FINAL HYDROGEOLOGIC CHARACTERIZATION REPORT

Stallings Wetland Compensation Site
(Former Luehmann Property)
Madison County, IL (FAP 999)

Bonnie J. Robinson
D. Bradley Ketterling
Christine S. Fucciolo

Illinois State Geological Survey
Transportation and Environment Center
Wetlands Geology Section
615 East Peabody Drive
Champaign, IL 61820-6964

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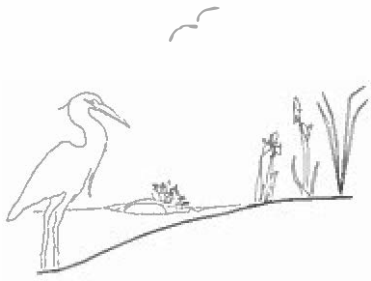

EXECUTIVE SUMMARY

In February 2000, the Illinois Department of Transportation (IDOT) tasked the Wetlands Geology Section of the Illinois State Geological Survey (ISGS) to conduct a hydrogeologic charactererization of the Stallings Potential Wetland Compensation Site (former Luehmann Property) in Madison County, Illinois.

Results of this investigation indicate that although hydric soil covers most of the site, no significant portions of the site conclusively exhibited wetland hydrology. The volume of water discharging via the main outlet from the site is likely insufficient to restore wetlands if existing alterations are reversed. In addition, the reversal of several hydrologic alterations would be infeasible due to infrastructure.

The viability of IDOT's proposition of reconnecting the site with the Cahokia Canal, located adjacent to the site, depends on several factors. During the monitoring period, water levels in the canal rose to levels that would flood portions of the site. Excavation to trap those flood peaks, installation of water control structures, and construction of a new levee would be required to utilize this water source. Excavation depths would depend on acreage required, but it is expected that excavation to an elevation of at least 416 ft NAVD 88 (126.8 m) would be required.

These recommendations were prepared using limited monitoring data. Additional monitoring is recommended to confirm the observed hydrologic conditions.

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INTRODUCTION

The Illinois State Geological Survey (ISGS) has prepared this report to provide the Illinois Department of Transportation (IDOT) with observations of the hydrogeologic conditions at the wetland compensation site located at the Luehmann property near Stallings, IL. The purpose of this report is to provide the IDOT with hydrogeologic data for future wetland compensation endeavors.

The potential compensation site is located in the NE¼, W½ of section 7, T3N, R8W, Madison County, Illinois (Figure 1) and covers about 68 acres (27.5 hectares). It lies within a roughly triangular, 205-acre (82.9 ha) drainage sub-basin, bounded by IL-162, the Cahokia Canal levee, and Interstate 255.

The ISGS was originally tasked to investigate the suitability of the entire basin for wetland restoration (dashed line, Figure 1). Data collection at the Luehmann property began in March 2000. The site boundaries were later revised to focus attention on the smaller parcel within Section 7, most of which is east of Luehmann Lane (Figure 2). The IDOT conceptual wetland compensation plan involves reconnecting the site with Cahokia Canal and planting trees to mitigate for forested wetlands impacted by the New Mississippi River Bridge Crossing.

Data collection at the site is ongoing and will continue until terminated by the IDOT. The data currently being collected will be used to compare the pre- and post-construction hydrology of the site, to determine the impact of hydrologic alterations to the area, and to measure the duration of wetland hydrology.

SUMMARY

The following hydrogeologic conditions occur onsite:

- Darwin silty clay, both a state and county-listed hydric soil, covers nearly 90% of the site (Figure 3). The permeability of Darwin soil is very low, less than 0.06in/hr (0.2 cm/hr), which facilitates the perching of surface water and long-term inundation (USDA 1986). The remaining 10% of the site is comprised of Dupo silt loam. While not a hydric soil, it also has a relatively low permeability ranging from less than 0.06 in/hr (0.2 cm/hr) to 2.0 in/hr (5 cm/hr).

- Hydrologic monitoring determined that no significant portions of the site conclusively satisfied the criteria for wetland hydrology (ISGS 2000, 2001a, 2002). A well-developed drainage network exists onsite consisting of ditches, levees, culverts and raised roadbeds. Adjacent infrastructure such as roadways has also altered the site's hydrology.

- Based on the measured volume of water exiting the site, reversal of existing alterations likely would not result in a significant amount of water being maintained onsite to restore wetland hydrology. Furthermore, several of these alterations (*e.g.* the road drainage ditch in Figure 2) cannot be altered since they provide drainage for adjacent infrastructure.

- Currently, a levee protects the site from the Cahokia Canal immediately east of the site. If the levee was not present, water would begin to enter at an elevation of approximately 417.0 ft (127.1 m). Water levels in the canal exceeded this value on five occasions between April 22 and June 14, 2002 (Figure 4).

WETLAND CREATION AND SITE DESIGN

The current IDOT concept for wetland mitigation involves reconnecting the site with the Cahokia Canal as a water source. The ISGS makes the following recommendations regarding the feasibility of this option (Figure 5).

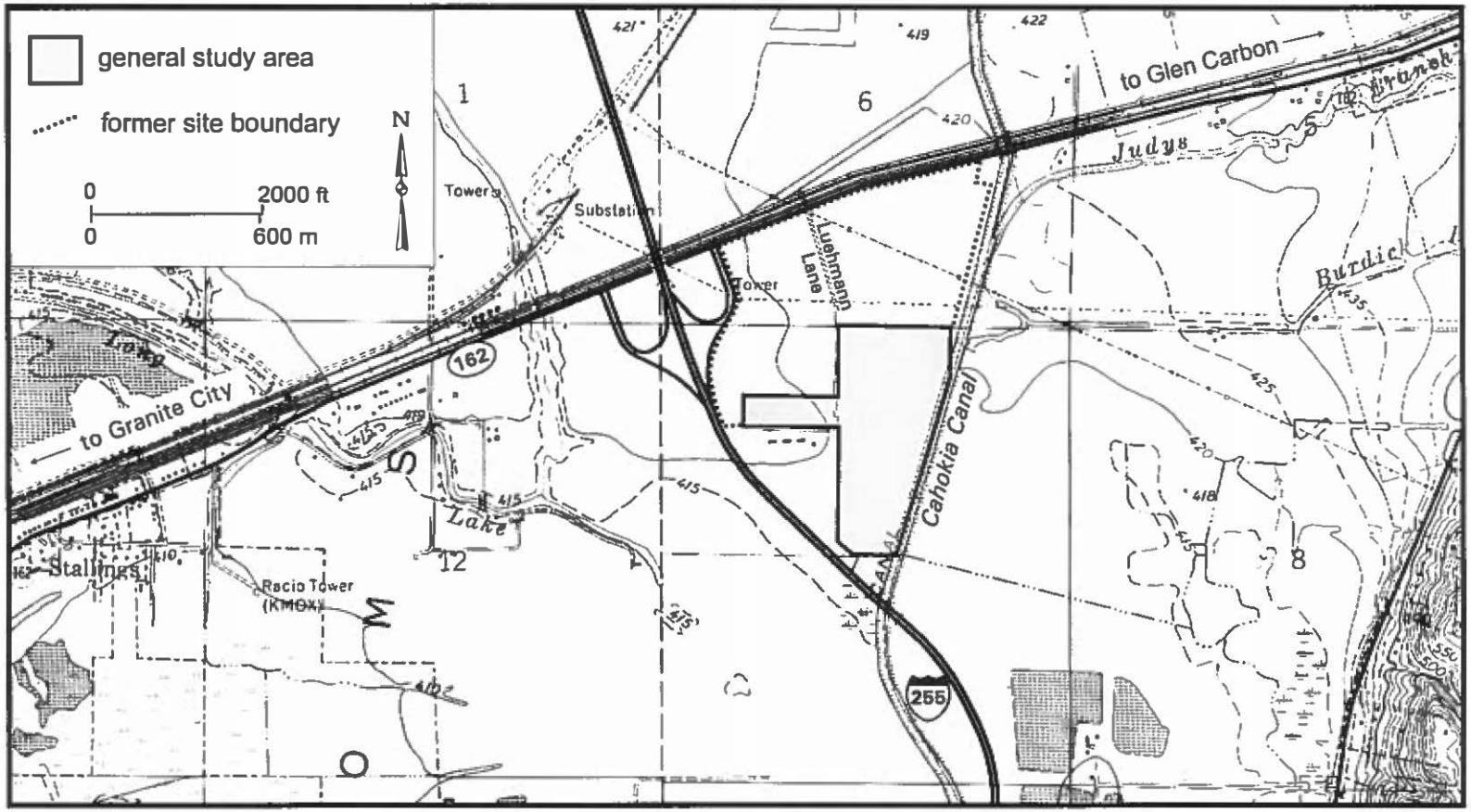

Figure 1. Location of the wetland compensation site (shaded grey) on the Monk's Mound, ILL 7.5-minute quadrangle map (USGS, 1993) Contour interval is 10 ft (3 m) with supplemental 5 ft (1.5 m) contours.

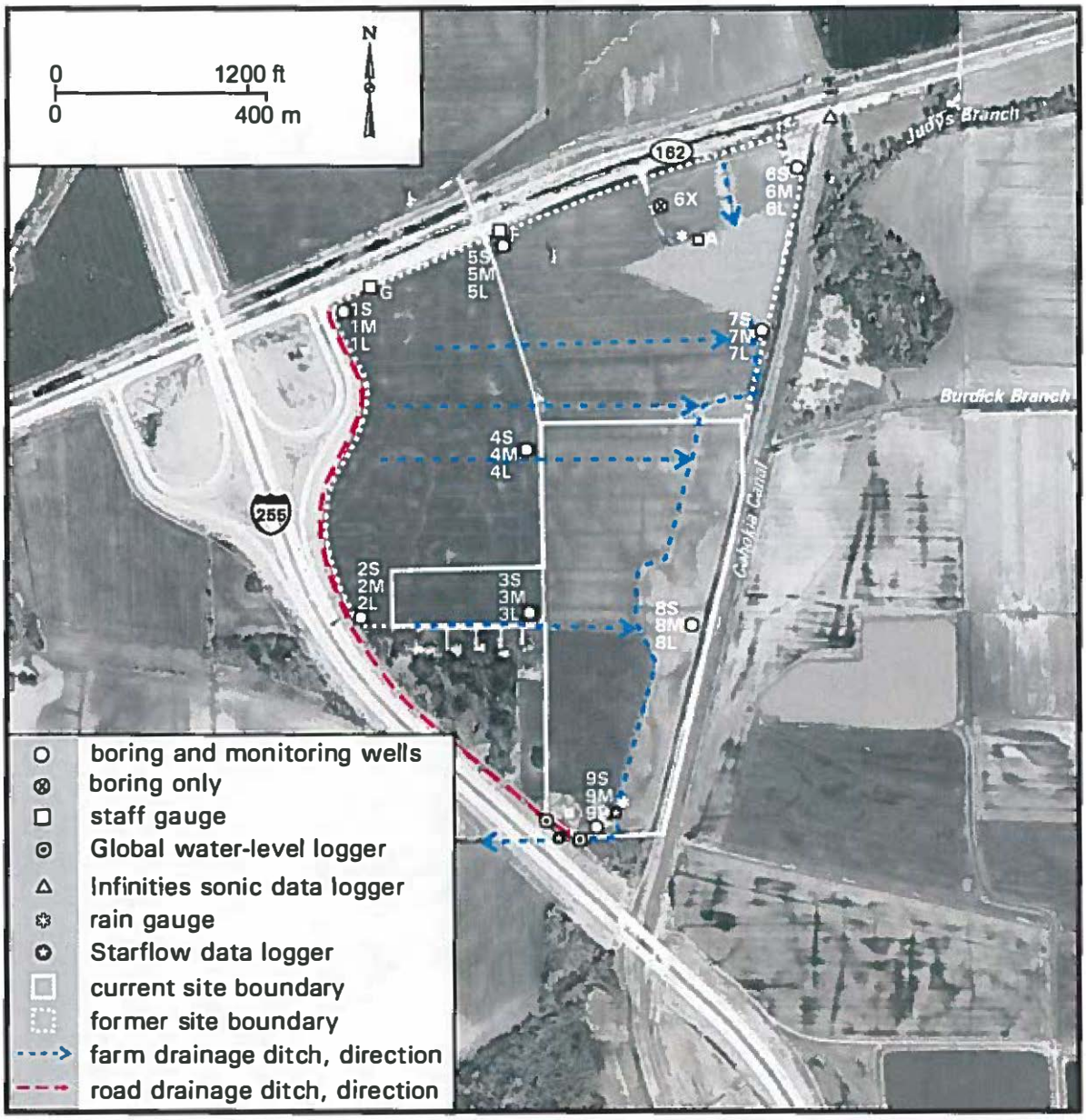

Figure 2. Locations of ISGS monitoring instruments and hydrologic alterations (map based on ISGS 2001b).

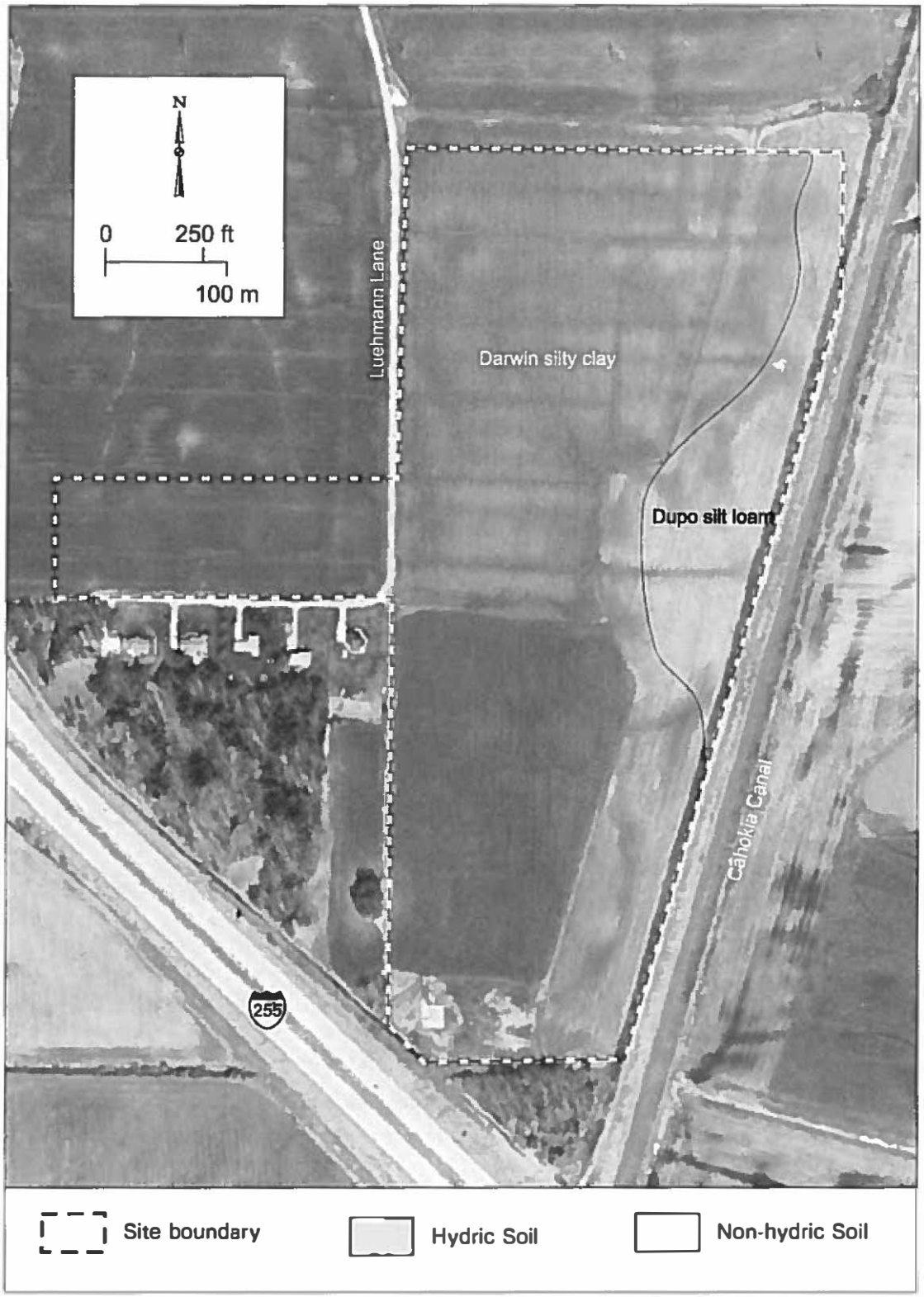

Figure 3. Soil types (map based on ISGS 2001b, USDA 2002).

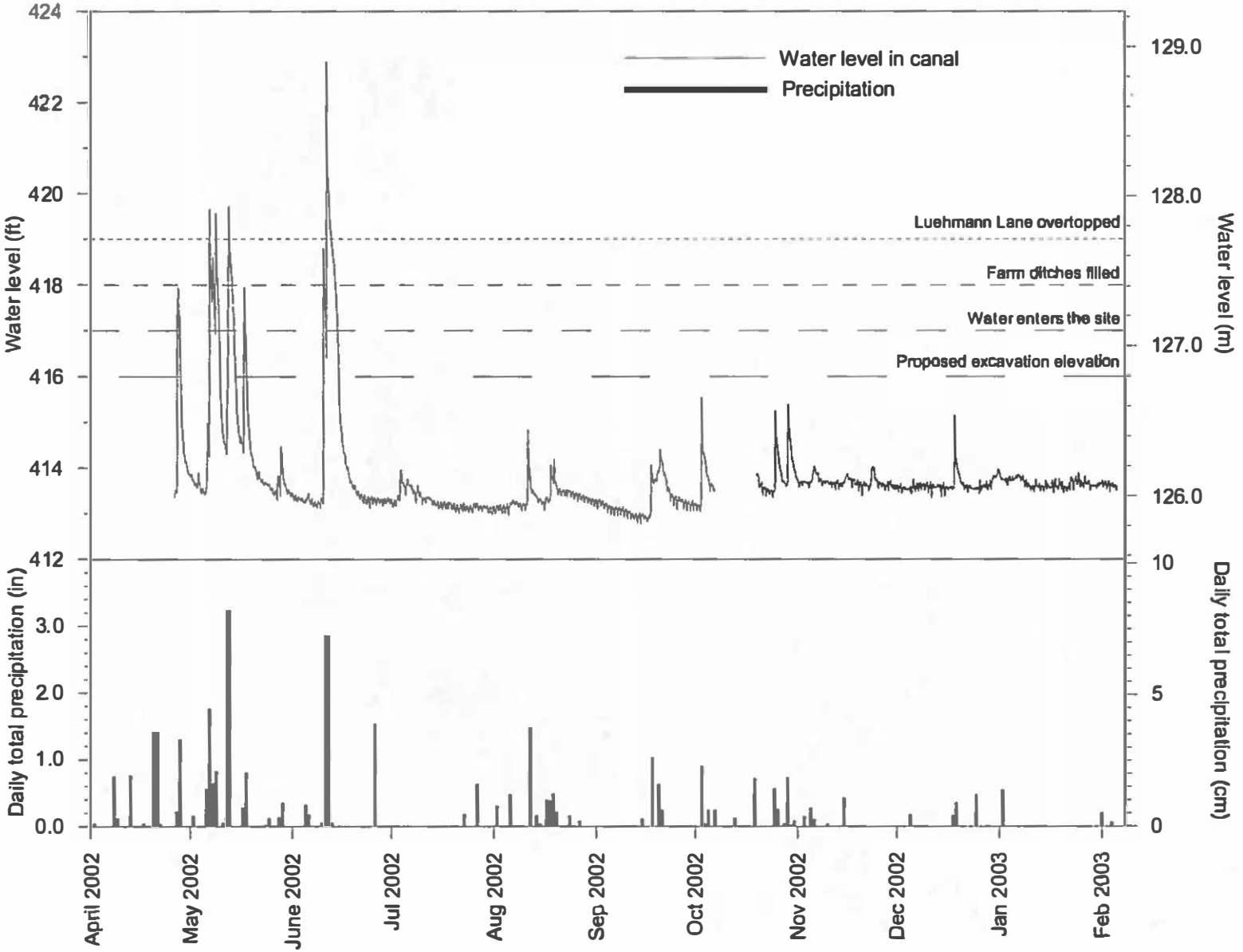

Figure 4. Water level in Cahokia Canal versus daily total precipitation: April 2002-Feb 2003.

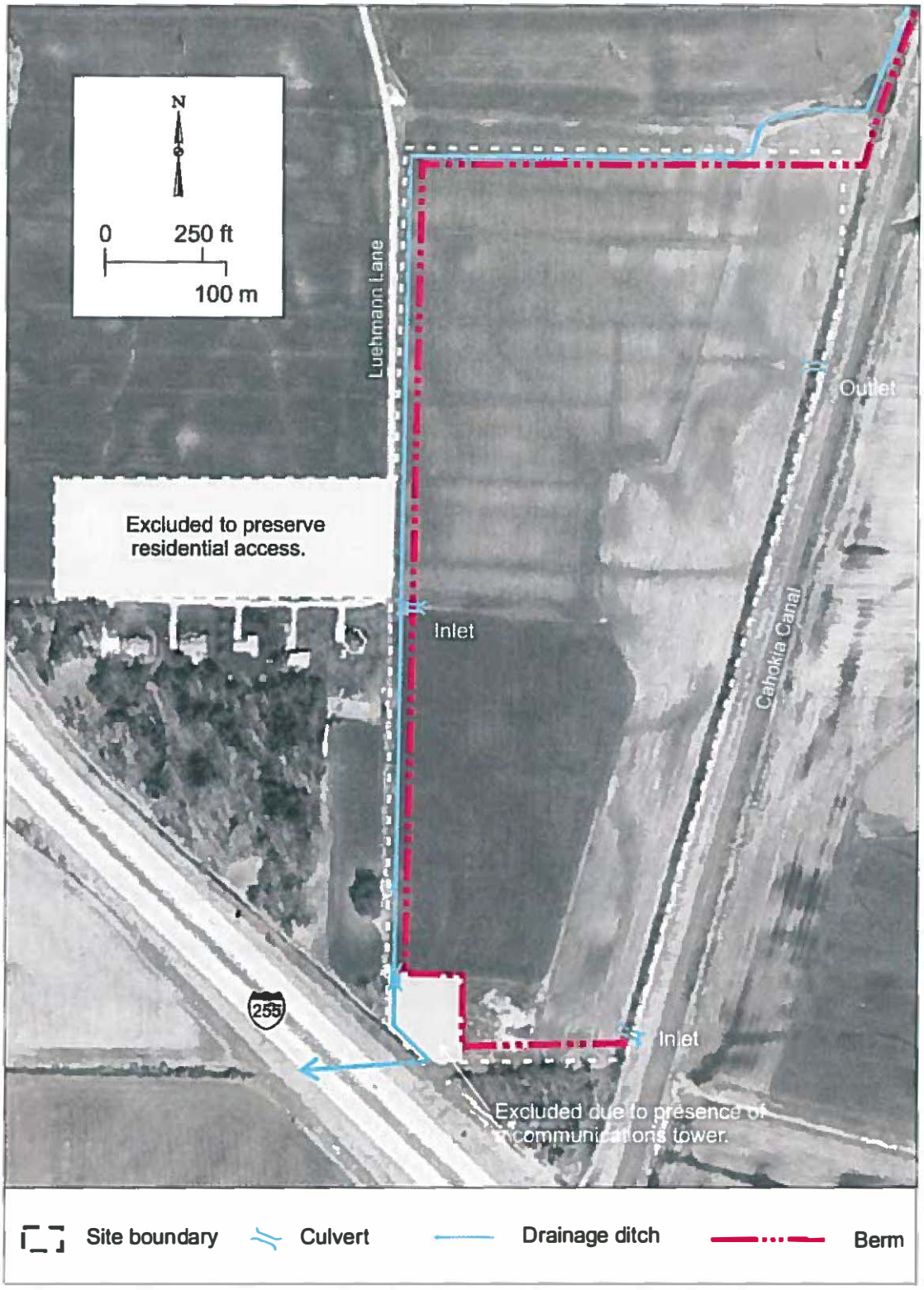

Figure 5. Suggested alterations (map based on ISGS 2001b).

- Excavate the interior portions of the site to form a basin that exploits the current topography, *i.e.* following the pattern of the existing ditch system. The area and depth of excavation will ultimately depend on how much wetland acreage is needed, the cost of excavating, and the plant communities desired. However, in order to maximize the entry of flood water from the Cahokia Canal, all portions of the site where wetland hydrology is desired should be excavated to at least 416 ft (126.8 m). Currently, only 0.4 acres (0.16 ha) is below this elevation, most of it confined to the north-south drainage ditch. Figure 6 shows the acreage at specific elevation intervals and can be used to calculate total excavation volumes.

- Construct a protective berm along the northern and western boundaries of the site. A berm of a size and configuration similar to the current levee on the west side of the Cahokia Canal is required to protect off-site fields, residences and development from flood water (Figure 5). The berm would completely enclose the site. Excavated material could be used to help construct the interior berm, although it would likely be of insufficient volume for the entire job.

- Install water-control structures; with perhaps an inlet at the southeastern corner of the site and an outlet at the northeast corner, preferably higher in elevation than the inlet. This configuration would ensure that the water backfloods the site, thereby reducing erosion. The difference in elevation would ensure that flood water is retained onsite following a flood event, and establish a maximum water depth. Based on data for the Cahokia Canal from the 2002 growing season, the intake culvert should have an approximate base elevation of 416 ft (126.8 m). This is approximately 3 ft (0.9 m) above the elevation of base flow in the canal, but at an elevation that would be exceeded during spring flooding.

- Any compensation-site design that interrupts the current drainage network must provide a continued means of drainage for adjacent areas. Both on- and off-site drainage modifications and site construction must be carried out with proper concern for adjacent residential and commercial properties. The existing ditches and drainage system need to be rerouted around the new berm. A water-control structure could be added along the western boundary of the site to allow water from the drainage ditch to enter the site as an additional water source.

CONSIDERATIONS AND RECOMMENDATIONS

- This plan was determined from only one season of monitoring the water-level in the Cahokia Canal (with above-average spring precipitation), so additional monitoring is recommended to confirm long-term conditions and refine culvert elevations and excavation depths.

- Prior to design, the culvert size required to support the acreage of wetlands desired must be calculated.

METHODS

Geology

To characterize the geology of the compensation site, ten borings were made using a CME 850 ATV rig. Monitoring wells were installed in nine of the ten borings. Each boring was sampled throughout its entire length using a split-spoon sampler. Cores were described in the field using the Munsell Soil Color Chart (1994 edition) and sampled using standard techniques.

Ground-Water Instrumentation

A total of 27 monitoring wells were installed in nests at 9 locations in a regularly-spaced grid throughout the compensation site to monitor water-level fluctuations. The data were used to evaluate vertical and horizontal hydraulic gradients, identify water sources that might be suitable for wetland restoration, and to map the extent of wetland hydrology.

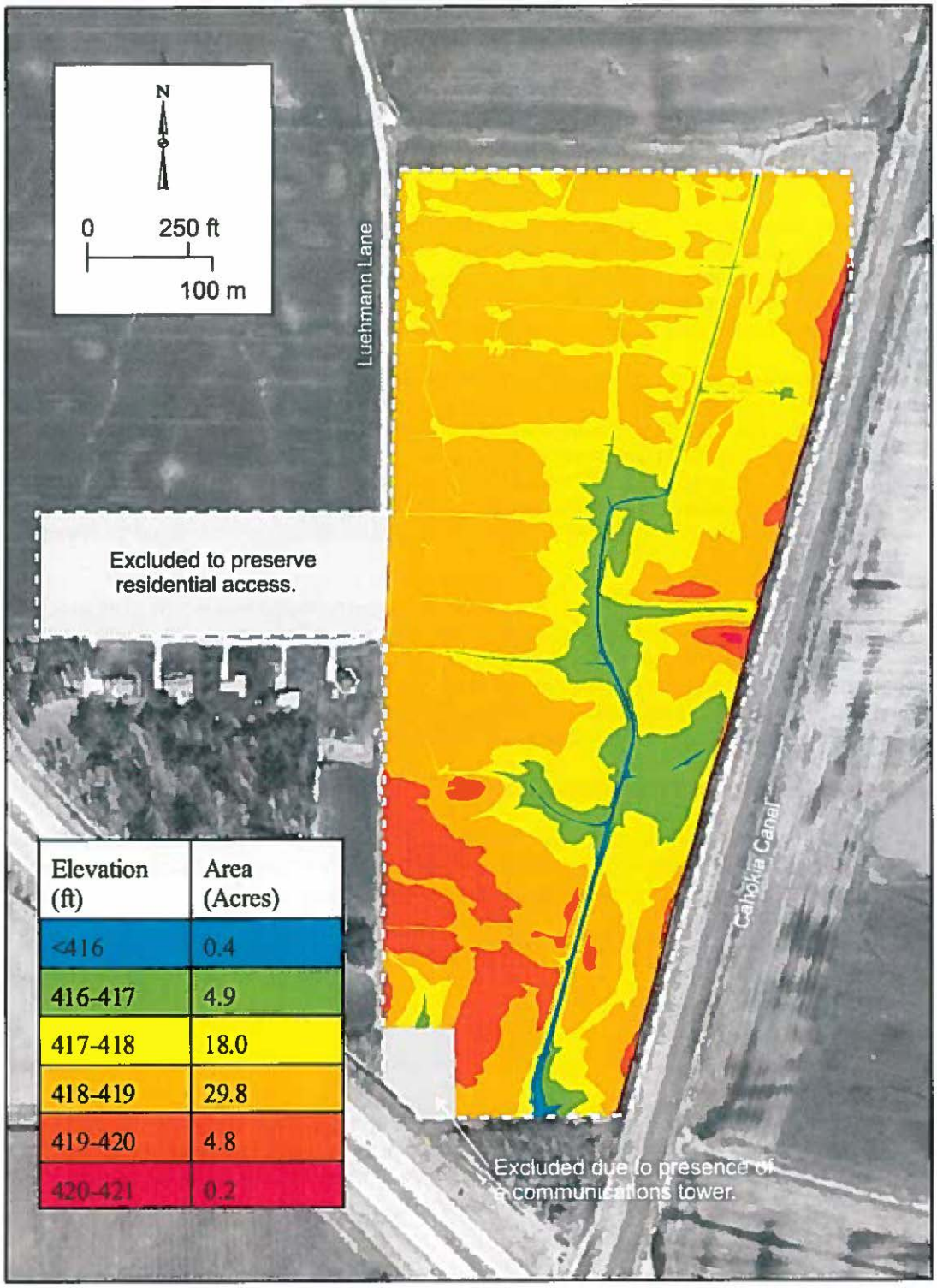

Figure 6. Acreage at specific elevation intervals (map based on ISGS 2001b, IDOT 2001).

The base of the deepest wells (L-wells) were installed at depths between 19.0 and 28.1 ft (5.8 and 8.6 m) below land surface, based on the location of a specific geological unit that was identified. The screen length for the L-wells varied from 0.89 to 2.33 ft (0.27 to 0.71 m) based on the thickness of the geologic unit. L-wells typically contain no filter pack due to the flowing sand encountered at depth.

Wells of intermediate depth (M-wells) terminated between 12.1 and 12.6 ft (3.7 and 3.8 m) below land surface, and have a screen length between 1.6 and 2.4 ft (0.49 and 0.73 m).

Soil-zone wells (S-wells) were also installed at each well nest. These wells are generally 2.5 ft (0.75 m) deep with screens 1.0 ft (0.30 m) in length. S-wells are specifically designed to monitor near-surface saturation. This information is used to delineate areas of wetland hydrology.

All M- and L-wells were constructed using 2-in (5.1-cm) PVC casings with 10-slot PVC screens. S-wells were constructed with 1-in (2.54-cm) PVC casing and 10-slot PVC screens. All wells were capped with the appropriate sized PVC cap (2-in for the M- and L-wells and 1-in for the S-wells), with a single drainage hole. Well screens were packed with quartz sand with a grain size of 0.038 in (0.9 mm), typically #5 Global silica filter pack or equivalent. The annulus was then back-filled with ⅜" bentonite chips. Well-construction details are provided in Appendix B.

Each M- and L-well was developed using either a surge block, Clean Environment Equipment 2-inch AutoPump, or bailer. Water was evacuated until the discharge was clear or the well went dry. S-wells were developed using a manually-cranked peristaltic pump.

A Global pressure transducer was installed in well 7L to record water-level fluctuations.

Surface-Water Instrumentation

A Starflow flow-meter and datalogger were installed in the box culvert in November 2000, and programmed to monitor water level and velocity at a 15-minute interval. Because the culvert discharges runoff from the farm fields and pavement of I-255, Global pressure transducers were installed in the two ditches upstream of their confluence with the culvert (*i.e.* road drainage and farm drainage ditches, Figure 2) in an attempt to determine their relative contributions. After the farm drainage ditch was dredged in the summer of 2002, the Starflow system was relocated to this channel so that runoff derived from the farm fields alone could be monitored.

In addition, two staff gauges were installed in the ditch south of IL 162 in areas of semi-permanent inundation.

In April, 2002, an Infinities USA Inc. acoustic water-level logger was mounted on the south sidewall of the IL-162 bridge to monitor fluctuations in the water level in the Cahokia Canal.

Site Monitoring and Surveying

The wells, data loggers, and staff gauges were monitored twice per month during the spring (March to June) and monthly thereafter. The entire record of surface-water elevations from staff gauges and the depth to water in wells are reported in graph form in Appendix C and as tabular data in Appendix D.

With the exception of the Starflow flow-meter above, all dataloggers were programmed to monitor water levels at 1-hour intervals. This was done to isolate and identify short-term events that may not have been detected by the monthly or biweekly readings.

On-site precipitation data were collected with a tipping-bucket rain gauge equipped with a datalogger. The on-site data supplemented the precipitation data recorded at Edwardsville, IL (Station #112679). These data were obtained from the National Water and Climate Center (NWCC) of the Natural Resources Conservation Service (NRCS) and the Midwestern Climate Center (MCC) at the Illinois State Water Survey (ISWS).

Normal (or average) precipitation values are calculated by the NWCC and are based on the 30-year period between 1961 and 1990. The precipitation data were used to determine the effect of monthly, seasonal, and annual precipitation trends on surface- and ground-water levels.

Temperature data from the Southern Illinois University Research Center at Belleville, IL (Station #110510) were obtained to determine the length of the growing season for the region. The growing season (USACE 1987) is the period between the last occurrence of 28°F (-2.2 °C) temperatures in the spring and the first occurrence in the fall. The median length (5 out of 10 years) of the growing season for the region was 203 days, with the median starting date on April 5 and the median ending date on October 25 (NWCC 2002).

The elevations of the monitoring wells, staff gauges, and water-level or flow meters were surveyed every spring with a Sokkia B1 Automatic Level and/or Leica TC702 total station using the NGVD 1929 datum plane. For the purposes of this report, these elevations were converted to the NAVD 1988 datum plane. In March 2001, instrument locations were surveyed using a Trimble Pathfinder ProXR GPS unit. To increase position accuracy, these locations were differentially corrected using the Trimble Pathfinder software.

SITE CHARACTERIZATION

Setting

Regional Setting

The compensation site lies in a formerly active portion of the Mississippi River flood plain. The pre-development flood plain of the Mississippi River near St. Louis (the American Bottoms) was a poorly-drained area of sloughs, oxbow lakes, and shallow ponds. The water table was at or near land surface. With the development of drainage pathways such as the Cahokia Canal and the advent of regional ground-water pumping, the water table dropped between 2 and 12 ft (0.61 and 3.66 m) (Voelker 1984).

Although drainage improvements facilitated residential and commercial development, interior flooding (*i.e.* the area between the Mississippi River levees and the bluffs) remains an issue. High-velocity streams drain the loess-mantled bluffs to the east, leading to high rates of siltation in flood-plain streams and canals. Under these conditions, storm-water storage is reduced as ditches, depressions, and gravity drains are choked with silt. Furthermore, interior flooding behind levees is common when high stages in the larger canals block gravity drains (SIMAPC 1975).

Local Setting

The compensation site lies within a drainage basin formed by three artificial barriers: Illinois Route 162 to the north, the west levee of Cahokia Canal to the east, and the raised roadbed of Interstate 255 on the west (Figure 1). The construction of I-255 required local drainage modifications. The ditch running along the south side of IL 162 was "designed to store runoff from a 50-year storm for its entire length" (IDOT 1983). Runoff from I-255 is routed to a perimeter ditch flowing south, merging with the north-to-south farm ditch (Figure 2). The catchment size is approximately 35 ac (14.2 ha). Runoff then flows west under I-255 in a 6-ft by 10-ft (1.8-m by 3.0-m) box culvert, eventually finding its way to Long Lake.

Precipitation is the primary hydrologic input to the site, and the slow permeability of the soil produces localized ponding for a short period of time in response to heavy precipitation. Many parallel farm ditches drain the 205-acre (83.0-ha) basin from west to east into the main north-south drainage ditch (Figures 2 and 3). These ditches cross under Luehmann Lane via culverts. According to the landowner, these culverts can be overwhelmed by runoff during major storm events, resulting in the road being overtopped. Intense rainfall on bare soil will readily mobilize silt and clay, and these culverts are prone to obstruction.

A clay borrow pit in the northeast corner of the sub-basin, north of the proposed site, traps runoff from the adjacent fields.

Topography

The majority of the site ranges in elevation from 416 to 419 ft (126.8 to 127.7 m). The highest point is in the southwestern corner of the site (419.7 ft or 127.9 m), while the lowest point is at the base of the north-south drainage ditch near the southern edge of the site (~412 ft or 125.6 m). The land surface slopes generally towards the ditch in the center (Figure 6).

Geology

The compensation site overlies the eastern flank of the Mississippi River bedrock valley (Herzog *et al.* 1994). Bedrock consists of the Pennsylvanian age Spoon Formation (Willman *et al.* 1967). The Spoon Formation consists of interbedded claystones and shaly mudstones, with some sandstones, and thin limestone and coal beds.

Bedrock in the general vicinity is overlain by between 100 and 200 ft (30.5 and 61.0 m) of Quaternary deposits (Piskin and Bergstrom 1975). The Cahokia Formation alluvium greater than 6.0 m (19.7 ft) thick overlies more than 6.0 m (19.7 ft) of outwash sand and gravel of the Henry Formation (Berg and Kempton 1988).

Borings made onsite intersected interbedded silty clay and clayey silt deposits of the Cahokia Formation to a depth of at least 19 ft (5.8 m). Each boring terminated in saturated fine sand of the Henry Formation, at depths between 19 and 28 ft (5.8 and 8.5 m) below land surface. Water pressure in the sand unit was artesian in each case. Appendix A contains detailed descriptions and graphic logs for each boring.

Radiocarbon dating was performed by the ISGS on two samples of woody material collected from boring 9L in the silty clay immediately overlying the sand layer at 19.5 ft (5.9 m) and 21.5 ft (6.6 m) below land surface. The ages of the woody materials were determined to be 7850 and 7890 ± 120 years B.P. respectively (Grimley, personal communication).

In general, deposits in the eastern half of the site are siltier. This is likely attributable to local flooding from historic Cahokia Creek, the course of which lay just east of the current Cahokia Canal (Figure 7). Much like the current canal, the historic creek likely carried silt-laden runoff from the adjacent bluffs. The silt-rich sediments may also have been laid down in alluvial fans that extended westward from the foot of the bluffs.

Soils

Hydric Darwin-series soil covers most of the site (Figure 3). These flood-plain soils are typically poorly or very-poorly drained silty clay (USDA 2002). Although described as "rarely flooded" due to protection behind Mississippi River levees, the water table may range from 2 ft (0.61 m) below land surface up to land surface and the area may be flooded with water up to 1 ft (0.30 m) deep from November to July, indicative of the slow permeability of the soil (USDA 2002). Regional ground-water pumping; permanent, regional hydrologic alterations and, to a lesser extent, local hydrologic alterations have eliminated the hydrology necessary to sustain the hydric soils onsite.

The non-hydric Dupo-series soil association occurs in a small area along the east perimeter. Dupo soils develop in silty alluvium covering a clayey buried soil (USDA 2002). As indicated previously, the silt in which this soil developed apparently was deposited by Cahokia Creek in the recent past. Permeability in Dupo soils generally decreases with depth. They are occasionally flooded for brief periods from January through June and have an apparent high water table 1.5 to 3.5 ft (0.46 - 1.07 m) below ground surface.

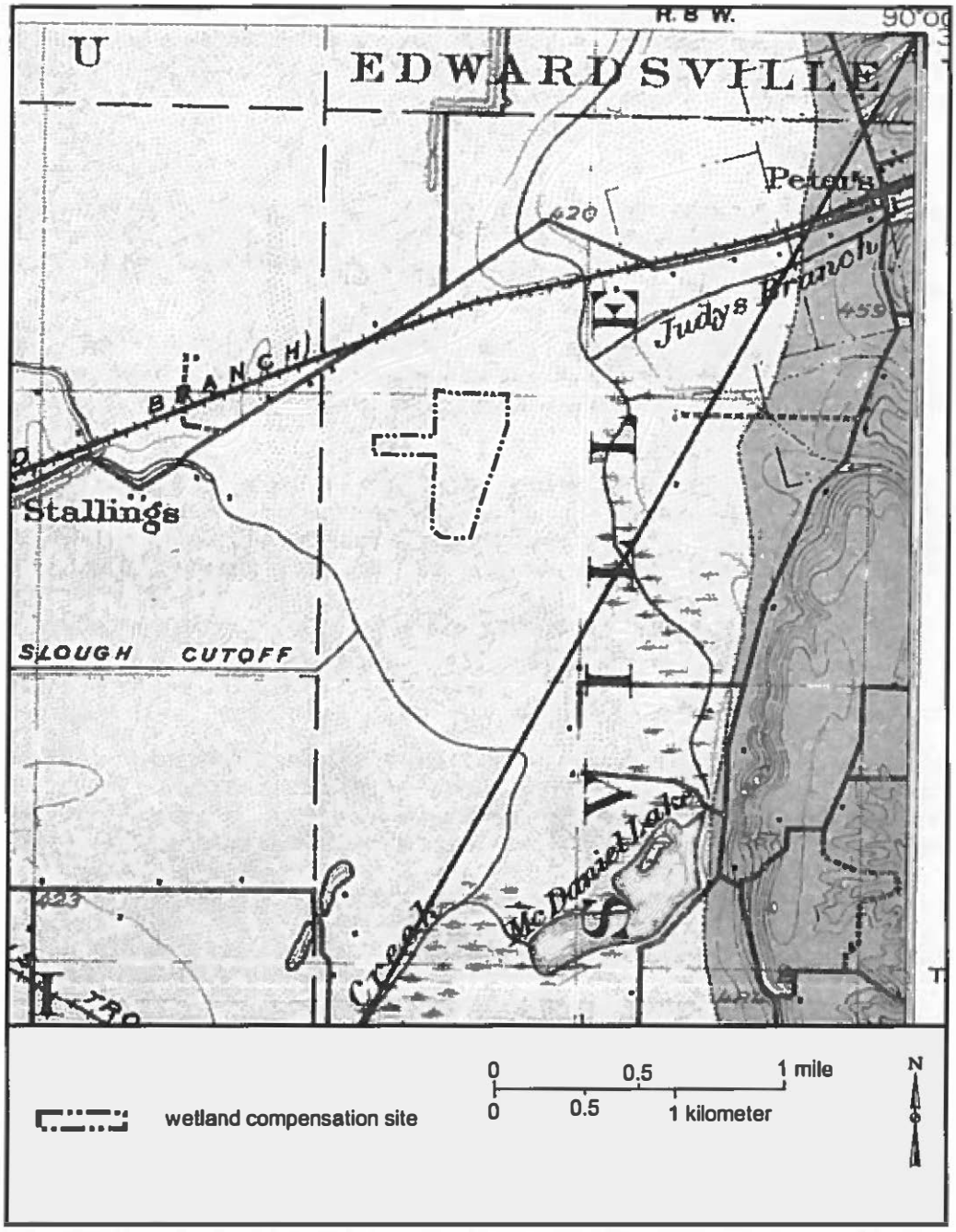

Figure 7. 1909 topographic map of the vicinity of the compensation site. The old Cahokia Creek stream course and associated swampy conditions are visible between the site and the bluffs (modified from Fenneman 1909).

Soil Type	Hydric	Permeability (in/hr)	Flooding	Water Table
Darwin silty clay (8071L)	yes	0-60in. (0-152cm): < 0.06in./hr (0.2cm/hr)	poorly drained, occasionally flooded, long duration, Jan -Jun	Depth: +1.0-2.0 ft Type: apparent Period: Nov-Jul
Dupo silt loam (8180A)	no	0-27in. (0-69cm): 0.6-2.0in./hr (1.5-5cm/hr) 27-60in. (69-152cm): 0.06-2.0in./hr (0.2-5cm/hr)	somewhat poorly drained, occasionally flooded, brief duration, Jan-Jun	Depth: 1.5-3.5 ft Type: apparent Period: Mar-Jun

Table 1. Hydrologic properties of on-site soil types (USDA 1986, 1995a, 1995b, 1995c, 2002).

Climate

Average annual precipitation at the nearby Edwardsville station is 38.2 in (97.0 cm) (MCC 2003). Rainfall is typically highest between March and July, peaking in June.

Figure 8 shows how much the monthly precipitation at Edwardsville from January 1997 through December 2002 deviated from the average monthly precipitation. For each year, the deviation from the average annual precipitation is presented as a negative or positive number (MCC 2003). Starting with slightly below average annual precipitation in 1997, high precipitation values in the first seven months of 1998 resulted in an 11.4 in (29.0 cm) surplus. Although dry conditions were recorded from August 1999 through April 2000, substantial precipitation in June through August 2000 led to an annual surplus of 13.9 in (35.3 cm). Below average precipitation from December 2000 through June 2001 was offset by above average values in July, August, and October 2001. In 2002, particularly high precipitation values in May and June offset the near- to below-average values for the rest of the year. Data from the rain gauge onsite indicated overall agreement with the nearby Edwardsville station. However, since the rain gauge was removed for the winter months, it could not show general, yearly trends.

Ground-Water Hydrology

Like the general pattern observed for precipitation, ground-water levels in the American Bottoms are seasonal, reaching "a peak in the late spring and then gradually [receding] during the summer and fall when water losses due to evapotranspiration, runoff into streams, and pumpage from wells exceeds the quantity of recharge from precipitation and induced infiltration from the Mississippi and other streams." (SIMAPC 1973).

Ground-Water Conditions in the Henry Formation

All L-wells were installed in the Henry Formation and water-level elevations varied little between them (Figure 9a). The difference between the highest and the lowest water-level measurement was typically less than 2.5 ft (0.76 m). Water levels in different wells also tracked each other closely. The water level in well 6L was consistently the highest, indicating ground-water flow toward the south and west (Figure 2).

Water levels associated with the Henry Formation generally followed climatic trends. Most of the lowest measured elevations occurred during Spring 2000, which followed a lengthy period of below-normal precipitation beginning in August 1999 (Figures 8 and 9a). A similar precipitation trend preceded the low elevations observed in July 2001. The highest water levels were observed on May 14, 2002, during an atypically wet spring. Over 4 inches (10.2 cm) of precipitation was recorded on the site in the two weeks preceding this date.

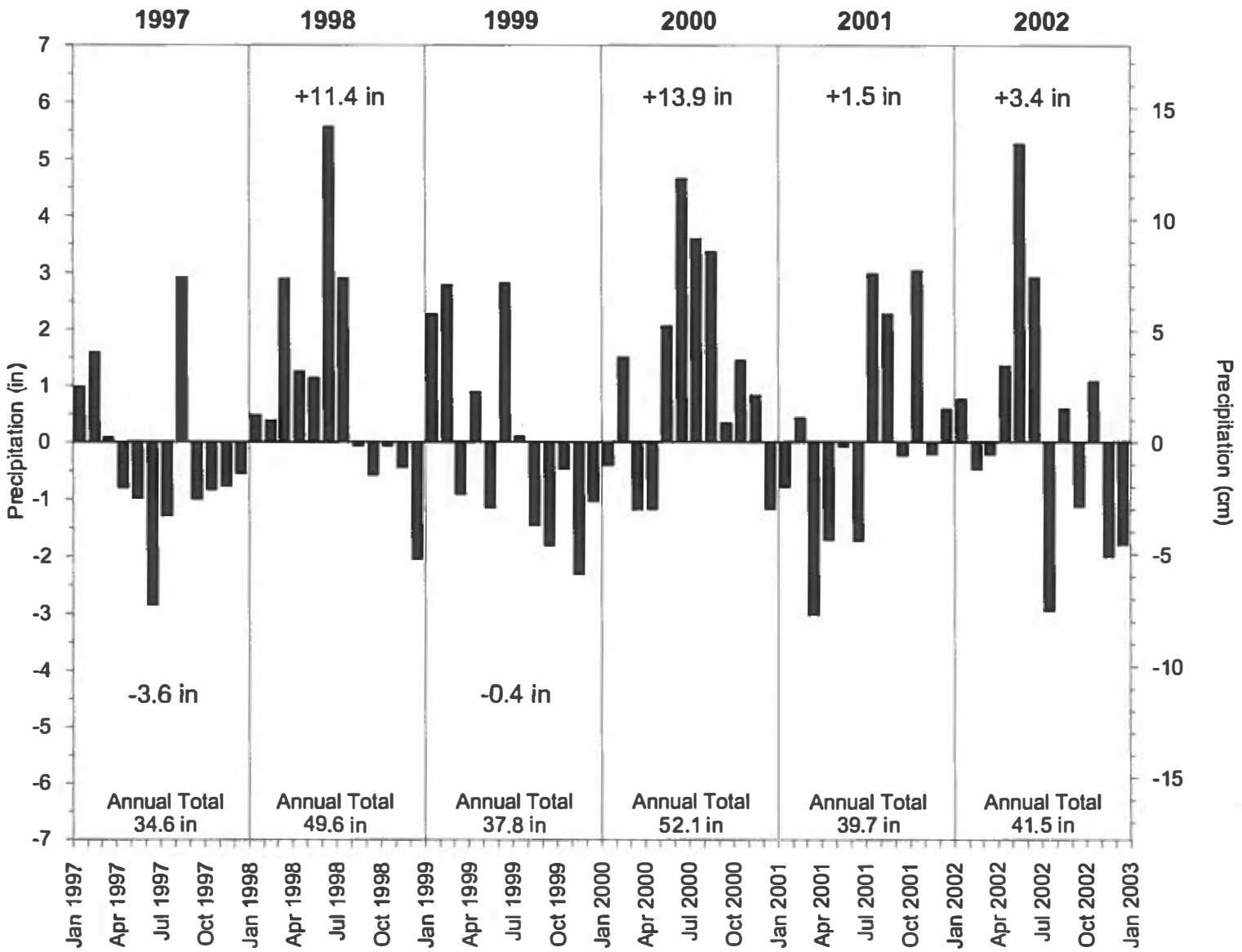

Figure 8. Deviation in monthly average and total annual precipitation for the period 1997 through 2002.

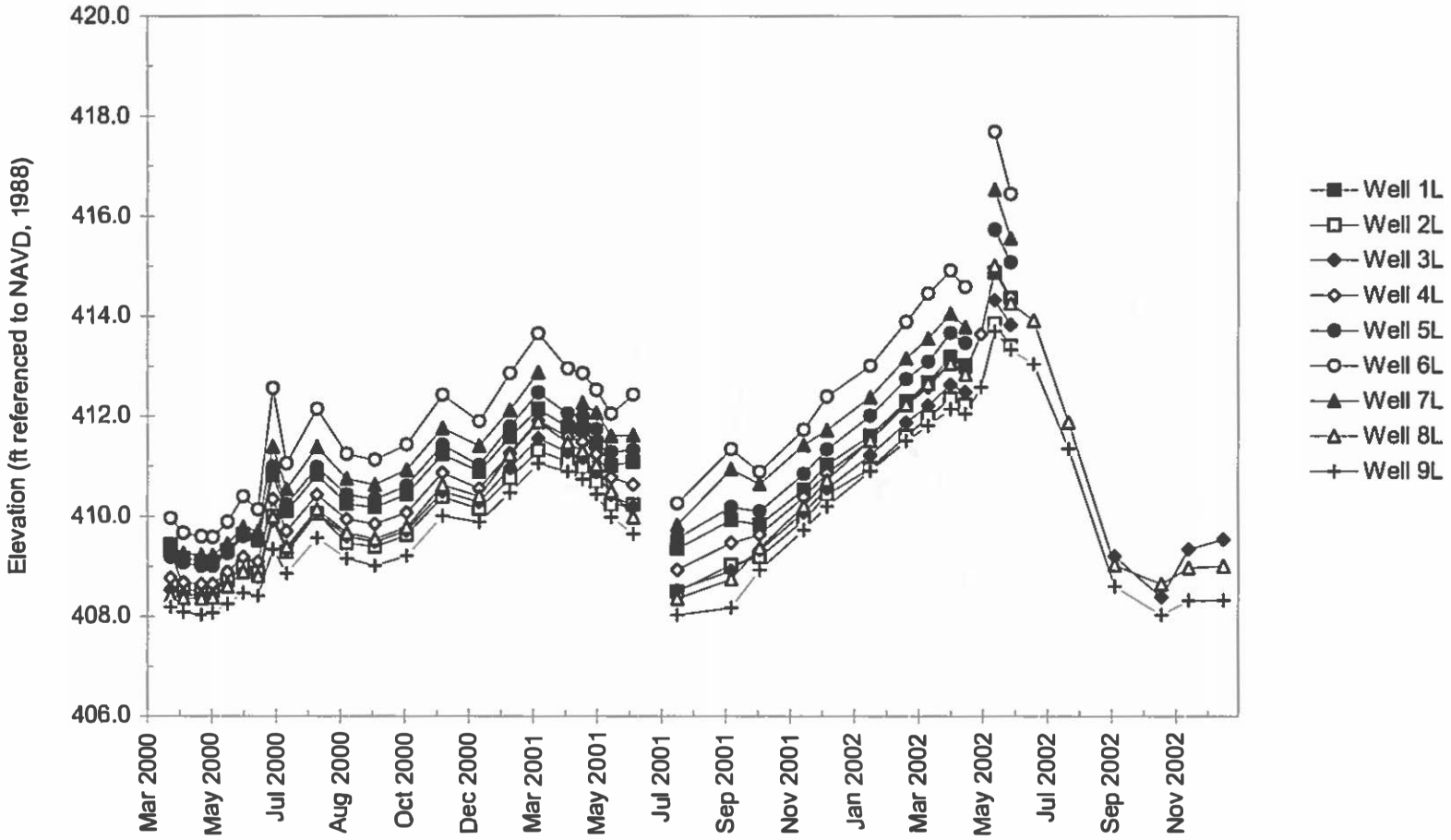

Figure 9a: Water-level elevations in L-wells.

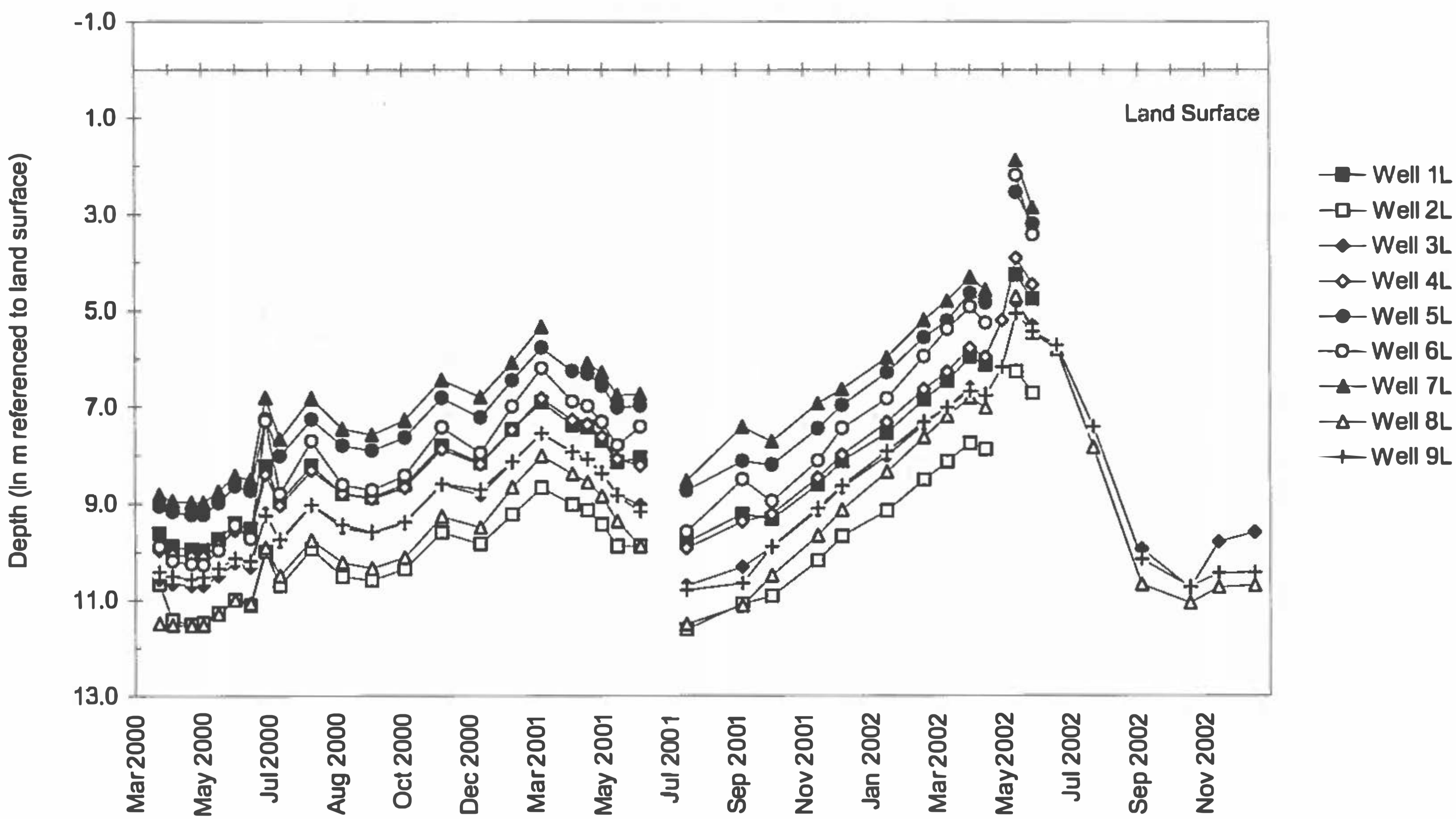

Figure 9b: Depth to water in L-wells.

Figure 9b shows the depth to water below the land surface in wells 1L through 9L. Water levels generally were found between 8.2 and 13.1 ft (2.5 and 4.0 m) above the top of the Henry Formation, showing that water in the Henry Formation is under artesian pressure. Ground-water is not capable of discharge to land surface due to the porosity of the overlying sediments.

Ground-Water Conditions in the Cahokia Formation

Water levels in the M-wells, all of which were installed in the Cahokia Formation, followed the same trend as the L-wells, although the range of elevations was broader. The water-level elevations in most M-wells have remained higher than those in the L-wells since installation (Figure 10a). However, in some cases, the difference is minimal. Water-level elevations in 4M, 6M, 7M, 8M and 9M closely followed their companion L-wells (see Appendix C for a complete record for each well cluster). Water-level elevations in wells 1M, 2M, 3M, and 5M were markedly higher than their associated L-well, as much as 3.3 ft (1.0 m).

It is worthwhile to note that sand heaving during well installation and the resulting, poorly-constrained filter pack may explain the similar records in wells 6M/6L and 7M/7L. The heaving may have prevented a proper annular seal.

Ground-Water Conditions in the Soil Zone

Most of the S-wells maintained a somewhat constant water level (Figure 11a) although the water level generally was too deep to support wetland hydrology onsite (Appendix C). Most of the high water-table elevations that were recorded in the S-wells were associated with rain events that occurred immediately preceding or during the reading of the well (i.e. the previous night or while being read). Only in the spring of 2002, following an extended period of above average precipitation (183% of the average), did many of the S-wells experience a general rise in water levels. Despite this high amount of precipitation and general rise in the water table at most wells, only 4S and 9S achieved wetland hydrology in 2002 and none in 2001. This suggests that the current conditions are not sufficient to create or maintain wetland hydrology at this site and additional modifications are required.

Surface-Water Hydrology

Box culvert

The Starflow water-velocity meter deployed in the box culvert recorded sixteen storm-related discharge events from November 2000 through October 2001. These events are shown in Figure 12, which depicts flow rate and precipitation amounts. The maximum flow rate of 21.2 ft^3/s (0.60 m^3/s) recorded in this study occurred on August 24, 2001during a storm event that lasted over two days in which 4.12 in (10.5 cm) of rain fell on the site. Snowmelt accounts for the single largest discharge event recorded January 14-16, 2001. Total event discharge of 639,831 ft^3 (18,118 m^3) or 14.7 acre-feet was recorded. Examination of Table 2 reveals that 4 of the 6 largest discharge events occurred during the winter months when infiltration and evaporation are reduced as a result of cooler temperatures, no crops are present to take up any of the water, and runoff increases as a result. Unfortunately, the on-site rain gauge had been removed for the winter, so the amount of precipitation on-site required to produce these events could not be determined.

Up to 14.7 acre-feet of water has been lost from the site via the box culvert during a maximum runoff event. Based on the current configuration of the site, a surplus of 14.7 acre-feet of water would result in the filling of the drainage ditches, plus an additional 3.7 ac (1.5 ha), roughly to an elevation of 417.2 ft (127.2 m). Even if most of the alterations were removed (*i.e.* the ditches were filled), 14.7 ac (5.9 ha) of flooding is only a small fraction of the site. In addition to the problem of maintaining snowmelt runoff onsite into the growing season, discharge through the box culvert has mixed provenance so not all of the water flowing through the box culvert comes from the site.

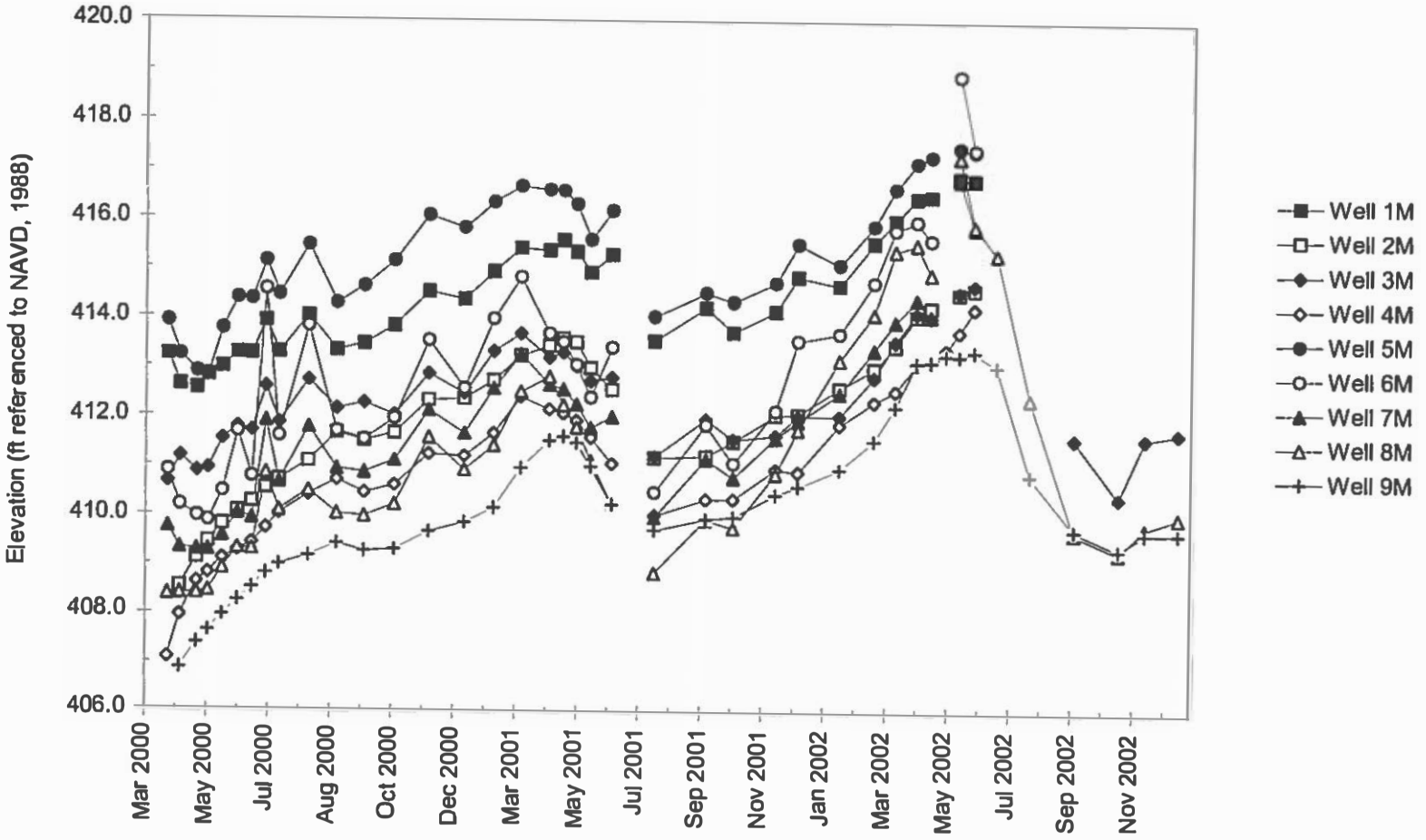

Figure 10a: Water-level elevations in M-wells.

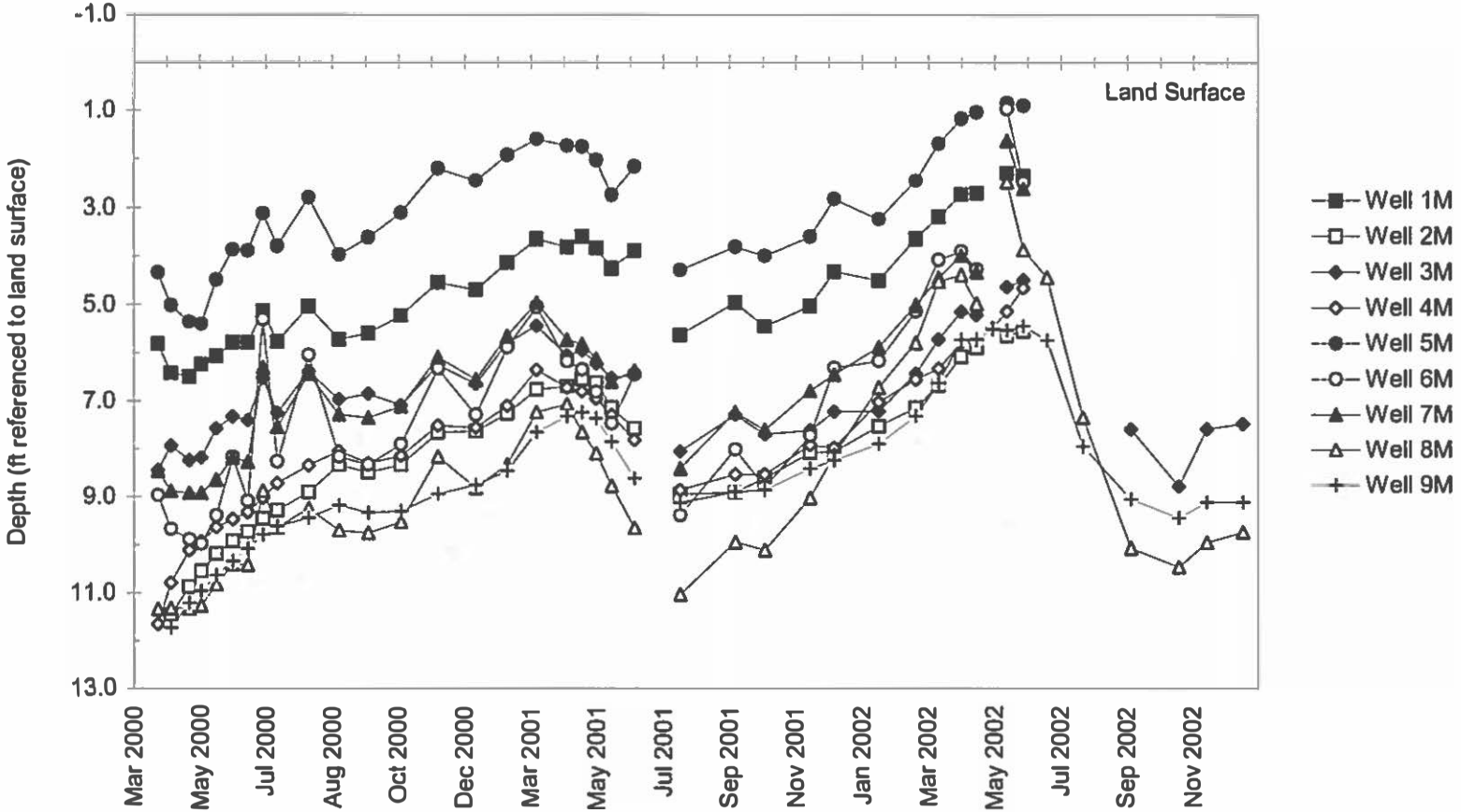

Figure 10b: Depth to water in M-wells.

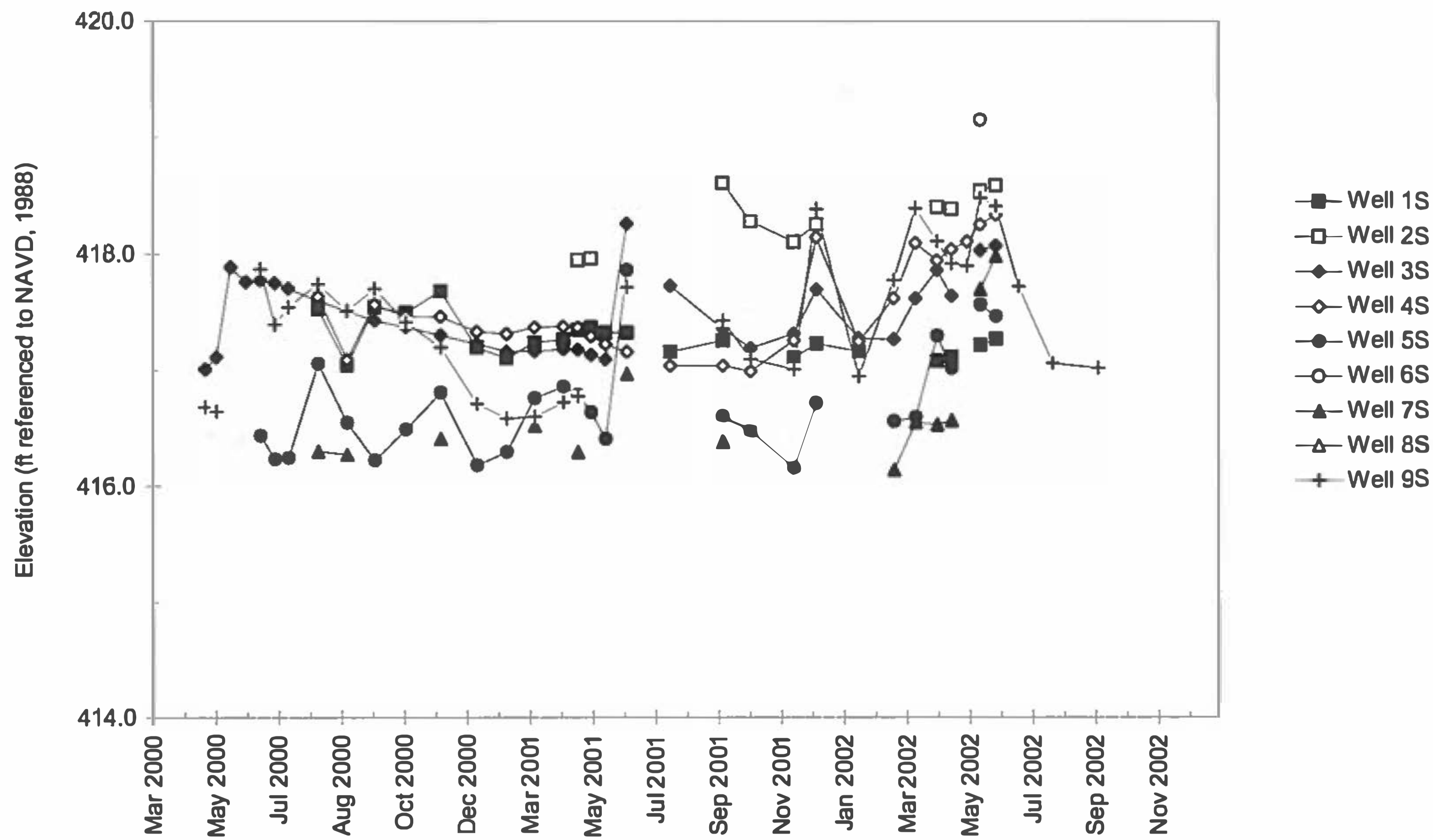

Figure 11a: Water-level elevations in S-wells.

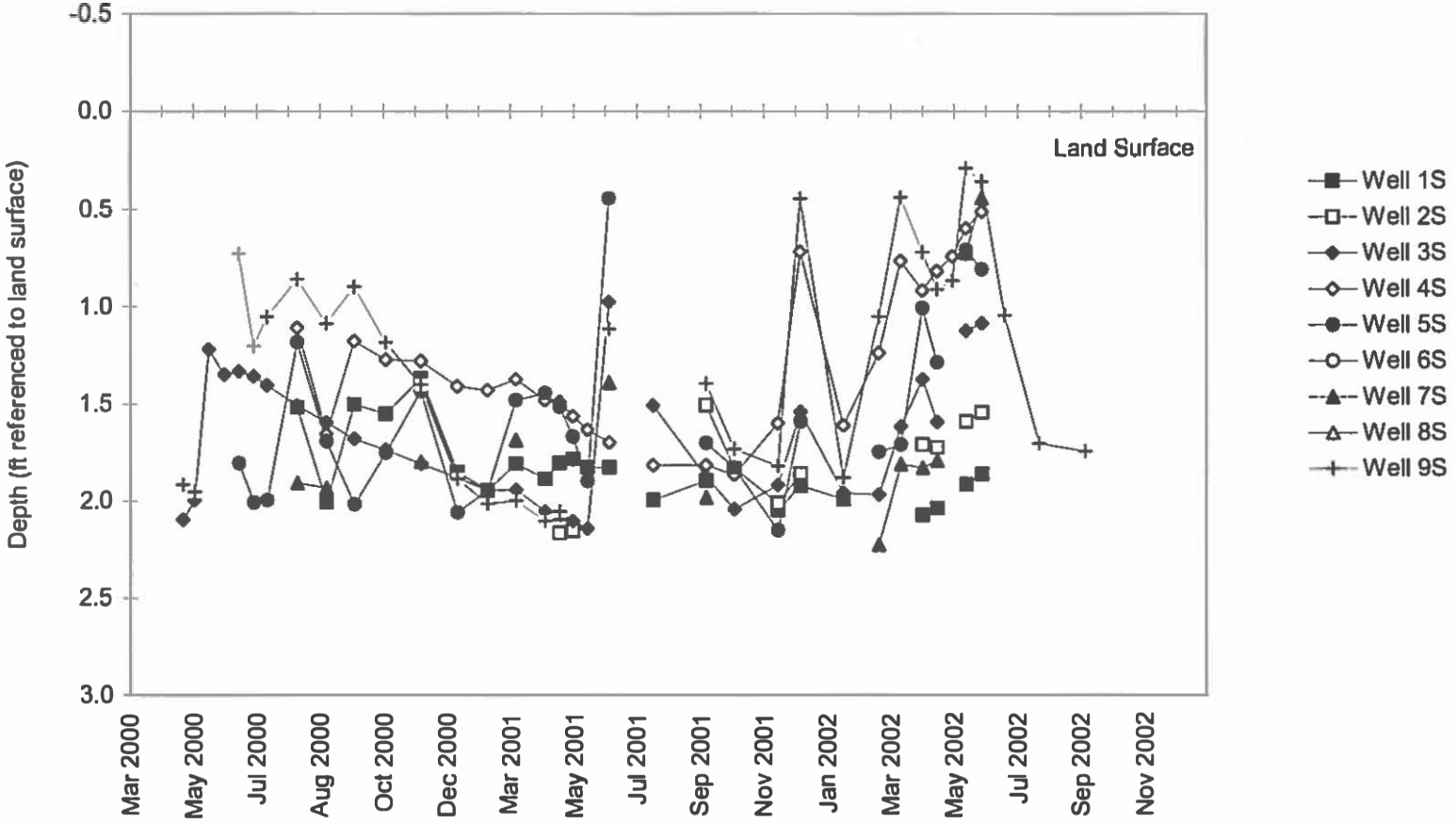

Figure 11b: Depth to water in S-wells.

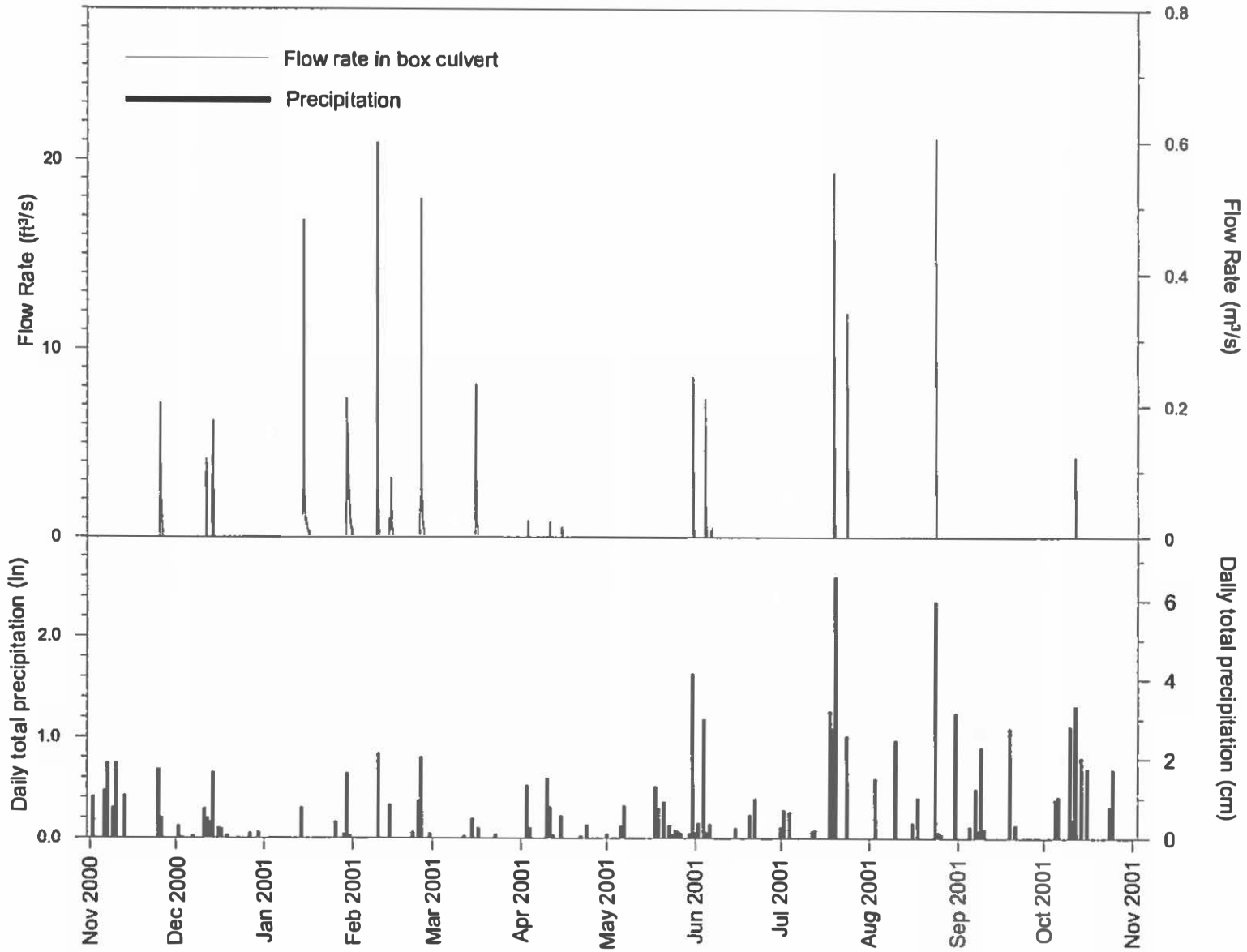

Figure 12. Discharge in the I-255 box culvert versus daily total precipitation: Nov 2000-Nov 2001.

Date	Volume Discharged (ft^3)	Volume Discharged (m^3)	Volume Discharged (acre-feet)
January 14-16, 2001	639,831	18,118	14.7
January 29 - February 1, 2001	489,143	13,851	11.2
February 24-25, 2001	482,434	13,661	11.1
February 9-10, 2001	474,417	13,434	10.9
August 24, 2001	444,753	12,594	10.2
July 19, 2001	441,610	12,505	10.1

Table 2. Six largest discharge events measured in the box culvert.

The catchment includes approximately 205 ac (83.0 ha) of farmland and forest bounded by the Cahokia Canal, Interstate 255, and Illinois Route 162, and an estimated 35 ac (14.2 ha) of I-225 pavement, medians, interchange infields, and environs. Both contributors have high runoff potential. However, most of the runoff from the roadways enters the box culvert via the road drainage ditch (Figure 2) and never passes through the site and is therefore unavailable for storage onsite. Attempts were made to determine the relative contribution from the road drainage ditch and the farm drainage ditch (collecting runoff from the farmed and forested catchment). Unfortunately, the complicated nature of the channels (*e.g.* bifurcations, localized changes in stream gradient, debris obstructions and vegetation) precluded any accurate calculation of storm discharge. At present, there is no way of diverting roadway runoff onto the site while still protecting adjacent residential and commercial properties.

Cahokia Canal

The hydrograph for Cahokia Canal through the 2002 growing season is provided in Figure 4. The highest recorded level, 422.88 ft (128.89 m), occurred on June 11. Baseflow elevation ranges from 412.8 to 413.8 ft (125.8 to 126.1 m).

If the levee was not present, water from the canal would begin to enter the site at approximately 417.0 ft (127.1 m). The water level in the canal exceeded this elevation on five occasions between April 22 and June 14 for a total of 231 hours. If the water level in the canal reaches 418 ft (127.4 m) for a sufficient period of time, all the farm ditches would be filled to capacity and roughly 23 ac (9.3 ha) of the site would be flooded (Figure 6). The water level in the canal exceeded this elevation during three flood events for a total of 130 hours. At approximately 419.0 ft (127.7 m), Luehmann Lane could be overtopped and roughly 53 ac (21.4 ha) inundated. However, the water level in the canal only exceeded this elevation during three flood events for a cumulative total of 45 hours.

Although the water level in the Cahokia Canal did reach elevations where water could easily enter and flood considerable portions of the site if the levee was not present, the translation of flood water is not instantaneous. The events discussed above were relatively short lived and would not likely allow a sufficient volume of water to flood the site. In addition, the data were collected during a period with above-average precipitation, it is not safe to assume that the water level in the canal reaches a similar elevation in years with more typical rainfall. In order to ensure that a sufficient amount of water is available to sustain wetland hydrology in drier years, large portions of the site should be excavated to at least 416 ft (126.8 m).

CONCLUSIONS

The following conclusions regarding the hydrogeology of this site are made:

- While hydric soil is present over most of the site, the current regional drainage system, infrastructure, and regional ground-water pumping have eliminated the hydrologic regime necessary to sustain hydric soils and wetland hydrology. Reversal of the existing local hydrologic alterations would not likely result in significant wetland restoration. The only potential source of water is the Cahokia Canal, adjacent to the site.

- Opening the site to the Cahokia Canal alone would not likely result in significant areas being flooded for a sufficient period of time. Excavation, using the current topography as a template, is needed to retain water onsite. Basin design will depend on the acreage and plant communities desired, but would likely require excavation to at least 416 ft (126.8 m).

- A berm and drainage system would have to be constructed to protect adjacent residential, commercial and agricultural properties. A berm would protect the adjacent properties from flooding, while the drainage system would replace the current system which, would be interrupted by any construction, and would accommodate runoff from adjacent fields and roads.

ACKNOWLEDGMENTS

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Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 1L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/13/00 - start 10:15, end 11:30
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	45°, cloudy
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

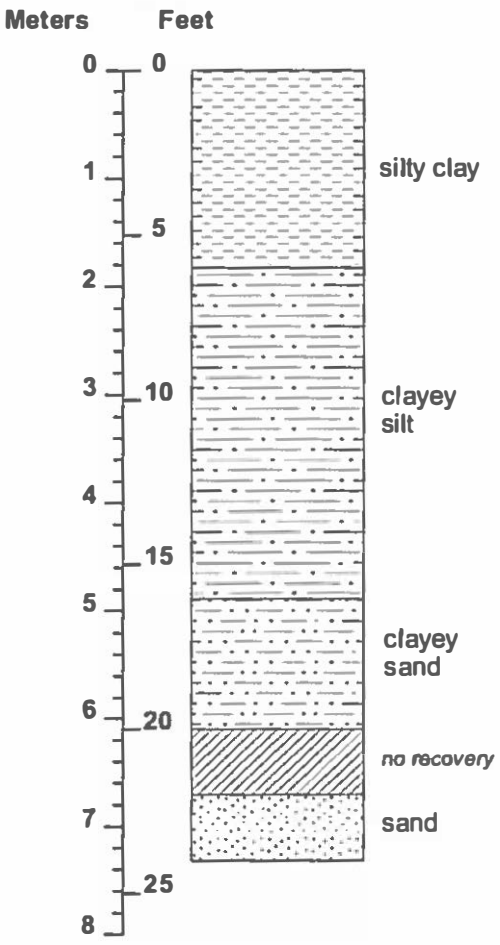
Depth	**Unit Descriptions**		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* silty clay (0/0/30/70)	*Recovery:* 8 inches	*Blows:* 4/3/4/4
	Color of matrix: black (10YR 2/1)	*Sampled:* no	*Calcareous:* no
	Notes: Damp at surface, otherwise stiff. Some oxidized root channels and few indistinct mottles.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 12 inches	*Blows:* 4/4/5/9
	Color of matrix: very dark gray (10 YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Faint blocky structure evident. Medium stiff with some faint brown mottles.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 14 inches	*Blows:* 4/4/4/6
	Color of matrix: very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* no
	Notes: Medium stiff with a blocky structure. Color changes in top 8 inches (20 cm). Common, fine (~1 mm) distinct yellowish brown (10YR 5/6) mottles. Silt content increases with depth.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/0/60/40)	*Recovery:* 23 inches	*Blows:* 6/6/8/10
	Color of matrix: dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium to stiff. Common, fine (≤ 2 mm) distinct yellowish brown (10YR 5/6) mottles. Chalky nodules approximately 2 mm in diameter, and Fe or Mn nodules less than 1 mm in diameter.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/0/55/45)	*Recovery:* 23 inches	*Blows:* 3/3/4/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Soft to medium stiff. Prominent mottles, now representing the matrix. Darker, soft wet zones of preferential water movement (possible organic layer). Fe or Mn nodules are common, possible zonation.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 1L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* clayey silt (0/5/50/45)	*Recovery:* 23 inches	*Blows:* 2/2/3/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: As for 8'-10', soft to medium stiff. Many, coarse, prominent redox masses (outweighing the matrix), amorphous, yellowish brown (10YR 5/6). Chalk nodules are less common.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* clayey silt (0/tr/50/50)	*Recovery:* 24"	*Blows:* 5/4/4/5
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Similar to above, with very few < 1mm Fe or Mn nodules		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* clayey silt to silty clay (0/tr/50/50 to 0/tr/30/70)	*Recovery:* 16"	*Blows:* 3/3/3/4
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: Soft, clay content increasing with depth. Marbled with other colors, diffuse mottles. **Water encountered in this interval.**		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* silty clay (0/0/15/85) grading to clayey fine sand	*Recovery:* 24"	*Blows:* 4/2/2/2
	Color of matrix: gray (10YR 5/1) in silty clay, dark greenish gray (10Y 3/1) in sand	*Sampled:* no	*Calcareous:* no
	Notes: Soft, gleyed sand & clay at bottom with no mottles. Structureless.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey fine sand	*Recovery:* 24"	*Blows:* ½/2/6
	Color of matrix: dark greenish gray (10Y 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Very soft and saturated. Thin layers of clayey silt and silty clay encountered, terminating in fine, sub-angular sand at base.		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* NA	*Recovery:* NA	*Blows:* NA
	Color of matrix: NA	*Sampled:* NA	*Calcareous:* NA
	Notes: INTERVAL SKIPPED TO FACILITATE WELL PLACEMENT.		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* fine sand (0/100/tr/0)	*Recovery:* 18"	*Blows:* NA
	Color of matrix: dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* no
	Notes: Saturated, well-sorted, sub-angular fine sand, predominantly quartz, some mica and ferro-mags. Sand flowed into borehole after well placed.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 1L (continued)



Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 2L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/13/00 - start 13:20, end NA
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	55°, sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 11.5 inches	*Blows:* 3/2/3/3
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Soft, lacking structure, some oxidized root channels and live roots. Plowed zone. Some mottling, few, faint.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 13 inches	*Blows:* 3/4/6/7
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Soft to medium stiff. Few faint, dark brown mottles. Somewhat blocky structure. Some oxidation around live root channels.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 24 inches	*Blows:* 4/5/5/8
	Color of matrix: dark gray (10YR 4/1) grading to gray (10YR 5/1) at bottom	*Sampled:* no	*Calcareous:* no
	Notes: Medium-stiff to stiff, as above without roots. Mottling becoming more distinct with depth.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 21 inches	*Blows:* 4/4/4/8
	Color of matrix: dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Common, fine (<1 mm), distinct yellowish brown mottles (10YR 5/5).		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 24 inches	*Blows:* 6/4/6/6
	Color of matrix: dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Many (~50%) coarse, distinct, yellowish brown (10YR 5/6) redox masses. Some moist, medium gray clay skins encountered at ~9' 3".		

Appendix A: Geologic descriptions and graphic logs

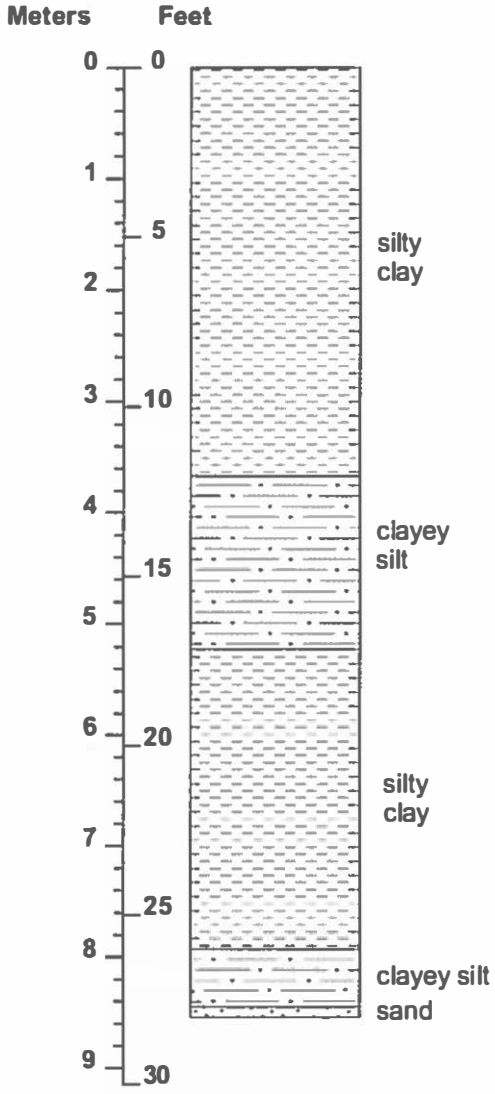
Boring	New River / Luehmann 2L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 23 inches	*Blows:* 4/4/4/5
	Color of matrix: brown (10YR 5/3) or light olive brown (2.5Y 5/3)	*Sampled:* yes, 11.5 ft	*Calcareous:* nodules
	Notes: Medium stiff. Appreciable zones of calcareous nodules, ~1 cm thick. Percentages of redox masses and matrix are 50/50. Platy structure at 11' 6", silty layers or sand stringers. Grades seamlessly to next interval, no contact.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* clayey silt (0/5/55/40)	*Recovery:* 24 inches	*Blows:* 5/5/5/6
	Color of matrix: brown (10YR 5/3) or light olive brown (2.5Y 5/3)	*Sampled:* no	*Calcareous:* nodules
	Notes: Locally saturated, with free water visible in calcareous zone. As above, redox masses on par with matrix. Parting surfaces / laminae present. Small pockets of medium-gray, wet clay. Some possibly organic black laminae.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* clayey silt (0/5/55/40)	*Recovery:* 24 inches	*Blows:* 5/5/5/5
	Color of matrix: grayish brown (10YR 5/2 or 2.5Y 5/3)	*Sampled:* no	*Calcareous:* no
	Notes: As above, without $CaCO_3$ nodules. Root trace filled with damp clay observed. Distinct, yellowish brown (10YR 5/6) redox masses.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* clayey silt (0/5/55/40) to silty clay (0/0/20/80) at ~17' 2"	*Recovery:* 24 inches	*Blows:* 5/4/4/4
	Color of matrix: grayish brown (10YR 5/2) above 17' 2", dark grey (10YR 4/1) below	*Sampled:* no	*Calcareous:* no
	Notes: Medium stiff to soft with parting surfaces having possible organics between layers. Definite organic layer at contact. Many (≥50%) coarse, distinct redox masses up to but not below the 17' 2" contact.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* silty clay (0/0/20/80) grading to sandy clay	*Recovery:* 24 inches	*Blows:* 2/2/2/3
	Color of matrix: greenish grey (5GY 5/1)	*Sampled:* no	*Calcareous:* shell
	Notes: Soft, with sand lenses encountered at 18' 7" and 19' 4". Shells observed at 19' 2". No redox features. The lower 3" are sandy clay. **Water encountered in this interval.**		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 2L (continued)		
Depth	**Unit Descriptions**		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 24 inches	*Blows:* 2/2/2/3
	Color of matrix: greenish gray (5GY 5/1)	*Sampled:* no	*Calcareous:* no
	Notes: Soft, with few, fine, prominent dark yellowish brown (10YR 3/4) redox concentrations as masses.		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 24 inches	*Blows:* 3/3/3/3
	Color of matrix: greenish gray (5GY 5/1)	*Sampled:* no	*Calcareous:* no
	Notes: Soft to medium stiff, with common, fine, prominent dark yellowish brown (10YR 3/4) redox concentrations as masses.		
7.32 - 7.92 m (24 - 26 ft)	*Gaologic material:* silty clay (0/0/15/85) grading to clayey silt (0/0/80/20) at bottom	*Recovery:* 18 inches	*Blows:* 1/1/1/1
	Color of matrix: greenish gray (5GY 5/1) to dark gray (10YR 4/1) in silt	*Sampled:* no	*Calcareous:* no
	Notes: Very soft. Otherwise, as per previous interval, but moist to saturated in silt.		
7.92 - 8.53 m (26 - 28 ft)	*Geologic material:* clayey silt (0/0/80/20)	*Recovery:* 18 inches	*Blows:* 6/8/10/10
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: Terminates in fine sand, last 3 inches of the interval.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 2L (continued)



Appendix A: Geologic descriptions and graphic logs

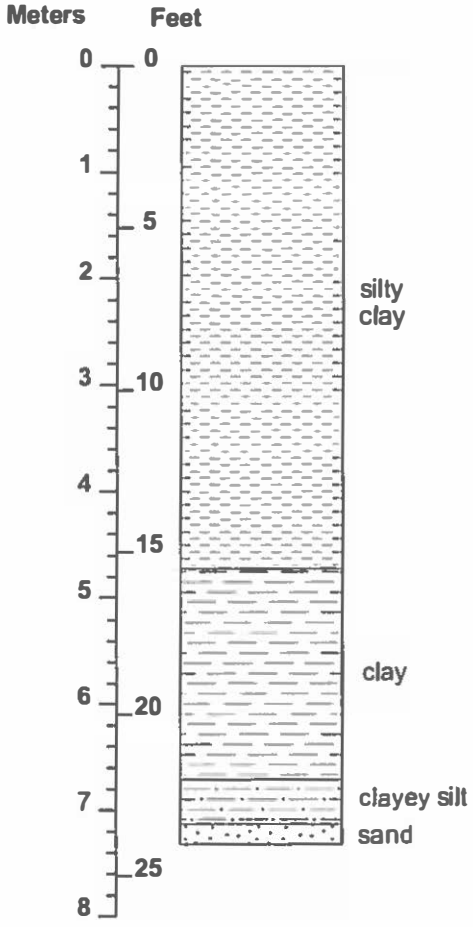
Boring	New River / Luehmann 3L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/13/00 - start 15:35
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	55°, sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* silty clay (0/tr/30/70)	*Recovery:* 11 inches	*Blows:* 3/3/3/4
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Medium stiff, dry with some oxidized root channels and faint mottling. More organic-rich, browner close to surface in plowed zone.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silty clay (0/tr/30/70)	*Recovery:* 11 inches	*Blows:* 5/5/13/13
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Medium to very stiff. Redox concentrations increasing in frequency.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* silty clay (0/tr/30/70)	*Recovery:* 14 inches	*Blows:* 4/4/4/6
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:*
	Notes: Dry, medium stiff, with few, fine (<1 mm), prominent reddish brown redox concentrations as masses. Few Fe or Mn nodules.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 24 inches	*Blows:* 4/4/4/7
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Medium stiff with common, fine (~1-2 mm), prominent dark yellowish brown (10YR 4/6) redox concentrations as masses.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* silty clay (0/tr/35/65)	*Recovery:* 18 inches	*Blows:* 2/2/4/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Many, medium (2-5 mm), prominent dark yellowish brown (10YR 4/6) redox concentrations as masses. Calcareous nodules at base, ~ 2" from 10 ft mark.		

Boring	New River / Luehmann 3L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silty clay (0/tr/36/65)	*Recovery:* 24 inches	*Blows:* 3/3/3/5
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: moist. Redox concentrations as masses represent up to 50% of whole and are disseminated to banded through the interval. Medium-gray, wet clay skins were observed, perhaps forming along old root channels. All concentrated calcareous band was observed between 10' and 10' 4". Interval was moist to saturated in clay skins.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* silty clay (0/tr/36/65)	*Recovery:* 24 inches	*Blows:* 3/3/4/5
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: moist. Medium stiff with an occasional manifestation of a platy structure. Free water observed on some breaks. Calcareous zonations also present. Old root channels found corresponding to gray, wet clay.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* silty clay (0/tr/35/65) grading through interval to silty clay (0/0/15/85) at base	*Recovery:* 24 inches	*Blows:* 4/2/2/3
	Color of matrix: grayish brown (2.5Y 5/2) to dark gray (2.5Y 4/1) at base	*Sampled:* no	*Calcareous:* no
	Notes: Recovered sample was wet, although sediments only moist. Redox concentrations diminish towards base of interval.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 24 inches	*Blows:* 3/2/2/2
	Color of matrix: greenish grey (5GY 5/1)	*Sampled:* no	*Calcareous:* shells
	Notes: Soft, moist to wet. Redox concentrations grade to absent by the end of the interval, shells encountered at 17' 4"		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 22 inches	*Blows:* 2/2/2/2
	Color of matrix: greenish grey (5GY 5/1)	*Sampled:* no	*Calcareous:* shells
	Notes: No redox concentrations. Roots common ~19'.		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* silty clay (0/0/15/85)	*Recovery:* 10 inches	*Blows:* 1/1/1/2
	Color of matrix: greenish grey (5GY 5/1)	*Sampled:* no	*Calcareous:* shells
	Notes: Some shells and $CaCO_3$ nodules present. Few, fine, prominent olive brown (2.5Y 4/4) redox concentrations. Some free water.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 3L (continued)		
Depth	**Unit Descriptions**		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* clayey silt (0/0/60/40) grading to silt and finally to fine sand	*Recovery:* 24 inches	*Blows:* 11/11/14/18
	Color of matrix: silt: dark gray (2.5Y 4/1)	*Sampled:* no	*Calcareous:*
	Notes: Saturated, terminating to fine, sub-angular to angular, well-sorted sand. Contact with sand is ~23' 4". Woody material observed at contact. Hole drilled to 24' and well set.		



Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 4L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/14/00 - start: 08:11
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	36°, partly sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

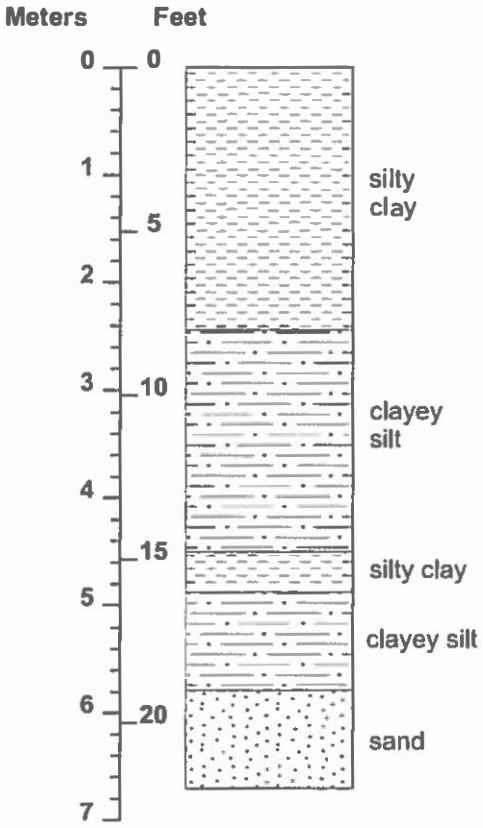
Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* silty clay (0/tr/40/60)	*Recovery:* 5.5 inches	*Blows:* 6/4/4/5
	Color of matrix: dark gray /grayish brown (10YR 4/1.5)	*Sampled:* no	*Calcareous:* no
	Notes: Medium-stiff, with bright orange oxidized root channels or poorly-developed redox concentrations. Darker brown in the upper 3-4" of the plowed zone.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silty clay (0/tr/40/60)	*Recovery:* 16-inches	*Blows:* 7/6/6/5
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: Dry and crumbly with roots through the entire interval. Few, fine (<1 mm), prominent redox concentrations or oxidized root channels. Matrix is a very even color.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* silty clay (0/tr/45/55)	*Recovery:* 15 inches	*Blows:* 5/5/5/7
	Color of matrix: dark grayish brown (10YR 4/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Moist but stiff silty clay with calcareous nodules starting at ~4.5', some of which measure up to 1.5 cm. Common, fine, distinct, dark yellowish brown (10YR 4/6) redox concentrations as both masses and Fe or Mn nodules up to 2 mm in diameter.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* silty clay (0/tr/45/55)	*Recovery:* 22 inches	*Blows:* 6/6/7/7
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Many, fine to medium, prominent dark yellowish brown (10YR 4/6) redox concentrations as masses, increasing in frequency to 50/50 by 8'. Common, fine (~1 mm) dark Fe or Mn nodules.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/tr/60/40)	*Recovery:* 20 inches	*Blows:* 3/3/3/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* yes, 4L - 9ft	*Calcareous:* nodules
	Notes: Soft, moist with slick medium gray clay skins. Slight transition to a higher silt content. Old roots observed - linear, black features. Wet, soft clay at the 10' mark. Redox concentrations as per interval immediately above, but with a less diffuse boundary around masses. Calcareous nodules rare.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 4L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silty clay or clayey silt (0/tr/50/50)	*Recovery:* 14 inches	*Blows:* 3/3/3/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Moist, easily parts, medium stiff. Many, medium, prominent dark yellowish brown (10YR 4/6) redox concentrations as masses with hard Fe nodules as "nucleus." The concentrations seem to be preferentially located along laminae, similar to those observed in the previous boring (3L) at the same depth. Calcareous nodules are rare. Some slick, gray clay skins.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* silty clay or clayey silt (0/tr/50/50)	*Recovery:* 24 inches	*Blows:* 5/4/4/4
	Color of matrix: gray to grayish brown (2.5Y 5/1 to 2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: As per previous interval, but having zones of higher silt content (0/tr/65/35). Well-developed silty stratifications observed ~13'. Calcareous nodules reappear in strength near the top of the interval. Some clay skins.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* silty clay or clayey silt (0/tr/50/50) to silty clay (0/5/65/30)	*Recovery:* 23 inches	*Blows:* 3/2/2/2
	Color of matrix: gray (2.5Y 5/1) to dark gray (10YR 4/1) at base	*Sampled:* no	*Calcareous:* shells
	Notes: Moist. Transition zone in both color and texture ~14' 8". Interval starts with laminated clayey silt (as above) and grades to silty clay with less frequent redox concentrations. Old roots and shells observed at 15'.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* clayey silt (0/5/85/10) to clayey silt (0/tr/70/30)	*Recovery:* 24 inches	*Blows:* 2/2/2/2
	Color of matrix: dark greenish gray (10Y 4/1) to greenish gray (10Y 5/1)	*Sampled:*	*Calcareous:* shells
	Notes: Soft to medium stiff by base. High silt content from 16' through 17.5' - some fine sand and wet, possibly a water-bearing layer. Redox features and clay skins are absent in the silty layer. Below 17.5', common, fine (1-3 mm), prominent dark olive brown (2.5Y 3/3) redox concentrations present. Becomes more clay-rich, and clay skins and shells also return below this depth. Percentage redox concentrations / matrix reach 50/50 by 18'.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 4L (continued)		
Depth	**Unit Descriptions**		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey silt (0/tr/70/30) to fine sand at 19'	*Recovery:* 16-Inches	*Blows:* 1/1/1/3
	Color of matrix: greenish gray (10Y 5/1) to grayish brown (2.5Y 5/2) in sand	*Sampled:* no	*Calcareous:* no
	Notes: Soft, moist to saturated clayey silt grading to fine, well-sorted, angular sand at 19'. Silt content increases in the 2-3 inches immediately preceding the sand contact.		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* fine sand (0/100/tr/0) to silty fine sand (0/75/25/0)	*Recovery:* 24 inches	*Blows:* 1/3/3/3
	Color of matrix: dark grayish brown (2.5Y 4/2)	*Sampled:* no	*Calcareous:* no
	Notes: Fine, well-sorted, angular, water-bearing sand and silty fine sand.		



Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 5L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/14/00 - start: 10:05
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	45°, partly sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

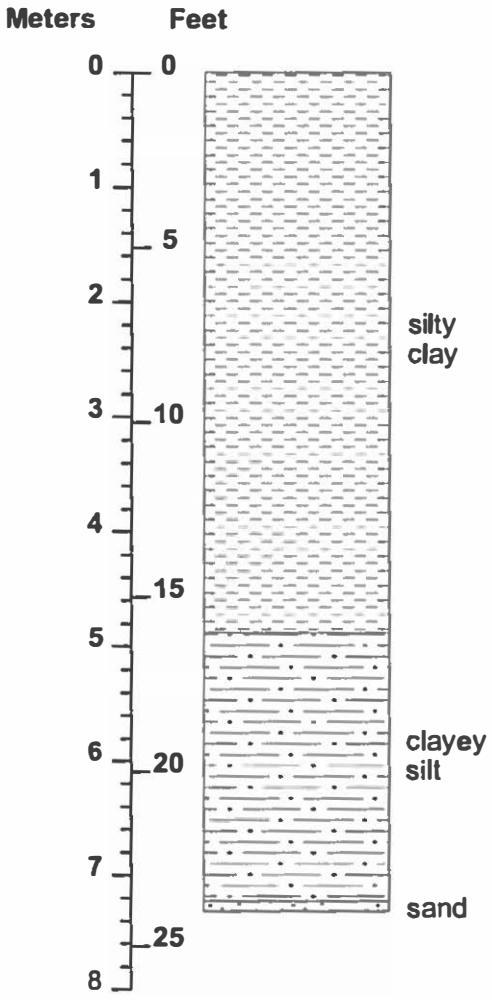
Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* silty clay (0/0/65/35)	*Recovery:* 10 inches	*Blows:* 3/4/5/5
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Dry, stiff to medium-stiff with some oxidized root channels and organics associated with farming / plowed zone. Some Fe or Mn clasts observed. Few, fine (<1 mm), faint redox concentrations.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silty clay (0/0/65/35)	*Recovery:* 16-inches	*Blows:* 6/8/11/12
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Dry, stiff to very stiff with some well-developed oxidized root channels. Redox features as above, as well-defined round masses.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* silty clay (0/tr/45/55)	*Recovery:* 14 inches	*Blows:* 4/5/5/6
	Color of matrix: very dark gray (10YR 3/1) to dark grayish brown (10YR 4/2) at ~5'	*Sampled:* no	*Calcareous:* nodules
	Notes: Dry to moist, medium stiff silty clay. Color change and increasing frequency of distinct, dark yellowish brown (10YR 4/6-3/6) redox concentrations at 5', which also marks the beginning of calcareous nodules. Nodules represent 35-40% of total by 6' with 2-3 mm clasts observed.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* silty clay (0/tr/45/55)	*Recovery:* 20 inches	*Blows:* 3/3/3/4
	Color of matrix: dark grayish brown (10YR 4/2) grading to grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Moist to saturated, soft to very soft silty clay with a layer of Fe or Mn nodules ~1" thick at 6' 5". A zone of wet, putty-like clay occurs at 7' 2" to 7' 6" along with some Fe or Mn nodules or rock fragments. This may represent the former trace of a large root. Slick gray, clay-rich areas are common. Many (40-50%), medium, distinct to prominent dark yellowish brown (10YR 4/6) redox concentrations as masses.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 5L (continued)		
Depth	**Unit Descriptions**		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* silty clay (0/tr/45/55)	*Recovery:* 24 inches	*Blows:* 2/2/2/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Moist to wet, medium to very soft in center. Another wet zone from 8' 9" through 9' 6" with a corresponding lack of redox concentrations. Compared with boring 4L, this boring is lacking in calcareous nodules.		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silty clay (0/tr/40/60)	*Recovery:* 24 inches	*Blows:* 2/2/2/5
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* yes: 5L-11' - 11¼'	*Calcareous:* no
	Notes: Wet at 10', otherwise moist. Soft to medium stiff. Many (~50%), fine (<1 mm), prominent, dark yellowish brown (10YR 4/6) redox concentrations as masses, commonly having a hard Fe "nucleus". The mottles have increasingly amorphous boundaries with depth. Slick gray clay skins also noted.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* silty clay (0/tr/40/60)	*Recovery:* 24 inches	*Blows:* 3/2/3/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium to soft, especially in the lower third. Silty laminations begin in this interval. A wet layer was observed at 12'. Redox concentrations now lack any obvious structure. A shell layer was observed at 12.5" and an Fe or Mn nodule-rich layer at 15.5'.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* silty clay (0/0/30/70)	*Recovery:* 24 inches	*Blows:* 2/2/2/3
	Color of matrix: grayish brown (2.5Y 5/2) to dark greenish gray (10Y 4/1) at 15'-15.5'	*Sampled:* no	*Calcareous:* no
	Notes: This interval represents a transition zone - is wet in upper 8" with a color change to gleyed silty clay at 15' - 15.5'. Very clean fracture planes were observed. Some free water noted along breaks. Redox concentrations down to 15-20%.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* clayey silt (0/tr/70/30)	*Recovery:* 24 inches	*Blows:* 2/1/2/3
	Color of matrix: dark greenish gray (10Y 4/1)	*Sampled:* yes: 5L - 16'	*Calcareous:* shells
	Notes: Wet, soft silty clay in upper 6", coarsening downwards. Shells encountered between 16' and 17'. Distinct lack of redox concentrations. Some free water on breaks.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 24 inches	*Blows:* 1/1/1/2
	Color of matrix: dark greenish gray (5GY 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: moist to moist. Redox concentrations still absent until 19', after which they are common (20-30%), fine (<1 mm), prominent dark yellowish brown (10YR 3/6) masses. Very slight increase in clay with depth. Woody fibers observed at 19.5'.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 5L (continued)		
Depth	**Unit Descriptions**		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 21 inches	*Blows:* 2/2/2/2
	Color of matrix: dark greenish gray (5GY 4/1) grading to very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: Grading back to predominantly silt. Mottled as above, perhaps less frequent.		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* clayey silt (0/tr/85/15) to fine sand (0/100/0/0)	*Recovery:* 24"	*Blows:* 4/8/19/13
	Color of matrix: very dark gray (10YR 3/1) in clayey silt, dark grayish brown (2.5Y 4/2) in sand	*Sampled:* no	*Calcareous:* no
	Notes: Contact with fine, well-sorted, angular sand at 23.75' Moist to saturated in sand.		



Appendix A: Geologic descriptions and graphic logs

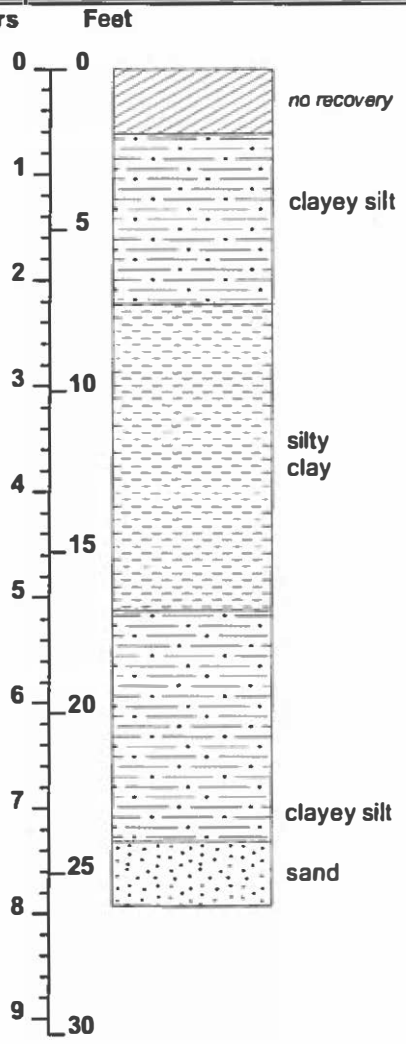
Boring	New River / Luehmann 6X (no well installed due to flowing sand)
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/14/00 - start: 13:05
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	50°, drizzle
Comments	ATV rig, CME 850, 6-Inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* NA	*Recovery:* 3 inches	*Blows:* 4/4/4/4
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Junk from plowed zone.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 8.5 inches	*Blows:* 4/5/5/8
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: Dry, stiff, structureless. Few, fine (<1 mm), distinct redox concentrations and Fe or Mn nodules.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* clayey silt (0/tr/80/20)	*Recovery:* 11 inches	*Blows:* 3/4/4/5
	Color of matrix: gray (10YR 5/1)	*Sampled:* no	*Calcareous:* nodules
	Notes: moist, medium to stiff. Fine (<1 mm) calcareous nodules beginning at 5' 6". Zone of coarse (up to 4mm) Fe or Mn nodules between 5' 6" and 5' 9". Redox concentrations as yellowish-brown masses still few. Clay content increasing with depth.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/tr/80/20) grading to silty clay (0/0/40/60)	*Recovery:* 17 inches	*Blows:* 3/3/3/3
	Color of matrix: grayish brown (10YR 5/2) in silt to grayish brown (2.5Y 5/2) in clay	*Sampled:* no	*Calcareous:* NA
	Notes: moist and soft. A band of Fe or Mn nodules was observed at 7'. Soft gray clay at 7' 4" also marks the change to silty clay. Redox concentrations as masses increasing. Some old root channels observed in the silty clay.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* silty clay (0/0/40/60)	*Recovery:* 24 inches	*Blows:* 3/2/2/2
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Prominent redox concentrations between 8' and 8' 10" (up tp 50%), less through 9' 7", but then resuming to end of interval. Mottle-free area is clay-rich, bounded by siltier areas.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 6X (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silty clay or clayey silt (0/0/50/50)	*Recovery:* 21 inches	*Blows:* 2/1/2/2
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Moist, soft with many(50%), medium (>1 mm), prominent yellowish brown (10YR 4.5/6) redox concentrations as masses with indistinct boundaries. Some silty laminations visible at ~11', below which slick gray, wet, linear features (old roots?) are common.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* silty clay (0/0/35/65)	*Recovery:* 22 inches	*Blows:* 2/2/2/2
	Color of matrix: gray (N 5/0)	*Sampled:* no	*Calcareous:* nodules
	Notes: Calcareous nodules encountered at 12'. Starting as per previous interval and becoming more clay-rich from 12' 3" to bottom. Free water observed on fractures from 13' down. Clay skins still evident.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* silty clay (0/0/35/65 to 0/0/50/50)	*Recovery:* 22 inches	*Blows:* 2/2/2/2
	Color of matrix: gray (N 5/0) to dark gray (N 4/0)	*Sampled:* no	*Calcareous:* no
	Notes: Moist and soft, sharp transition in color corresponding to an increase in silt content to 50%. Very few or no redox concentrations.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* silty clay (0/0/50/50) to clayey silt (0/0/90/10) at 16' 9"	*Recovery:* 18 inches	*Blows:* 3/3/3/3
	Color of matrix: dark gray (N 4/0) to greenish gray (5GY 5/1)	*Sampled:* yes: labeled 6L-17'	*Calcareous:* no
	Notes: Moist to saturated and soft. As per previous interval until 16' 9", where gleyed clayey silt begins. Few, fine (<1 mm) redox concentrations observed in the silt. No laminations visible.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey silt (0/0/90/10)	*Recovery:* 12 inches	*Blows:* 2/4/8/8
	Color of matrix: greenish gray (5GY 5/1 to 10GY 5/1)	*Sampled:* no	*Calcareous:* no
	Notes: Soft to slop, saturated. Some possible laminations, but the sample deteriorated due to the amount of water in the spoon (~250 ml).		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* silty clay or clayey silt (0/0/50/50)	*Recovery:* 4 inches	*Blows:* 0/0/0/1
	Color of matrix: NA	*Sampled:* yes: labeled 6L-21ft	*Calcareous:* no
	Notes: Moist, soft. Difficult to tell where sample recovered from. Clay content has increased and some woody fibers and charcoal are present.		

Boring	New River / Luehmann 6X (continued)		
Depth	**Unit Descriptions**		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* silty clay or clayey silt (0/0/50/50) to clayey silt (0/tr/75/25)	*Recovery:* 24 inches	*Blows:* 4/7/8/9
	Color of matrix: reddish brown (5YR 4/3)	*Sampled:* yes: labeled 6L-23ft	*Calcareous:* no
	Notes: Medium stiff, moist. As per previous interval until a sharp transition at 22' 4" to a reddish clayey silt. Some old roots are visible at the contact, as are charcoal and woody debris.		
7.32 - 7.92 m (24 - 26 ft)	*Geologic material:* fine sand (0/98/2/0)	*Recovery:* 24 inches	*Blows:* NA
	Color of matrix: NA	*Sampled:* yes: labeled 6L-25ft	*Calcareous:* nodules
	Notes: The interval is almost entirely well-rounded, quartz-rich fine sand, with just the lower basket terminating in reddish clay. Some calcareous nodules in the sand.		



Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 6L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/14/00 - start: 15:45
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	65°, sunny
Comments	ATV rig, CME 850, 6-Inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

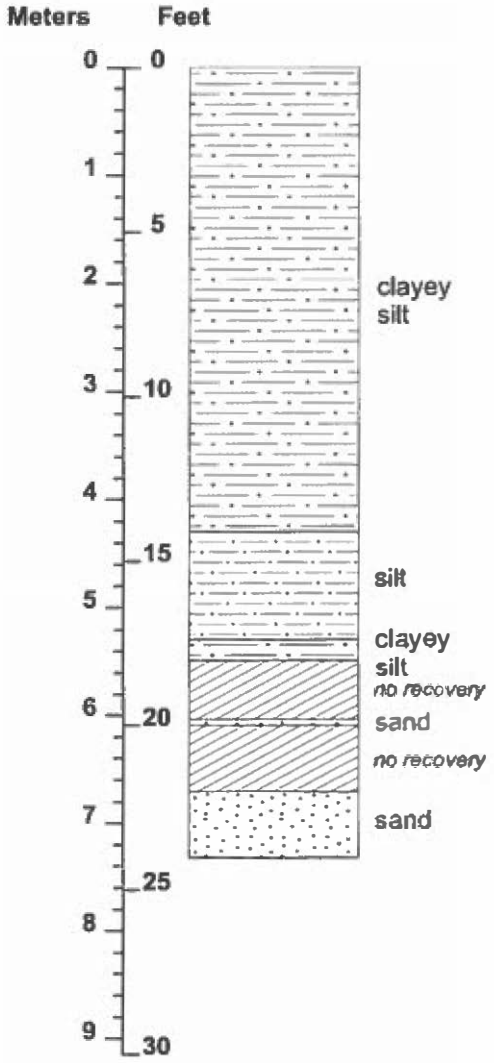
Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* clayey silt (0/5/85/10)	*Recovery:* 12 inches	*Blows:* 4/2/2/3
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Dry to moist, soft. Plowed zone, crumbly silt with some fine sand.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* clayey silt (0/5/85/10)	*Recovery:* 11 inches	*Blows:* 4/3/3/4
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: moist, soft with a slight increase in clay content.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* as above to clayey silt (0/tr/75/25)	*Recovery:* 17 inches	*Blows:* 4/3/5/5
	Color of matrix: dark gray (10YR 4/1) to gray (10YR 5/1)	*Sampled:* no	*Calcareous:* no
	Notes: Color and texture grade throughout sample - fining downwards. Common (30%), fine (<1mm) and disseminated, prominent crimson and yellowish brown redox concentrations. Some roots at 5' 8".		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/tr/75/25)	*Recovery:* 20 inches	*Blows:* 6/6/6/8
	Color of matrix: gray (10YR 5/1)	*Sampled:* no	*Calcareous:* nodules
	Notes: Dry tp moist, medium stiff. First layer of calcareous nodules at 7'2" and again at 7' 6", occurring with Fe or Mn nodules. Localized fine (<1 mm), strong brown (7.5YR 4/6) redox concentrations.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/tr/75/25) to clayey silt (0/tr/90/10)	*Recovery:* 15 inches	*Blows:* 2/3/4/7
	Color of matrix: gray (10YR 5/1) to grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium-stiff with medium calcareous nodules occurring at ~9'. A major Fe and/or Mn zonation occurs at that depth to 9.5", where nodules represent up to 50% of the whole. Fe or Mn nodules are generally fine (<1 mm) but coalesce into large masses having a yellowish-brown corona.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 6L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 16-inches	*Blows:* 4/4/4/4
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: A saturated silt lens was observed between 11' 2" and 11' 6". No redox concentrations were noted in the silt lens until 11' 8", after which many (up to 50%), fine (≥1 mm), prominent, yellowish brown (10YR 5/6) redox concentrations as masses were observed. As in previous borings, the masses often had hard Fe nuclei.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 13 inches	*Blows:* 3/3/3/3
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Moist to saturated. Same as previous interval, possibly laminated with more discrete, fine (≤1 mm) Fe or Mn nodules. Localized saturated zone at ~13' 2".		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* silt (0/tr/95/5)	*Recovery:* 12 inches	*Blows:* 5/5/5/5
	Color of matrix: grayish brown (2.5Y 5/2)	*Sampled:* no	*Calcareous:* no
	Notes: Saturated throughout with many, coarse, prominent redox concentrations yielding and overall orange/gray color.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* silt (0/tr/95/5) to clayey silt (0/tr/85/15) at 17.5'	*Recovery:* 24 inches	*Blows:* 2/4/3/2
	Color of matrix: dark greenish gray (10Y 4/1) to dark brown (7.5YR 3/2) or brown (7.5YR 4/2)	*Sampled:* no	*Calcareous:* no
	Notes: Very soft, moist to saturated with an abrupt contact to brown clayey silt at 17.5'. Redox features rare or non-existent. Trace of fine sand at bottom of interval.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* fine sand	*Recovery:* none	*Blows:* 0/0/2/2
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Only returned sand at the bottom of the basket at ~20'.		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* fine sand (0/98/2/0)	*Recovery:* 17 inches	*Blows:* NA
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Fine, well-sorted sand with some larger (~2 mm clasts). No other details as crew rushed to get well into hole.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 6L (continued)



Appendix A: Geologic descriptions and graphic logs

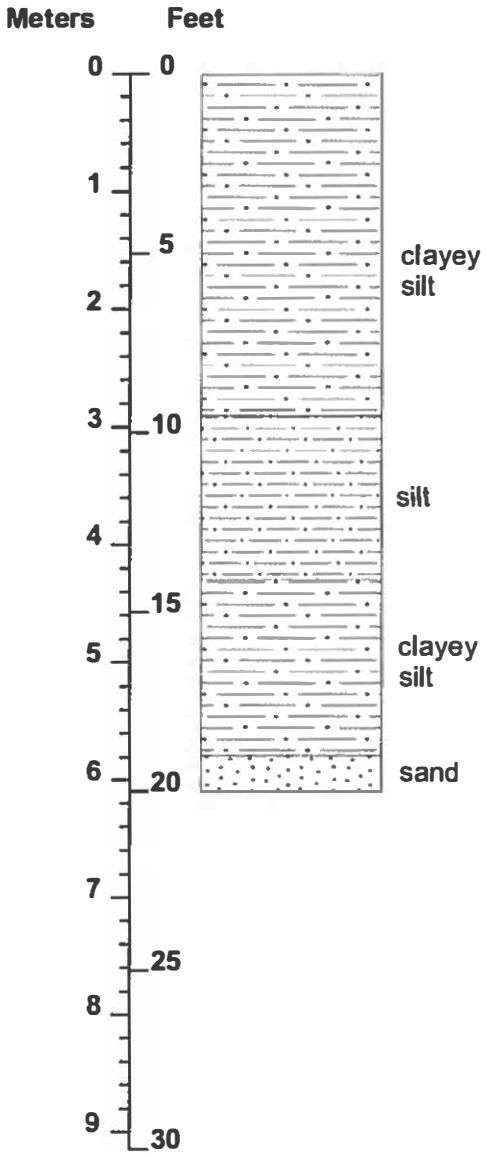
Boring	New River / Luehmann 7L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/15/00 - start: 8:15
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	52°, sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	**Unit Descriptions**		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* clayey silt (0/tr/80/20)	*Recovery:* 12 inches	*Blows:* 4/5/5/5
	Color of matrix: very dark gray (10YR 3/1)	*Sampled:* no	*Calcareous:* no
	Notes: moist, medium to soft. Few to common, fine (<1 mm) yellowish brown redox concentrations. Some lighter silt-rich sub-laminations, possibly deposited during pond overflow events. Roots observed.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* clayey silt (0/tr/80/20 to 0/tr/60/40)	*Recovery:* 15 inches	*Blows:* 4/6/6/6
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Soft, clayey silt changing to stiff clayey silt at ~3'. Some oxidized root channels and few, fine (<1 mm) but very prominent yellowish red (5YR 4/6) redox concentrations.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* clayey silt (0/tr/60/40)	*Recovery:* 11 inches	*Blows:* 3/3/3/6
	Color of matrix: dark gray (2.5Y 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: moist, stiff to medium-stiff. Change in color to more gray with an accompanying decrease in redox concentrations with depth. Poor recovery limits actual depth designations.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/tr/60/40)	*Recovery:* 20 inches	*Blows:* 7/7/7/6
	Color of matrix: gray (10YR 5/1) to grayish brown (2.5Y 5/2) by 8'	*Sampled:* no	*Calcareous:* no
	Notes: -moist or to moist between 6.5' and 7.25'. Medium-stiff with redox concentrations increasing in size (1-2 mm) and frequency (up to 30-40% by 8'). Slick gray clay skins observed at 7.5'.		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 7L (continued)		
Depth	**Unit Descriptions**		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/tr/60/40) to clayey silt (0/tr/90/10) at 9.5' to end	*Recovery:* 16-inches	*Blows:* 5/4/4/5
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Fe or Mn nodule-rich zone, approximately 2 inches thick starting at 9'. Silty layer of saturated sediments encountered at 9.5' through end of interval. The clay content generally fluctuates through the interval. Many (up to 50%) coarse (up to 5mm) redox concentrations are mainly below the Fe/Mn band. Some slick gray clay skins noted and what may be weak bedding in the sediments.		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* silt (0/tr/95/5)	*Recovery:* 10 inches	*Blows:* 3/4/3/2
	Color of matrix: light olive brown (2.5Y 5/3) - mix of matrix/redox features, no discernable boundaries	*Sampled:* no	*Calcareous:* no
	Notes: Saturated, very soft silt, possibly marking the point at which clay mining of the adjacent depression (pond) stopped. Some faint laminations are visible. The separation of the matrix from the redox concentrations is impossible, as boundaries are diffuse over 2-5 millimeters, producing a "sunburst" effect. At 11.75', a 2-inch clay-rich layer was observed. Sediments below this layer were appreciably drier, suggesting it is acting as a perching layer, albeit localized.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* slit (0/tr/95/5)	*Recovery:* 12 inches	*Blows:* 3/2/1/2
	Color of matrix: NA	*Sampled:* yes: Bore B - 13'	*Calcareous:* no
	Notes: As per interval immediately above, minus the clay layer. Some thin, dark, slick clay-rich lineations noted, possibly old root traces.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* clayey silt (0/tr/90/10)	*Recovery:* 21 inches	*Blows:* 2/2/2/1
	Color of matrix: light olive brown (2.5Y 5/3) to greenish gray (10Y 5/1) at 15' 3"	*Sampled:* no	*Calcareous:* no
	Notes: As per previous interval, but drier from 14' through 15'. A saturated zone was encountered between 15' 2" and 15' 6". Color change at 15' 3", but texture remains essentially the same. Redox concentrations are absent below 15' 3", and the sediments adopt a gleyed hue.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 19 inches	*Blows:* 3/2/1/2
	Color of matrix: dark greenish gray (10Y 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: As per previous interval, very soft and saturated until 16.5' after which sediments are only moist. Few, fine (<1 mm) dark brown redox concentrations.		

Boring	New River / Luehmann 7L (continued)		
Depth	**Unit Descriptions**		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey silt (0/5/85/10)	*Recovery:* 17 inches	*Blows:* 3/4/8/10
	Color of matrix: dark brown (7.5YR 3/2) to very dark grayish brown (10YR 3/2) in sand	*Sampled:* yes: 7L-19ft, SAMPLE MISSING	*Calcareous:* no
	Notes: Continuity with the last interval is not evident. This interval starts with a reddish-grey clayey silt and some fine sand. The reddish hue is actually dark brown (7.5YR 3/2), but appears prominently red against the gleyed hue of the upper interval. Changes to sub-angular to sub-rounded fine sand at 19'.		



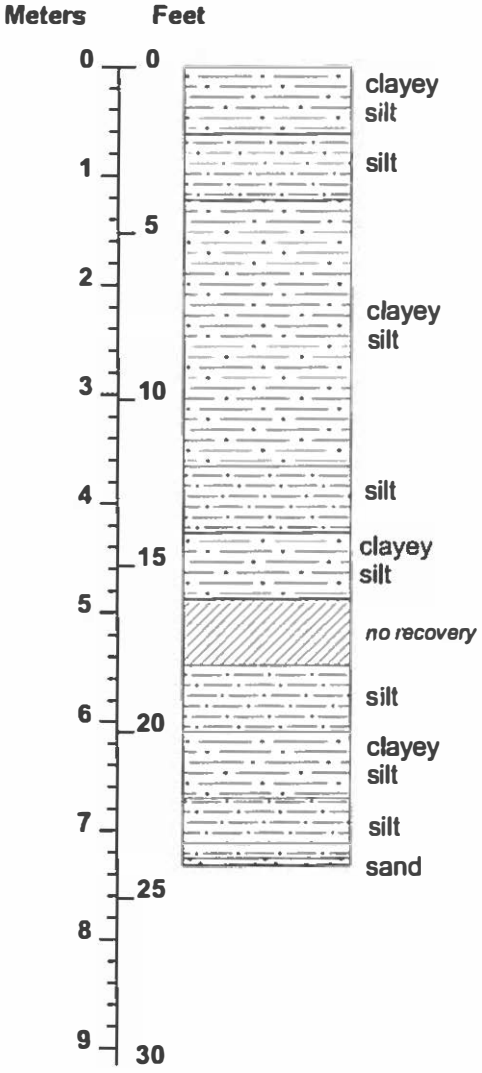
Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 8L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/15/00 - start: 9:55
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	60°, sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* clayey silt (0/tr/90/10)	*Recovery:* 12 inches	*Blows:* 7/6/5/4
	Color of matrix: dark brown (10YR 3/3)	*Sampled:* no	*Calcareous:* no
	Notes: Dry to moist plowed zone. Generally lacking the redox concentrations and oxidized root channels seen in the borings on the west side. Few, fine (<1 mm) Fe or Mn concretions.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* silt (0/tr/100/tr)	*Recovery:* 2 inches	*Blows:* 6/5/5/4
	Color of matrix: dark olive brown (2.5YR 3/3)	*Sampled:* no	*Calcareous:* no
	Notes: Very stiff and dry with visible silt laminations. Dark yellowish brown (10YR 4/6) redox concentrations as masses oriented along "bedding planes"		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* clayey silt (0/tr/75/25)	*Recovery:* 12 inches	*Blows:* 5/5/4/7
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Very stiff and dry, with a slight increase in clay content with depth. Darker in color with few, fine, distinct redox concentrations or oxidized root channels, but still generally less redox features than seen *in* previous borings. Stiffest and driest interval yet encountered.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/tr/75/25)	*Recovery:* 17 inches	*Blows:* 6/8/9/10
	Color of matrix: dark gray (10YR 4/1)	*Sampled:* no	*Calcareous:* no
	Notes: Dry and very stiff. At 6' 7" a 2-inch, 100% silt layer as encountered. Otherwise, as per previous interval. Redox concentrations are increasing in frequency to 20-30%, still fine (<1 mm) with occasional Fe or Mn nodule.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/tr/75/25)	*Recovery:* 20 inches	*Blows:* 6/8/11/12
	Color of matrix: light olive brown (2.5Y 5/3)	*Sampled:* no	*Calcareous:* no
	Notes: Dry to moist, stiff. Common, coarse (up to 1 cm) Fe and/or Mn nodules observed, starting at 8' 2" and continuing through the interval. Orange-brown redox concentrations also noted, up to 2 mm in diameter. Concentrations and Fe or Mn nodules comprise ~40% of whole. Some gray wet clay at 9'.		

Boring	New River / Luehmann 8L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* clayey silt (0/2/88/10)	*Recovery:* 15 inches	*Blows:* 3/3/4/4
	Color of matrix: olive brown (2.5Y 4/3)	*Sampled:* yes: 8L-11/12ft	*Calcareous:* no
	Notes: As per previous interval but now softer and moist. Prominent redox concentrations in the last 4". Faint laminations and some charcoal and sand, up to 5-8% of whole, especially in the last 6". Clay absent by 11'.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* silt (0/2/98/tr) to silty sand in lenses (0/95/5/0)	*Recovery:* 9.5 inches	*Blows:* 4/3/2/3
	Color of matrix: olive brown (2.5Y 4/3)	*Sampled:* no	*Calcareous:* no
	Notes: Soft and moist to saturated in the sand lenses. A 2" lens of fine, sub-angular to sub-rounded sand was observed between 13' 3" and 13' 5" and also at the very bottom of the interval. Amorphous, dark yellowish brown (10YR 4/6) coloring along some faint laminations. Some roots noted.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* clayey silt (0/tr/90/10)	*Recovery:* 15 inches	*Blows:* NA
	Color of matrix: olive brown (2.5Y 4/3)	*Sampled:* no	*Calcareous:* no
	Notes: Moist to saturated and very soft. Sand at very top, otherwise as per previous interval. Free water on break at 17.5'.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* NA	*Recovery:* NA	*Blows:* NA
	Color of matrix: NA	*Sampled:* NA	*Calcareous:* NA
	Notes: Drillers missed taking a spoon from this interval.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* silt (0/tr/98/2)	*Recovery:* 24 inches	*Blows:* 5/4/4/4
	Color of matrix: dark greenish gray (10Y 4/1)	*Sampled:* yes: labeled "8L-16-18ft" but actually from 19ft	*Calcareous:* no
	Notes: Saturated and soft, generally ~100% silt with some sand lenses. Clay content increases to 20% in the last 3" of the interval. As per 14'-16' interval until redox concentrations discontinue and clay drops out by 18.5'. Sandy lens encountered between 17' 4" and 17' 6". Large charcoal masses (~2 cm) comprising a pseudo-vein between 17' 11" and 18' 1", associated with sandy sediments.		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* clayey silt (0/tr/75/25)	*Recovery:* 18 inches	*Blows:* 4/3/3/3
	Color of matrix: dark greenish gray (10Y 4/1) to brown (7.5YR 4/2)	*Sampled:* no	*Calcareous:* shells
	Notes: Soft, moist. A faint, less than 1 inch thick layer of shells visible at 20'. Clay content increases until sand appears at ~21'. Sand occurs in small lenses, inter-tonguing with silt. Inter-tonguing precedes the color change to brown (7/5Y 4/2).		

Boring	New River / Luehmann 8L (continued)		
Depth	**Unit Descriptions**		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* silt (0/tr/95/5) to fine sand (0/95/5/0)	*Recovery:* 24 inches	*Blows:* 4/4/6/6
	Color of matrix: dark greenish gray (10Y 4/1) in silt to dark grayish brown (2.5Y 4/2) in sand	*Sampled:* no	*Calcareous:* no
	Notes: Sand occurs between 22' 8" and 23' 4" and in last 3" of the interval. Contacts are fairly abrupt. The sand is sub-angular to sub-rounded and fine with some medium clasts. Silt is uniform gleyed color without redox concentrations and is faintly laminated.		



Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 9L
Location	SW¼, SW¼ Sec. 6, T3N, R8W, Monk's Mound, Illinois
Date / Time	3/15/00 - start: 12:40
Field Crew	Steve Benton, Brad Ketterling, Blaine Watson
Weather Conditions	65°, sunny
Comments	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Well Construction	(see Appendix B)

Depth	Unit Descriptions		
0 - 0.61 m (0 - 2 ft)	*Geologic material:* clayey silt (0/0/70/30)	*Recovery:* 8 inches	*Blows:* 4/5/5/4
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Dry, stiff, plowed zone. Some roots and very few redox concentrations.		
0.61 - 1.22 m (2 - 4 ft)	*Geologic material:* clayey silt (0/0/70/30)	*Recovery:* 11 inches	*Blows:* 4/6/7/8
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* no
	Notes: Dry and very stiff. As per previous interval. Has an almost massive structure. Few, fine (<<1 mm) redox concentrations. Clay content may be dropping below 20%.		
1.22 - 1.83 m (4 - 6 ft)	*Geologic material:* clayey silt (0/0/70/30)	*Recovery:* 14 inches	*Blows:* 6/6/6/12
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Dry and very stiff. A layer of angular calcareous nodules observed at 5' 4", but are also disseminated through the interval. Yellowish-brown redox concentrations increasing with depth, but still less than 1 mm in diameter.		
1.83 - 2.44 m (6 - 8 ft)	*Geologic material:* clayey silt (0/tr/80/20)	*Recovery:* 24 inches	*Blows:* 7/8/7/9
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* yes: 9L-6-8ft	*Calcareous:* nodules
	Notes: Dry to moist. Large calcareous nodules (up to 7mm) at 7' 4" and 8'. Blocky structure. Redox concentrations increasing to 35%, generally fine (<2 mm). Occasional fine (<1 mm) Fe or Mn nodule.		
2.44 - 3.05 m (8 - 10 ft)	*Geologic material:* clayey silt (0/tr/80/20)	*Recovery:* 9 inches	*Blows:* 2/2/4/5
	Color of matrix: very dark grayish brown (10YR 3/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium stiff. Possible gray clay skins. Poor recovery.		

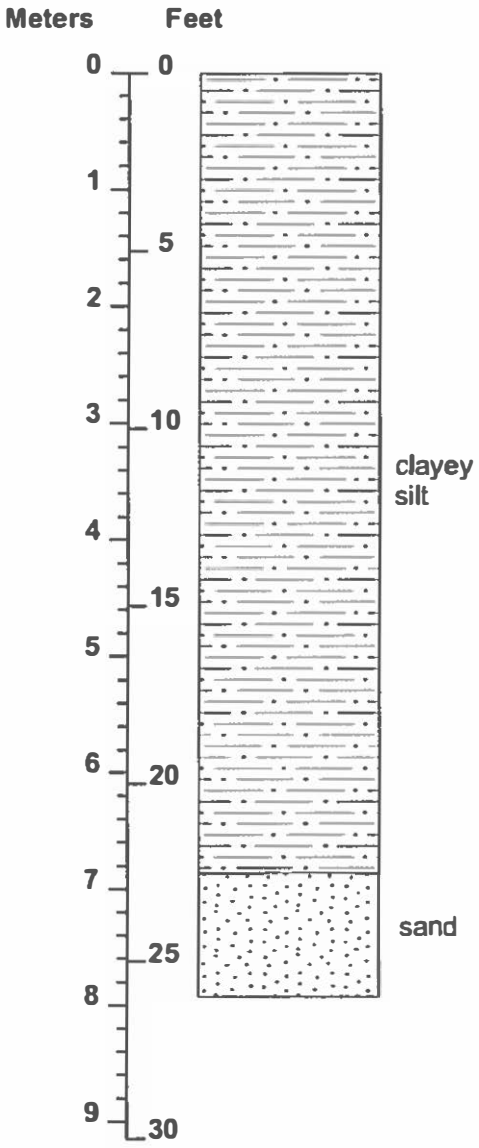
Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 9L (continued)		
Depth	**Unit Descriptions**		
3.05 - 3.66 m (10 - 12 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 24 inches	*Blows:* 5/4/4/5
	Color of matrix: grayish brown (10YR 5/2)	*Sampled:* yes: 9L-10-11 ft	*Calcareous:* nodules
	Notes: moist, medium to soft clayey silt. A layer of calcareous nodules was observed at 10' 6" and again at 10' 10" (0.75" thick). Redox concentrations increase in size and frequency between 10' 6" and 11' 4" Fe or Mn nodules up to 3mm in diameter noted. Between 11' 4" and 11' 8", redox concentrations cease and texture becomes a sticky, gray, clay-rich and saturated silt. Redox concentrations and s.c. silt texture resume below 11' 8" and faint laminations begin.		
3.66 - 4.27 m (12 - 14 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 24 inches	*Blows:* 5/5/5/8
	Color of matrix: grayish brown (10YR 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium stiff and moist. Woody debris or root noted at 12' 7". As above until another clay-rich, mottle-free layer occurs between13' 3" and 13' 9". Redox concentrations resume and become coarse (up to 8mm) masses with indistinct boundaries.		
4.27 - 4.88 m (14 - 16 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 24 inches	*Blows:* 5/5/7/2
	Color of matrix: grayish brown (10YR 5/2)	*Sampled:* no	*Calcareous:* nodules
	Notes: Medium stiff and moist. Fine (<1 mm) calcareous nodules are disseminated throughout the interval and appear to be occupying old root channels. Laminations are becoming well-developed. Redox concentrations are approaching 50%.		
4.88 - 5.49 m (16 - 18 ft)	*Geologic material:* clayey silt (0/tr/85/15)	*Recovery:* 24 inches	*Blows:* 5/9/8/8
	Color of matrix: gray (2.5Y 5/1)	*Sampled:* no	*Calcareous:* nodules
	Notes: Dry to moist and medium stiff. As per previous interval, with areas of ~95% silt. Old root voids are present. An organic-rich layer was observed at 16'. Redox concentrations and silt laminae are faint by 17' 4". Charcoal laminations observed at 17' 11". Becoming massive.		
5.49 - 6.10 m (18 - 20 ft)	*Geologic material:* clayey silt (see breakdown below)	*Recovery:* 24 inches	*Blows:* 5/9/8/8
	Color of matrix: see below	*Sampled:* yes: 9L-19-20ft	*Calcareous:* no
	Notes: Moist, medium-stiff to soft: 18' 0" - 18' 6": clayey silt (0/tr/70/30), grayish brown (2.5Y 5/2), $CaCO_3$ now absent, few redox concentrations few 18' 6" - 19' 6" clayey silt (0/0/60/40), dark gray (10YR 4/1), few redox concentrations, faint laminations and some woody fibres 19' 6" - 20' 0" clayey silt (0/tr/70/30), very dark gray (10YR 3/1) and organic rich with visible woody fibers		

Appendix A: Geologic descriptions and graphic logs

Boring	New River / Luehmann 9L (continued)		
Depth	**Unit Descriptions**		
6.10 - 6.71 m (20 - 22 ft)	*Geologic material:* clayey silt (0/tr/70/30)	*Recovery:* 13 inches	*Blows:* 2/2/2/3
	Color of matrix: greenish gray (5GY 5/1)	*Sampled:* yes: 9L-21.5ft	*Calcareous:* no
	Notes: Moist to saturated, soft. A thick, organic-rich layer with visible woody fibers noted at 21' 4". Otherwise, similar to the bottom layer of the previous interval. Clay content decreases by 22' to ~90% silt.		
6.71 - 7.32 m (22 - 24 ft)	*Geologic material:* clayey silt (0/tr/70/30) to fine sand (0/100/0/0)	*Recovery:* 22 inches	*Blows:* 5/4/4/5
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Moist to saturated and soft. Grades from clayey silt to fine sandy silt to fine sand by 22' 6". Fine sand persists until 23' 10" where another ½" layer of organic debris (definitely wood) was observed. Rock fragments and reddish silt noted at contact with woody debris. A thinner woody layer noted at 23' 2".		
7.32 - 7.92 m (24 - 26 ft)	*Geologic material:* fine sand (0/90/5/5 to 100% sand)	*Recovery:* NA	*Blows:* 5/5/7/7
	Color of matrix: NA	*Sampled:* no	*Calcareous:* no
	Notes: Saturated and very soft. Shells noted at 24' 9". More woody debris encountered. Primarily pure fine sand with some sticky areas. Terminates in fine sand and some silt.		

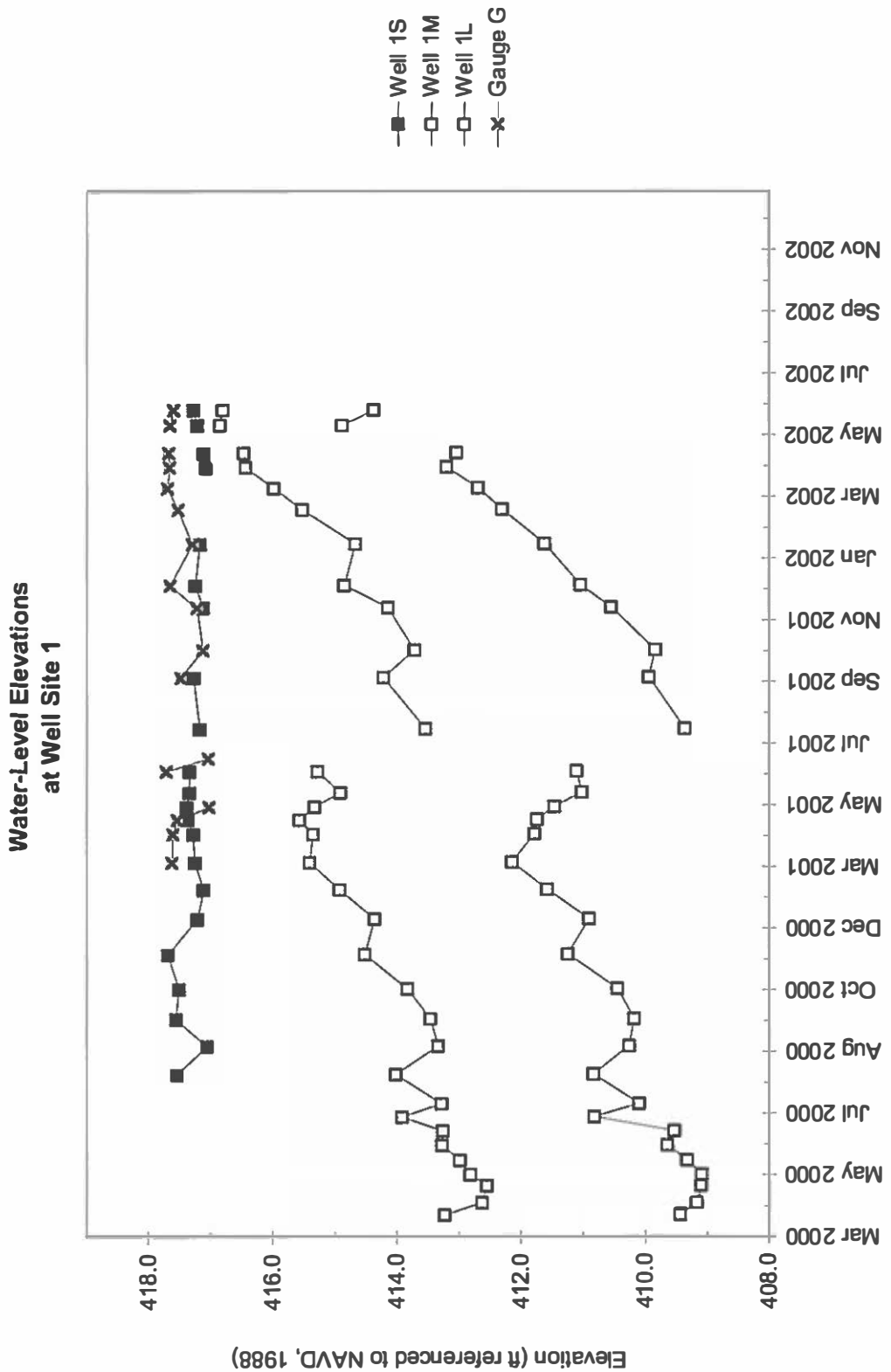
Boring	New River / Luehmann 9L (continued)



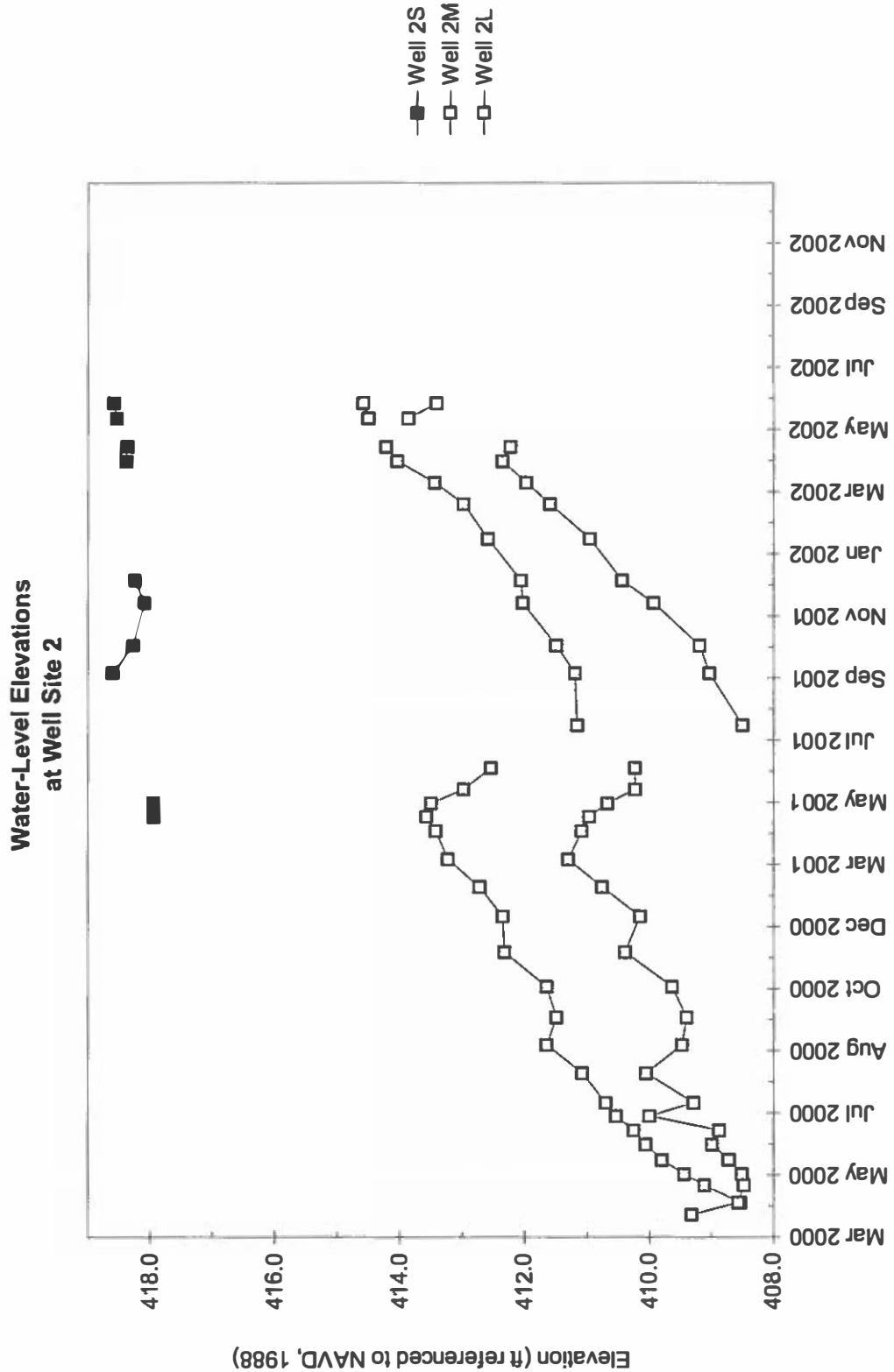
Appendix B: Well construction

Well Number	Elevation of well top (ft)	Land surface elevation (ft)	Total length of well (ft)	Bottom of well **	Well seal - top **	Well seal - bottom **	Sand pack - top **	Sand pack - bottom **	Top of screen **	Bottom of screen **
1S	422.88	419.05	6.20	2.33	0.00	0.98	0.98	2.33	1.36	2.25
1M	421.96	419.05	15.44	12.53	0.00	8.00	8.00	12.53	10.03	12.34
1L	421.92	419.05	24.64	21.76	0.00	12.00	12.00	21.76	19.29	21.60
2S	423.92	419.99	6.34	2.46	0.00	0.98	0.98	2.46	1.30	2.32
2M	423.11	419.99	15.20	12.08	0.00	8.00	8.00	12.08	9.73	11.90
2L	422.91	419.99	31.49	28.57	0.00	14.00	14.00	28.57	26.07	28.40
3S	423.05	419.11	6.33	2.46	0.00	0.98	0.98	2.46	1.34	2.26
3M	420.53	419.11	14.04	12.62	0.00	8.00	8.00	12.62	10.01	12.43
3L	422.27	419.11	27.25	24.09	0.00	19.39	19.39	24.09	21.86	23.90
4S	422.99	418.75	6.40	2.46	0.00	0.98	0.98	2.46	1.22	2.31
4M	421.55	418.75	15.08	12.27	0.00	8.00	8.00	12.27	9.91	12.10
4L	421.26	418.75	26.32	23.80	0.00	19.29	19.29	23.80	21.32	23.63
5S	421.96	418.24	6.29	2.46	0.00	0.98	0.98	2.46	1.32	2.29
5M	421.09	418.24	15.14	12.29	0.00	8.00	8.00	12.29	9.84	12.10
5L	421.73	418.24	29.22	25.73	0.00	19.00	19.00	25.73	23.31	25.56
6S	423.80	419.85	2.43	2.43	0.00	0.98	0.98	2.43	1.17	2.31
6M	422.79	419.85	15.18	12.24	0.00	9.00	9.00	12.24	10.04	12.05
6L	422.73	419.85	22.51	19.63	0.00	14.92	14.92	19.63	17.45	19.48
7S	422.20	418.21	6.45	2.46	0.00	0.98	0.98	2.46	1.25	2.33
7M	421.26	418.21	15.27	12.21	0.00	8.00	8.00	12.21	10.03	12.08
7L	421.96	418.21	22.67	18.92	0.00	15.50	15.50	18.92	16.76	18.76
8S	423.49	419.61	6.32	2.46	0.00	0.98	0.98	2.46	1.31	2.30
8M	422.11	419.73	14.56	12.18	0.00	8.00	12.18	10.43	11.99	12.18
8L	423.12	419.89	26.69	23.46	0.00	20.50	20.50	23.46	22.39	23.28
9S	422.67	418.60	6.56	2.49	0.00	0.98	0.98	2.49	1.43	2.41
9M	421.12	418.60	14.61	12.09	0.00	8.00	8.00	12.09	10.42	12.01
9L	421.48	418.60	26.54	23.66	0.00	21.00	21.00	23.66	22.50	23.50
* NAVD. 88										
** reported in feet below ground surface										

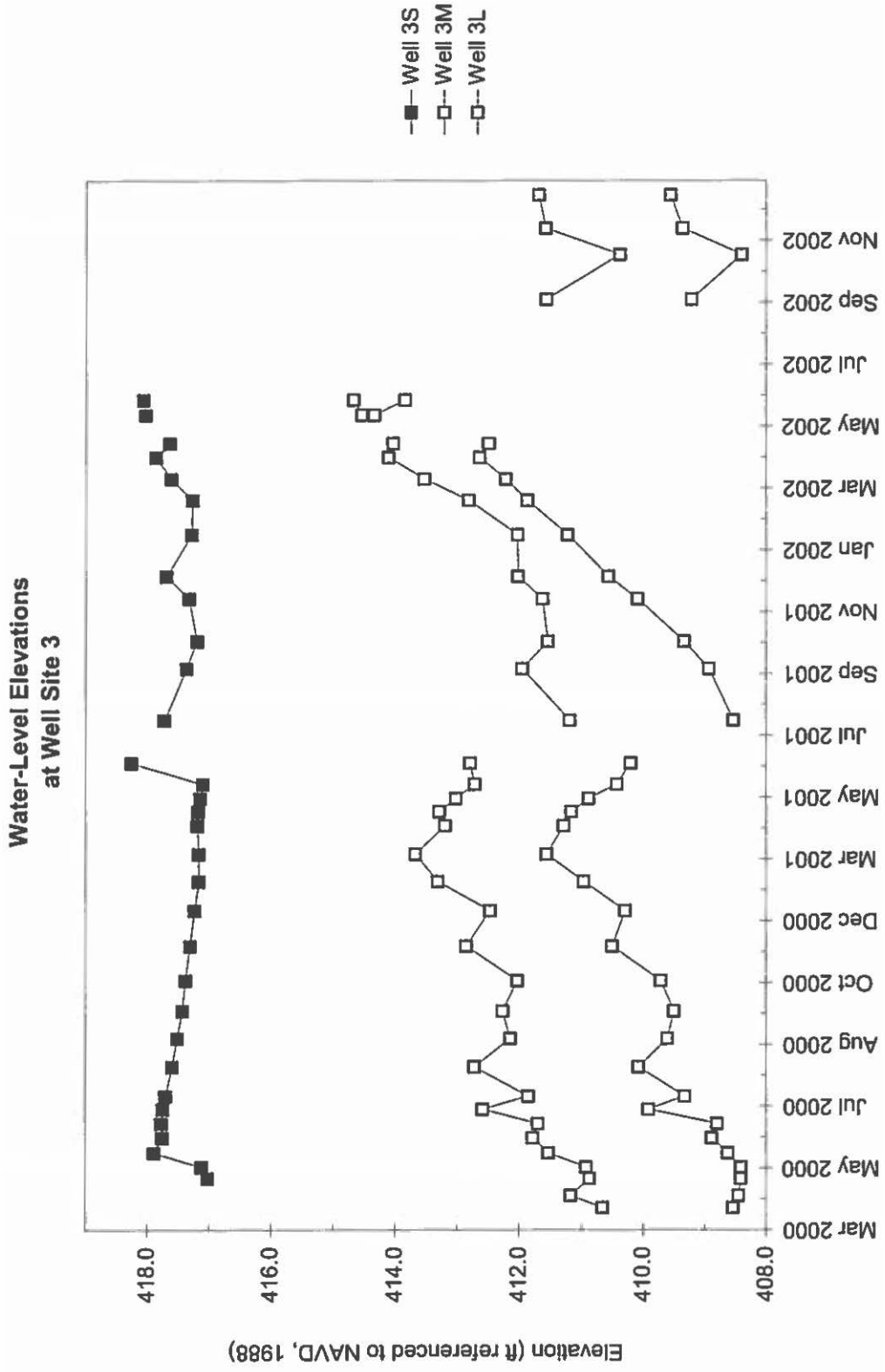
Appendix C: Water-level records - graphical



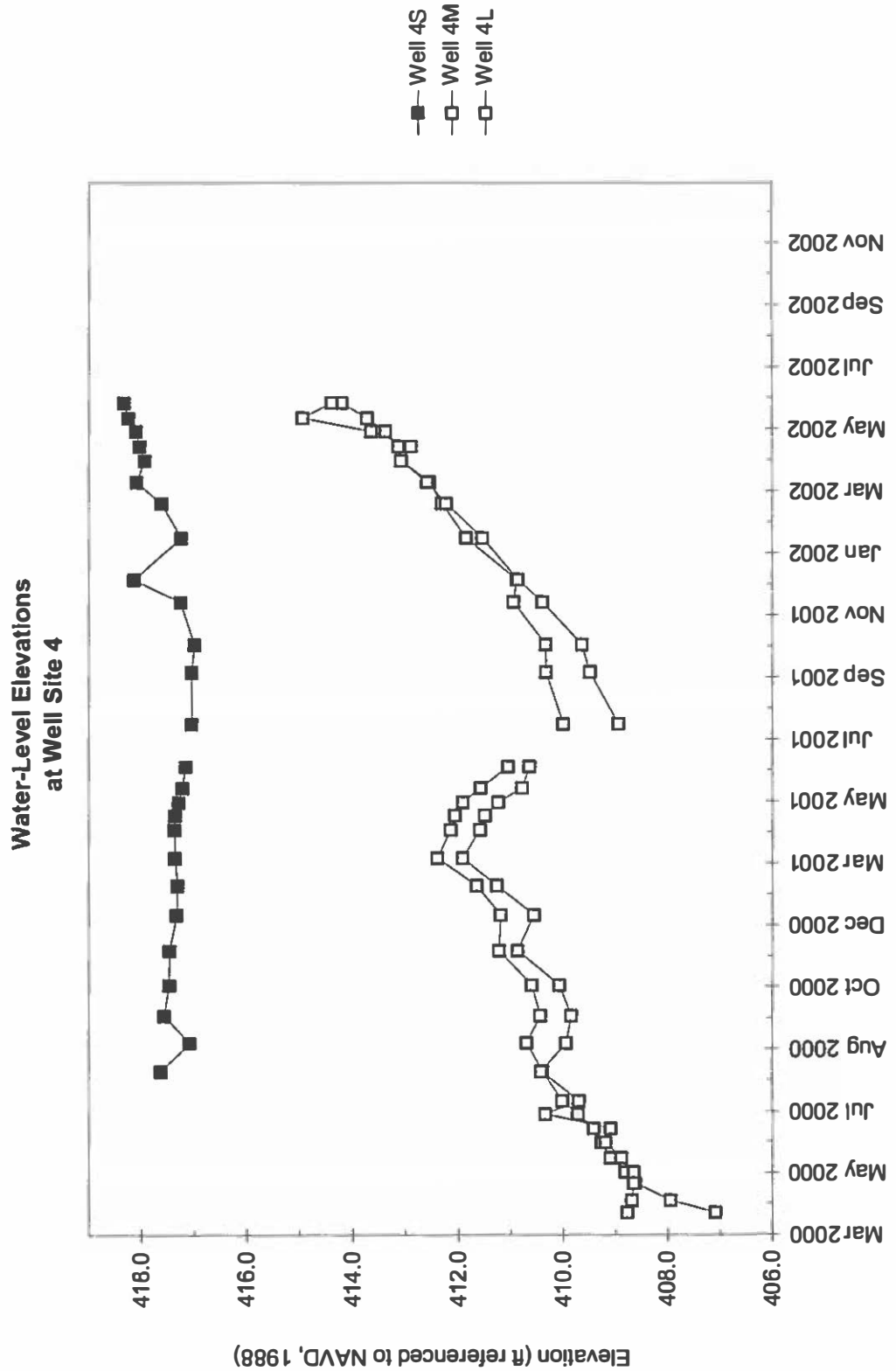
Appendix C: Water-level records - graphical



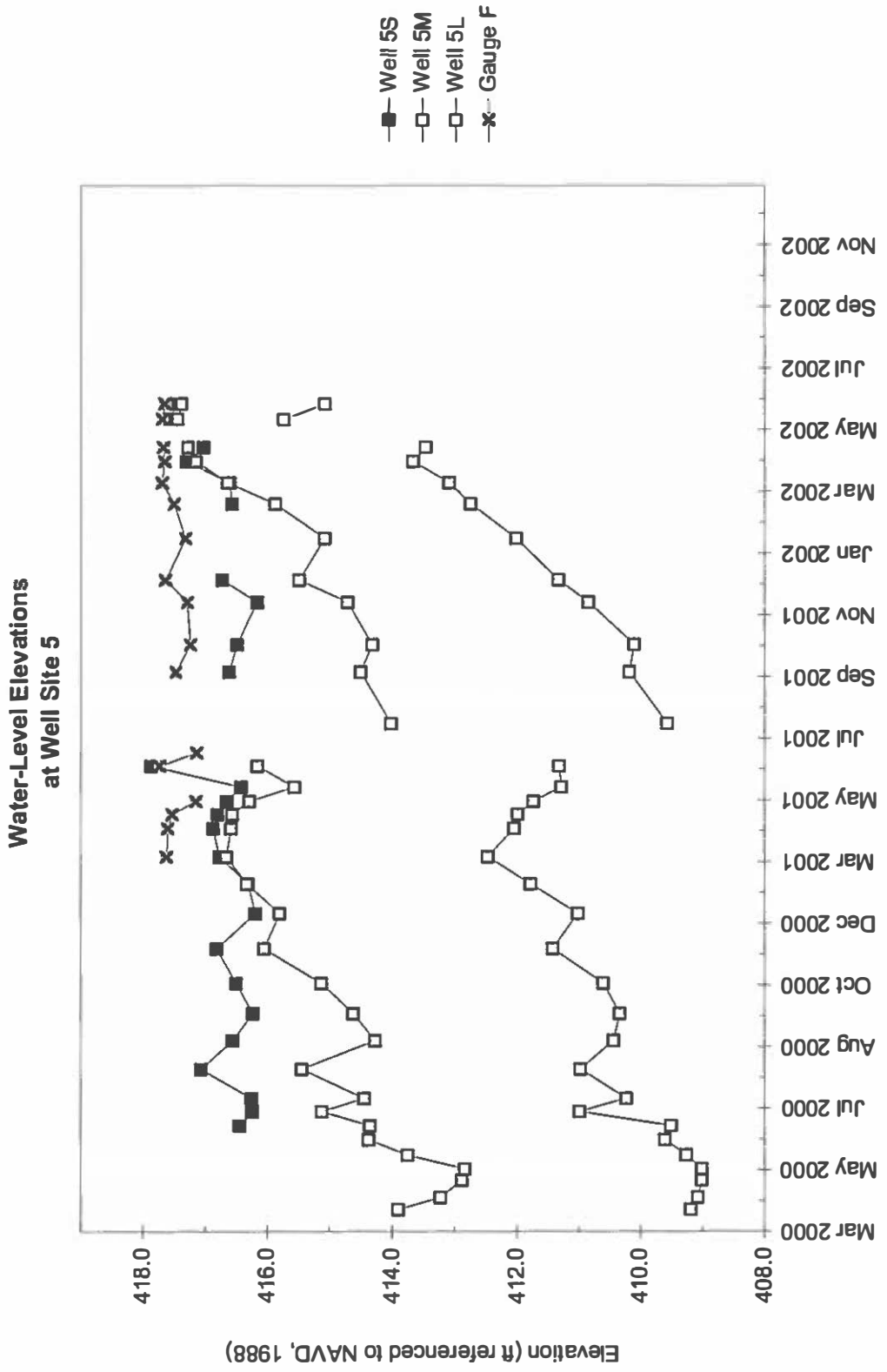
Appendix C: Water-level records - graphical



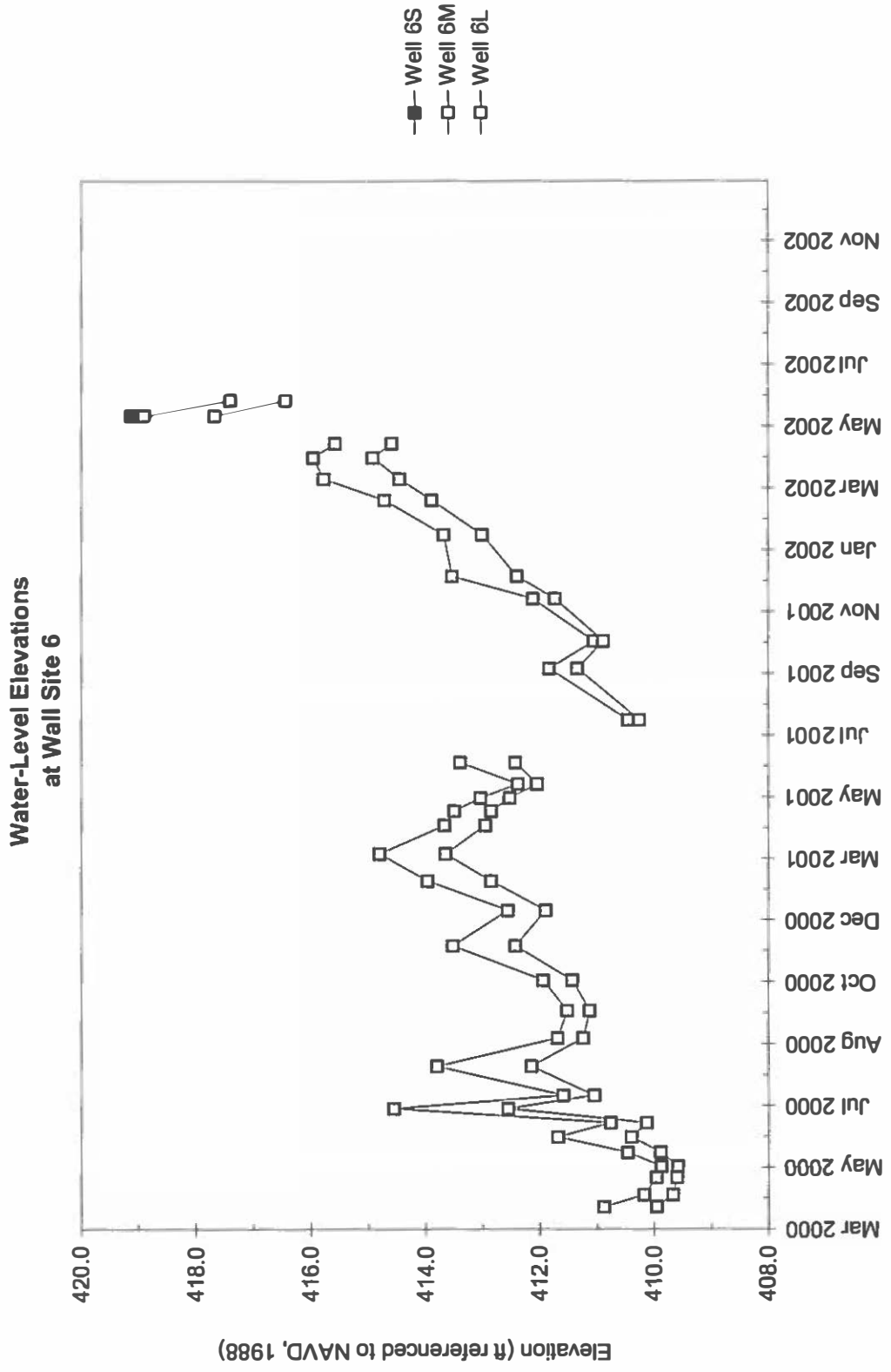
Appendix C: Water-level records - graphical



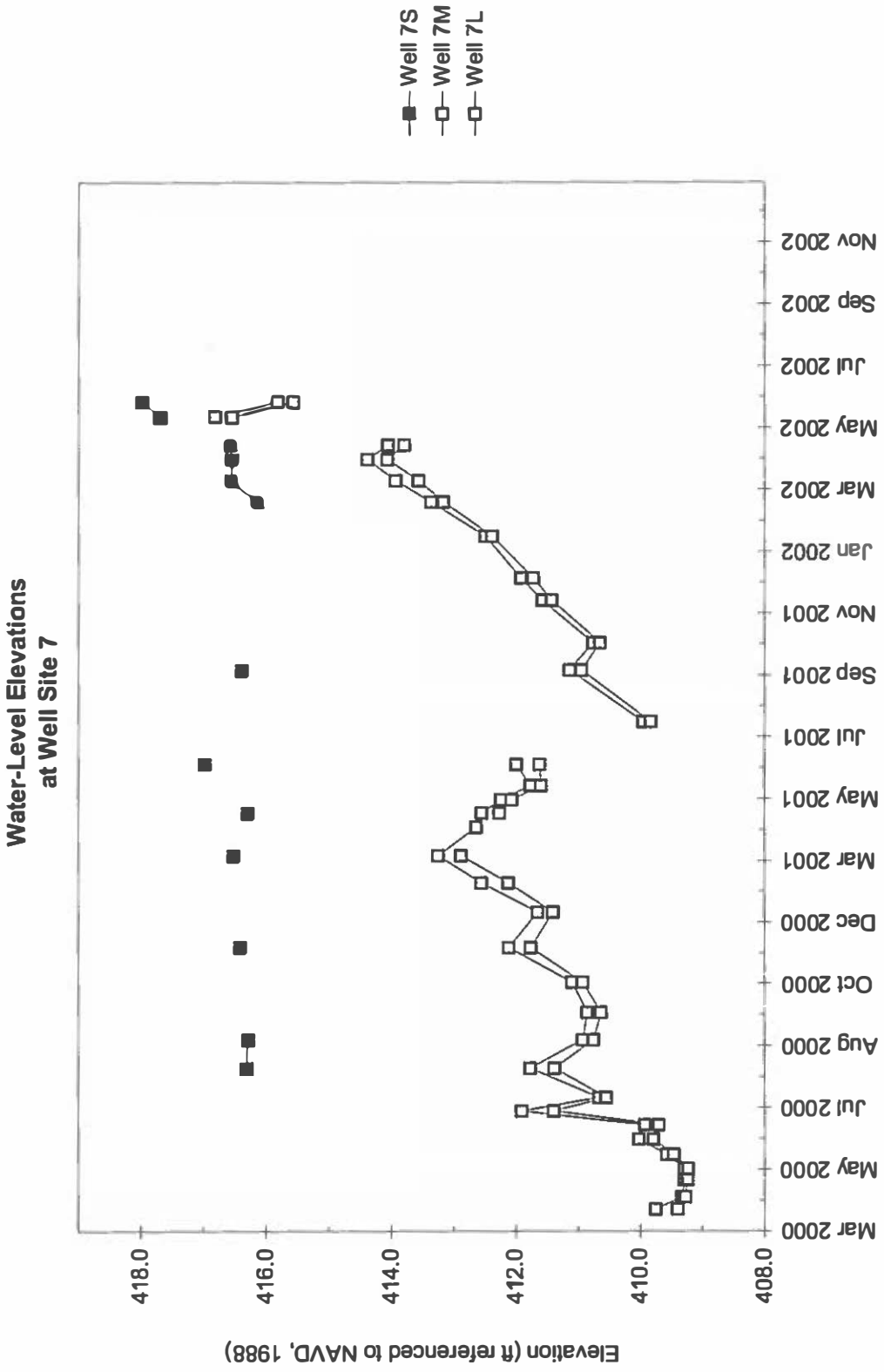
Appendix C: Water-level records - graphical



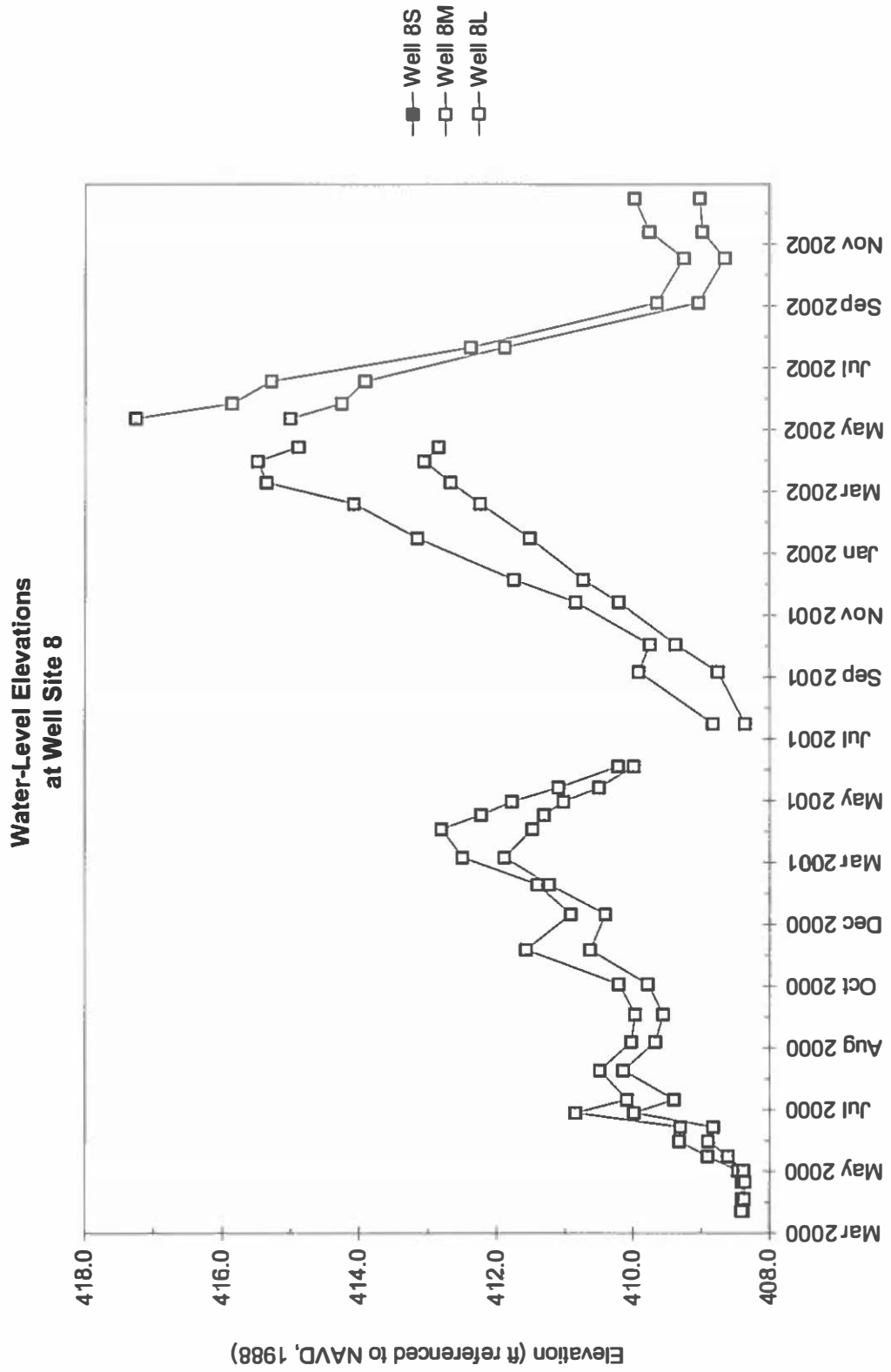
Appendix C: Water-level records - graphical



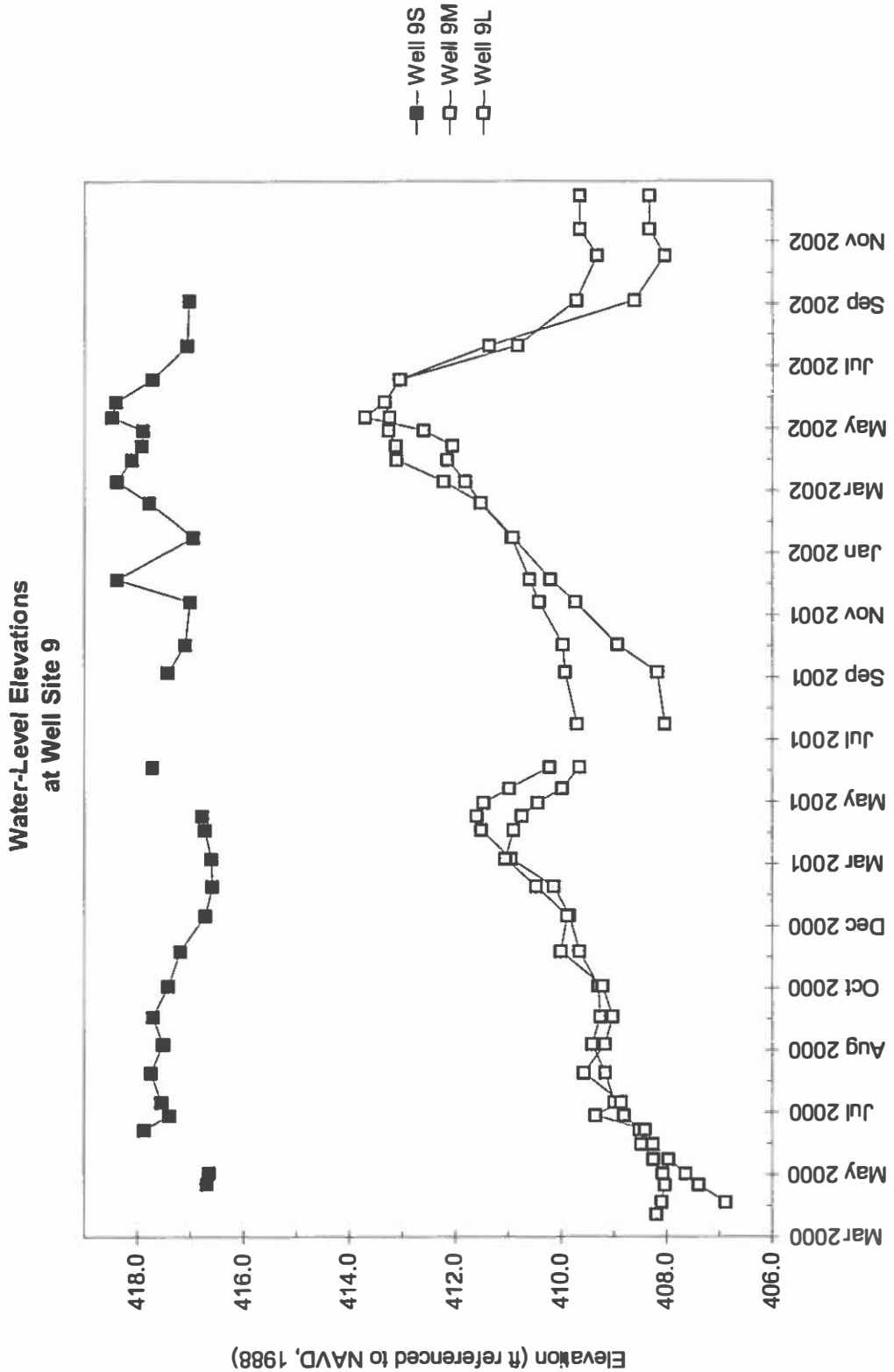
Appendix C: Water-level records - graphical



Appendix C: Water-level records - graphical



Appendix C: Water-level records - graphical



Luehmann Property, New River Crossing
2000 to 2003

	Water-Level Elevations (in ft referenced to NAVD, 1988)													
Date	3/23/2000	4/4/2000	4/21/2000	5/2/2000	5/16/2000	5/31/2000	6/14/2000	6/28/2000	7/11/2000	8/9/2000	9/6/2000	10/3/2000	11/2/2000	12/6/2000
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	417.53	417.05	417.55	417.50	417.68
Well 1M	413.23	412.63	412.55	412.81	412.98	413.27	413.26	413.91	413.28	414.01	413.33	413.46	413.82	414.51
Well 1L	409.44	409.17	409.10	409.09	409.33	409.65	409.53	410.82	410.10	410.83	410.25	410.18	410.44	411.24
Well 2S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 2M	dry	408.54	409.12	409.44	409.80	410.06	410.25	410.54	410.70	411.08	411.65	411.50	411.66	412.32
Well 2L	409.32	408.57	408.48	408.51	408.72	408.99	408.88	410.00	409.29	410.05	409.46	409.40	409.64	410.39
Well 3S	dry	dry	417.01	417.11	417.89	417.76	417.78	417.75	417.71	417.60	417.51	417.43	417.37	417.30
Well 3M	410.66	411.17	410.87	410.92	411.53	411.78	411.70	412.58	411.86	412.72	412.14	412.26	412.02	412.85
Well 3L	408.54	408.45	408.41	408.41	408.62	408.88	408.80	409.91	409.32	410.07	409.61	409.50	409.71	410.50
Well 4S	dry	dry	dry	dry	dry	dry	dry	dry	dry	417.64	417.09	417.57	417.47	417.47
Well 4M	407.09	407.95	408.63	408.81	409.10	409.27	409.42	409.72	410.02	410.40	410.70	410.44	410.60	411.23
Well 4L	406.78	408.69	408.65	408.65	408.89	409.20	409.10	410.34	409.70	410.43	409.95	409.85	410.07	410.87
Well 5S	dry	dry	dry	dry	dry	dry	416.44	416.24	416.25	417.06	416.55	416.23	416.49	416.81
Well 5M	413.91	413.23	412.88	412.84	413.75	414.38	414.35	415.12	414.44	415.44	414.27	414.62	415.13	416.05
Well 5L	409.19	409.08	409.01	409.01	409.26	409.61	409.51	410.99	410.23	410.98	410.44	410.34	410.61	411.42
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 6M	410.88	410.18	409.96	409.87	410.46	411.68	410.76	414.55	411.59	413.80	411.69	411.52	411.94	413.53
Well6L	409.96	409.67	409.60	409.59	409.89	410.40	410.13	412.55	411.05	412.15	411.24	411.13	411.43	412.43
Well7S	dry	dry	dry	dry	dry	dry	dry	dry	dry	416.30	416.28	dry	dry	416.41
Well 7M	409.75	409.33	409.29	409.28	409.57	410.02	409.93	411.90	410.66	411.77	410.93	410.86	411.10	412.11
Well7L	409.39	409.27	409.23	409.23	409.46	409.79	409.70	411.39	410.55	411.38	410.75	410.63	410.93	411.76
Well 8S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well8M	408.38	408.40	408.40	408.46	408.91	409.32	409.30	410.64	410.08	410.48	410.02	409.97	410.20	411.56
Well8L	408.41	408.37	408.36	408.38	408.60	408.90	408.82	409.98	409.40	410.14	409.67	409.56	409.78	410.63
Well 9S	dry	dry	416.68	416.65	dry	dry	417.87	417.40	417.55	417.74	417.51	417.70	417.42	417.20
Well 9M	dry	406.88	407.39	407.64	407.97	408.26	408.52	408.81	408.99	409.16	409.41	409.26	409.30	409.66
Well 9L	408.19	408.09	408.03	408.08	408.25	408.48	408.41	409.35	408.86	409.58	409.16	409.02	409.22	410.01
Gauge A	414.02	413.90	413.76	413.72	413.82	414.00	413.87	416.11	415.84	416.04	415.65	415.54	415.67	frozen
Gauge F	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Gauge G	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Gauge H	**	**	**	**	**	**	**	**	**	**	**	**	**	**

* no measurement
** not yet installed
*** discontinued
S indicates soil-zone monitoring well
M indicates middle monitoring well
L indicates lower monitoring well

Luehmann Property, New River Crossing
2000 to 2003

	Water-Level Elevations (in ft referenced to NAVD, 1988)												
Date	1/10/2001	2/8/2001	3/7/2001	4/4/2001	4/18/2001	5/1/2001	5/15/2001	6/5/2001	6/18/2001	7/17/2001	9/6/2001	10/3/2001	11/14/2001	12/6/2001
Well 1S	417.20	417.10	417.24	417.27	417.35	417.37	417.33	417.33	*	417.16	417.26	dry	417.11	417.23
Well 1M	414.36	414.91	415.40	415.34	415.56	415.32	414.90	415.27	*	413.53	414.20	413.71	414.13	414.84
Well 1L	410.89	411.58	412.14	411.78	411.73	411.46	411.01	411.09	*	409.36	409.93	409.83	410.54	411.03
Well 2S	dry	dry	dry	dry	417.95	417.96	dry	dry	*	dry	418.61	418.28	418.10	418.25
Well 2M	412.35	412.72	413.22	413.42	413.57	413.50	412.98	412.54	*	411.17	411.20	411.50	412.03	412.06
Well 2L	410.15	410.76	411.31	411.09	410.97	410.68	410.23	410.23	*	408.50	409.03	409.19	409.93	410.44
Well 3S	417.23	417.16	417.17	417.18	417.18	417.13	417.09	418.26	*	417.73	417.36	417.19	417.32	417.70
Well 3M	412.46	413.31	413.67	413.18	413.28	413.01	412.71	412.78	*	411.19	411.95	411.54	411.62	412.02
Well 3L	410.29	410.96	411.56	411.28	411.16	410.88	410.42	410.20	*	408.53	408.93	409.33	410.09	410.56
Well 4S	417.33	417.31	417.37	417.38	417.37	417.30	417.23	417.16	*	417.04	417.04	416.99	417.26	418.14
Well 4M	411.19	411.65	412.39	412.14	412.06	411.91	411.57	411.04	*	410.00	410.32	410.33	410.94	410.88
Well 4L	410.56	411.26	411.91	411.58	411.49	411.24	410.78	410.64	*	408.94	409.48	409.64	410.39	410.86
Well 5S	416.18	416.30	416.76	416.88	416.79	416.64	416.41	417.86	*	dry	416.61	416.48	416.16	416.72
Well 5M	415.80	416.32	416.65	416.58	416.56	416.28	415.56	416.15	*	414.02	414.50	414.32	414.71	415.49
Well 5L	411.02	411.78	412.47	412.05	411.99	411.73	411.28	411.32	*	409.57	410.18	410.10	410.85	411.33
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 6M	412.56	413.96	414.80	413.67	413.50	413.04	412.38	413.39	*	410.46	411.83	411.05	412.12	413.54
Well 6L	411.89	412.85	413.65	412.95	412.85	412.52	412.04	412.43	*	410.26	411.34	410.89	411.73	412.39
Well7S	dry	dry	416.52	dry	416.30	dry	dry	416.97	*	dry	416.38	dry	dry	dry
Well 7M	411.65	412.55	413.25	412.64	412.55	412.24	411.77	411.99	*	409.95	411.13	410.76	411.57	411.91
Well 7L	411.41	412.12	412.88	*	412.27	412.07	411.60	411.62	*	409.83	410.95	410.64	411.42	411.72
Well 8S	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 8M	410.91	411.40	412.49	412.80	412.22	411.77	411.09	410.22	*	408.83	409.92	409.75	410.84	411.74
Well 8L	410.40	411.23	411.88	411.47	411.30	411.02	410.50	409.99	*	408.36	408.76	409.38	410.21	410.73
Well 9S	416.71	416.59	416.60	416.73	416.78	dry	dry	417.72	*	dry	417.43	417.10	417.01	418.38
Well 9M	409.84	410.14	410.95	411.50	411.59	411.47	410.98	410.21	*	409.70	409.93	409.97	410.42	410.59
Well 9L	409.89	410.47	411.05	410.89	410.74	410.44	409.99	409.66	*	408.03	408.18	408.94	409.73	410.20
Gauge A	frozen	415.84	415.84	415.75	415.72	415.54	415.32	415.82	415.60	415.10	415.57	416.36	flooded	414.91
Gauge F	**	**	417.62	417.60	417.53	417.14	dry	417.73	417.13	dry	417.47	417.23	417.28	417.64
Gauge G	**	**	417.62	417.60	417.53	417.02	dry	417.71	417.03	dry	417.47	417.12	417.21	417.65
Gauge H	**	**	**	**	**	**	**	**	**	**	**	**	**	**

* no measurement
** not yet installed
*** discontinued
S indicates soil-zone monitoring well
M indicates middle monitoring well
L indicates lower monitoring well

Luehmann Property, New River Crossing
2000 to 2003

	Water-Level Elevations (in ft referenced to NAVD, 1988)													
Date	1/16/2002	2/19/2002	3/12/2002	4/2/2002	4/16/2002	5/1/2002	5/14/2002	5/29/2002	6/20/2002	7/23/2002	9/5/2002	10/19/2002	11/14/2002	12/17/2002
Well 1S	417.16	dry	dry	417.08	417.12	*	417.22	417.27	***	***	***	***	***	***
Well 1M	414.66	415.52	415.97	416.43	416.46	*	416.85	416.80	***	***	***	***	***	***
Well 1L	411.61	412.30	412.68	413.18	413.03	*	414.88	414.37	***	***	***	***	***	***
Well2S	dry	dry	dry	418.40	418.39	*	418.54	418.59	***	***	***	***	***	***
Well 2M	412.59	412.98	413.44	414.04	414.21	*	414.50	414.58	***	***	***	***	***	***
Well 2L	410.96	411.60	411.98	412.35	412.23	*	413.86	413.41	***	***	***	***	***	***
Well 3S	417.28	417.27	417.62	417.86	417.64	*	418.03	418.07	*	*	dry	dry	dry	dry
Well 3M	412.02	412.81	413.52	414.10	414.02	*	414.53	414.66	*	*	411.56	410.37	411.57	411.68
Well 3L	411.22	411.87	412.22	412.63	412.49	*	414.33	413.83	*	*	409.21	408.40	409.36	409.55
Well4S	417.25	417.62	418.09	417.94	418.04	418.11	418.25	418.34	***	***	***	***	**	***
Well 4M	411.84	412.31	412.53	413.08	413.13	413.37	413.72	414.20	***	***	***	***	***	***
Well4L	411.53	412.22	412.58	413.07	412.89	413.64	414.94	414.39	***	***	***	***	***	***
Well 5S	dry	416.56	416.60	417.30	417.02	*	417.57	417.47	***	***	***	***	***	***
Well 5M	415.07	415.86	416.63	417.14	417.27	*	417.45	417.38	***	***	***	***	***	***
Well 5L	412.01	412.74	413.09	413.67	413.47	*	415.73	415.08	***	***	***	***	***	***
Well 6S	dry	dry	dry	dry	dry	*	419.15	dry	***	***	***	***	***	***
Well 6M	413.68	414.72	415.78	415.96	415.58	*	418.91	417.41	***	***	***	***	***	***
Well 6L	413.01	413.89	414.45	414.92	414.59	*	417.68	416.45	***	***	***	***	***	***
Well 7S	dry	416.14	416.55	416.53	416.57	*	417.70	417.98	***	***	***	***	***	***
Well7M	412.49	413.36	413.93	414.38	414.04	*	416.80	415.81	***	***	***	***	***	***
Well 7L	412.38	413.16	413.56	414.06	413.79	*	416.54	415.56	***	***	***	***	***	***
Well 8S	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry	dry	dry	dry
Well 8M	413.15	414.08	415.36	415.49	414.89	*	417.28	415.86	415.29	412.37	409.65	409.26	409.76	409.98
Well8L	411.51	412.23	412.66	413.05	412.84	*	415.01	414.26	413.92	411.88	409.04	408.66	408.98	409.02
Well 9S	416.95	417.78	418.39	418.11	417.92	417.90	418.48	418.41	417.72	417.06	417.02	dry	dry	dry
Well 9M	410.94	411.52	412.21	413.11	413.12	413.26	413.24	413.33	413.03	410.82	409.71	409.32	409.65	409.65
Well 9L	410.90	411.51	411.81	412.14	412.05	412.59	413.70	413.33	413.04	411.35	408.61	408.03	408.33	408.33
Gauge A	414.54	414.62	414.74	414.65	414.61	414.72	flooded	414.90	***	***	***	***	***	***
Gauge F	417.31	417.50	417.69	417.65	417.67	*	417.69	417.65	***	***	***	***	***	***
Gauge G	417.28	417.52	417.69	417.66	417.67	*	417.66	417.60	***	***	***	***	***	***
Gauge H	**	**	**	**	**	*	417.48	413.69	413.46	413.46	413.08	413.86	413.50	413.45

* no measurement
** not yet installed
*** discontinued
S indicates soil-zone monitoring well
M indicates middle monitoring well
L indicates lower monitoring well

Luehmann Property, New River Crossing
2000 to 2003

	Depth to Water (in ft referenced to land surface)													
Date	3/23/2000	4/4/2000	4/21/2000	5/2/2000	5/16/2000	5/31/2000	6/14/2000	6/28/2000	7/11/2000	8/9/2000	9/6/2000	10/3/2000	11/2/2000	12/6/2000
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	1.52	2.00	1.50	1.55	1.37
Well 1M	5.82	6.42	6.50	6.24	6.07	5.78	5.79	5.14	5.77	5.04	5.72	5.59	5.23	4.54
Well 1L	9.61	9.88	9.95	9.96	9.72	9.40	9.52	8.23	8.95	8.22	8.80	8.87	8.61	7.81
Well 2S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 2M	dry	11.45	10.87	10.55	10.19	9.92	9.73	9.45	9.28	8.91	8.34	8.49	8.33	7.66
Well2L	10.67	11.42	11.51	11.48	11.27	10.99	11.11	9.99	10.70	9.93	10.51	10.59	10.35	9.60
Well3S	dry	dry	2.10	1.99	1.22	1.35	1.33	1.36	1.40	1.51	1.59	1.68	1.74	1.81
Well 3M	8.45	7.94	8.24	8.19	7.58	7.33	7.41	6.53	7.25	6.39	6.97	6.85	7.09	6.26
Well3L	10.57	10.66	10.70	10.70	10.49	10.23	10.31	9.20	9.79	9.04	9.50	9.61	9.40	8.61
Well 4S	dry	dry	dry	dry	dry	dry	dry	dry	dry	1.11	1.65	1.18	1.27	1.28
Well 4M	11.65	10.79	10.12	9.94	9.64	9.47	9.32	9.03	8.72	8.35	8.05	8.30	8.15	7.52
Well 4L	9.97	10.06	10.09	10.09	9.85	9.55	9.65	8.40	9.04	8.32	8.80	8.90	8.67	7.88
Well 5S	dry	dry	dry	dry	dry	dry	1.80	2.01	1.99	1.18	1.69	2.02	1.75	1.43
Well 5M	4.34	5.02	5.36	5.41	4.49	3.87	3.89	3.12	3.80	2.80	3.97	3.63	3.11	2.19
Well 5L	9.06	9.17	9.23	9.23	8.98	8.64	8.73	7.25	8.01	7.26	7.81	7.91	7.64	6.82
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 6M	8.97	9.68	9.89	9.98	9.39	8.18	9.09	5.31	8.27	6.05	8.17	8.33	7.91	6.33
Well 6L	9.89	10.18	10.25	10.27	9.97	9.46	9.72	7.30	8.80	7.71	8.61	8.72	8.43	7.43
Well 7S	dry	dry	dry	dry	dry	dry	dry	dry	dry	1.91	1.93	dry	dry	1.80
Well 7M	8.46	8.88	8.92	8.93	8.64	8.19	8.28	6.31	7.55	6.44	7.28	7.35	7.11	6.10
Well 7L	8.82	8.94	8.98	8.98	8.75	8.43	8.51	6.82	7.66	6.83	7.46	7.58	7.28	6.45
Well8S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 8M	11.34	11.32	11.33	11.27	10.82	10.41	10.42	8.88	9.64	9.24	9.70	9.76	9.52	8.17
Well 8L	11.49	11.52	11.53	11.52	11.29	11.00	11.07	9.91	10.50	9.76	10.22	10.34	10.11	9.27
Well 9S	dry	dry	1.92	1.95	dry	dry	**0.73**	1.20	1.05	**0.86**	1.09	**0.90**	1.18	1.40
Well 9M	dry	11.72	11.21	10.96	10.63	10.34	10.09	9.79	9.61	9.44	9.19	9.34	9.30	8.94
Well9L	10.41	10.51	10.57	10.52	10.35	10.12	10.19	9.25	9.74	9.03	9.44	9.58	9.38	8.60

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S indicates soil-zone monitoring well
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L indicates lower monitoring well
bold depth values less than or equal to 1 ft

Luehmann Property, New River Crossing
2000 to 2003

	Depth to Water (in ft referenced to land surface)													
Date	1/10/2001	2/8/2001	3/7/2001	4/4/2001	4/18/2001	5/1/2001	5/15/2001	6/5/2001	6/18/2001	7/17/2001	9/6/2001	10/3/2001	11/14/2001	12/6/2001
Well 1S	1.85	1.95	1.81	1.89	1.80	1.78	1.83	1.83	*	1.99	1.90	dry	2.05	1.92
Well 1M	4.69	4.14	3.65	3.81	3.60	3.84	4.25	3.89	*	5.63	4.95	5.45	5.02	4.32
Well 1L	8.16	7.47	6.91	7.38	7.42	7.70	8.14	8.06	*	9.80	9.22	9.32	8.62	8.12
Well 2S	dry	dry	dry	dry	2.17	2.15	dry	dry	*	dry	1.51	1.83	2.01	1.86
Well 2M	7.64	7.27	6.77	6.69	6.55	6.62	7.14	7.58	*	8.95	8.91	8.61	8.08	8.05
Well 2L	9.84	9.23	8.68	9.02	9.14	9.44	9.88	9.88	*	11.61	11.08	10.92	10.18	9.68
Well 3S	1.88	1.95	1.94	2.05	2.06	2.10	2.14	**0.98**	*	1.51	1.88	2.04	1.92	1.54
Well 3M	6.65	5.80	5.44	6.05	5.95	6.22	6.53	6.45	*	8.05	7.29	7.70	7.61	7.22
Well 3L	8.82	8.15	7.55	7.96	8.08	8.36	8.82	9.04	*	10.71	10.31	9.90	9.15	8.68
Well 4S	1.41	1.43	1.37	1.48	1.49	1.56	1.63	1.70	*	1.82	1.82	1.87	1.60	**0.72**
Well 4M	7.56	7.10	6.35	6.72	6.80	6.95	7.29	7.82	*	8.86	8.54	8.53	7.92	7.98
Well 4L	8.19	7.48	6.83	7.28	7.37	7.62	8.08	8.22	*	9.92	9.38	9.22	8.47	8.00
Well 5S	2.06	1.95	1.48	1.45	1.52	1.67	1.90	**0.45**	*	dry	1.70	1.83	2.15	1.59
Well 5M	2.45	1.92	1.59	1.73	1.75	2.03	2.75	2.16	*	4.29	3.81	3.99	3.60	2.82
Well 5L	7.22	6.46	5.77	6.26	6.32	6.57	7.02	6.99	*	8.74	8.13	8.21	7.46	6.97
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 6M	7.30	5.89	5.05	6.18	6.35	6.81	7.47	6.45	*	9.39	8.02	8.80	7.73	6.31
Well 6L	7.96	7.00	6.20	6.90	6.99	7.32	7.81	7.42	*	9.59	8.51	8.96	8.12	7.45
Well 7S	dry	dry	1.69	dry	2.07	dry	dry	1.39	*	dry	1.98	dry	dry	dry
Well 7M	6.56	5.66	4.96	5.73	5.82	6.13	6.60	6.37	*	8.42	7.23	7.60	6.79	6.45
Well 7L	6.80	6.09	5.33	*	6.10	6.30	6.77	6.75	*	8.54	7.42	7.72	6.94	6.64
Well 8S	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 8M	8.82	8.33	7.23	7.07	7.65	8.10	8.77	9.65	*	11.04	9.95	10.11	9.03	8.12
Well 8L	9.49	8.66	8.01	8.40	8.57	8.85	9.37	9.88	*	11.51	11.11	10.49	9.66	9.14
Well 9S	1.89	2.01	2.00	2.10	2.05	dry	dry	1.12	*	dry	1.40	1.73	1.82	**0.45**
Well 9M	8.76	8.46	7.65	7.33	7.24	7.37	7.85	8.62	*	9.13	8.90	8.86	8.41	8.24
Well 9L	8.71	8.13	7.55	7.94	8.09	8.39	8.85	9.17	*	10.80	10.65	9.89	9.10	8.63

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Luehmann Property, New River Crossing
2000 to 2003

	Depth to Water (in ft referenced to land surface)													
Date	1/16/2002	2/19/2002	3/12/2002	4/2/2002	4/16/2002	5/1/2002	5/14/2002	5/29/2002	6/20/2002	7/23/2002	9/5/2002	10/19/2002	11/14/2002	12/17/2002
Well 1S	1.99	dry	dry	2.07	2.04	*	1.92	1.86	***	***	***	***	***	***
Well 1M	4.50	3.64	3.18	2.73	2.70	*	2.29	2.33	***	***	***	***	***	***
Well 1L	7.55	6.86	6.48	5.97	6.13	*	4.26	4.76	***	***	***	***	***	***
Well 2S	dry	dry	dry	1.71	1.73	*	1.59	1.55	***	***	***	***	***	***
Well 2M	7.53	7.14	6.68	6.08	5.90	*	5.64	5.55	***	***	***	***	***	***
Well 2L	9.15	8.51	8.14	7.76	7.88	*	6.27	6.73	***	***	***	***	***	***
Well 3S	1.96	1.97	1.62	1.37	1.59	*	1.13	1.09	*	*	dry	dry	dry	dry
Well 3M	7.22	6.43	5.72	5.14	5.21	*	4.63	4.49	*	*	7.59	8.79	7.59	7.47
Well 3L	8.02	7.37	7.02	6.60	6.75	*	4.83	5.32	*	*	9.94	10.76	9.80	9.60
Well 4S	1.61	1.24	**0.77**	**0.92**	**0.82**	**0.74**	**0.80**	**0.52**	***	***	***	***	***	***
Well 4M	7.02	6.56	6.33	5.78	5.73	5.48	5.13	4.65	***	***	***	***	***	***
Well 4L	7.33	6.64	6.28	5.79	5.97	5.21	3.91	4.46	***	***	***	***	***	***
Well 5S	dry	1.75	1.71	1.01	1.29	*	**0.71**	**0.81**	***	***	***	***	***	***
Well 5M	3.23	2.44	1.68	1.16	1.04	*	**0.83**	**0.90**	***	***	***	***	***	***
Well 5L	6.30	5.57	5.22	4.64	4.84	*	2.55	3.20	***	***	***	***	***	***
Well6S	dry	dry	dry	dry	dry	*	**0.73**	dry	***	***	***	***	***	***
Well 6M	6.17	5.13	4.07	3.89	4.27	*	**0.97**	2.47	***	***	***	***	***	***
Well 6L	6.84	5.96	5.39	4.93	5.26	*	2.19	3.43	***	***	***	***	***	***
Well7S	dry	2.22	1.81	1.83	1.79	*	**0.73**	**0.44**	***	***	***	***	***	***
Well 7M	5.88	5.01	4.44	3.99	4.32	*	1.62	2.61	***	***	***	***	***	***
Well 7L	5.99	5.20	4.81	4.31	4.58	*	1.88	2.86	***	***	***	***	***	***
Well8S	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry	dry	dry	dry
Well 8M	6.72	5.79	4.51	4.38	4.98	*	2.47	3.86	4.44	7.35	10.08	10.47	9.96	9.74
Well 8L	8.35	7.63	7.20	6.81	7.03	*	4.71	5.47	5.81	7.85	10.68	11.07	10.74	10.71
Well9S	1.88	1.05	**0.44**	**0.72**	**0.91**	**0.67**	**0.29**	**0.36**	1.05	1.71	1.75	dry	dry	dry
Well 9M	7.89	7.31	6.62	5.72	5.71	5.51	5.53	5.44	5.74	7.95	9.06	9.45	9.12	9.12
Well 9L	7.93	7.32	7.02	6.69	6.78	6.18	5.07	5.44	5.72	7.41	10.16	10.73	10.44	10.44

- indicates water above land surface
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bold depth values less than or equal to 1 ft

Appendix E: Discharge volumes recorded in the box culvert.

Date	Volume Discharged (ft^3)	Volume Discharged (m^3)
11/25-26/2000	288,521	8,170
12/11/2000	67,486	1,911
12/13-14/2000*	156,726	4,438
1/14-16/2001**	639,831	18,118
1/29-2/1/2001	489,143	13,851
2/9-10/2001	474,417	13,434
2/13-14/2001	124,096	3,514
2/24-25/2001	482,434	13,661
3/15-16/2001	190,523	5,395
4/3/2001	22,178	628
4/10-11/2001	18,152	524
4/15/2001	9,041	256
5/31/2001	171,892	4,870
6/4/2001	180,988	5,125
6/6/2001	5,827	165
7/19/2001	441,610	12,505
7/24/2001	133,984	3,794
8/24/2001	444,753	12,594
10/11/2001	48,840	1,383

* - snowfall event
** - snowmelt event