLM Campbell Tract well drilled in September 2020. (well depth 92 ft, confined aquifer).

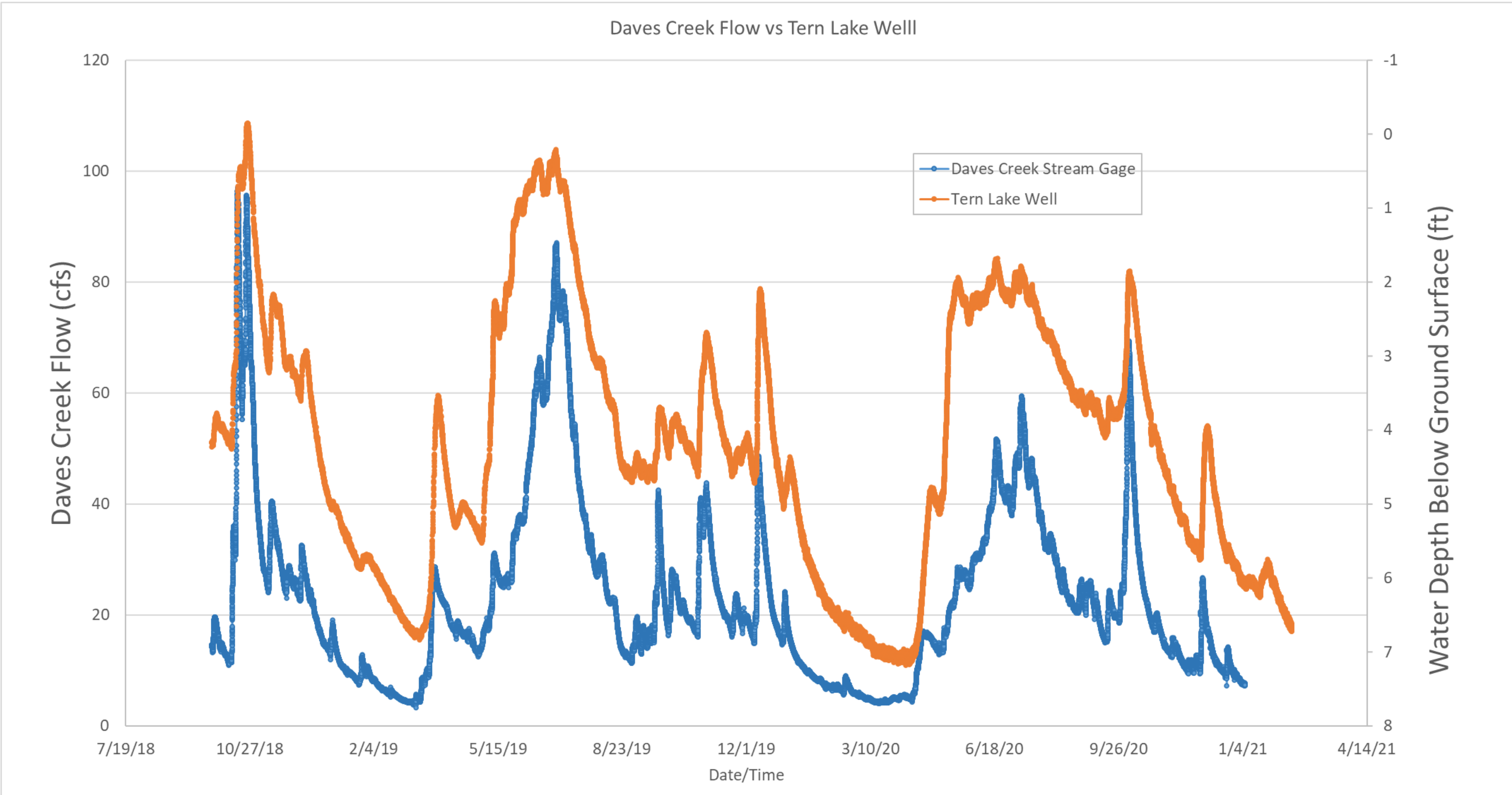


Fig 9 Groundwater and surface water dynamics at Tern Lake on thenKenai Peninsula. Tern Lake groundwater well (unconfined aquifer) and adjacent Daves Creek flow at the outlet of Tern Lake.

10. Groundwater Response to Earthquakes and Seismic Activity

Hydrologic changes following earthquakes have been measured in many studies worldwide and step changes in groundwater levels can be used to infer aquifer properties (Wang and Manga 2010). The most recent earthquake (7.1M on November 30 2018) was XX miles from Anchorage. This 2018 Anchorage earthquake was widely documented in seismic activity, structural damage and hydrologic response including liquefaction. West et al. 2020 documented a 6cm the drop in KB-6 groundwater level and a concomitant rise in streamflow. We observed groundwater changes from the 2018 earthquake in three additional wells. The greatest groundwater level changes were observed in the ADFG-11 well in Elmendorf and the MatSu Exp Farm, and the slightest change was observed at the Portage well on the Kenai Peninsula. Two recent high-magnitude earthquakes located near the Anchorage bowl (7.1M on Jan 24 2016 and 7.1M on November 30 2018) were captured in groundwater level observations at the MatSu Exp Farm, showing a similar response to two different earthquakes (see Fig 11).

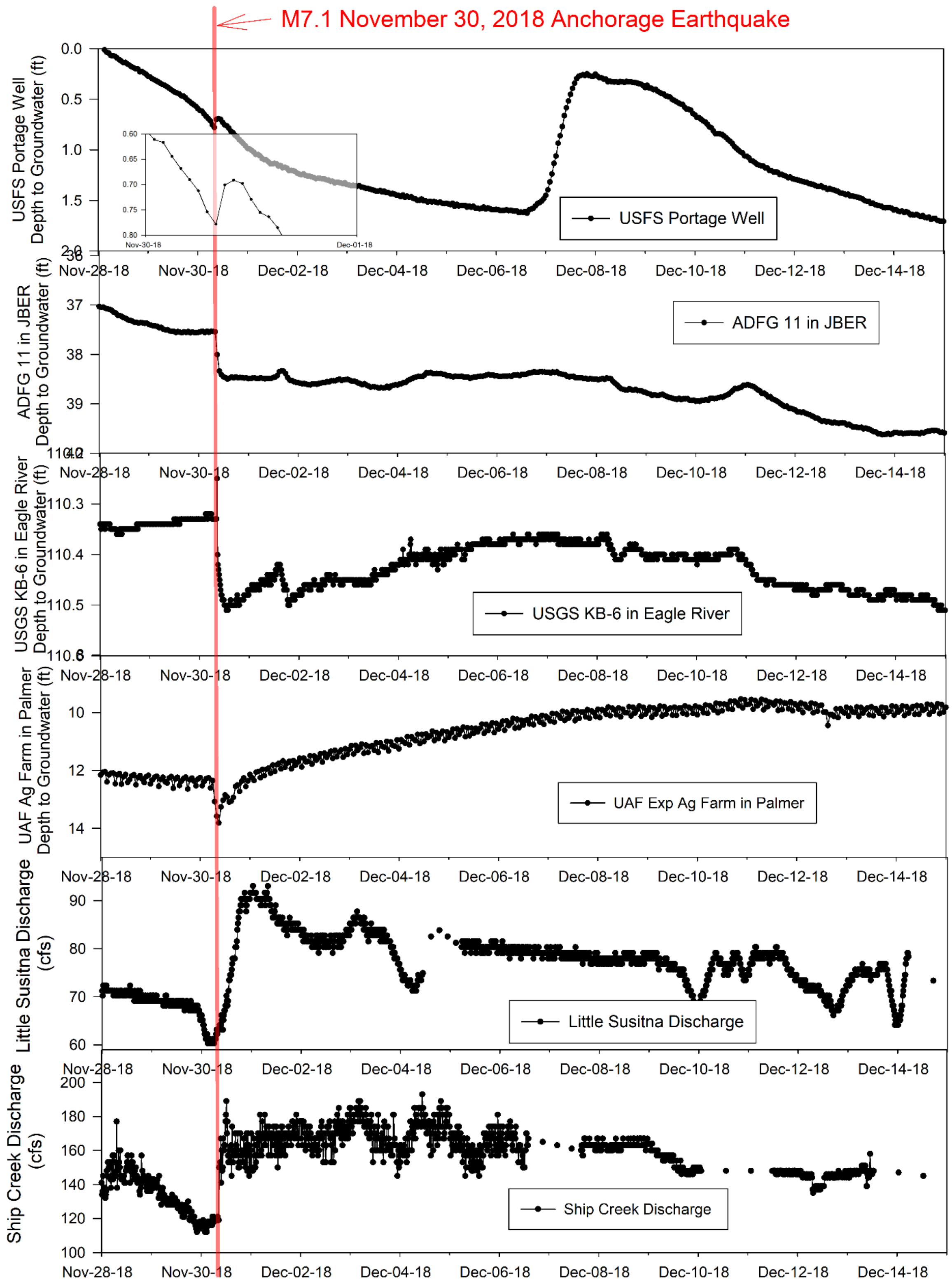

M7.1 November 30, 2018 Anchorage Earthquake
USFS Portage Well
Depth to Groundwater (ft)
USFS Portage Well
ADFG 11 in JBER
Depth to Groundwater (ft)
ADFG 11 in JBER
USGS KB-6 in Eagle River
Depth to Groundwater (ft)
USGS KB-6 in Eagle River
UAF Ag Farm in Palmer
Depth to Groundwater (ft)
UAF Exp Ag Farm in Palmer
Little Susitna Discharge
(cfs)
Little Susitna Discharge
Ship Creek Discharge
(cfs)
Ship Creek Discharge
Nov-28-18
Nov-30-18
Dec-02-18
Dec-04-18
Dec-06-18
Dec-08-18
Dec-10-18
Dec-12-18
Dec-14-18
Nov-30-18
Dec-01-18

Fig 10.

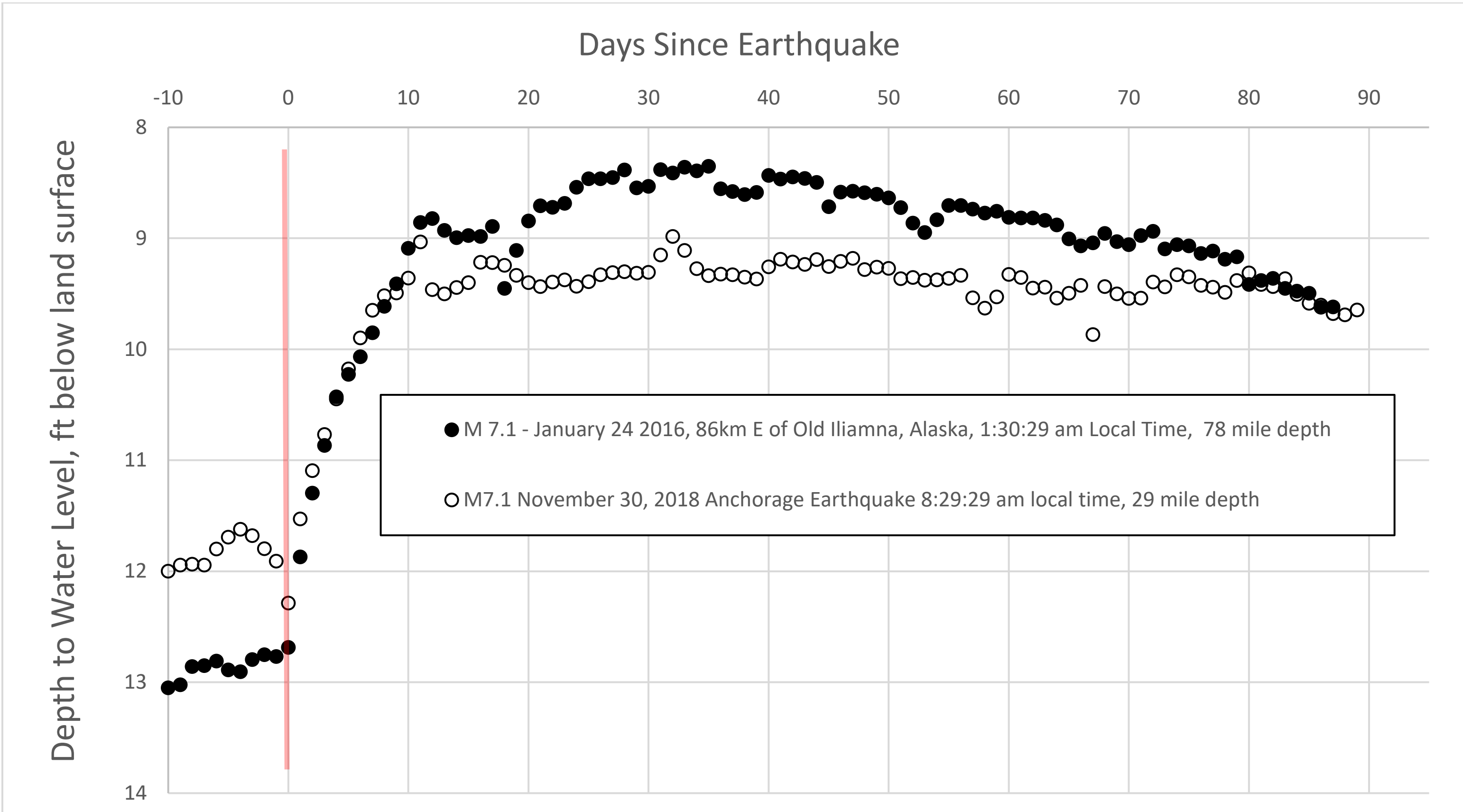


Figure 11. Response of MatsU Wxp Farm Ag well to recent major earthqiakes near Anchorage Alaska.

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12. Appendix A Groundwater Level Monitoring Protocols

Well Completion/Construction

• A dedicated folder should be maintained for each well in the monitoring program. This folder should contain documentation regarding:

- The well log,
- The well permit or cooperator agreement if applicable,
- Location documentation,
- Data files,
- Field notes, and site photos.

Water Level Measurement

All water level measurements shall be made from a consistent reference point/measuring point (MP) specific to each well.

The MP (top of casing or hole in insert) should be clearly marked on the wellhead and documented in the well folder. The same MP shall be consistently used for all measurements from that well.

The distance of the measuring point above (positive) or below (negative) ground surface shall be measured and recorded to within one-tenth of a foot. This stickup or subsurface distance must be measured yearly and documented in the well folder/data file.

The instrument/device used to measure water level should be clean, free of contaminants, and appropriate for the space and downhole equipment that may be in the well.

Electronic flat tape, wire, or cable water level meters are the most common. Tapes or wires which are graduated in the 100ths of a foot are preferred. Meters with tapes or wires that have fewer graduations will require an additional measurement from the closest available graduation marker. This measurement should be made with a measuring tape graduated in the 10ths and 100ths of a foot.

Graduated steel tape is more suited for use in wells with small access openings or wells with downhole pumps, wiring, stabilizers, and other materials that could hang up the tape, wire, or cable of an electronic water level meter.

Sonic well depth meters are also an alternative measuring device. These units usually operate in 2-inch or larger well diameters. Sonic well depth meters require optimization to filter out potentially erroneous sonic returns. For example, adjusting the meter for the well dimensions and expected water level range.

The depth measurement from the MP to the top of the water table should be made and recorded in the field on a minimum accuracy of one tenth of a foot (ideally one hundredth of a foot). The date and time of the measurement, name of the person who made the measurement and method of measurement should also be recorded.

Water-level measurements should not be made in a pumping well or a well which is known to have been pumping just prior to the scheduled event.

The frequency of water-level measurements should be made quarterly, ideally, at the same time of day.

Data Quality Control/Management

When making and recording water-level measurements in the field, the value measured should be compared to prior values to make sure the value is within a reasonable range of previous values. Water-level measurements that are anomalously high or low should be repeated to verify that the reading is correct. Anomalous values should also be noted in the field notebook/data sheet with an explanation, if known. For example, the pump may have recently been on.

Water-level measurements should be recorded in a dedicated field notebook, field datasheet, or electronic equivalent and maintained to preserve historical measurements as an archive.

When water levels of all the wells within the National Groundwater Monitoring Network have been measured, the data should be compiled and uploaded through the uploader developed by DNR.

13. Appendix B. Well log *WELTS ID #)

STATE OF ALASKA 73074
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
Alaska Hydrologic Survey

WATER WELL LOG Revised 08/18/2016

Drilling Started: 9 / 1 / 2020 Completed: 9 / 3 / 2020 Pump Install: ___ / ___ / ___

City/Borough	Subdivision	Block	Lot	Property Owner Name & Address
Anchorage				Bureau Of Land Management , AK

Well location: Latitude 61.16097 **Longitude** -149.7905
Meridian S Township 012N Range 003W Section 03 , SE 1/4 of NE 1/4 of SE 1/4 of NW 1/4

BOREHOLE DATA: (from ground surface)
Suggest T.M. Hanna's hydrogeologic classification system*
https://my.ngwa.org/NC__Product?id=a185000000BYub3AAD

Description	Depth From	Depth To
Dry sandy gravel	0.0	14.0
Wet water gravel	14.0	18.0
Clay, dense	18.0	26.0
Clay and gravel	26.0	56.0
Boulder	56.0	57.0
Small water zone, 1-2gpm	57.0	58.0
Damp gravel	58.0	77.0
Water zone	77.0	92.0

Include description or sketch of well location (include road names, buildings, etc.):

Drilling method: [x] Air rotary, [ ] Cable tool, [ ] Other ______
Well use: [ ] Public supply, [ ] Domestic, [ ] Reinjection, [ ] Hydrofracking, [ ] Commercial, [x] Observation/Monitoring, [ ] Test/Exploratory, [ ] Cooling, [ ] Irrigation/Agriculture, [ ] Grounding, [ ] Recharge/Aquifer Storage, [ ] Heating, [ ] Geothermal Exploration, [ ] Other ______
Fluids used: ______

Depth of hole: 92 ft Casing stickup: 3 ft
Casing type: A53B Steel Casing thickness: 0.25 inches
Casing diameter: 6 inches Casing depth: 95 ft
Liner type: ______ Depth: ___ ft Diameter: ___ inches
Note: ______

Well intake opening type: [x] Open end [ ] Open hole [ ] Other ______
Screen type: ______, Screen mesh size: ______
Screen start: ______ ft, Screen stop: ______ ft, Perforated [ ] Yes [x] No
Perforation description: ______ Perf from: ______ ft, Perf to: ______ ft, Perf from: ______ ft, Perf to: ______ ft
Gravel packed [ ] Yes [x] No Gravel start: ______ ft , Gravel stop: ______ ft
Note: ______

Static water (from top of casing): 44.5 ft on 9 / 3 / 2020 Artesian well [ ]
Pumping level & yield: 95 feet after 1 hours at 30 gpm
Method of testing: Air
Development method: ______ Duration: ______
Recovery rate: ______ gpm

Grout type: Casing seal Volume ______
Depth: From 0 ft, To 40 ft

Final pump intake depth: ______ ft Model: ______
Pump size: ______ hp Brand name: ______

Was well disinfected upon completion? [ ] Yes [ ] No
Method of disinfection:

Was water quality tested? [ ] Yes [ ] No
Water quality parameters tested: ______

Well driller name: ......
Company name: DENALI DRILLING
Mailing address: ......
City: ______ State: AK Zip: ______
Phone number: (______) ______ - ______
Driller's signature: ______
Date: ___ / ___ / ___

AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be submitted to the Department of Natural Resources within **45 days of well completion.** Well logs may be submitted using the online well log reporting system available at:

https://dnr.alaska.gov/welts/

OR email electronic well logs to

dnr.water.reports@alaska.gov

Anchorage Municipal Code 15.55.060(I) and North Pole Ordinance 13.32.030(D) require that a copy of this well log be submitted to the Development Services Department/City **within 30 days of well completion.**

City Permit Number: ______
Date of Issue: ___ / ___ / ___
Parcel Identification Number: ___ - ___ - ___

*Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press

14. Appendix C.. Location, aquifer type and land ownership for Alaska NGWMN groundwater wells.

Table 1. Location, aquifer type and land ownership for Alaska NGWMN groundwater well

NGWMN Site Name	Site No	Latitude	Longitude	County	National Aquifer	Local Aquifer	Ownership/ Land steward
USFS G1	604342834014919	60.728565	-149.32097	Kenai Pen Borough	UNCLASSIFIED	Quat Sys (110QRNR)	United States Forest Service
USFS P7	604706108014852	60.78503	-148.86772	Muni of Anchorage	UNCLASSIFIED	Quat Sys (110QRNR)	United States Forest Service
Tern Lake	603148777614933	60.530148	-149.556791	Kenai Pen Borough	UNCLASSIFIED	Quat Sys (110QRNR)	United States Forest Service
UAF AG	613406149152103	61.56827	-149.257647	Mat-Susitna Borough	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	University of Alaska Fairbanks
UAF ExFarm	603353244014914	61.564788	-149.245113	Mat-Susitna Borough	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	University of Alaska Fairbanks
Teeland MS	613633868814921	61.609413	-149.3619	Mat-Susitna Borough	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	Teeland Middle School/Mat-Su Borough
ADFG 11	611440156814942	61.244491	-149.712176	Muni of Anchorage	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	Alaska Department of Fish and Game
ADFG H-1	611442489614942	61.245118	-149.709867	Muni of Anchorage	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	Alaska Department of Fish and Game
Eagle River	611836554414932	61.310369	-149.540685	Muni of Anchorage	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	Alaska Department of Natural Resources
BLM Campbell Tract	610939542414947	61.160984	-149.790387	Muni of Anchorage	Alaska unc-deposit aquifers (N100AKUNCD)	Quat Sys (110QRNR)	United States Bureau of Land Management

Table 2. . Well completion, period of record and network/monitoring categories for Alaska NGWMN groundwater wells.

NGWMN Site Name	Aquifer Type	Screen Opening	Well Depth (ft.)	WELTS #	Period of record	Recording interval (minutes)	Drill Completion Date	Subnetwork	Monitoring Category
USFS G1	UNCONFINED	unknown	13.2	44034	7/24/2002 to present	15	unknown	Background	Trend
USFS P7	UNCONFINED	unknown	13.1	44033	5/17/2017 to present	15	unknown	Background	Trend
Tern Lake	UNCONFINED	32' -37'	37	51173	9/26/2018 to present	15	5/14/1965	Background	Trend
UAF AG	CONFINED	Open End	310	6707	9/10/1955-8/3/1970, 1/18/1972-8/14/1974, 4/2/2014	5	9/10/1955	Documented	Trend
UAF ExFarm	CONFINED	272' - 285'	290	8060	4/9/2019 to present	15	4/24/1972	Documented	Trend
Teeland MS	CONFINED	84 - 94'	101	25812	4/17/2019 to present	15	3/29/2001	Suspected	Trend
ADFG 11	CONFINED	111' - 150.3'	150.3	29947	5/19/2016-5/02/2017, 9/26/2018 to present	15	6/27/2003	Suspected	Trend
ADFG H-1	CONFINED	Open End	187.1	43993	5/19/2016-5/02/2017, 9/25/2018 to present	15	8/24/1983	Suspected	Trend
Eagle River	CONFINED	263' - 268'	280	2583	8/10/2020 to present	15	4/11/1983	Suspected	Trend
BLM Campbell Tract	CONFINED	Open End	92	73074	12/7/2020 to present	15	9/3/2020	Suspected	Trend