SANDIA NATIONAL LABORATORIES
WASTE ISOLATION PILOT PLANT (WIPP)

TEST PLAN, TP 99-10
Groundwater Monitoring Activities: Troll Measurements, Bell Canyon Injection Well Monitoring Near H-9, and Meteorological Monitoring at H-9

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3.0 Revision History

This is the original issue of this Test Plan, Rev. 0; no prior revisions exist. Significant modifications to this document shall be reviewed and approved by the same organizations as those who performed the original review and approval. Revisions will have at least the same distribution as the original document.

4.0 Purpose and Scope

The following activities will be performed to support compliance monitoring, performance assessment, and well maintenance through the development of tools and methods that increase the understanding of groundwater flow and behavior in relation to natural and human activities in the WIPP area. In addition to the monthly measurements for Compliance Monitoring, more detailed measurements will be made at selected wells in the WIPP area with more advanced and recently developed instruments than currently used in the Compliance Monitoring program. This will provide us with the necessary intelligence to make appropriate decisions regarding the validity of data/information being generated by the new technology. The results of these efforts will be evaluated and reported annually. These activities will complement the data currently collected in the groundwater monitoring program.

The first activity will provide additional water level measurements. The Troll SP4000-232, manufactured by In Situ, Inc., is one of the monitoring instruments to be used. The Troll is lowered into the well approximately 30 to 40 feet below the water surface and measures the pressure exerted from the water over the instrument. Therefore, the Troll will measure a change in water level as a change in pressure. The Troll stores the measurements in time intervals selected by the user and the data are downloaded as a text file onto a portable PC platform. The time interval currently being used for the pressure measurement is 45 minutes. This gives substantial detail of the water-level change over time. However, the database will be recording measurements in six-hour intervals so the data will be more manageable and records of up to 30 years may be stored in a single file. The measurement time interval for the Trolls will remain at 45 minutes and the raw text files will be stored so they can be retrieved in the future if more detailed analysis is necessary.

The second investigation will gather information on human activities that are occurring (or have occurred) near WIPP monitoring wells. Injection wells operated by private resource exploration companies are located near the WIPP area boundary. There is a cluster of four wells up-gradient of the H-9 hydropad and it has been suggested by WIPP stakeholders that a possible connection exists between injection well activities and changes in water level in H-9 wells. To investigate this potential connection, data will be collected on the rate of injection at the four wells and compared to Troll measurements at H-9.

In addition to the collection of the well injection data, a third activity will measure precipitation at the H-9 hydropad. This will be done because a connection to precipitation recharge has also been hypothesized in the past. The local weather can create great variability in precipitation over relatively small areas and the nearest meteorological data are recorded at the WIPP site, 8 miles from the H-9 hydropad. Therefore, a measurement system needs to be in place at the hydropad to provide site specific information to test the hypothesis.

5.0 Troll Data Measurements, Calibration, and Records

Six Trolls are currently in use at wells H-9, WIPP-13, WIPP-30, P-17, Cabin Baby-1 and AEC-8. These Trolls were installed to measure changes in water level at greater resolution. At present, the monthly measurements do not give the necessary resolution to make meaningful evaluations regarding the possible cause of water level deviations. Not all five Trolls were available at the same time due to their calibration and maintenance requirements. As they became available, they were installed in priority wells. The following briefly describes the decision making process which was used for the installation of the Trolls.

Wells H-9 and P-17, both completed to the Culebra, were the first wells to be monitored by the Trolls. Well H-9 was chosen because of a history of water-level changes. P-17 was chosen because it is one of the two closest wells to the north of the commercial injection activities near H-9. The other well that could have been used for these measurements was H-17. However, H-17 is known to have a low transmissivity in comparison to P-17 (Beauheim, 1987, Table 5-3) and was not used for this reason.

In February 1998, Culebra well sites north of the WIPP area, especially WIPP-30, showed a general rise in water levels. In July 1998, Trolls were placed in WIPP-30 and DOE-2, the Culebra well closest to WIPP-30. In September 1998, the packer in DOE-2 slipped and the Troll was removed. This Troll was placed in WIPP-13 in October 1998, because it is a Culebra well that is adjacent to DOE-2.

In November 1998, a new Troll became available and was placed in well AEC-8. The AEC-8 well is completed to the Bell Canyon Formation. Water levels in AEC-8 have been rising steadily since 1993 while petroleum exploration and recovery activities in the Bell Canyon in the area have been intensifying.

In August 1999, Cabin Baby-1 was re-configured to allow measurements of water level of both the Culebra (through the annulus of the casing) and the Bell Canyon (through the center tubing) formations. A Troll was placed in September 1999 to measure Bell Canyon head because this well is south of the WIPP site and complements the measurements in AEC-8, which is north of the site.

Two additional Trolls will be available after calibration. However, these instruments will be utilized as replacements or back-ups if one of the others should fail. The current plan is to continue monitoring the wells with the Trolls that are already in place.

5.1 Measurements and Calibration

The Troll SP4000 is a fully submersible instrument that is 1.5 inches in diameter. This allows use in wells with inner diameters as small as 2 inches. The Troll contains a pressure and temperature sensor, an internal clock, and 208 kilobytes of internal memory for 106,496 stored readings. The data are transferred via an RS232 cable to a desktop or portable PC and In Situ's Win-Situ software converts the file to ASCII format. This data format will input into a database that will be created for this work..

In accordance with NP 12-1, calibration will be performed by In Situ, Inc. and was recommended by the manufacturer to be done at time intervals governed by the battery life of the instrument. This is approximately every two to three years. It was also recommended by In Situ to perform a calibration verification by pulling the instrument from the well and measuring a zero pressure in air along with an additional measurement in a known water depth of one to two feet.

5.2 Records

All data processing and entry will be performed on a desktop PC using Microsoft Excel Version 8.0 and the associated Visual Basic code that is embedded in the macro function of the software. The data will be retrieved via attached files on email using Microsoft Outlook in conjunction with SNL's internal email system.

The Trolls will provide continuous head data in specified wells recorded at 45-minute intervals. The Trolls measure head pressure from the water above the instrument. This reading must be corrected for small changes in water height caused by barometric pressure fluctuations in the atmosphere. The corrected pressure can be converted to a water height above the instrument by using the density of the fluid. The following will describe the details of the steps for receiving, entering, presenting, and archiving the data.

5.2.1 Receiving Data

Troll data are acquired by WIDs Environmental Monitoring Group in monthly intervals and sent via email to SNL as text files. Barometric pressure data are acquired from the meteorological database at WID in monthly intervals and are also sent via email as text files. These text files include all other meteorological data as well. These data files will be stored in a folder on the “C” drive labeled “GW Data Files” of PC serial number S817710 located at SNL’s Carlsbad office. All files will be periodically backed-up on a bi-monthly basis on a DLT-40 storage tape.

5.2.2 Entering Data

The relative head from the Troll data will be entered in six-hour intervals for the SNL database. The barometric pressures are recorded by WID every 15 minutes and the Trolls record pressure data every 45 minutes. In addition, the database for the barometric pressure includes a 24 hour summary embedded in the data set. In order to retrieve data every six hours from these data sets without extensive data entry, utility codes in Visual Basic are written and embedded in macros for Microsoft Excel spreadsheets. The six-hour data for both head pressure from the Trolls and barometric pressure from the meteorological data can be copied and pasted into the Troll Database Excel spreadsheet.

5.2.2.1 Troll Data Entry

This part of the procedure must be done for each individual well data set. The data in the text files for the Troll measurements will not always start at the same time for each data set. This means that the text file must be viewed by the user to check where the data must start as it is retrieved by the macro. This is done by using the “Troll input check” Excel file in the “GW Database” folder on the “C” drive. After opening the “Troll input check” file, enter the location of the appropriate text file on Sheet1 of the workbook (see Appendix 1). Then go to “Tools” label on the Toolbar and select Macros. Inside the macros window, select the “trollinputcheck” macros and select run. This macro (see Appendix 2) will create a new workbook with the text file imported into a spreadsheet labeled with the same name as the text file that was retrieved. Within this sheet, the range of cells for the necessary start and end date and time (columns “A” and “B”) with the corresponding pressures (column "E") should be noted. This information will be entered in the next Excel file "Troll Input".

Once the cell range for the data is determined, open the "Troll Input" file in the "GW Database" folder. The text file location must be entered and the directions for running the macro "Trollinput" are on the sheet labeled "Input" (see Appendix 1). After the macro (see Appendix 2) is run, go to the sheet labeled "Output" and copy the column containing the pressure data. (Note that the date and time are also listed for the corresponding pressure values. This serves as a check for the data import and aids in viewing the values.) Next, open the Excel file "Troll Database" in the GW Database folder. Paste the pressure values that were copied from the "Troll Input" file into the appropriate date and time range under the heading "Raw Pressure Data" (note that this range is to the right of the viewable area of the monitor screen).

5.2.2.2 Barometric Pressure Data Entry

The meteorology data from WID are recorded starting from the first hour of the first day for each month. Open the file "Baro Input" located in the "GW Database" folder. Enter the number of days for the month of interest along with the text file location and start date and time. Next, run the macro labeled "baro" (see Appendix 2). The pressure data are displayed on the "Data Output" sheet much like the format for the Troll data. Copy the pressure data and paste it in the corresponding range on the "Troll Database" file. Save the "Troll Database" file under the "Save As" command and change filename to reflect last date entered (For example, "Troll Database 7_6_99"). This will maintain the integrity of the database in the event errors associated with data entry are introduced and accidentally saved over the previously correct data.

5.2.3 Calculations for Well Head

The Trolls measure the pressure from the water overlying the instrument in the well. The level of water in the well is also influenced by changes in atmospheric pressure. These changes need to be corrected first before calculating the water level from the pressure measurement. The pressure can be corrected using the following equation (Beauheim and Ruskauff, 1998, p. 60):

$$P_C = P_W + BE(P_{atm} - P_{atm,std}) \tag{5.1}$$

where:

P_c = corrected pressure (Pa)

P_w = uncorrected pressure of the water (Pa)

BE = barometric efficiency

P_{atm} = atmospheric pressure (Pa)

$P_{atm,std}$ = 89,838 Pa (standard atmospheric pressure at 1000 m above sea level)

The barometric efficiency, BE, is defined as (Domenico and Schwartz, 1990, p. 128):

$$BE = \gamma_w \left(\frac{dh}{dP_{atm}} \right) \tag{5.2}$$

where:

γ_w = specific weight of the fluid

dh = change in hydraulic head

dP_{atm} = change in atmospheric pressure

The value for barometric efficiency can be found by manually iterating between 0 and 1 and visually determining the best fit. The best fit results in the smoothest curve when the barometric changes have been correctly eliminated. For WIPP-13, it was previously determined that a barometric efficiency of approximately 0.7 gave the best correction (Beauheim and Ruskauff, 1998, p. 65). For this case, the barometric efficiency was examined for the H-9, WIPP-13, and WIPP-30 wells and a value of 0.7 provided the best fit for all three wells.

Once the corrected pressure is known, the water height associated with that pressure could be calculated. This is done using the following equation:

$$h = \frac{P_c}{\rho g} \qquad (5.3)$$

where:

h = water height above the instrument (m)

P_c = the corrected pressure from the water (Pa)

ρ = the density of the water (kg/m^3)

g = gravity (9.79 m/s^2) (Barrows et al., 1983)

Since the units of the barometric pressure are reported in millibars and the Trolls give pressure readings in psi, some conversions are necessary. These can be included in an expression that combines equations 5.1 and 5.3 and calculates the water height above the Troll. The following is the final equation (units included) used in the “Troll Database” file:

$$h(m) = \frac{\left(P_w(psi)\left(\frac{101{,}325(Pa)}{14.696(psi)}\right) + BE\left(P_{atm}(mb)\left(\frac{100(Pa)}{(mb)}\right) - 89{,}838(Pa)\right)\right)}{\left(9.79(m/s^2) \bullet \rho(kg/m^3)\right)} \qquad (5.4)$$

The calculations will be reviewed annually in accordance with NP 9-1 and prior to submission of the annual report.

6.0 Injection Well Measurements and Records

Data for the injection wells Todd 26F#2, Todd 26F#3, Todd 27F#16, Cal Mon#5 and Sand Dunes 28 #1 near the H-9 hydropad will be collected daily by WID during non-weekend and non-holiday periods. The data measured will be in total cumulative volume as read on the injection meter. The date and time will be recorded with each measurement in a WID worksheet (Appendix 3) so accurate calculations can be made of injection rate. The date and time will be entered along with the cumulative reading for each respective time in the Excel workbook file “Injection Well Database”. The spreadsheet will automatically calculate the injection rate by subtracting the previous volume total from the current total and dividing by the time interval between the two measurements. For weekend and holiday periods, the data will be averaged into daily intervals during that period. Also, the cumulative meter readings will periodically be reset to zero. If this should happen at an unknown time, then the user must use the next recorded time and volume reading as the next starting point for the records. The questionable data will not be included in the database.

The flow meters used to mesure the injection rates are owned by private oil interests and permission has been granted to WID to to take daily readings. Since SNL does not own or control the meters, they cannot be calibrated internally. However, this is acceptable because the data from the flow meters is more important with respect to whether the injection pump is on or off rather than the exact flow rate of the injected brine. Therefore considerable error can be tolerated for these instruments. Each meter will be observed by SNL quarterly and the model and serial number will be recorded and compared to the previous check. Appendix 4 lists the current model and serial numbers for each injection well.

7.0 H-9 Precipitation Measurements and Records

It has been suggested in the past that recharge from precipitation may cause anomalous changes in water level at specific wells. Although this is not thought to be the case at H-9, collecting precipitation data at this site will allow quantitative evaluation of any potential correlation between precipitation and water-level changes.

A standalone, remote tip-bucket rain gauge (RG200) will be placed at the H-9 hydropad and an associated data logger (RG780) will record precipitation. Both instruments are manufactured by Global Water, Inc. The rain gauge and data logger were designed by the

National Weather Service for low-cost and reliable measurements of precipitation. The data will be downloaded monthly from the logger as a text file to a portable PC and entered into a records database operated by SNL. The data will be stored in daily intervals on an Excel spreadsheet. Because the instrument for this task is not currently used, the format of the text file is not available. Therefore, the method of data entry into the database will be manual until a separate procedure for automatic data import via an Excel macro is written and prepared in accordance with NP 5-1.

8.0 Records Archiving

Records for data-collection activities will be archived in the SNL records center both by computer disc storage and by submission of the annual report. All data stored on the desktop PC will be transferred to a Zip disk and submitted in duplicate to records and the annual reports (calendar year) will also be submitted in duplicate to records in accordance with NP 17-1.

9.0 Training

All personnel involved in the activities described in this document are trained and qualified for their assigned work. This requirement is implemented through NP 2-1 (Qualification and Training) for those working under the SNL WIPP QA Program. All qualification and QA training records are submitted to and maintained by the NWMP Records Center.

Training on assigned Nuclear Waste Management Program Procedures (NPs), Activity/Project Specific Procedures (SPs), this test plan, and any other required training shall be completed and documented prior to beginning work. Annual refresher QA training ensures that on-site personnel are trained to the WIPP QA Program.

10.0 Health and Safety

No health and safety activities are required for this work.

11.0 Permitting/Licensing

No permitting or licensing activities are required for this work.

12.0 References

Barrows, L.J., S.E. Shaffer, W.B. Miller, and J.D. Fett. 1983. *Waste Isolation Pilot Plant (WIPP) Site Gravity Survey and Interpretation*. SAND82-2922. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R.L. 1987. *Interpretations of Single-Well Hydraulic Tests Conducted At and Near the Waste Isolation Pilot Plant (WIPP) Site, 1983-1987*. SAND87-0039. Albuquerque, NM: Sandia National Laboratories.

Beauheim, R.L., and G.J. Ruskauff. 1998. *Analysis of Hydraulic Tests of the Culebra and Magenta Dolomites and Dewey Lake Redbeds Conducted at the Waste Isolation Pilot Plant Site*. SAND98-0049. Albuquerque, NM: Sandia National Laboratories.

Domenico, P.A., and F.W. Schwartz. 1990. *Physical and Chemical Hydrogeology*. New York: John Wiley and Sons Inc.

Appendix 1

Sample input screens for "Troll input check" and "Troll Input" Excel files

Troll input check

	A	B	C	D
1		Enter File Location		
2		C:\GW Data Files\h-09bm.txt		
3				

Troll Input

	A	B	C	D	E	F	G	H	I	J
1		Enter File Location								
2		C:\GW data files\h-09bm.txt								
3										
4		Go to Tools…Macros, select "Trollinput", and select Edit.								
5		Enter range of data set from "Troll Input Check" between the ********** lines in the visual basic code.								
6		(Enter range 3 times;one for date, time, and pressure)								
7		Exit Macro and then run Macro								

Baro Input

	A	B	C
1			
2		Number of days in Month	
3		30	
4			
5		File Location	
6		C:\GW data files\june99	
7			
8		Start Date and Time	
9		6/1/99 6:00 AM	
10			

Appendix 2

Visual Basic Code for Excel Macros

Visual Basic Code for "Troll input check"

```
Sub trollinputcheck()

'SELECT TROLL DATA TEXT FILE AND PASTE TO SHEET
'
    Sheets("Sheet1").Select

    Workbooks.OpenText FileName:= _
        Range("B2"), Origin:=xlWindows, _
        StartRow:=1, DataType:=xlDelimited, TextQualifier:=xlDoubleQuote, _
        ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, Comma:=True _
        , Space:=False, Other:=True, FieldInfo:=Array(Array(1, 1 _
       ), Array(2, 1))
'

End Sub
```

Visual Basic Code for "Troll Input"

```
Sub Trollinput()
'
'________________________________________________________________
'CLEAR PREVIOUS DATA
'
   Sheets("Sheet3").Select
   Columns("A:C").Select
   Selection.ClearContents

   Sheets("Output").Select
   Columns("A:C").Select
   Selection.ClearContents
'
'________________________________________________________________
'OPEN TROLL DATA TEXT FILE
'
   Sheets("Input").Select
   Workbooks.OpenText FileName:= _
      Range("B2"), Origin:=xlWindows, _
      StartRow:=1, DataType:=xlDelimited, TextQualifier:=xlDoubleQuote, _
      ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, Comma:=True _
      , Space:=False, Other:=True, FieldInfo:=Array(Array(1, 1 _
     ), Array(2, 1))
'
'________________________________________________________________

'SELECT COLUMN "A" AND PASTE
'
'*************************************************************
Range("A47:A935").Select
'*************************************************************
'
   Selection.Copy
   Windows("Troll Input.xls").Activate
   Sheets("Sheet3").Select
   Range("A1").Select
   ActiveSheet.Paste
'
'________________________________________________________________
'SELECT EVERY 6th HOUR OF DATA AND PASTE IN SHEET2
'
   n = 1
   For i = 1 To 150
   Worksheets("Sheet3").Cells(n, 1).Copy
   Worksheets("Output").Cells(i, 1).PasteSpecial Paste:=xlAll
   n = n + 8
```

```
    Next i
'
'
'________________________________________________________________
'________________________________________________________________
'RE-OPEN TROLL DATA TEXT FILE; COPY AND PASTE COLUMN "B"
'
    Sheets("Input").Select
    Workbooks.OpenText FileName:= _
        Range("B2"), Origin:=xlWindows, _
        StartRow:=1, DataType:=xlDelimited, TextQualifier:=xlDoubleQuote, _
        ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, Comma:=True _
        , Space:=False, Other:=True, FieldInfo:=Array(Array(1, 1 _
       ), Array(2, 1))
'
'*************************************************************
Range("B47:B935").Select
'*************************************************************
'
    Selection.Copy
    Windows("Troll Input.xls").Activate
    Sheets("Sheet3").Select
    Range("B1").Select
    ActiveSheet.Paste
'
'
'________________________________________________________________
'SELECT EVERY 6th HOUR OF DATA AND PASTE IN SHEET2
'
    n = 1
    For i = 1 To 150
    Worksheets("Sheet3").Cells(n, 2).Copy
    Worksheets("Output").Cells(i, 2).PasteSpecial Paste:=xlAll
    n = n + 8
    Next i
'
'
'________________________________________________________________
'________________________________________________________________
'RE-OPEN TROLL DATA TEXT FILE; COPY AND PASTE COLUMN "E"
'
    Sheets("Input").Select
    Workbooks.OpenText FileName:= _
        Range("B2"), Origin:=xlWindows, _
        StartRow:=1, DataType:=xlDelimited, TextQualifier:=xlDoubleQuote, _
        ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, Comma:=True _
        , Space:=False, Other:=True, FieldInfo:=Array(Array(1, 1 _
       ), Array(2, 1))
'
```

```
'***********************************************************
Range("E47:E935").Select
'***********************************************************
'
    Selection.Copy
    Windows("Troll Input.xls").Activate
    Sheets("Sheet3").Select
    Range("C1").Select
    ActiveSheet.Paste
'
'____________________________________________________
'SELECT EVERY 6th HOUR OF DATA AND PASTE IN SHEET2
'
    n = 1
    For i = 1 To 150
    Worksheets("Sheet3").Cells(n, 3).Copy
    Worksheets("Output").Cells(i, 3).PasteSpecial Paste:=xlValues
    n = n + 8
    Next i
'
'____________________________________________________
'SELECT OUTPUT SHEET FOR FINAL DISPLAY

    Sheets("Output").Select
'
End Sub
```

Visual Basic Code for "baro input"

```
Sub baro()
'
'
'DEFINE VARIABLES
'
Dim num_entry As Integer
Dim num_days As Integer
'
'
'RETRIEVE INPUTS FOR NUMBER OF DAYS IN MONTH
'
    Sheets("Input").Select
    num_days = Range("B3").Value
    '
'
'OPEN BAROMETRIC DATA TEXT FILE
'
    Sheets("ImportBP").Select
    Workbooks.OpenText FileName:= _
        Range("B1"), Origin:=xlWindows, _
        StartRow:=1, DataType:=xlDelimited, TextQualifier:=xlDoubleQuote, _
        ConsecutiveDelimiter:=False, Tab:=True, Semicolon:=False, Comma:=True _
        , Space:=False, Other:=True, FieldInfo:=Array(Array(1, 1 _
       ), Array(2, 1))
       '
'
'SELECT BAROMETER DATA AND PASTE TO IMPORT SHEET
'
    Range("V1:V3100").Select
    Selection.Copy
    Windows("baro input.xls").Activate
    Sheets("ImportBP").Select
    Range("A1").Select
    ActiveSheet.Paste
    '
'
'SET "num_entry" TO THE NUMBER OF DAY TIMES 4
'(SIX HOUR TIME INTERVALS ARE FOUR TIMES A DAY)
'
    num_entry = num_days * 4
    '
'
'LOOP TO DELETE 24 HOUR SUMMARIES
```

```
'
    n = 97
    For i = 1 To num_days
    Worksheets("ImportBP").Cells(n, 1).Delete
    n = n + 96
    Next i
'
'_______________________________________________________________________
'LOOP TO COPY AND PASTE EVERY SIX HOUR BAROMETRIC PRESSURE
READING
'
    m = 1
    For i = 1 To num_entry
    Worksheets("ImportBP").Cells((24 * m), 1).Copy
    Worksheets("Data Output").Cells(i + 3, 3).PasteSpecial Paste:=xlValues
    m = m + 1
    Next i
'
'_______________________________________________________________________
'SELECT DATA OUTPUT SHEET FOR FINAL DISPLAY
'
    Sheets("Data Output").Select
'
'_______________________________________________________________________
    End Sub
```

Appendix 3

OIL AND GAS SURVEILLANCE WATER/WATERFLOOD/INJECTION WELLS

NAME	GAGE PSI	FLOW BPD	TOTAL BBLS	TIME	DATE	INIT
Sand Dunes 28 #1						
Cal Mon #5						
Littlefield Fed #1						
Todd St 36 Fed #1						
Todd 27P #16						
Todd 26G #2						
Todd 26 #3						
Sand Dunes 28 #1						
Cal Mon #5						
Littlefield Fed #1						
Todd St 36 Fed #1						
Todd 27P #16						
Todd 26G #2						
Todd 26 #3						
Sand Dunes 28 #1						
Cal Mon #5						
Littlefield Fed #1						
Todd St 36 Fed #1						
Todd 27P #16						
Todd 26G #2						
Todd 26 #3						
Sand Dunes 28 #1						
Cal Mon #5						
Littlefield Fed #1						
Todd St 36 Fed #1						
Todd 27P #16						
Todd 26G #2						
Todd 26 #3						
Sand Dunes 28 #1						
Cal Mon #5						
Littlefield Fed #1						
Todd St 36 Fed #1						
Todd 27P #16						
Todd 26G #2						
Todd 26 #3						

COMMENTS:

Appendix 4

Sand Dunes 28 #1: UMC Automation, Serial #15076

Calmon #5: UMC Automation, Serial # 17121

Todd 27P #16: Haliburton MC-II, Serial # 226960

Todd 26P #2: Haliburton MC-II, Serial # 239698

Todd 26 #3: Haliburton MC-II, Serial # 185709