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TECHNICAL REVIEW OF THE SEPTEMBER 1999 GROUNDWATER DISTURBANCE NEAR ESTER, ALASKA

by

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EXECUTIVE SUMMARY

In late fall 1999, several homeowners in the Goldhill Road area near Fairbanks, Alaska experienced problems with their water wells. The Alaska Department of Natural Resources, Division of Mining, Land and Water (DMLW) was asked to investigate and determine a cause of this disruption. An aggressive investigation has yielded several important pieces of data, has served to collate historical hydrologic data in the area, and has clarified the facts surrounding this situation. Over the course of this investigtion, a total of five homes lost use of their water resources at some point, two others experienced degradation in water quality. To satisfy their water needs, one homeowner redrilled their well and is pumping adequately from the new source; another obtains water from a commercial source and trucks it to the home three times a week to a holding tank; another installed a tank system and purchases water through a commercial water hauler to supplement what can be obtained from the well; another continues to get water from alternative sources; and another has regained the use of the well. The two that experienced water quality problems, i.e. increased sedimentation, have continued to use their wells and report that the problem has dissipated.

To determine what caused the drop in static water levels in the Goldhill Road area, DMLW conducted the following tasks over a five-month period: 1)monitored water levels in domestic wells in the affected area, 2)analyzed the water in the nearby (and downgradient) Yellow Eagle Mining Inc. 1999 pit and in domestic well water in the area for a suite of chemical parameters such that a geochemical comparison could be made, and 3)monitored the water level in the 1999 pit to identify any correlation between the 1999 pit and nearby domestic wells. Additionally, the public was kept informed concerning the status of the situation on a regular basis.

The Division of Mining, Land and Water concludes that the actions at the Yellow Eagle Mine caused the water quantity and quality problems in the wells of nearby homeowners. This is supported by the following facts: 1)the sharp decline in water levels in nearby homes occurred immediately following the interception of groundwater in the 1999 pit, 2)the water in the 1999 pit is similar from a geochemical standpoint as that in the domestic wells, 3)well logs (where available) indicate that the affected wells are in an alluvial aquifer which appears to be similar to that intercepted in the 1999 pit, and 4)water levels in most domestic wells have rebounded somewhat since the initial depression, although during mid-winter normal recharge is typically negligible.

TECHNICAL REVIEW OF THE SEPTEMBER 1999 GROUNDWATER DISTURBANCE NEAR ESTER, ALASKA

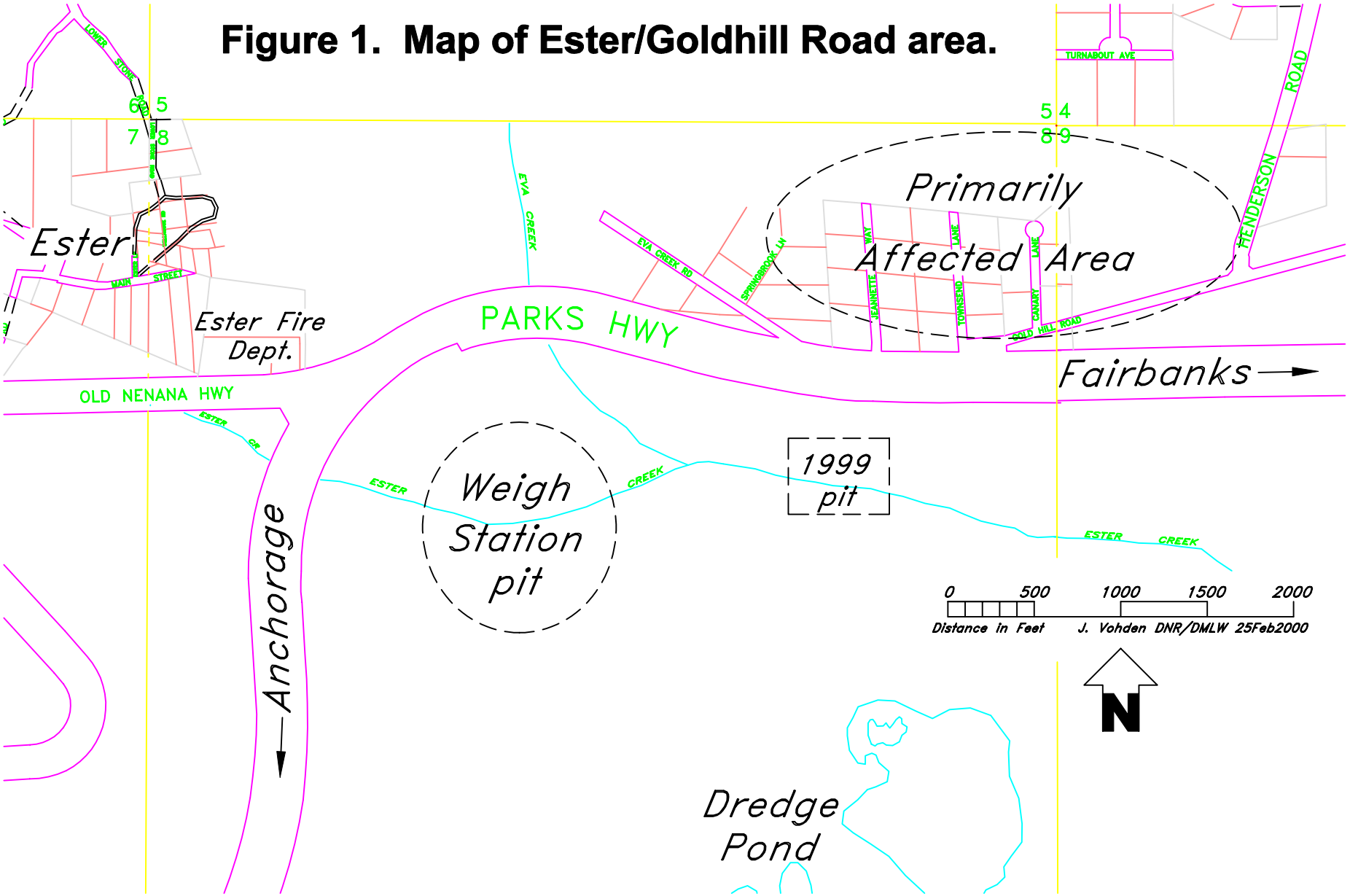
INTRODUCTION

The Goldhill Road area is approximately 5 miles west of Fairbanks, Alaska and one mile east of Ester, Alaska. Access to this area is via the George Parks Highway (Figure 1). This single and multiple family residential area is bounded to the north by the Healy to Fairbanks 138kV transmission line, and to the south by a currently and historically mined area. In the area bounded by Eva Creek on the west and Henderson Road on the east, there are approximately 33 single and multiple family residences located on a slightly south sloping terrain, upgradient of the nearby mining areas to the south. Permafrost is prevalent in the area, and accompanying vegetation is a mixture of black and white spruce, alder and willow. The region has a long history of gold mining, with recorded production from the Ester area topping three million ounces. Alaska Gold operated bucket-line dredges south of the Goldhill Road/Ester area up until the mid-1960's.

On 30 September 1999, the Alaska Department of Natural Resources, Division of Mining, Land and Water (DMLW) received a phone call from a resident of the Goldhill Road area, who expressed concerns about her drinking water well. This resident reported that her well had gone dry, and that it was not the first time this had happened. She requested that the State step in and determine why it had happened again. In the days to follow, a clearer picture of an area-wide problem began to unfold.

Based on preliminary research carried out by DMLW through mid-October 1999, an affected area was delineated that spanned from Townsend Way to Henderson Road, an area of approximately forty acres. The well which DMLW was first notified as being dry was serviced by a local well driller and the problem was determined to be increased sedimentation clogging the pump, which was rectified. There was approximately fourteen feet of standing water above the pump at that time. However, DMLW ascertained that a total of three other domestic wells had static water levels (water availability) drop sufficiently in prior weeks such that the wells were not usable by the residents. In addition, two other domestic wells were experiencing degradation of water quality but were still deemed potable by the residents

Figure 1. Map of Ester/Goldhill Road area.

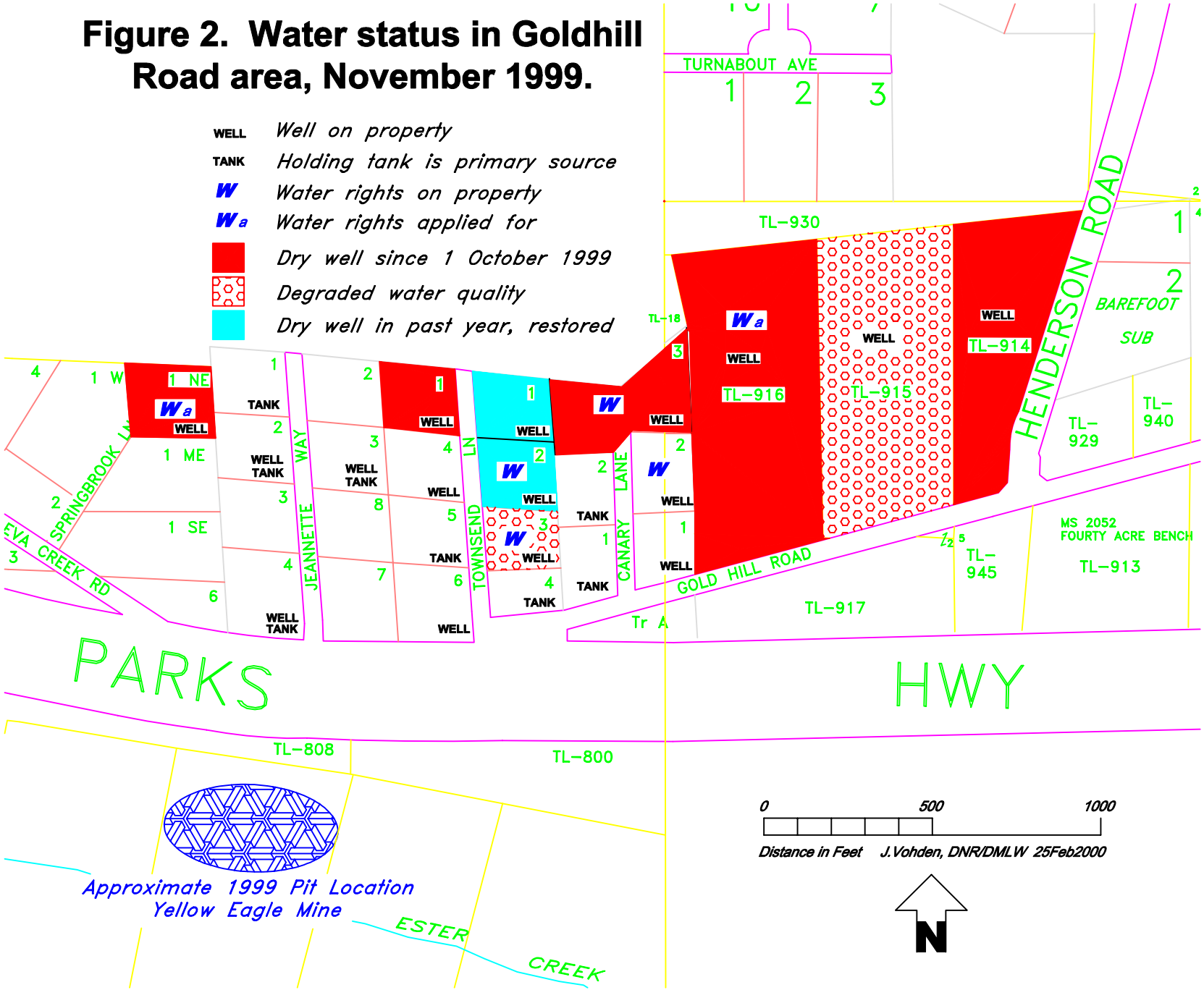


(Figure 2). The common complaint was increased sediment in the water requiring sediment filters to be changed more frequently, sometimes as often as every other day. One additional well was reportedly dry beyond normal use but could not be confirmed as the homeowner was out of town for several months. By early November 1999, DMLW confirmed that two other wells experienced a drop in the static water levels sufficiently in prior weeks such that the wells were not usable by the residents, for a total of five residences (which includes the one in question) experiencing water shortage problems since late September 1999, and two residences experiencing water quality degradation.

Based on information gathered in the days following the initial reports of water disturbances, attention was turned to the mining operation located just south of the affected residential area. Yellow Eagle Mining Inc. (to be referred to as "Yellow Eagle") had been excavating a pit on privately owned land within Section 8 of Township 1 South, Range 2 West, Fairbanks Meridian, which is owned by and leased from Mr. Walter Wigger. Yellow Eagle has had a three year history of placer gold mining in the vicinity south of Ester. By mid-October 1999, a pit had been excavated that was approximately 500 feet by 400 feet, with a depth of 100 feet below the initial ground surface. Material from this pit was distributed to other claims within the area. The stratigraphic sequence of the 1999 pit includes an upper layer of thawed native loess, ice rich loess and gravel, underlain by a frozen gravel layer with pockets of thawed gravels. Reports by the operators of the mine and from an unidentified employee of the mine who came to the DMLW office on his own accord, confirmed that during the course of regular mining operations on 25 September 1999, Yellow Eagle intercepted the groundwater table at the bottom of the north face of the 1999 pit. Water was reportedly flowing from a thawed pocket within the frozen gravel layer

By mid-October 1999, several methods were discussed internally within DMLW, as well as with other local professionals, that would conclusively determine the cause of the dewatering of domestic wells in the Goldhill Road area. Ideas included injecting a tracer into one of the affected wells to determine where and when it surfaced elsewhere; geochemical modeling of the water in the affected wells and the water that was flowing into the pit; and continued

Figure 2. Water status in Goldhill Road area, November 1999.



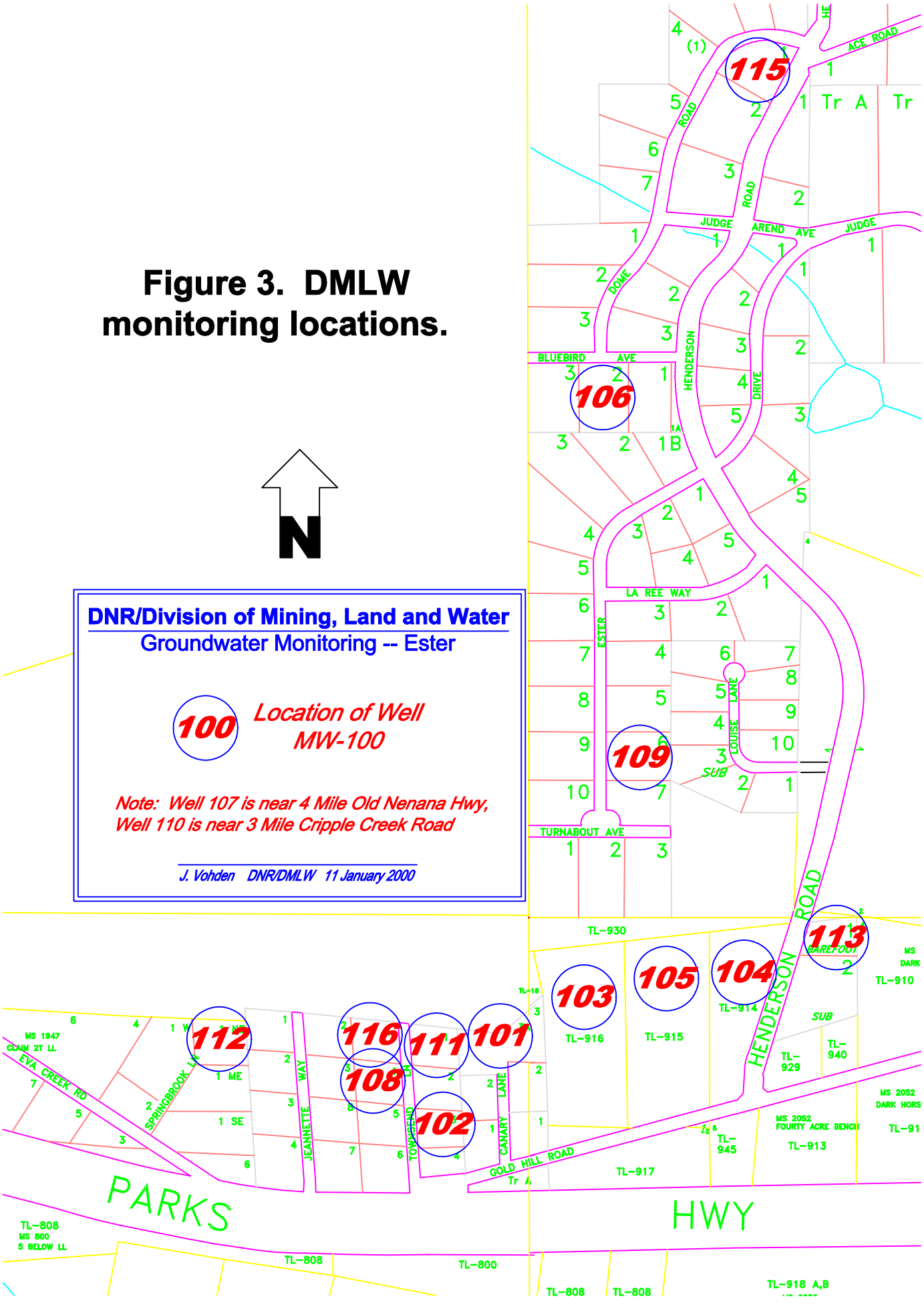
monitoring of water level elevations. DMLW determined that tracer methods were not appropriate for two reasons. First, injection of a tracer compound (various compounds including sodium chloride, other halogenated salts, radioactive solutions or specific fluorescent dyes) may adversely affect domestic wells in an area which so heavily relies on groundwater as the primary source of drinking water. Second, the excavated pit at Yellow Eagle had water flowing into it at a reported rate of 500 gallons per minute (Design Science and Engineering, personal communication). Therefore, the orifice at the base of the north face of the 1999 pit was becoming more and more difficult to sample safely and efficiently. With this in mind, DMLW decided to approach the problem with a three-fold plan: 1) monitor water levels in domestic wells in the affected area, 2) analyze the water in the Yellow Eagle pit and domestic well water in the area for a suite of chemical parameters such that a geochemical comparison could be made and the source water identified, and 3) monitor the water level in the Yellow Eagle pit to determine when or if the water level stabilizes and compare that information to the water levels in domestic wells in the affected area. Additionally, a concerted effort was to be made to keep the public informed to the best extent possible concerning the status of the situation.

METHODS

Water Level Monitoring

Initially the task of measuring water levels began with only a few wells in the Goldhill Road area, and has now grown to include 15 domestic wells throughout the area (Figure 3). Wells were monitored beyond the known affected area in the event that further impact to residential wells occurred beyond the area delineated at that time. Additionally, two locations remote from the study site were included as controls, so as to note any regional changes in water level fluctuations that might occur. Monitoring the water level in a well involves lowering a calibrated water level meter (Figure 4) into a well casing and measuring the distance between the top of the water surface and a known point at the top of the well casing. The monitor operates on an electric current; specifically, when the probe reaches the surface of the water it

Figure 3. DMLW monitoring locations.



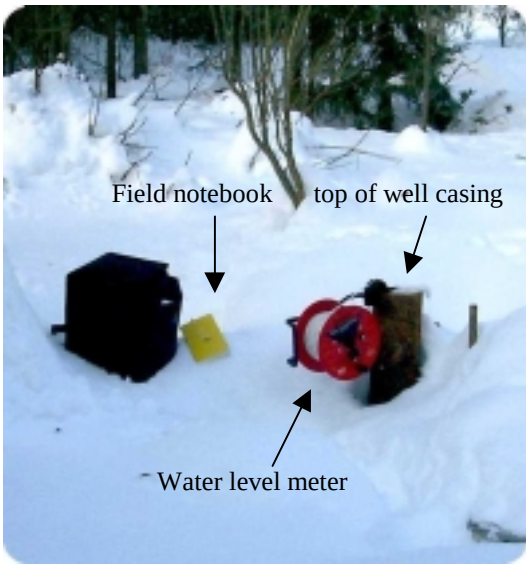


Figure 4. Water level monitoring equipment.

completes a circuit and alerts the operator that the air/water interface has been reached. The probe is connected to a calibrated tape, from which the "depth to water" is determined. As this measurement is repeated over time, trends in the fluctuation of the water surface can be measured. Ideally, the point at which the measurements are compared to, that is, the known point at the top of the well casing, is surveyed to a known benchmark to determine the actual elevation of that point. From this information, the actual elevation of the water surface can be determined. This would allow for a more comprehensive comparison of data from all wells in the area, from which a map the surface of the groundwater table could be formulated. It is anticipated that this survey will be carried out following breakup in 2000. However, by measuring the depth to water in each well during this phase of our investigation, a valid comparison can be made in terms of the vertical fluctuations in the area-wide groundwater table.

In order to limit potential cross-contamination between wells while monitoring, a new pair of disposable latex gloves are worn by field personnel while measuring "depth to water" and are discarded after each measurement is complete. Once the depth to water was determined at any given well, the probe was cleaned in the field by rinsing with tap water obtained from the DNR building (supplied by College Utilities), followed by rinsing in a bleach solution to disinfect the probe, followed by a final rinse of tap water before progressing to the next well head. While bacterial contamination was not anticipated in any of the domestic wells, the cleaning process ensured that bacterial cross-contamination between wells would be minimized. The MW-110 well was analyzed (and paid for by the homeowner) for total coliform bacteria on 12 October 1999, and again on 26 January 2000, with both analyses proving no coliform bacteria detected. This was done as a precaution and as confirmation that the cleaning process was in fact not causing any cross contamination between wells.

Water Chemistry

Water samples from residential wells and from the Yellow Eagle 1999 pit were taken on the dates outlined in Table 1. Samples were collected using new bottles obtained from the commercial laboratory contracted for the analytical work and were analyzed for the parameters outlined in Table 2.

Table 1. Water sampling by DMLW for chemical analysis, listed chronologically.

Date Sampled	Identification	Location
27-Oct-99	Yellow Eagle 1999 Pit	at orifice near base of north face
27-Oct-99	MW-104	Pierce residence
29-Oct-99	MW-103	Thomas residence
29-Oct-99	MW-102	Capoun residence
01-Nov-99	MW-105	Murphy residence
01-Nov-99	MW-111	Williams residence
03-Nov-99	MW-146	Hein residence
03-Nov-99	MW-112	Keith residence
03-Nov-99	Ester Fire Dept.	Ester Fire Department
28-Jan-00	MW-101	Fisher residence (new well)

Table 2. Analytical parameters for chemical analysis.

Parameter	Analytical Method	Description
Calcium	EPA 200.7	ICP
Magnesium	EPA 200.7	ICP
Sodium	EPA 200.7	ICP
Potassium	EPA 200.7	ICP
Chloride	EPA 300.0	Ion Chromatograph
Sulfate	EPA 300.0	Ion Chromatograph
Alkalinity	SM2320-B	Titration
Conductivity	SM2510-B	Direct Measurement

Samples were collected from each source before any kind of treatment such as sediment filters or softeners. Water was allowed to flow for several minutes before sample collection to ensure that water was coming directly from the well and had not had a long residence time in the above-ground plumbing. The sample collected at the Ester Fire Department was taken from the drinking water source, not the fire support well. Samples were kept chilled (<4^{o}C) until delivery to the laboratory. Analysis was conducted by Northern Testing Laboratories, Inc. of Fairbanks, Alaska, which is certified by the Alaska Department of Environmental Conservation and the United States Environmental Protection Agency.

Pit Water Levels

Water levels in the Yellow Eagle 1999 pit were visually monitored initially on a weekly basis, then monthly by DMLW. Pictures were taken of the pit from one particular vantage point, providing a long-term visual history of the water level in the pit. On several occasions a piece of survey lath was anchored in the frozen gravels at the edge of water, on the ramp exiting the west side of the pit. The initial intent of DMLW was to survey these gravel surfaces once the ice in the pit was thick enough to walk on safely. This would have provided a more accurate description of the rate at which the pit was filling with water. However, as water continued to flow into the pit, the perimeter has remained wet and slushy. This created what was deemed an unsafe situation, preventing DMLW from accessing the pit and surveying the actual water elevations.

RESULTS

Water Level Monitoring

DMLW began periodic water level measurements on area wells on 12 November 1999. Measurement data is summarized in Appendix F. Included in the list of sites are two wells which are remote from the Goldhill Road area (MW-107 and MW-110). MW-110 was initially included to serve as a control site, one that was far enough removed from the major study area and that would indicate if there were any regional trends which might be otherwise misconstrued as a localized trend specific to the Goldhill Road area. The second control site

(MW-107) was added primarily in response to the concerns of the homeowner, and serves the same function as the first control site. Well hydrographs (Figures 5 through 8) indicate that the water levels had been depressed at the onset of monitoring and have been recovering for some time now to various degrees. Most recently, MW-111 and MW-116 appear to have "turned the corner" and the water levels are now increasing in elevation.

Coincidentally, a fairly large body of data exists from previous efforts to monitor the groundwater table on Ester Dome, and specifically in the Goldhill Road area. This database was most recently maintained by Design Science and Engineering of Fairbanks Alaska, and was courteously shared with DMLW. One well monitored (MW-111) is located in the middle of the primarily affected area and two are located on the fringe of this area (MW-113 and MW-114). These wells have been monitored sporadically since 1993. These long term hydrographs have been serendipitously useful in describing the state of the groundwater table before, during and after the 25 September 1999 incident at Yellow Eagle (Figure 9). As seen in Figures 9 and 10, there is a marked depression in the groundwater table just following the 21 September measurement. Clearly the best-fit of the data in the individual segments of time since 1996 produce trend lines with very good correlation. Although the long term slope of the hydrograph of MW-111, for instance, prior to 25 September 1999 is declining, the significant decline beginning with the 13 October 1999 measurement indicates that there was a major change in the system, one which hadn't been observed in this long period of record. The regular monitoring of some of these historic wells is now being continued by DMLW as part of this investigation. The seasonal trends in the Fairbanks area dictate that during winter, when the ground is frozen, there is very little probability of increased groundwater recharge occurring (Table 3). However, as seen in Figures 5 through 10, there appears to be recharge in all of the primarily affected Goldhill Road area wells monitored as of 22 February 1999. Additionally, wells upgradient of the Goldhill Road area (i.e. MW-106 and MW-115) appear to be unaffected by the 1999 groundwater disturbance, in effect confirming the extent of the primarily affected area. The "control" wells demonstrate some fluctuation over the period of record, but essentially no significant trend.

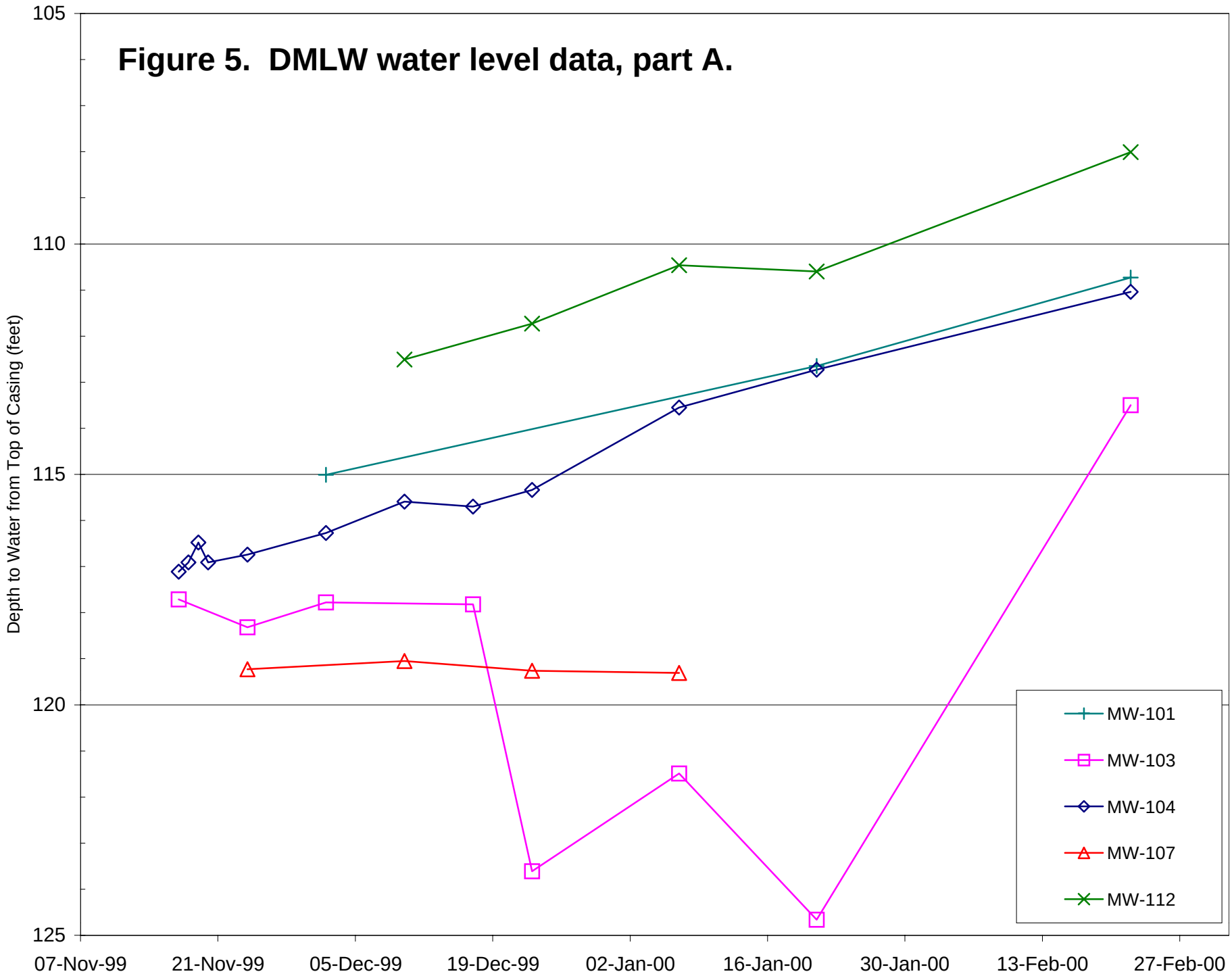


Figure 5. DMLW water level data, part A.
Depth to Water from Top of Casing (feet)
105
110
115
120
125
07-Nov-99
21-Nov-99
05-Dec-99
19-Dec-99
02-Jan-00
16-Jan-00
30-Jan-00
13-Feb-00
27-Feb-00
MW-101
MW-103
MW-104
MW-107
MW-112

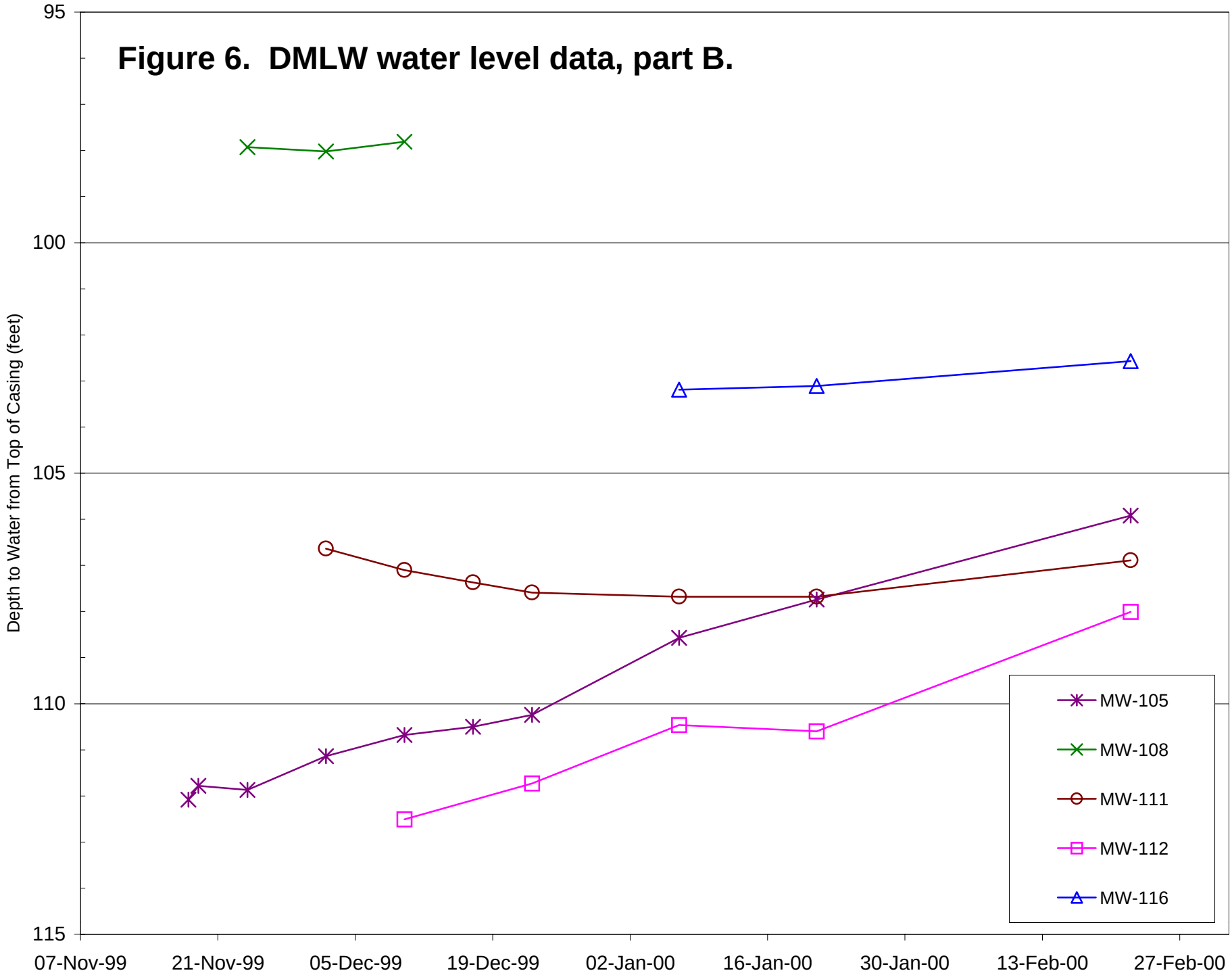
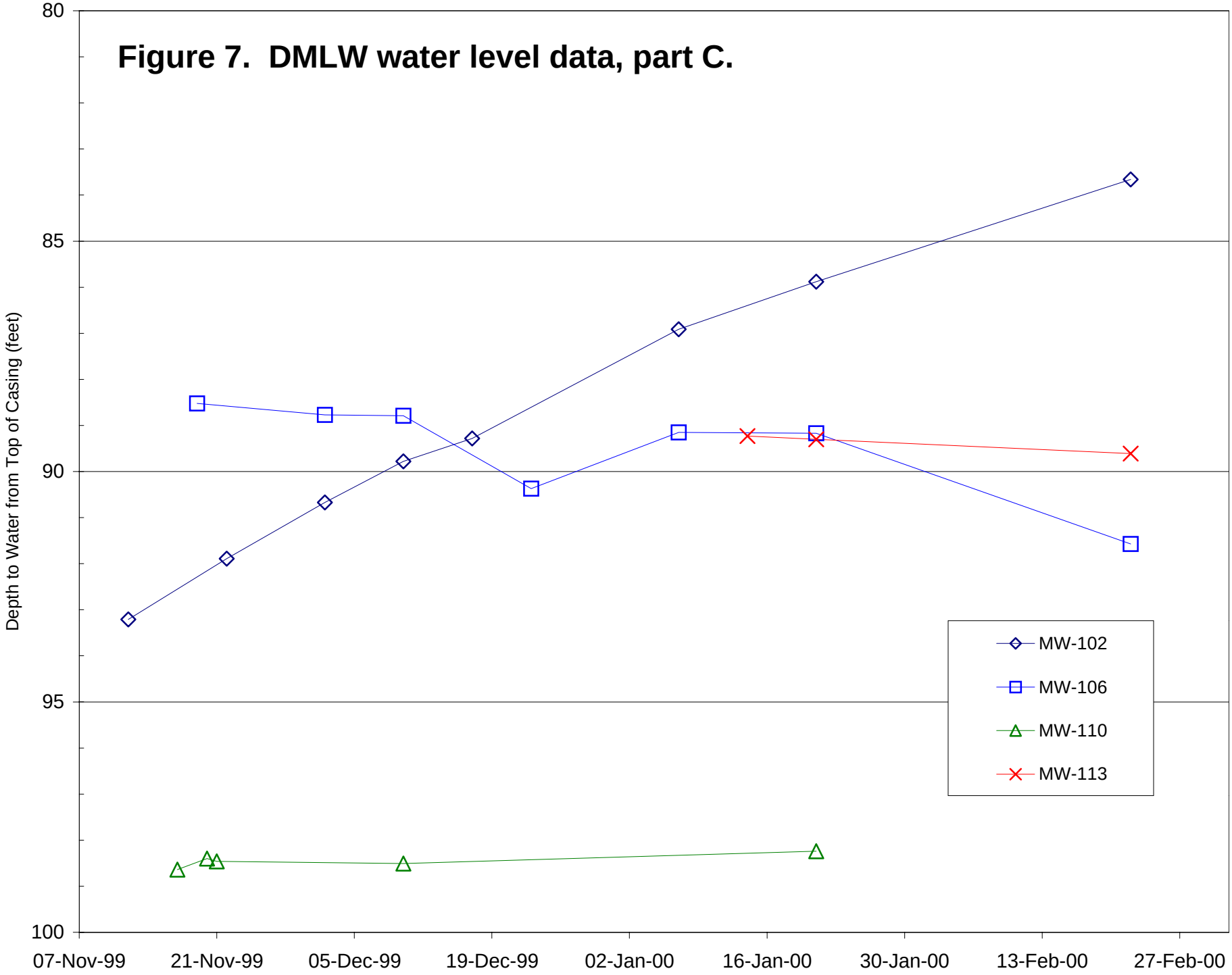


Figure 6. DMLW water level data, part B.
Depth to Water from Top of Casing (feet)
95
100
105
110
115
07-Nov-99
21-Nov-99
05-Dec-99
19-Dec-99
02-Jan-00
16-Jan-00
30-Jan-00
13-Feb-00
27-Feb-00
MW-105
MW-108
MW-111
MW-112
MW-116

Figure 7. DMLW water level data, part C.



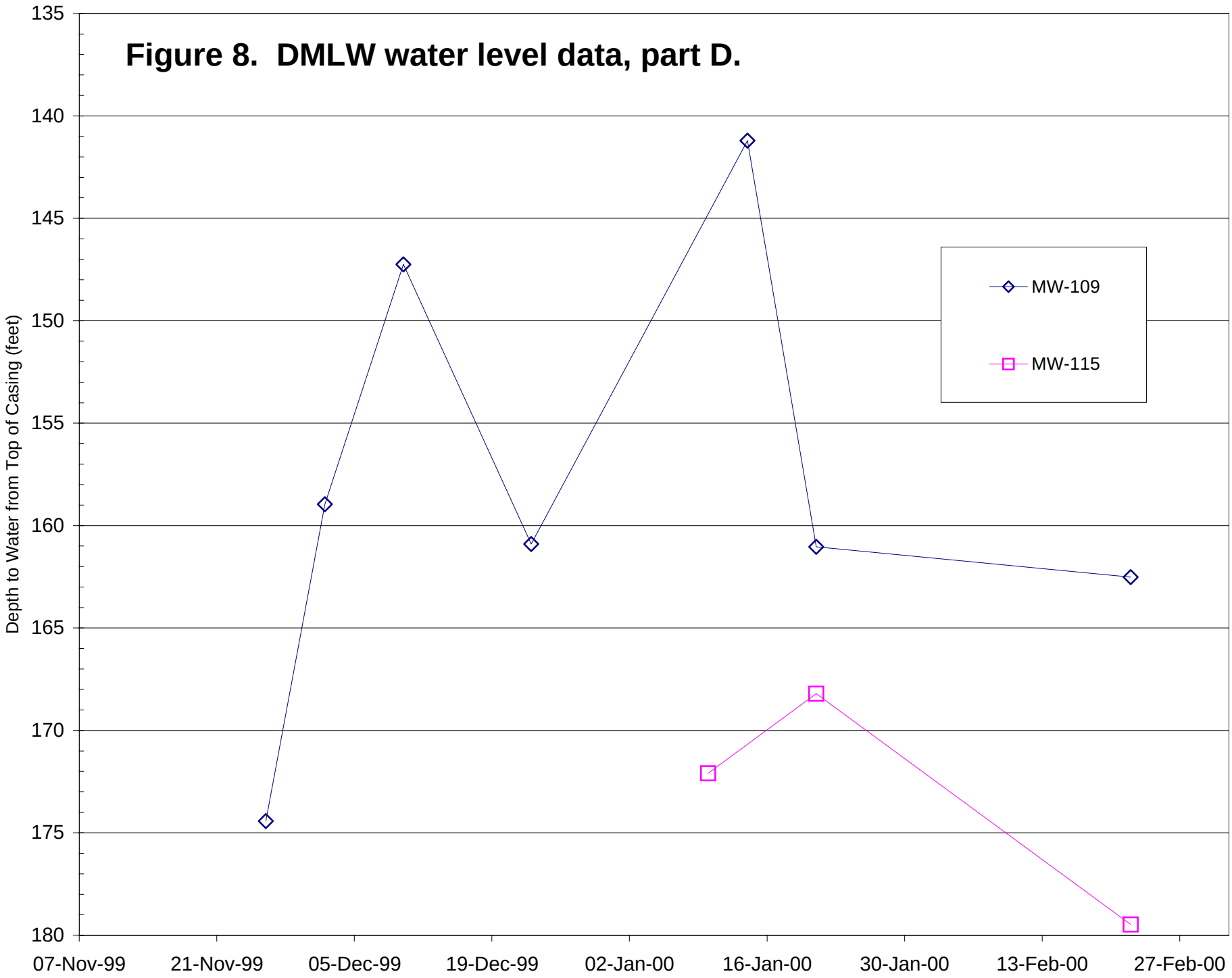


Figure 8. DMLW water level data, part D.
Depth to Water from Top of Casing (feet)
135
140
145
150
155
160
165
170
175
180
07-Nov-99
21-Nov-99
05-Dec-99
19-Dec-99
02-Jan-00
16-Jan-00
30-Jan-00
13-Feb-00
27-Feb-00
MW-109
MW-115

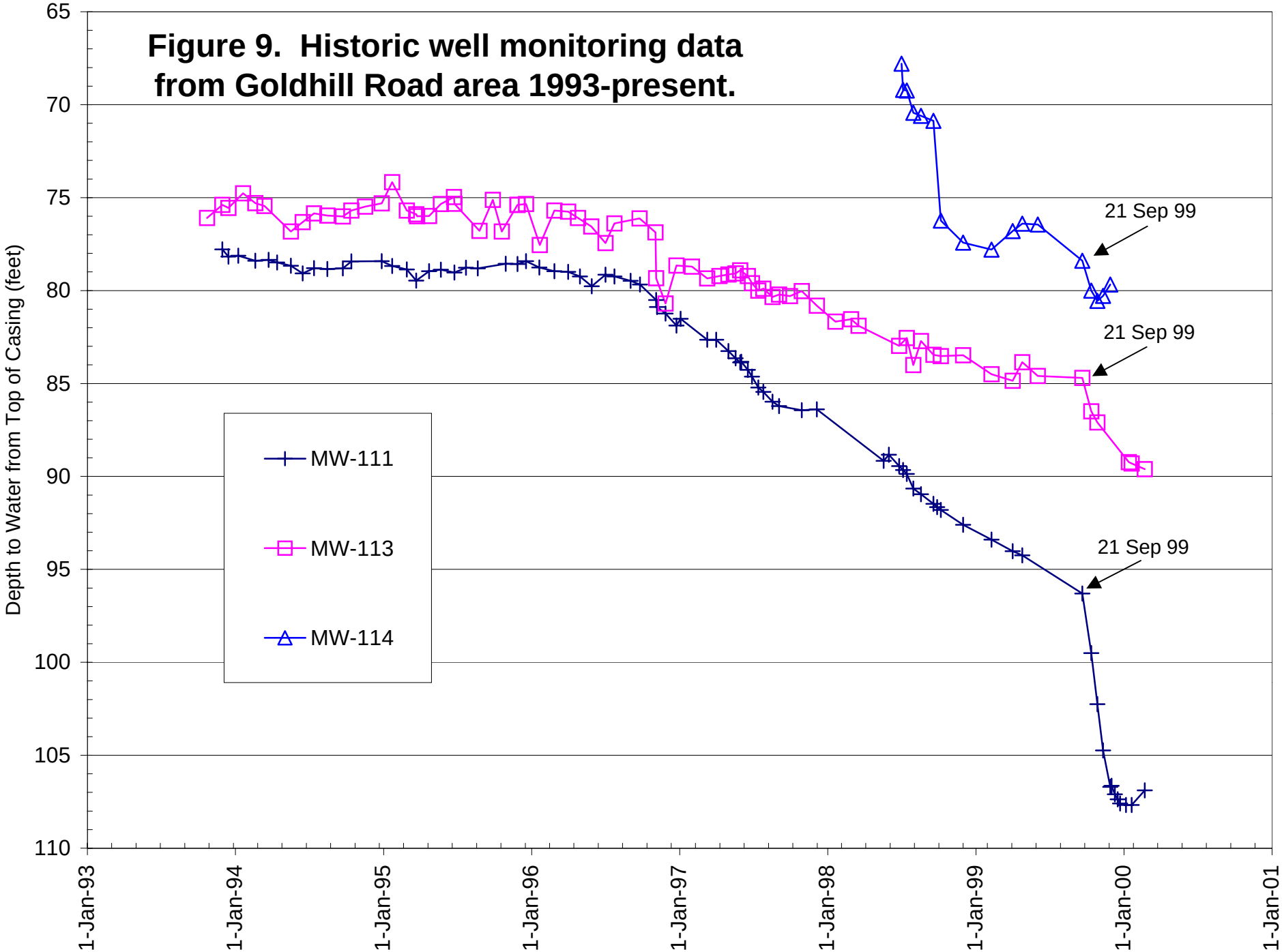


Figure 9. Historic well monitoring data from Goldhill Road area 1993-present.
Depth to Water from Top of Casing (feet)
65
70
75
80
85
90
95
100
105
110
1-Jan-93
1-Jan-94
1-Jan-95
1-Jan-96
1-Jan-97
1-Jan-98
1-Jan-99
1-Jan-00
1-Jan-01
MW-111
MW-113
MW-114
21 Sep 99
21 Sep 99
21 Sep 99

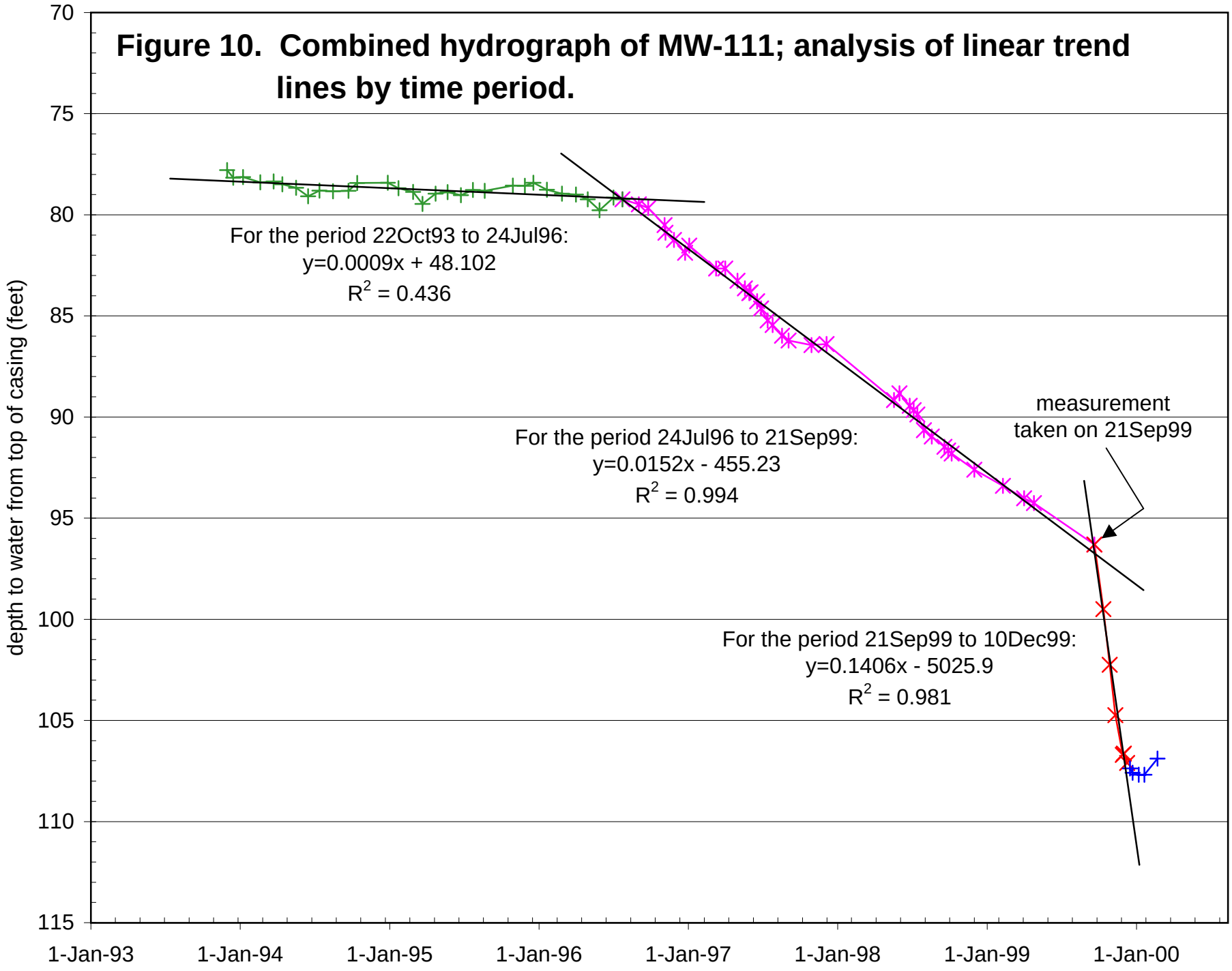


Figure 10. Combined hydrograph of MW-111; analysis of linear trend lines by time period.
depth to water from top of casing (feet)
70
75
80
85
90
95
100
105
110
115
1-Jan-93
1-Jan-94
1-Jan-95
1-Jan-96
1-Jan-97
1-Jan-98
1-Jan-99
1-Jan-00
For the period 22Oct93 to 24Jul96:
y=0.0009x + 48.102
R2 = 0.436
For the period 24Jul96 to 21Sep99:
y=0.0152x - 455.23
R2 = 0.994
For the period 21Sep99 to 10Dec99:
y=0.1406x - 5025.9
R2 = 0.981
measurement
taken on 21Sep99

Table 3. Description of seasonal groundwater recharge periods in the Fairbanks area.

Summer	June through August	Some recharge from summer precipitation
Autumn	August through September	Moderate recharge as precipitation levels increase
Winter	September through May	Low period of recharge capability due to frozen ground, increased drawdown as water use continues
Spring	May	Breakup period during which major recharge occurs

Water Chemistry

Water samples were collected from seven residential wells and the 1999 pit at Yellow Eagle. There was a longer than anticipated time span between when the samples were delivered to the laboratory and when the final report was generated by the lab. This was due to instrumental difficulties at the lab which delayed analysis of some of the parameters, namely calcium, magnesium, sodium and potassium. These parameters have long holding times (6 months when acidified to pH<2 and kept cool <4^{o}C); the analysis was well within the bounds of acceptability by USEPA standards. Analytical results can be found in Table 4, laboratory reports are found in Appendix E.

Table 4. Analytical results from water samples collected (all parameters in mg/L except alkalinity, in mg/L as CaCO3, and conductivity, in uS/cm).

Site ID	Date Sampled	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulfate	Alkalinity	Conductivity
1999 Pit	27-Oct-99	135	46.4	25.1	3.8	1.27	57.1	490	960
MW-104	27-Oct-99	234	95.5	58.8	5.2	3.80	236	881	1800
MW-105	1-Nov-99	216	46.2	97.5	4.0	17.5	186	732	1600
MW-103	29-Oct-99	166	51.1	33.2	3.1	1.09	2.3	520	1200
MW-111	1-Nov-99	118	52.2	25.6	5.5	1.76	76.9	496	980
MW-146	3-Nov-99	137	45.1	27.1	3.2	1.36	63.5	492	1000
MW-102	29-Oct-99	145	47.7	26.4	4.4	2.22	36.8	531	1000
MW-112	3-Nov-99	124	39.7	15.6	2.9	1.24	100	330	910
Ester Fire	3-Nov-99	99.7	43.3	12.1	2.9	2.19	104	304	770
MW-101	28-Jan-00	84.4	37.9	23.4	3.6	1.70	171	227	750

Analysis shows that the water of the area is principally the calcium bicarbonate type, which is typical of the Fairbanks area. Narrowing the field of view to selected analytical parameters (Figure 11), the data does not intuitively imply a relationship on its own. However, once the relative percentage of each of the major ions is plotted in a trilinear diagram (Figure 12), a relationship begins to become evident. With the exception of MW-101, all of the samples plot within the same area, indicative of similar geochemical composition. This similarity establishes two things. One, that the water flowing into the 1999 pit at Yellow Eagle is geochemically similar to water found in the domestic wells where samples were taken. Two, because the water from the well at the Ester Fire Department shows the same similarity, it can be generalized that water in the entire region will show the same similarity. Water flowing through native material in the vicinity of the Fire Department is comprised of similar ratios of major chemical constituents to that of water flowing near Goldhill Road because the native geologic material is, in a very basic sense, the same. This point is critical because it confirms that the source of water in the Yellow Eagle 1999 pit *could* be from the same source that supplies the domestic wells near Goldhill Road, and at the same time it is not conclusive evidence on its own that it is the *sole* source. One slight anomaly in the chemical analysis are the results from MW-101, which was sampled after the homeowner had the well re-drilled. The original well was finished at approximately 120' below ground surface in alluvium, the re-drilled well was completed in bedrock at 240' below ground surface. Using the trilinear diagram, it appears that water from the re-drilled well is slightly dissimilar from the other waters, indicating that it might be from a different source than the original well.

Discussion of the re-drilled MW-101 brings up an interesting finding. After the static water level in MW-101 dropped such that the well was not functional, the homeowner decided to have the well re-drilled. The original well log (Appendix G) described how that the well was finished in "highly fractured bull quartz that furnished water freely, best formation encountered in this highly mineralized area." The first material brought up during the re-

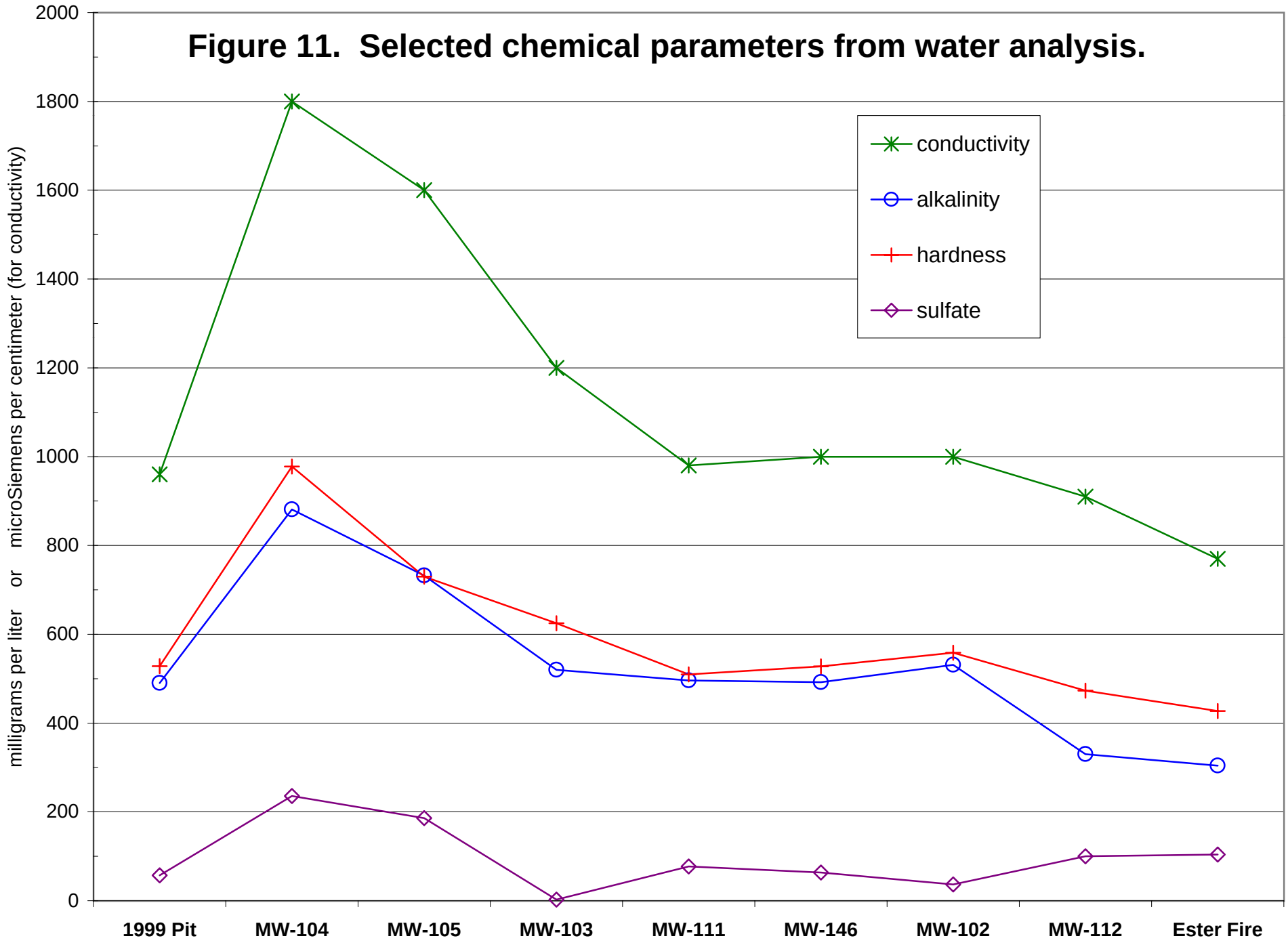


Figure 11. Selected chemical parameters from water analysis.
milligrams per liter or microSiemens per centimeter (for conductivity)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
conductivity
alkalinity
hardness
sulfate
1999 Pit
MW-104
MW-105
MW-103
MW-111
MW-146
MW-102
MW-112
Ester Fire

Figure 12. DMLW geochemical data in trilinear diagram format, identifying relationship of major ions in solution from various samples.

Legend	
1	1999 Pit Inflow
2	MW-104
3	MW-105
4	MW-103
5	MW-111
6	MW-146
7	MW-102
8	MW-112
9	Ester Fire Dept.
A	MW-101 (new well)

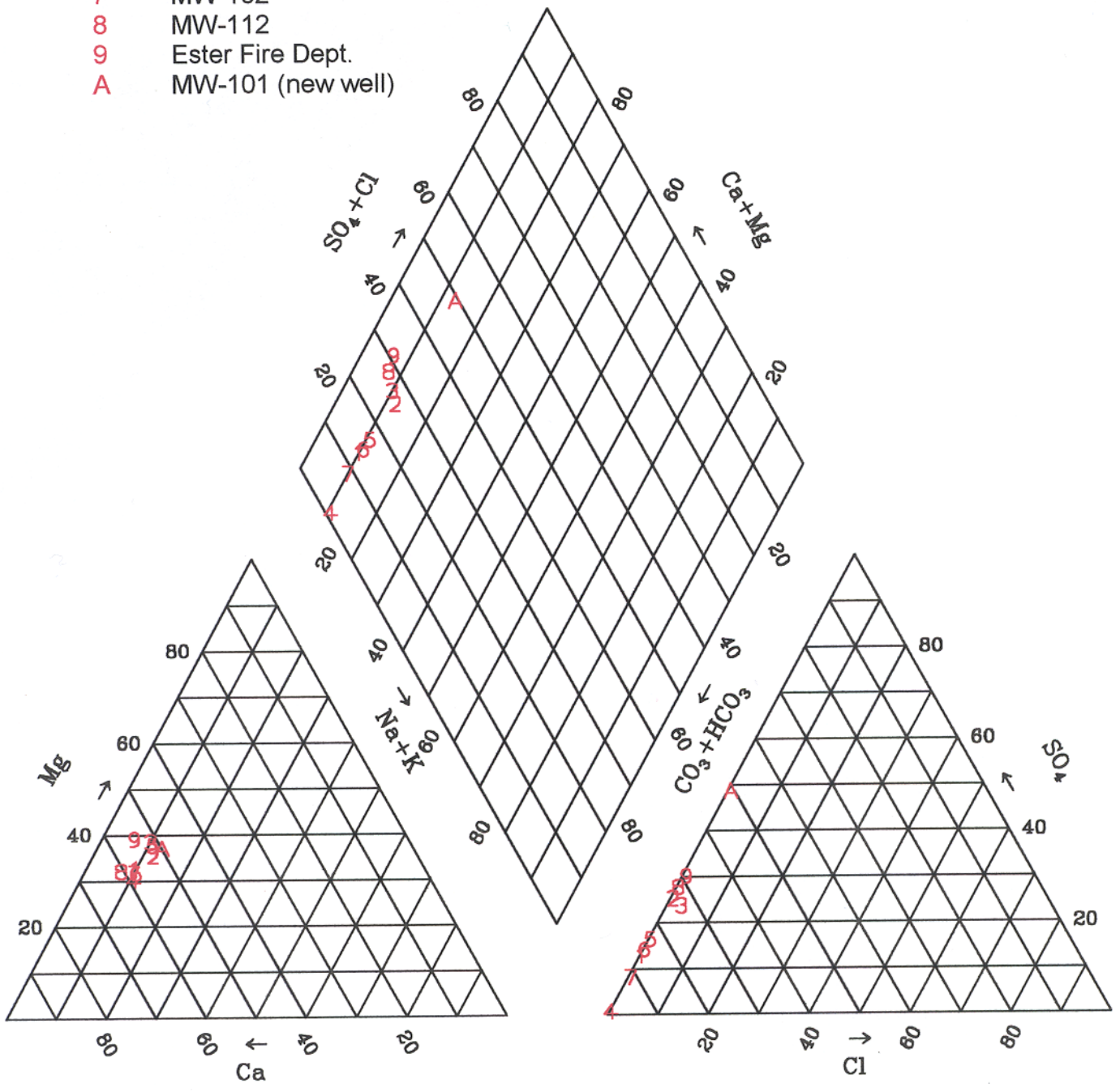


Figure 13. Material brought up during re-drilling of MW-101, from approximately 121 feet below ground surface.

drilling process was washed with clean water and contains alluvial gravels (Figure 13). Most of the wells in the Goldhill Road study area are finished at a similar depth below ground surface (although a more complete survey will confirm this); it is presumed that most of these wells are in a similar portion of the aquifer. It can be surmised that the domestic wells are completed in an ancient riverbed which is conveying water that remains perched due to the presence of a clay layer identified during the redrilling of MW-101, and described in the new well log for MW-101 (Appendix G). Similarly, the material at the bottom of the Yellow Eagle 1999 pit have been classified as "thawed and frozen gravels" by Yellow Eagle's consulting geologist. From preliminary elevation data, it is determined that the bottom of the 1999 pit is lower in elevation than the bottom of any of the wells that experienced problems in the Goldhill Road area. The only possible exception is MW-101 after it was redrilled. Further surveying, as discussed, will confirm this.

Pit Monitoring

Because Yellow Eagle was implicated as being a potential cause of the groundwater disturbance in the initial stages of this study, DMLW included monitoring of the 1999 pit as part of the investigation. As discussed previously, it was reported that the groundwater table was intercepted in the 1999 pit during the course of regular mining. Reports of the height of

the water column produced when the water was intercepted vary from six inches to three feet. Regardless, it does appear that the water flowing into the pit was under pressure similar to that of an artesian well. The pit was first viewed during a site visit on 12 October 1999. From that time to the present, a photographic record was constructed which follows the progression of mining and the ensuing flow of water into the pit. A portion of the photographic record is seen in Figure 14. The vantage point for these photographs is the top of the north face of the pit, accessed from the Parks Highway. After the water was encounterd in the pit, an effort was made to keep a pump operating and discharging the water outside of the pit confines. It should be clearly understood that pumping of the water in no way influenced the fact that the water was flowing freely into the pit itself; the pit was not being dewatered in a traditional sense in an effort to depress the water table but rather to keep the workable area in the pit dry. As winter approached, Yellow Eagle decided to curtail its pumping effort and discontinue mining for the winter season. The pump was shut down on 25 October 1999.

In terms of the relative height of the water in the 1999 pit, two surveys have been carried out. On 1 November 1999, the Alaska Department of Transportation surveyed the relative elevation of the water in the 1999 pit and in the Weigh Station pit. The data showed the 1999 pit was 38' lower in elevation than the Weigh Station pit. In a survey completed by DMLW on 22 February 2000, the elevation of the ice surface in the 1999 pit was approximately 19 feet below the elevation of ice in the Weigh Station pit. Given that the elevation of the water in the Weigh Station pit appears to have risen slightly since the previous survey, the difference between the two pits is diminishing. As there are no known geologic structures between the two pits to account for a difference in the water elevations, it is surmised that the water levels in the two pits will equilibrate in time. During the course of work on 22 February, DMLW staff confirmed that the apparent inflow of slightly warmer groundwater into the 1999 pit has caused slushy conditions around the entire perimeter of the body of water, preventing safe access to the ice surface.

Figure 14. Photos of 1999 pit taken from top of north face, looking towards the southeast corner of the pit; note rise in water level over time and wetness around perimeter of pit.

DISCUSSION

Public Meetings

As stated previously, a prime objective of DMLW was to keep the public informed of the situation throughout our investigation. From the outset, rumors spread quickly and feverishly about many facets of the situation. After completing an initial review of the wells and mine site, a public meeting was scheduled on 2 November 1999 at University Park School in Fairbanks. The objective of the meeting was to provide the public with the facts that had been assembled to date. Prior to the 2 November meeting, and at the request of John Miller and Frank Saunders of Yellow Eagle, DMLW facilitated an open meeting between company representatives and the six (at that time) primarily affected homeowners on 28 October 1999. The reasons for this smaller gathering were twofold: one, the president of Yellow Eagle, John Miller, and the mine's consulting geologist, Georges Gagnon, were previously scheduled to depart Fairbanks before the 2 November public meeting was to occur. Second, Yellow Eagle and the primarily affected homeowners concurred that a smaller discussion group might be more productive in reaching resolution than would the larger group which was expected for the 2 November meeting. As all parties agreed to participate, a meeting was held at the DMLW offices on 28 October 1999. The meeting was facilitated by Jim Vohden, Hydrologist and Ryan Hull, Geologist, both of DMLW. Information that had been collected to date by DMLW was presented, the homeowners were given opportunity to discuss their own situations, and Yellow Eagle was given time to discuss their situation. Unfortunately, no firm decision was reached during this process, although it was beneficial for the homeowners and the mine to hear each others problems and concerns. The meeting was adjourned with all parties carrying a better understanding of the situation and a commitment by Yellow Eagle to provide a written statement regarding their intent to rectify the situation should it be determined that the mine was responsible for causing the disturbance in the domestic wells. A copy of the resulting letter from Yellow Eagle is included in Appendix C.

The public meeting held on 2 November 1999 at University Park School was arranged by Sharon Fisher, one of the primarily affected homeowners in the Goldhill Road area. She

enlisted support for the meeting from Senator Gary Wilken and Representative John Davies. Although Representative Davies could not attend due to other commitments, his Aide, Amy Coffman, agreed to moderate the meeting. The meeting was attended by over 30 people including Senator Gary Wilken; Gary Prokosch, Chief of the Water Resources Section – DMLW; Jim Vohden, Hydrologist – DMLW; Ryan Hull, Geologist – DMLW; local water professionals; residents of the affected area; residents of nearby areas; and the media. Similar to the format of the 28 October meeting, a summary of the data gathered to date by DMLW was presented, affected parties were invited to express their concerns, and further comments and questions were received from the public and responded to by various parties. Additionally, the letter submitted by Yellow Eagle as requested in the 28 October 1999 meeting (Appendix C), was read aloud by Amy Coffman.

Water Rights

Wherever occurring in a natural state, Alaska's water is reserved to the people for common use and is subject to appropriation and beneficial use. Water rights are secured through the Department of Natural Resources, Division of Mining, Land and Water. A person may not construct works for an appropriation, or divert, impound, withdraw, or use a significant amount of water from any source without a permit, certificate of appropriation, or a Temporary Water Use Authorization.

Priority of appropriation gives prior right. Priority of appropriation does not include the right to prevent changes in the condition of water occurrence, such as the increase or decrease of stream flow, or the lowering of a water table, artesian pressure, or water level, by later appropriators, if the prior appropriator can reasonably acquire the appropriator's water under the changed conditions. The priority date given to a homeowner is the date the application for water rights is filed. That is, even though a permit or certificate may not be granted until some time in the future, the effective date is the date the initial application was filed. If a homeowner applies a day before a nearby homeowner, the former is considered the senior water right holder, the latter is considered the junior.

A permit may place a time limit in terms of the start date of construction and perfecting appropriation. Additionally, DMLW may require modification of plans and specifications for the appropriation. DMLW may issue a permit subject to terms, conditions, restrictions, and limitations necessary to protect the rights of others, and the public interest. Reasonable extensions of time shall be permitted if good cause is shown.

Upon completion of construction of the works and commencement of the use of water, DMLW may issue the permit holder a Certificate of Appropriation (water right). The certificate shall set out conditions that are necessary to protect the prior rights of other persons and the public interest. A person violating an order of the Commissioner of DNR to cease and desist from preventing any water from moving to a person having a prior right to use it, or disobey an order of the Commissioner of DNR requiring the person to take steps to cause the water to move to a person having a prior right to use it, is guilty of a misdemeanor. A Permit to Appropriate Water or a Certificate of Appropriation does not represent a guarantee by the State to the permittee or certificate holder that water will be available for appropriation at a certain volume, quality, artesian pressure, or cost. This does not, however, alter the right a permittee or certificate holder may have against a later appropriator, including a government agency.

In addition to a water right, a person who plans to use water for a limited time may apply for a Temporary Water Use Authorization. This authorization allows for the use of a significant amount of water as long as the use is for less than five years and the water to be used is not already appropriated. This authorization, if issued, will not establish a water right.

Water rights are also required for mining operations under the same requirements as any other user of a significant amount of water. Yellow Eagle had applied for water rights based on their Alaska Placer Mine Applications (APMA's), dated 1996-1999. However, the source of water applied for was surface water or surface water infiltration. It should be noted that a Certificate of Appropriation is held by the claim owner (Mr. Walter Wigger) dating back to December 31, 1962 for 1.0 cubic foot per second (CFS) of water (646,272 gallons per day)

from Eva Creek, also a surface source. These water rights, although senior in some cases, are tied to surface water sources and were not associated with the groundwater aquifer that was exposed during the mining operation at Yellow Eagle. There are four homeowners in the Goldhill Road area that have secured water rights prior to the 25 September groundwater disturbance (see Appendix D). Since that time, two other homeowners have filed for water rights. Those residents that hold water rights, the water right applicants (and other residents who do not hold water rights) were adversely affected by the actions taken at the Yellow Eagle mining operation.

Current Conditions

As of 22 February 2000, the groundwater table has rebounded somewhat throughout the Goldhill Road study area. Of the five residents whom experienced depletion of their water supply: 1) at the expense of the homeowner, MW-101 has been redrilled from an original depth of 120 feet to 240 feet into bedrock, from which the supply has been restored although the water quality is equal to or less than the quality before the problem occurred. 2) one homeowner installed a tank system at his own expense to supplement the limited volume of water withdrawn from the well (MW-103) in order to keep a constant supply to the home; the water level in the tank is maintained by a commercial water hauler at the homeowner's expense. 3) one homeowner removed the well house and associated plumbing in anticipation of redrilling the well (MW-104) and has since decided to wait until hydrologic conditions in the area stabilize. In the interim he has installed a small holding tank in the basement and continues to haul water from a commercial source every two days, at his own expense. 4) one homeowner has been able to utilize their well (MW-112) as the water table has rebounded; the amount of time without adequate supply was approximately 4 weeks. 5) one homeowner is not using his well (MW-116) at all and gets water from alternative sources. The two residents whom experienced degradation of water quality, at MW-102 and MW-105, have since reported that the water quality has improved.

Summary

The precise conditions under the surface of the earth cannot be determined within the scope of this project. However, based on the information gathered over the course of the past five months, this investigation has determined that: a) the domestic wells in the Goldhill Road area are finished in a shallow perched alluvial aquifer located approximately 100 feet below the ground surface, supported by a narrow layer of clay; b) the alluvial aquifer that these wells are finished appears to wind its way to the south and intercept the Yellow Eagle 1999 pit, then continues to what is known as the Dredge Pond, located to the south of the 1999 pit; c) water most likely is conveyed through this "conduit" of alluvial material to the Dredge Pond as part of the normal hydrologic regime (supported by reports from Yellow Eagle that the Dredge Pond turned turbid immediately after the groundwater was intercepted); d) at the time the groundwater was intercepted in the 1999 pit, the flow of water increased from the source (somewhere in the vicinity of Goldhill Road) because the hydrostatic pressure had been released in the pit. The release of hydrostatic pressure caused the wells finished upgradient in this alluvium to be depleted; e) as increased head pressure is applied by the height of the standing water column in the 1999 pit, the flow through the "conduit" of gravels to the 1999 pit has presumably reverted to previous levels, essentially "backing up" water in the alluvium, and allowing for what appears to be mid-winter recharge to the wells in the Goldhill Road area. As long as the transmissivity of the "conduit" is maintained at or below the current value, the water levels in the associated domestic wells should remain steady or recover somewhat.

CONCLUSION

DMLW will continue to collect water level information and monitor the situation near Goldhill Road. In light of the facts presented herein, the Department of Natural Resources, Division of Mining, Land and Water has come to the conclusion that the mining activities at the Yellow Eagle Mine near Ester that occurred on 25 September 1999, were the primary cause of the groundwater disturbance in the Goldhill Road area which has resulted in the dewatering of several domestic wells beyond normal use. Specifically, during the course of

normal mining activity, Yellow Eagle intercepted the groundwater table which released groundwater previously held under pressure, allowing it to flow freely into the 1999 pit. This caused the rapid drawdown of water from the aquifer serving as a water supply to residential wells in the Goldhill Road area. Information determined during this investigation that supports this conclusion is summarized as follows:

- During the course of mining on 25 September 1999, Yellow Eagle Mining, Inc. intercepted the groundwater table at the base of the north face of the 1999 pit.
- Within weeks after the 25 September incident, five residential wells in the Goldhill Road area, located within one-half mile of the Yellow Eagle 1999 pit, reportedly experienced a drop in static water levels such that the wells were not usable; two other residences experienced degradation in water quality which included increased sedimentation.
- Monitoring of water levels in domestic wells near Goldhill Road has verified that there was a major change in the groundwater system which caused a marked depression of the water table in the period of time between 21 September 1999 and 13 October 1999 (dates of the actual water level measurements). There appears to be no other likely scenario which might have caused this rapid perturbation of the groundwater levels during this time of year.
- Material obtained during the redrilling of one of the residential wells in the Goldhill Road area appears to be alluvial gravels, consistent with those found in the 1999 pit. This supports the description of the most probable underground lithology which includes a narrow “conduit” of water bearing material both north and south of the 1999 pit, leading upgradient into the residential area and downgradient into the Dredge Pond.
- Analysis of water chemistry from water flowing from the base of the north side of the Yellow Eagle 1999 pit and from domestic wells near Goldhill Road proves that the water is geochemically similar, increasing the probability that the source which supplies the domestic wells is the same source of water in the 1999 pit, and does not discount that probability.

- Further monitoring of water levels in most domestic wells near Goldhill Road shows a steady increase in the water levels in the months following the initial major depression. The increased well depth is coincident with the filling of the 1999 pit and has occurred during the time when seasonal conditions inhibit natural recharge.

Acknowledgements

We would like to thank the residents of the Goldhill Road area for their understanding and patience during this investigation and their willingness to share information; Yellow Eagle Mining, Inc. for their readiness to provide information and access to the mine site; Design Science and Engineering for sharing collected data; Gary Prokosch of DMLW for providing text on the discussion of Water Rights; and Ryan Hull of DMLW for the long hours dedicated to this investigation.

Appendix A.

Timeline of activities (following).

Summary of Events

Groundwater Disturbance near Ester, Alaska

September 1999 through March 2000

Alaska Department of Natural Resources Division of Mining, Land and Water

Activity	Start Date of Event	September				October				November				December				January				February			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Yellow Eagle Mining intercepts groundwater table	25-Sep-99																								
Some residents report wells dry beyond normal use	30-Sep-99																								
Article in The Ester Republic	Oct-99																								
Article in Fairbanks Daily-News Miner	13-Oct-99																								
Article in Fairbanks Daily-News Miner	16-Oct-99																								
Yellow Eagle stops mining in 1999 pit	25-Oct-99																								
MW-101 redrilled	26-Oct-99																								
Water samples collected for chemical analysis	27-Oct-99																								
Public meeting--Primarily affected homeowners	28-Oct-99																								
Door-to-door survey in Goldhill Road area--DMLW	29-Oct-99																								
Article in Fairbanks Daily-News Miner	30-Oct-99																								
Article in The Ester Republic	Nov-99																								
Public meeting--General public and media	2-Nov-99																								
DMLW conducts well monitoring	12-Nov-99																								
Chemistry results received from lab	29-Dec-99																								
Article in Fairbanks Daily-News Miner	19-Feb-00																								
Chemistry results received from lab	22-Feb-00																								
DMLW completes report of findings	13-Mar-00																								

Appendix B.

List of associated parties (following).

List of associated parties.

Name	Location	Participation	Monitoring Well ID
E. Hein	Townsend Way	First resident to report well disturbance in Goldhill Road area	MW-146
S. Fisher	Canary Road	Well dry beyond use, October 1999; well deepened to rectify	MW-101
T. Pierce	Henderson Road	Well dry beyond use October 1999	MW-104
D. Thomas	Goldhill Road	Well dry beyond use, October 1999	MW-103
B. Murphy	Goldhill Road	Water quality degradation, October 1999	MW-105
C. Capoun	Townsend Way	Water quality degradation, October 1999	MW-102
J. Williams	Townsend Way	Well dry beyond use, February 1999; well deepened	MW-111
R. Rustad	Townsend Way	Pump failed first during winter 1998-1999, and again October 1999	MW-116
H. Keith	Springbrook Lane	Well dry beyond use, October 1999	MW-112
V. MacDonald	Henderson Road	Monitoring well	MW-113
A. Witt	Dome Road	Monitoring well	MW-115
J. Johnston	Bluebird Avenue	Monitoring well	MW-106
J. Knopke	Ester Drive	Monitoring well	MW-109
C. Maynor	Townsend Way	Monitoring well	MW-108
D. Brady	4 mile Old Nenana Highway	Monitoring well (control)	MW-107
J. Vohden	3 mile Cripple Creek Road	Monitoring well (control)	MW-110
John Z. Miller	Yellow Eagle Mining, Inc.	President, Yellow Eagle Mining, Inc.	--
Frank Saunders	Yellow Eagle Mining, Inc.	Vice President/General Manager, (retired) Yellow Eagle Mining, Inc.	--

Appendix C.

Letter from Yellow Eagle Mining, Inc. as requested during

28 Oct 1999 public meeting (following).

CRIPPLE CREEK VENTURE

[A Venture Between Yellow Eagle Mining Inc. and Exploration Orbite VSPA Inc.]

3550 Parks Highway
P.O. Box 449
Ester, Alaska 99725

Phone: 907-479-0470
Fax: 907-479-0492
E-Mail: ccven@ptialaska.net

30 October 1999

To the Residents of Ester:

Georges Gagnon, Geologist, and I, John Miller were pleased to meet with members of the Ester community on Thursday evening. The meeting was arranged by the Alaska Department of Natural Resources (DNR) because both Georges and myself were unavailable for the Tuesday meeting. Frank Saunders, our General Manager, is recovering from a recent medical setback and will be unable to attend. The members of the Ester community who had experienced the loss of water and/or serious degradation of their wells were invited. Two (2) of the Ester residents had reported the loss of water in their wells and two (2) have reported degradation, i.e. cloudy water, etc.

Serious efforts are being made by DNR scientists and engineers consulting to the Cripple Creek Venture (CCV) which is operating a placer mine on the Ester/Cripple Creek drainages immediately down grade from the affected wells, to clarify the relationship between the mine's de-watering and community well performance. The water situation is complicated. Wells in the area have been monitored by Design Science and Engineering since 1993. A steady decline has been noticeable over this period. The Cripple Creek Venture began mining during the summer of 1996. Drilled wells are charged by precipitation and snow accumulation which has been very limited over the past several years. On approximately September 25th, the CCV encountered a steady flow of water from the bottom of the north wall of their active mining pit. This flow was measured and continues to date. The CCV pit is located in the bottom of the Ester Creek drainage and is possible the flow of water comes from the aquifer supplying the affected Ester wells or from Ester Creek which travels underground through thawed gravels. While various scientific observations are being made it appears that the exact source of the water may not be accurately identified. It is significant to note that the CCV has stopped mining for the winter and has stopped pumping water. We expect that the water will continue to flow into our open pit until equilibrium is established and if the water is flowing from the aquifer which supplies the affected wells that the wells will recover in the near future.

CCV has retained the services of Design Engineering to continue collecting well data. We are genuinely concerned with the water problem in our community. Unfortunately at the moment we do not have the financial resources to help those homeowners who are experiencing water problems. Efforts are being made to re-capitalize our venture and

return in the spring. Hopefully, by spring we will have a better understanding of the cause and effect of well water levels. The owners and operators of the venture, present and future, are aware of the problem and will seek a mutually satisfactory solution to the problem. We have provided limited financial assistance to Ester residents in the past. This was done in a spirit of goodwill and cooperation and not as a result of a court order or formal legal action.

CCV has enjoyed the goodwill and support of the Ester community for the past four years. We value that relationship and cannot envision continuing to operate under any other circumstances. We will work with you to the every best of our financial ability to mitigate any damage which may be directly or indirectly associated with our mining activity.

Again I regret the members of our Venture are not available for your public meeting. We will be informed of your discussion and trust that we will all become better informed and knowledgeable about the water issues in the Ester area. We will work with you to assist in finding a fair solution.

Sincerely,

Cripple Creek Venture
By: John Z. Miller
Management Committee

JZM/mms

Appendix D.

Summary of water rights holders in the Goldhill Road area prior to 25 September 1999 (following).

Domestic Water Rights Holders in the Goldhill Road Area near Fairbanks, Alaska; prior to 25 September 1999.

Name	Location	Date of Application	DNR ID Number
E. Hein	Townsend Way	26 December 1985	LAS 5758
S. Fisher	Canary Road	11 April 1984	LAS 1406
C. Capoun	Townsend Way	28 June 1985	LAS 3001
R. Graham	Canary Road	5 December 1975	ADL 73344
Ester Fire Dept.	Old Nenana Highway	5 December 1984	LAS 2500

Appendix E.

Analytical results (following).

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701, (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518, (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734, (907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 10/28/99
Date Sampled: 10/27/99
Time Sampled: 1211
Collected By: J.Vohden

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188152
Location/Project: Ester
Your Sample ID: PIT Water
Sample Matrix: Water
Comments:

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188152	EPA 200.7	Calcium, Dissolved	mg/L	135	0.40		12/24/99
		Potassium, Dissolved	mg/L	3.8	0.2		12/20/99
		Magnesium, Dissolved	mg/L	46.4	0.2		12/20/99
		Sodium, Dissolved	mg/L	25.1	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	1.27	0.08		11/19/99
		Sulfate, Dissolved	mg/L	57.1	8.0		10/29/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3) Diss.	mg/L	490	15		10/29/99
	SM2510-B	Conductance	uMHOS/cm	960	1		11/02/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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8005 SCHOON STREET
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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 10/28/99
Date Sampled: 10/27/99
Time Sampled: 1831
Collected By: J.Vohden

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188158
Location/Project: Ester
Your Sample ID: Pierce
Sample Matrix: Water
Comments:

MW-104

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188158	EPA 200.7	Calcium, Dissolved	mg/L	234	0.40		12/24/99
		Potassium, Dissolved	mg/L	5.2	0.2		12/20/99
		Magnesium, Dissolved	mg/L	95.5	0.2		12/20/99
		Sodium, Dissolved	mg/L	58.8	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	3.8	0.08		11/19/99
		Sulfate, Dissolved	mg/L	236	8.0		10/29/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3) Diss.	mg/L	881	15		10/29/99
	SM2510-B	Conductance	uMHOS/cm	1800	1		11/02/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/31/99

Date Arrived: 11/02/99
Date Sampled: 11/01/99
Time Sampled: 1750
Collected By: JV

MRL = Method Reporting Limit

Our Lab #: F188182
Location/Project: Ester
Your Sample ID: Murphy
Sample Matrix: Water
Comments:

MW-105

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188182	EPA 200.7	Calcium, Dissolved	mg/L	216	0.40		12/24/99
		Potassium, Dissolved	mg/L	4.0	0.2		12/20/99
		Sodium, Dissolved	mg/L	46.2	0.1		12/20/99
	EPA 242.1	Magnesium, Dissolved	mg/L	97.5	20.0		12/31/99
	EPA 300.0	Chloride, Dissolved	mg/L	17.5	0.80		11/11/99
		Sulfate, Dissolved	mg/L	186	10.0		11/11/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	732	15		11/04/99
	SM2510-B	Conductance	uMHOS/cm	1600	1		11/02/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 10/29/99
Date Sampled: 10/29/99
Time Sampled: 1222
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188170
Location/Project: Ester
Your Sample ID: Thomas
Sample Matrix: Water
Comments:

MW-103

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188170	EPA 200.7	Calcium, Dissolved	mg/L	166	0.40		12/24/99
		Potassium, Dissolved	mg/L	3.1	0.2		12/20/99
		Magnesium, Dissolved	mg/L	51.1	0.2		12/20/99
		Sodium, Dissolved	mg/L	33.2	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	1.09	0.08		10/29/99
		Sulfate, Dissolved	mg/L	2.3	0.2		10/29/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	520	15		10/29/99
	SM2510-B	Conductance	uMHOS/cm	1200	1		10/29/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 11/02/99
Date Sampled: 11/01/99
Time Sampled: 1812
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188181
Location/Project: Ester
Your Sample ID: Williams
Sample Matrix: Water
Comments:

MW-111

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188181	EPA 200.7	Calcium, Dissolved	mg/L	118	0.40		12/24/99
		Potassium, Dissolved	mg/L	5.5	0.2		12/20/99
		Magnesium, Dissolved	mg/L	52.2	0.2		12/20/99
		Sodium, Dissolved	mg/L	25.6	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	1.76	0.08		11/12/99
		Sulfate, Dissolved	mg/L	76.9	2.0		11/11/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	496	15		11/04/99
	SM2510-B	Conductance	uMHOS/cm	980	1		11/02/99

Marci L. Irwin
Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
8005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
ANCHORAGE, ALASKA 99518
PRUDHOE BAY, ALASKA 99734

(907) 456-3116 • FAX 456-3125
(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 11/03/99
Date Sampled: 11/03/99
Time Sampled: 1523
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188223
Location/Project: Ester
Your Sample ID: Hein
Sample Matrix: Water
Comments:

MW-146

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188223	EPA 200.7	Calcium, Dissolved	mg/L	137	0.40		12/24/99
		Potassium, Dissolved	mg/L	3.2	0.2		12/20/99
		Magnesium, Dissolved	mg/L	45.1	0.2		12/20/99
		Sodium, Dissolved	mg/L	27.1	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	1.36	0.16		11/12/99
		Sulfate, Dissolved	mg/L	63.5	2.0		11/12/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	492	15		11/05/99
	SM2510-B	Conductance	uMHOS/cm	1000	1		11/04/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/23/99

Date Arrived: 10/29/99
Date Sampled: 10/29/99
Time Sampled: 1159
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188169
Location/Project: Ester
Your Sample ID: Capoun
Sample Matrix: Water
Comments:

MW-102

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188169	EPA 200.7	Calcium, Dissolved	mg/L	145	0.40		12/21/99
		Potassium, Dissolved	mg/L	4.4	0.2		12/20/99
		Magnesium, Dissolved	mg/L	47.7	0.2		12/20/99
		Sodium, Dissolved	mg/L	26.4	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	2.22	0.16		11/11/99
		Sulfate, Dissolved	mg/L	36.8	2.0		11/11/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	531	15		10/29/99
	SM2510-B	Conductance	uMHOS/cm	1000	1		10/29/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE, FAIRBANKS, ALASKA 99701 — (907) 456-3116 • FAX 456-3125
8005 SCHOON STREET, ANCHORAGE, ALASKA 99518 — (907) 349-1000 • FAX 349-1016
POUCH 340043, PRUDHOE BAY, ALASKA 99734 — (907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/27/99

Date Arrived: 11/03/99
Date Sampled: 11/03/99
Time Sampled: 1550
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188224
Location/Project: Ester
Your Sample ID: Keith
Sample Matrix: Water
Comments:

MW-112

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188224	EPA 200.7	Calcium, Dissolved	mg/L	124	0.40		12/24/99
		Potassium, Dissolved	mg/L	2.9	0.2		12/20/99
		Magnesium, Dissolved	mg/L	39.7	0.2		12/20/99
		Sodium, Dissolved	mg/L	15.6	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	1.24	0.08		11/12/99
		Sulfate, Dissolved	mg/L	100	4.0		11/12/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	330	15		11/05/99
	SM2510-B	Conductance	uMHOS/cm	910	1		11/04/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

3330 INDUSTRIAL AVENUE
9005 SCHOON STREET
POUCH 340043

FAIRBANKS, ALASKA 99701
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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 12/23/99

Date Arrived: 11/03/99
Date Sampled: 11/03/99
Time Sampled: 1607
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F188225
Location/Project: Ester
Your Sample ID: Ester Fire Sta.
Sample Matrix: Water
Comments:

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F188225	EPA 200.7	Calcium, Dissolved	mg/L	99.7	0.10		12/21/99
		Potassium, Dissolved	mg/L	2.9	0.2		12/20/99
		Magnesium, Dissolved	mg/L	43.3	0.2		12/20/99
		Sodium, Dissolved	mg/L	12.1	0.1		12/20/99
	EPA 300.0	Chloride, Dissolved	mg/L	2.19	0.16		11/12/99
		Sulfate, Dissolved	mg/L	104	4.0		11/12/99
	SM2320-B	Bicarbonate Alkalinity (as CaCO3), Diss.	mg/L	304	15		11/05/99
	SM2510-B	Conductance	uMHOS/cm	770	1		11/04/99

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

NORTHERN TESTING LABORATORIES, INC.

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8005 SCHOON STREET
POUCH 340043

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(907) 349-1000 • FAX 349-1016
(907) 659-2145 • FAX 659-2146

Department of Natural Resources
Division of Mining & Water
3700 Airport Way
Fairbanks AK 99709

Attn: Jim Vohden

Report Date: 02/17/00

Date Arrived: 01/28/00
Date Sampled: 01/28/00
Time Sampled: 1300
Collected By: JV

MRL = Method Reporting Limit

* Flag Definitions
B = Below Regulatory Min.
H = Above Regulatory Max.

Our Lab #: F189512
Location/Project: Ester
Your Sample ID: Fisher
Sample Matrix: Water
Comments:

MW-101

Lab#	Method	Parameter	Units	Results *	MRL	Digest Prepared	Date Analyzed
F189512	EPA 200.7	Calcium, Dissolved	mg/L	84.4	0.40		02/01/00
		Potassium, Dissolved	mg/L	3.6	0.2		02/10/00
		Magnesium, Dissolved	mg/L	37.9	0.2		02/10/00
		Sodium, Dissolved	mg/L	23.4	0.1		02/01/00
	EPA 300.0	Chloride, Dissolved	mg/L	1.7	0.40		01/28/00
		Sulfate, Dissolved	mg/L	171	10.0		02/14/00
	SM2320-B	Bicarbonate Alkalinity (as CaCO3)	mg/L	227	15		02/03/00
	SM2510-B	Conductance	uMHOS/cm	750	1		01/28/00

Marci L. Irwin

Reported By: Marci L. Irwin
Chemistry Supervisor

Appendix F.

Water level data collected by DMLW, Nov-99 through Feb-00 (following).

Water Level Measurements -- Ester / Goldhill Road
Department of Natural Resources Division of Mining, Land and Water

All measurements are in feet, and represent the distance between the surface of the groundwater and the top of the well casing.

Well ID	Residence	Date	Time	depth to water, from top of casing (feet)
MW-101	Fisher	02-Dec-99	15:01	115.01
MW-101	Fisher	21-Jan-00	13:18	112.65
MW-101	Fisher	22-Feb-00	14:14	110.73
MW-102	Capoun	12-Nov-99	11:01	93.21
MW-102	Capoun	22-Nov-99	18:02	91.89
MW-102	Capoun	02-Dec-99	15:12	90.67
MW-102	Capoun	10-Dec-99	16:10	89.78
MW-102	Capoun	17-Dec-99	10:02	89.28
MW-102	Capoun	07-Jan-00	14:34	86.91
MW-102	Capoun	21-Jan-00	13:59	85.88
MW-102	Capoun	22-Feb-00	13:45	83.66
MW-103	Thomas (Goldhill Rd)	17-Nov-99	14:10	117.71
MW-103	Thomas (Goldhill Rd)	24-Nov-99	11:01	118.32
MW-103	Thomas (Goldhill Rd)	02-Dec-99	14:51	117.78
MW-103	Thomas (Goldhill Rd)	17-Dec-99	10:59	117.82*
MW-103	Thomas (Goldhill Rd)	23-Dec-99	12:41	123.61
MW-103	Thomas (Goldhill Rd)	07-Jan-00	13:20	121.49
MW-103	Thomas (Goldhill Rd)	21-Jan-00	12:55	124.66
MW-103	Thomas (Goldhill Rd)	22-Feb-00	14:24	113.50
MW-104	Pierce	17-Nov-99	15:07	117.11
MW-104	Pierce	18-Nov-99	15:27	116.91
MW-104	Pierce	19-Nov-99	16:32	116.48
MW-104	Pierce	20-Nov-99	15:18	116.91
MW-104	Pierce	24-Nov-99	10:36	116.74
MW-104	Pierce	02-Dec-99	14:31	116.27
MW-104	Pierce	10-Dec-99	15:09	115.59
MW-104	Pierce	17-Dec-99	10:37	115.70
MW-104	Pierce	23-Dec-99	12:22	115.34
MW-104	Pierce	07-Jan-00	12:59	113.55
MW-104	Pierce	21-Jan-00	12:30	112.73
MW-104	Pierce	22-Feb-00	14:40	111.04

Well ID	Residence	Date	Time	depth to water, from top of casing (feet)
MW-105	Murphy	18-Nov-99	15:14	112.08
MW-105	Murphy	19-Nov-99	17:13	111.78
MW-105	Murphy	24-Nov-99	10:47	111.87
MW-105	Murphy	02-Dec-99	14:42	111.14
MW-105	Murphy	10-Dec-99	15:19	110.68
MW-105	Murphy	17-Dec-99	10:46	110.50
MW-105	Murphy	23-Dec-99	12:31	110.24
MW-105	Murphy	07-Jan-00	13:11	108.57
MW-105	Murphy	21-Jan-00	12:41	107.74
MW-105	Murphy	22-Feb-00	14:32	105.92
MW-106	Johnston	19-Nov-99	16:02	88.52
MW-106	Johnston	02-Dec-99	16:11	88.77
MW-106	Johnston	10-Dec-99	14:46	88.79
MW-106	Johnston	23-Dec-99	11:56	90.37
MW-106	Johnston	07-Jan-00	12:38	89.15
MW-106	Johnston	21-Jan-00	11:23	89.17
MW-106	Johnston	22-Feb-00	15:18	91.57
MW-107	Brady	24-Nov-99	9:14	119.23
MW-107	Brady	10-Dec-99	14:11	119.05
MW-107	Brady	23-Dec-99	11:25	119.26
MW-107	Brady	07-Jan-00	12:01	119.31
MW-108	Maynor	24-Nov-99	10:15	97.93
MW-108	Maynor	02-Dec-99	15:34	98.02
MW-108	Maynor	10-Dec-99	15:44	97.81
MW-109	Knopke	26-Nov-99	17:37	174.43
MW-109	Knopke	02-Dec-99	15:58	158.96
MW-109	Knopke	10-Dec-99	14:58	147.25
MW-109	Knopke	23-Dec-99	12:16	160.90
MW-109	Knopke	14-Jan-00	11:12	141.21
MW-109	Knopke	21-Jan-00	12:05	161.04
MW-109	Knopke	22-Feb-00	15:08	162.52
MW-110	Vohden	17-Nov-99	7:40	98.64
MW-110	Vohden	20-Nov-99	15:40	98.40
MW-110	Vohden	21-Nov-99	15:10	98.46
MW-110	Vohden	10-Dec-99	20:12	98.51
MW-110	Vohden	21-Jan-00	5:50	98.24

Well ID	Residence	Date	Time	depth to water, from top of casing (feet)
MW-111	Williams	02-Dec-99	15:25	106.64
MW-111	Williams	10-Dec-99	15:59	107.10
MW-111	Williams	17-Dec-99	9:51	107.37
MW-111	Williams	23-Dec-99	12:52	107.59
MW-111	Williams	07-Jan-00	13:37	107.68
MW-111	Williams	21-Jan-00	13:49	107.68
MW-111	Williams	22-Feb-00	13:53	106.89
MW-112	Keith	10-Dec-99	14:37	112.51
MW-112	Keith	23-Dec-99	11:44	111.73
MW-112	Keith	07-Jan-00	12:27	110.46
MW-112	Keith	21-Jan-00	14:23	110.60
MW-112	Keith	22-Feb-00	13:36	108.01
MW-113	MacDonald	14-Jan-00	11:24	89.23
MW-113	MacDonald	21-Jan-00	12:21	89.30
MW-113	MacDonald	22-Feb-00	14:57	89.61
MW-115	Witt	10-Jan-00	17:16	172.09
MW-115	Witt	21-Jan-00	11:10	168.21
MW-115	Witt	22-Feb-00	15:28	179.47
MW-116	Rustad	07-Jan-00	14:17	103.19
MW-116	Rustad	21-Jan-00	13:34	103.11
MW-116	Rustad	22-Feb-00	14:01	102.57

* to be used only as an estimate

Appendix G.

Available well logs from Goldhill Road area (following).

3001 Porcupine Dr.
Anchorage, Alaska 501

STAPLE FOR TAPE

DEPARTMENT OF NATURAL RESOURCES

WATER WELL RECORD

MW-101-ORIGINAL

Drilling Company Name: Thibodeau Drilling Contractors
3564 Peger Rd.
Fairbanks, Ak

Drilling Permit Number:

OWNER NO.:

1 LOCATION OF WELL

Borough	Subdivision	Lot	Block	Fraction	Section No.	Town	Range	Meridian
North Star	SONGBIRD	3A		& & &	8	15 N/S	2W E/W	FAIRBANKS

Distance and Direction from Road Intersections
LAT: 0645051.8
LON: 1475840.6 W
Street Address and Area of Well Location: 3½ Mile Old Nenana Hwy

3 OWNER OF WELL:
Address: 3½ Mile Old Nenana Rd, Fairbanks, AK 99701

2 WELL LOG

Material Type		
Frozen Brown Soil	0'	4'
Brown Soil, Dry	4'	8'
Brown Soil, Frozen	8'	15'
Grey Soil, Frozen	15'	34'
Grey Soil, Frozen with occasional Rock Pieces	34'	64'
Highly Fractured Brown Schist with Silt	64'	88'
Firm Fractured Black Rock, Rust Stains First Sign of water	88'	93'
Decomposed & Fractured Quartz with very heavy Rust Stains	93'	99'
Same and Very Soft	99'	104'
Black Firm Rock with Bands of Mineralized Quartz	104'	112'
Very Hard Black Rock Lavender Tint on Fractures	112'	113'
Highly Fractured Ball Quartz with Much Water	113	120

4 WELL DEPTH: (completed) 117 ft. | Surface Elevation | Date of Completion: 19 March 1981

5 [ ] Cable tool [ ] Rotary [ ] Driven [ ] Dug [ ] Auger [ ] Jetted [ ] Bored [ ] Other:

6 USE: [X] Domestic [ ] Public Supply [ ] Industry [ ] Irrigation [ ] Recharge [ ] Commercial [ ] Test Well [ ] Other:

7 CASING: [ ] Threaded [X] Welded Height: [X] Above [ ] Below
6 in. to 117 ft. Depth — surface 1 ft.
in. to ft. Depth — weight 17 lbs/ft.
Drive Shoe? [X] Yes [ ] No

8 FINISH OF WELL: Well Developed Porous Fractured Quartz
Type: Diameter:
Slot/Mesh Size Length
Set between ft. and ft.
Fittings:

9 STATIC WATER LEVEL: 80 ft. [ ] above [ ] below land surface
Type of Measurement: Elec. Probe

10 PUMPING LEVEL below land surface
81 ft. after 21 hrs. pumping 23 g.p.m.
ft. after hrs. pumping g.p.m.

11 WELL HEAD COMPLETION:
[ ] In Approved Pit [ ] Pitless Adapter [X] 12" Above Grade

12 SEALING: Well Grouted: [X] Yes [ ] No
Material: [ ] Neat Cement [ ] Other: DRILL SLURRY

13 CASING: [illegible]

14 PUMP: (if available) HP (1) 13EM10412
Length of Drop Pipe 102 ft. capacity 230 g.p.m. OPEN DISCHARGE
Type: [X] Submersible [ ] Other:
[ ] Jet [ ] Reciprocating

Nearest Source of Possible Contamination
Feet Direction NONE Type
Well disinfected upon completion [X] Yes [ ] No

15 REMARKS: Elevation, source of data, water quality tests, etc.
Well Finished in Highly Fractured Ball Quartz that Furnished Water Freely. Best Formation Encountered in This Highly Mineralized Area.

RECEIVED
APR 1 1 1984
DIV. OF FOREST, LAND & WATER MGMT-FAIRBANKS

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief:

Thibodeau Drilling Contractors — Registered business name
AA 4710 — Contractor License Number
Address: 3564 PEGER ROAD FAIRBANKS AK 99701
Signature: Evelyn Thibodeau — Date: 21 MAR 81
Authorized representative

AWN D NGS 05/01/84

MW-101
REDRILLED

AURORA DRILLING

A DIVISION OF AMERICAN ARCTIC COMPANY
P.O. BOX 61611 • FAIRBANKS, ALASKA 99706 • PHONE (907) 456-6712 • FAX (907) 451-4356

FLASH-FAX™ TOPS 14850

TO: FROM: DATE: 11/29/99
PAGES INCLUDING THIS PAGE: 1

FAX #: FAX #: PHONE #:

Well Log

OWNER...

Mailing Address 462 Canary Lane Fairbanks, AK 99709

Well Location 462 Canary Lane

Size of Casing 6" 0'to 117' (original)
5" 0'to 191'
4" 177'to 240'
Depth of Well 240' Cased to 240'

( ) Screen

Static Water Level 114' Yield in GPM 15 (X) Perforated 219'to 240'

Driller Damon Willford Date 11-17-99

Formations Encountered

120 to 129 Broken washed Schist
129 to 139 Rock Chips- Clay
139 to 141 Black Fractured Schist- Silt
141 to 156 Brown- Silt with Rock Chips
156 to 191 Black- Silt with Rock Chips
191 to 228 Black Schist
228 to 240 Mica Schist- Quartz

Pump Installation

Date Installed ... Type ... Size ...
Pump Model ... Water Line ...
Wire ... Heat Tape ...
Pipe ... Pump Depth 173'
Pitless Adaptor ... Pressure Tank ...

MW-102

SWAN DRILLING
4 Mile Steese Highway
P. O. Box 10109
Fairbanks, Alaska 99701

WELL LOG

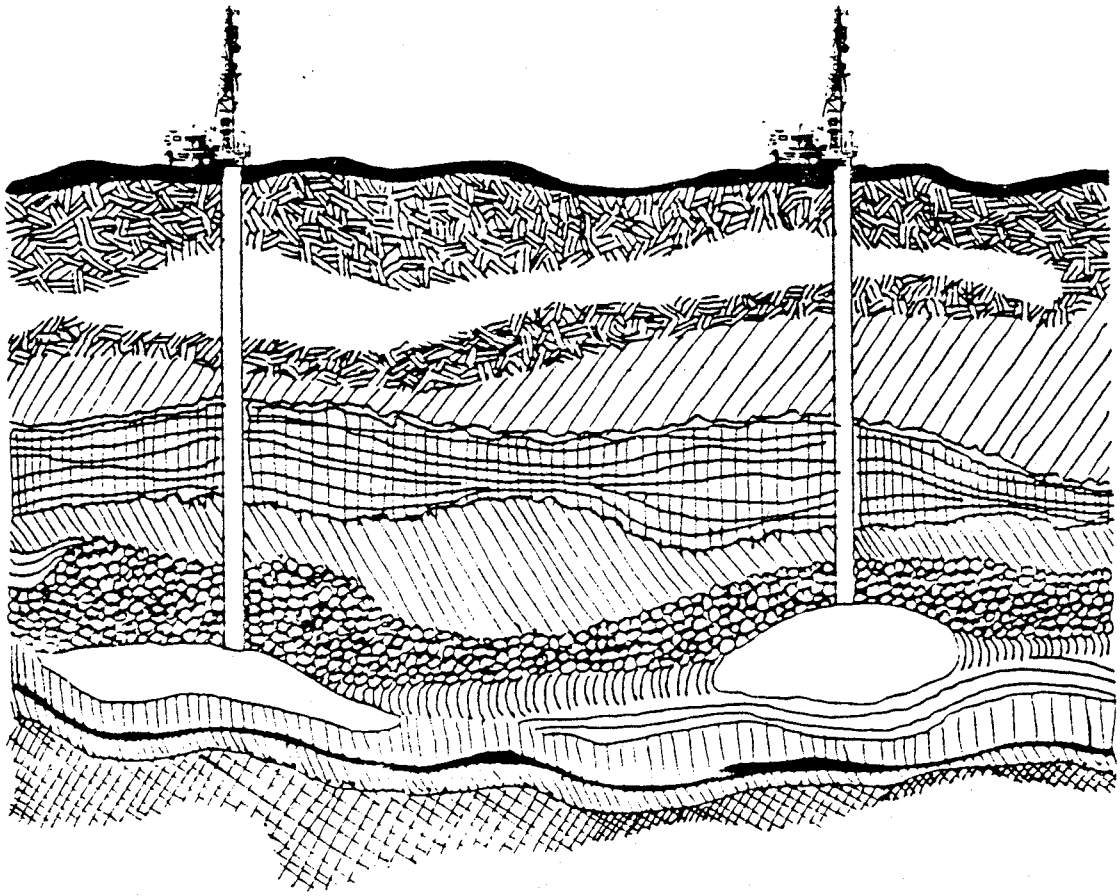
8-18-83

Old Nenana Hwy.
P. O. Box 2704
Fairbanks, Ak.

0' to 7' Silt
7' to 85' Frozen Silt Gray
85' to 115' Mud Gray
115' to 150' Brown & Gray Rock

Static water level 60' Well cased to 148'

Driller: Bill Bembry



WATER WELL DRILLERS LOG

BRANDS WELL DRILLING

Box 333, Fairbanks

Driller Richard H. Brand

DO NOT FILL IN

JLG 24-7.

USGS No.

Area MW-146

Well Owner _____ Use of Well Ros

Location (address of; Township, Range and Section, if known; or distance from main road:

100 Yards off old Nenana Road west end.

Size of Casing 6 + 5 Depth of Hole 116 feet. Cased to 120 feet.

Static water level 66 feet (above) (below) land surface. Finish of well (check one)

Open end (✓); Screen ( ); Perforated (✓)

Describe screen or perforations 41' 5" slotted Liner in bottom.

Well pumping test at 40 To 50 gallons per (hour) (minute) for 1 hours with Air

feet of drawdown from static level.

Remarks 6" shoe no slottes To 93'

WELL LOG

Depth in feet from ground surface		Give details of formations penetrated, size of material, color, and hardness.
0	to 5'	Thawed black muck.
5'	to 50	Frozen " " "
50	to 70	Thawed green " "
70	to 96	" " " + Sloat rock.
96	to 100'	Light brown shist rock
100'	to 112'	" + dark " " 25 GPM
112	to 114	Dark grey rock,
114	to 116'	" brown " , 50 GPM Est.
	to	
	to	
	to	Owner put in own pump.
	to	
	to	Well cleaned up 5 min after stopped
	to	drilling
	to	
	to	Nenana Alaska 47E 57-5E
	to	

LOT 1 OF THE 1980 REPLAT OF SOME CLAIM NO. 3 BELOW LEASE LIMIT ESTER CREEK [illegible] NW¼ SEC. 8 T.1S R.2W F.M.

J. & O. DRILLING

1932 BRIDGEWATER
FAIRBANKS, ALASKA 99701
452-4536

ESTER FIRE DEPT.

LAT 200'

WELL LOG

OWNER: P.O. BOX [illegible] FAIRBANKS, AK 99707

Name ESTER FIRE DEPT.

Address ESTER AK.

Well location ESTER AK.

Type of well X ROTARY DRILLED

Proposed use COMM.

Casing installed: threaded ____ weld X

8 "dia. 0 ft. to 82'9" ft. Guage ____

____"dia. ____ ft. to ____ ft. Guage ____

Perforated: yes ____ no XX size ____

____ perf. from ____ ft. to ____ ft.

____ perf. from ____ ft. to ____ ft.

____ perf. from ____ ft. to ____ ft.

Screen Installed: XX NO Mfg. ____

Dia. ____ slot ____ from ____ ft. to ____ ft.

Water level from top of ground to water

static level 22' Date 7/2/81

Well Test Approx. 9-10 gpm.

pump test yes yield 9 GPM 19 ft.

drawdown. Hours pumped 6

Construction:

Well seal used Botonite slurry depth 20 size 2"

Gravel pack no from ____ ft. to ____ ft.

Drive shoe yes depth well drilled 200'

Dia. of well below casing 8"

MATERIAL	From	To
Backfill & overburden	0	15
rock, mud, wet	15	62
decomposed rock	62	78
hard rock, [illegible]	78	90
fractred rock water bearing	90	100
hard rock	100	200

RECEIVED
DEC 05 1984
Division of Land and Water Mgt.
Northern Region

Work started ____ finished ____

Pump installed ____ date ~~9-16-81~~

brand ~~GOULD~~ S/N. ~~H029808~~

model ~~10EJ~~ hp ~~3/4~~ volt ~~230~~ depth ~~180~~ ft.

Pitless ~~MASS~~ size ~~8X~~ depth ~~6~~ ft. below ground

well cap used ____ size ~~8"~~ brand ~~Koolator~~

1 = L-4COSS well guard 160'

This well was constructed under my direct supervision, materials used and information reported above are true to my best knowledge and belief.

Signed James L Turner date 7/4/81

Appendix H.

Water level data from specific Goldhill Road area wells (following).

Combined data for well MW-111

Data from Design Science and Engineering as well as DMLW; collected by various entities 1993-2000; static measurements only, depth to water from top of casing, in feet.

30-Nov-93	77.79	1-Apr-96	79.00	19-May-98	89.16
15-Dec-93	78.17	30-Apr-96	79.24	1-Jun-98	88.83
8-Jan-94	78.13	29-May-96	79.77	26-Jun-98	89.44
19-Feb-94	78.39	2-Jul-96	79.15	6-Jul-98	89.66
24-Mar-94	78.35	24-Jul-96	79.24	15-Jul-98	89.87
14-Apr-94	78.49	2-Sep-96	79.48	31-Jul-98	90.65
18-May-94	78.66	25-Sep-96	79.67	19-Aug-98	90.96
16-Jun-94	79.08	4-Nov-96	80.51	19-Sep-98	91.47
14-Jul-94	78.8	6-Nov-96	80.89	28-Sep-98	91.65
16-Aug-94	78.84	27-Nov-96	81.24	7-Oct-98	91.80
23-Sep-94	78.81	24-Dec-96	81.88	1-Dec-98	92.60
14-Oct-94	78.43	3-Jan-97	81.52	9-Feb-99	93.40
28-Dec-94	78.42	10-Mar-97	82.65	2-Apr-99	94.02
23-Jan-95	78.68	1-Apr-97	82.65	26-Apr-99	94.25
28-Feb-95	78.87	1-May-97	83.26	21-Sep-99	96.30
23-Mar-95	79.46	19-May-97	83.64	13-Oct-99	99.50
24-Apr-95	78.96	30-May-97	83.87	28-Oct-99	102.25
23-May-95	78.88	2-Jun-97	83.83	11-Nov-99	104.74
25-Jun-95	79.03	18-Jun-97	84.27	29-Nov-99	106.70
24-Jul-95	78.77	28-Jun-97	84.63	2-Dec-99	106.64
22-Aug-95	78.81	14-Jul-97	85.22	10-Dec-99	107.10
30-Oct-95	78.56	26-Jul-97	85.45	17-Dec-99	107.37
28-Nov-95	78.57	18-Aug-97	85.98	23-Dec-99	107.59
19-Dec-95	78.42	3-Sep-97	86.22	7-Jan-00	107.68
21-Jan-96	78.76	29-Oct-97	86.44	21-Jan-00	107.68
27-Feb-96	78.96	5-Dec-97	86.39	22-Feb-00	106.89

Combined data for well MW-113

Data from Design Science and Engineering as well as DMLW; collected by various entities 1993-2000; static measurements only, depth to water from top of casing, in feet.

23-Oct-93	76.10	28-Nov-95	75.39	18-Aug-97	80.34
30-Nov-93	75.39	28-Nov-95	75.39	3-Sep-97	80.22
15-Dec-93	75.55	19-Dec-95	75.34	30-Sep-97	80.30
20-Jan-94	74.77	22-Jan-96	77.55	29-Oct-97	80.03
19-Feb-94	75.30	27-Feb-96	75.70	5-Dec-97	80.81
14-Mar-94	75.45	1-Apr-96	75.75	20-Jan-98	81.67
18-May-94	76.82	25-Apr-96	76.09	28-Feb-98	81.54
16-Jun-94	76.32	28-May-96	76.55	18-Mar-98	81.89
14-Jul-94	75.85	2-Jul-96	77.44	26-Jun-98	82.98
16-Aug-94	75.97	24-Jul-96	76.39	15-Jul-98	82.55
23-Sep-94	76.01	24-Sep-96	76.12	31-Jul-98	84.01
14-Oct-94	75.70	2-Nov-96	76.87	19-Aug-98	82.72
17-Nov-94	75.48	4-Nov-96	79.33	19-Sep-98	83.45
28-Dec-94	75.31	27-Nov-96	80.70	7-Oct-98	83.53
23-Jan-95	74.17	24-Dec-96	78.65	1-Dec-98	83.48
28-Feb-95	75.69	31-Jan-97	78.71	9-Feb-99	84.50
23-Mar-95	75.89	10-Mar-97	79.35	2-Apr-99	84.85
25-Mar-95	76.00	9-Apr-97	79.22	26-Apr-99	83.85
24-Apr-95	75.99	1-May-97	79.13	3-Jun-99	84.60
23-May-95	75.34	19-May-97	79.08	21-Sep-99	84.70
24-Jun-95	74.97	30-May-97	78.91	13-Oct-99	86.50
25-Jun-95	75.33	18-Jun-97	79.22	28-Oct-99	87.10
26-Aug-95	76.79	28-Jun-97	79.60	14-Jan-00	89.23
28-Sep-95	75.12	14-Jul-97	80.00	21-Jan-00	89.30
20-Oct-95	76.82	26-Jul-97	79.90	22-Feb-00	89.61

Data for well MW-114

Data from Design Science and Engineering; collected by various entities 1993-2000; static measurements only, depth to water from top of casing, in feet.

2-Jul-98	67.79
6-Jul-98	69.20
15-Jul-98	69.24
31-Jul-98	70.43
19-Aug-98	70.60
19-Sep-98	70.87
7-Oct-98	76.23
1-Dec-98	77.42
9-Feb-99	77.80
2-Apr-99	76.80
26-Apr-99	76.40
3-Jun-99	76.45
21-Sep-99	78.40
13-Oct-99	80.00
28-Oct-99	80.55
11-Nov-99	80.29
29-Nov-99	79.68