CAHOKIA POTENTIAL WETLAND COMPENSATION SITE: LEVEL II HYDROGEOLOGIC CHARACTERIZATION REPORT

(Former Tiernan Property)
St. Clair County, Illinois
(Federal Aid Project 999, Sequence Number 33G)

Bonnie J. Robinson

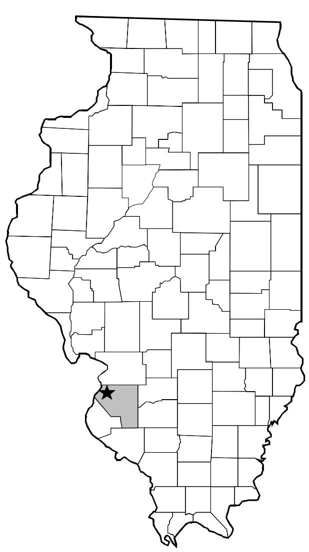
Illinois State Geological Survey
Transportation and Environment Center
Wetlands Geology Section
615 East Peabody Drive
Champaign, IL 61820-6964

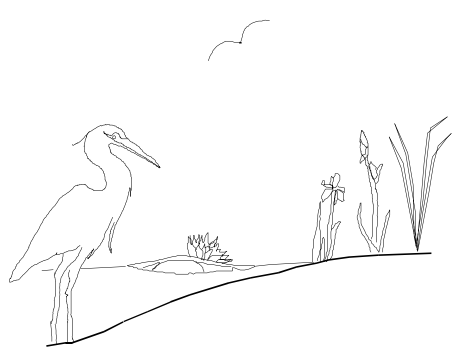
Submitted Under Contract No. IDOT SW WIP FY05 to:

Illinois Department of Transportation
Bureau of Design and Environment, Wetlands Unit
2300 South Dirksen Parkway
Springfield, IL 62764-0002

July 21, 2005

Illinois State Geological Survey
Open File Series 2005-11





EXECUTIVE SUMMARY

In July 2000, the Illinois Department of Transportation (IDOT) tasked the Wetlands Geology Section of the Illinois State Geological Survey (ISGS) to conduct a hydrogeologic characterization of the former Tiernan property, a potential wetland compensation site near Cahokia in St. Clair County, Illinois.

Results of this investigation indicate that a minimum of 16.0 ha (39.5 ac.) already satisfy the criteria for jurisdictional wetland hydrology in at least two out of four years. This includes 8.5 ha (21.0 ac.) in the former farm field that was previously mapped by the Natural Resources Conservation Service (NRCS) as prior converted wetland. Since this area developed into wetland following the cessation of farming in 2000, it is expected to be eligible for restoration credit. The remaining 7.5 ha (18.5 ac.) of wetland hydrology consists of 1.1 ha (2.7 ac.) of ditches throughout the site, and a 6.4 ha (15.8 ac.) wetland in the former borrow pit on the south end of the site, as mapped by the U.S. Fish and Wildlife Service (USFWS) and the Illinois Natural History Survey (INHS).

The area satisfying wetland hydrology criteria could be increased by 2.4 ha (6.0 ac.) with the construction of a small berm with a maximum elevation of 121.7 m (398.3 ft.) in the outlet channel at the southernmost limit of the site. This additional acreage would be in an area where hydrophytic vegetation and hydric soils already are present. Construction of the berm would also serve to stabilize the hydrology in the wetlands in the former borrow pit by limiting the amount of water draining from the site. This could improve the quality of the 6.4 ha (15.8 ac.) wetland previously mapped on the southern end of the site, potentially making it eligible for enhancement credit.

On the northern half of the site, any attempts to exploit surface water sources to increase the area of wetland hydrology would involve excavation. However, if excavated, the presence of coarse-grained sediments near land surface may increase drainage and reduce wetland hydrology. Therefore, the mitigation credits in the northern portion of the site may be limited to the 8.5 ha (21.0 ac.) area that developed into wetland following the cessation of farming in 2000.

A total of 10.9 ha (26.0 ac.) of wetland restoration is feasible at this site, plus an additional 6.4 ha (15.8 ac.) may be eligible for enhancement credit. Before proceeding with any alterations, consultation and cooperation with numerous agencies will be required to ensure there is no interruption of the current drainage network that will negatively impact the surrounding parcels.

CONTENTS

FIGURES

PHOTOS

INTRODUCTION

This report was prepared by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with observations regarding the hydrogeologic conditions of the former Tiernan property, a 26.4 ha (65.3 ac.) potential wetland compensation site located south of Cahokia in St. Clair County (W ½, Section 10, T1N, R10W). The site is bounded by the raised roadbed of IL 3 to the west, a drainage ditch and the Union Pacific railroad tracks to the east, a residential area to the north, and the levee of Prairie du Pont Creek to the south (Figure 1).

The purpose of this report is to provide IDOT with recommendations regarding the suitability of the site for wetland compensation. Therefore, wetland compensation recommendations are presented first, followed by a discussion of the methods and the supporting data. The supporting data include ground- and surface-water levels, soil moisture and precipitation data collected from April 2001 to December 2004, observations made during the initial site evaluation in Spring 2000 (Ketterling et al. 2000) and the geologic data collected during the installation of monitoring wells. Soils information in this report is from published reports and maps, and is presented for hydrogeologic purposes. All soil mapping or classification should be verified by a qualified soil scientist.

Data collection at the site is ongoing and will continue until terminated by 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 on the area, and to measure the duration of wetland hydrology.

SUMMARY

The following factors indicate that the potential for wetland preservation and creation at this compensation site is **high**:

- Water-level data collected from 2001 through 2004 indicated that a minimum of 16.0 ha (39.5 ac.) of the site has satisfied the criteria for jurisdictional wetland hydrology for at least 5 percent of the growing season in at least two out of four years (Figure 2; Illinois State Geological Survey 2001a, 2002, 2003, 2004).

- Located in the American Bottoms, the site and surrounding area contain hydrologic alterations that typify the region. Unfortunately, because many of these alterations are connected to the regional drainage system, they can not be reversed due to their potential for adverse offsite impacts (Figure 3).

- Two distinct hydrologic inputs were observed on the site. Precipitation is the primary hydrologic input to the north portion of the site where low permeability of the surface sediments produces localized ponding in response to precipitation. The southern portion of the site receives backflooding from Blue Waters Ditch and runoff from the subdivisions to the west.

- Hydric soil is mapped over the entire site (Figure 4). The Illinois Natural History Survey (INHS) has mapped a small area in the southern portion of the site as borrow pit or undetermined while Karnak silty clay covers the remaining 85 percent of the site (A. Plocher per. comm. 2005a). The permeability of this soil is low, 0.2-0.5 cm/hr (0.06-0.2 in./hr), which facilitates the perching of surface water and long-term inundation (U.S. Department of Agriculture 1978).

- Initial mapping at the site by the INHS indicated that the southern half of the site was dominated by hydrophytic plant communities while the northern portion was described as prior converted wetland (Illinois Natural History Survey 2000). Recent surveys indicate most of the area that was formerly cropland has evolved into wet forbland, while a small portion developed into non-

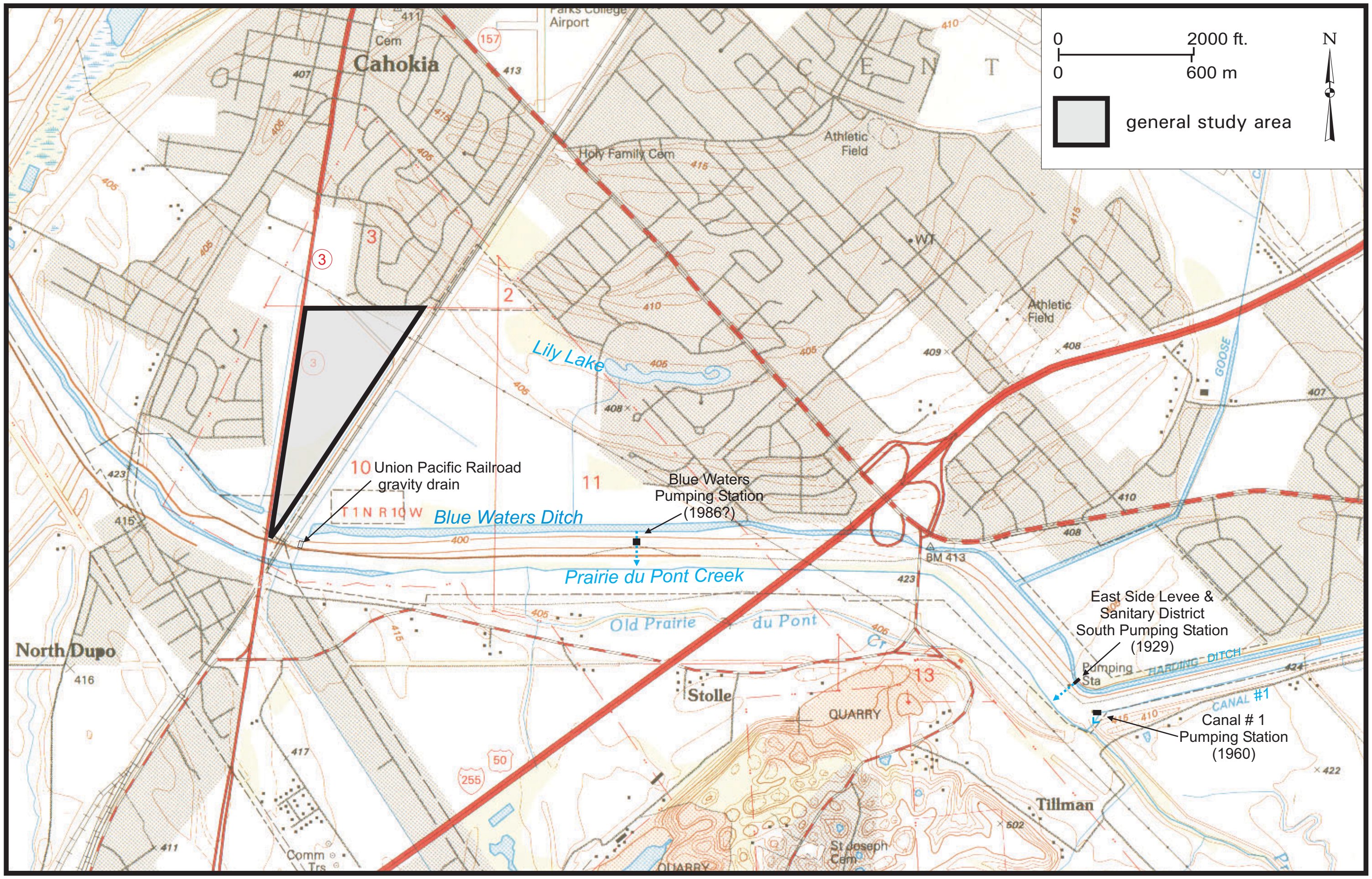


Figure 1. Location of the wetland compensation site (shaded grey) on the Cahokia, IL 7.5-minute quadrangle map (U.S. Geological Survey 1993). Contour interval is 3 m (10 ft.) with supplemental 1.5 m (5 ft.) contours.

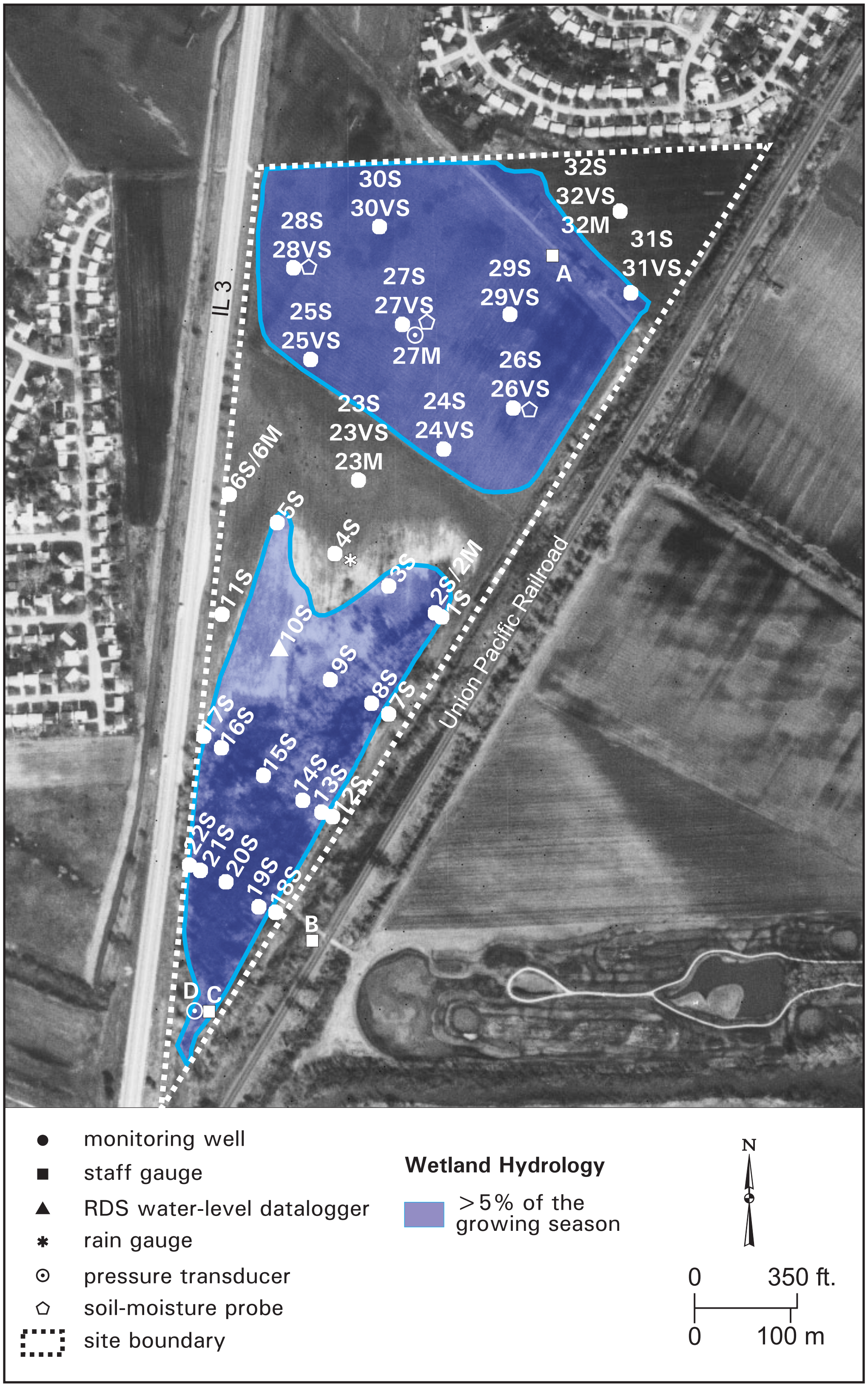


Figure 2. Summary of areas exhibiting wetland hydrology in at least two out of four years (map based on Illinois State Geological Survey 2001a, 2001b, 2001c, 2002, 2003, 2004).

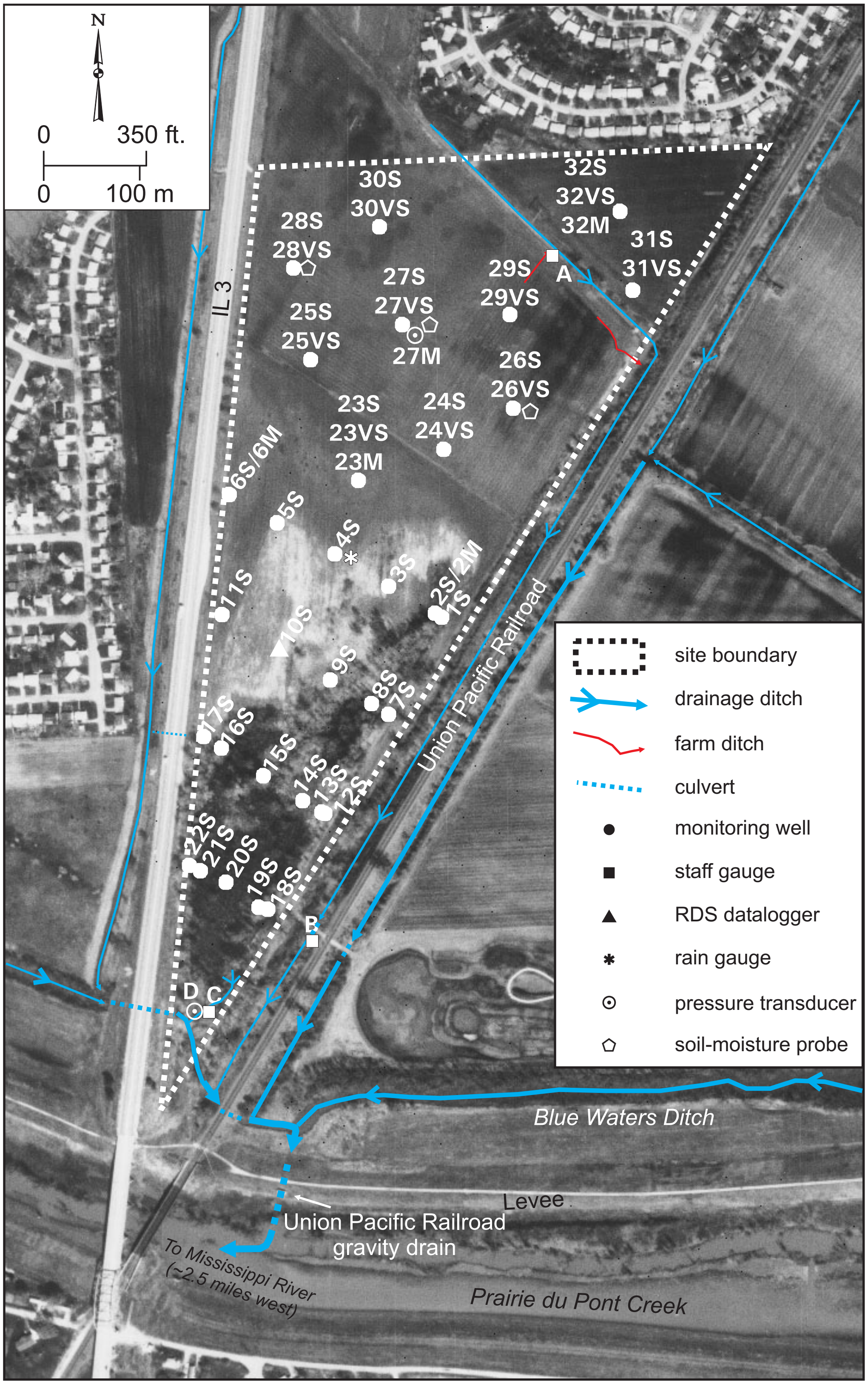


Figure 3. Locations of ISGS monitoring instruments and hydrologic alterations (map based on Illinois State Geological Survey 2001b, 2001c).

Figure 4. Soil types mapped by the INHS (map based on Illinois State Geological Survey 2001b, 2001c, A. Plocher, pers. comm. 2005a).

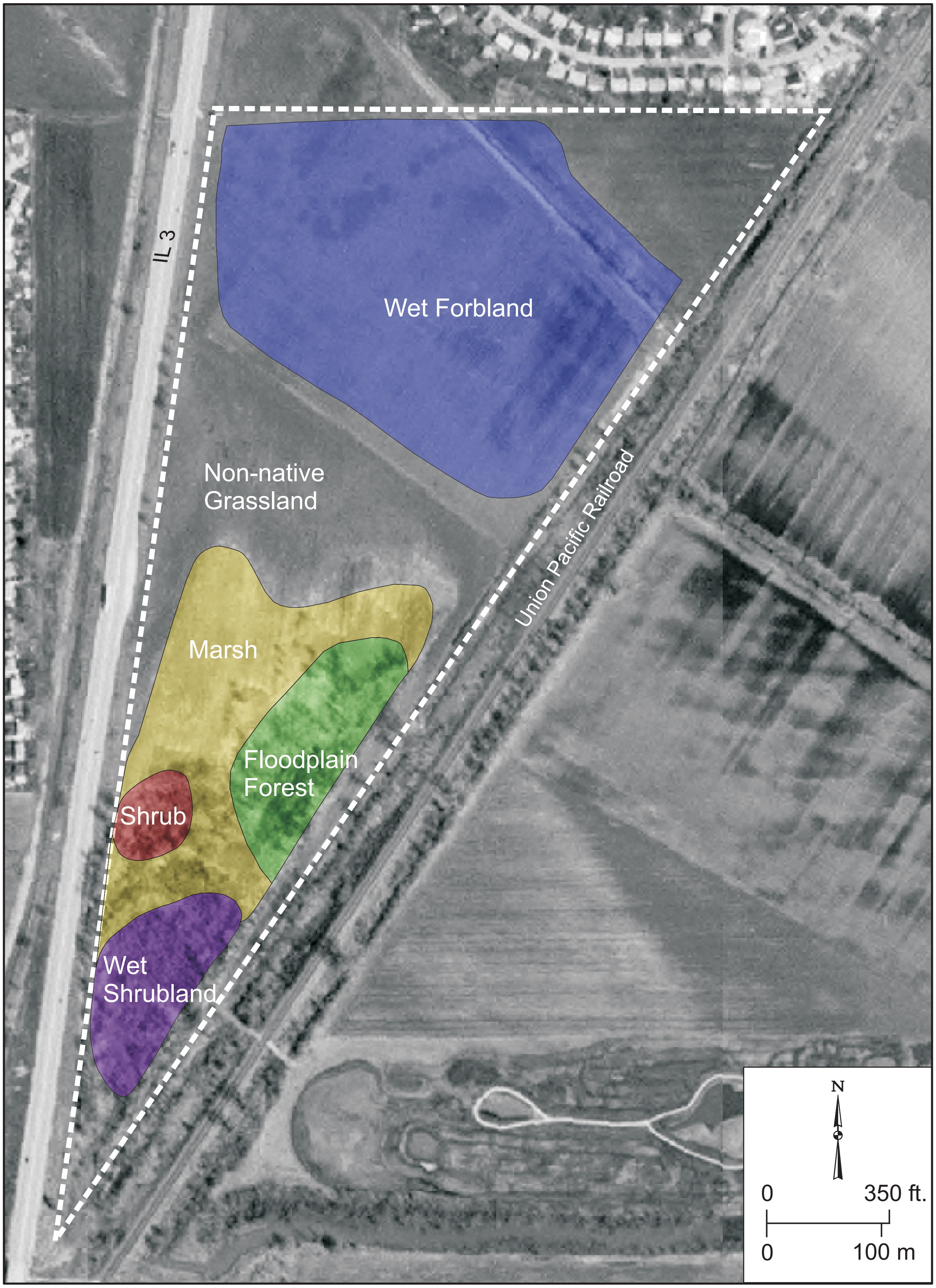


Figure 5. Current vegetation mapped on site by the INHS (map based on Illinois State Geological Survey 2001b, 2001c, A. Plocher per. comm. 2005b).

native grassland (Figure 5, A. Plocher per. comm. 2005b).

- At present, 16.0 ha (39.5 ac.) of the site satisfies all three criteria for jurisdictional wetland. This includes 8.5 ha (21.0 ac.) on the north end of the site that was previously mapped by the Natural Resources Conservation Service (NRCS) as prior converted wetland (Illinois Natural History Survey 2000). Since this area has reverted to jurisdictional wetland following the cessation of farming in 2000 (Ketterling et al. 2000), it is likely eligible for restoration credit. On the south end of the site, 6.4 ha (15.8 ac.) that was previously classified as wetland by the U.S. Fish and Wildlife Service and the INHS (U.S. Fish and Wildlife Service 1996, Illinois Natural History Survey 2000) could be eligible for enhancement credit as discussed below. The final 1.1 ha (2.7 ac.) with wetland hydrology encompasses the drainage ditches that cut across the north end of the site.

WETLAND CREATION AND SITE DESIGN

There is considerable potential for mitigation credit at the former Tiernan property. Restoration credit is likely possible for most of the area north of the farm road already mapped as satisfying wetland hydrology in this study [8.5 ha (21.0 ac.)]. The alterations discussed below could restore an additional 2.4 ha (6.0 ac.) of wetland hydrology in an area where hydrophytic vegetation and hydric soils are already present. Finally, enhancement credit may be available for the 6.4 ha (15.8 ac.) area of wetland in the former borrow pit in an area that has already been mapped as wetland (U.S. Fish and Wildlife Service 1996, Illinois Natural History Survey 2000).

- Restrict the drainage of water from the southern end of the site by constructing a berm with a maximum elevation of 121.7 m (398.3 ft.) in the channel that drains the wetlands in the former borrow pit, roughly 50 m (165 ft.) south of gauges C and D (Figure 3). This berm would serve two purposes: potentially restore wetland hydrology to an additional 2.4 ha (6.0 ac.), and stabilize the hydrology of the wetland in years with highly fluctuating water levels. Water will still be able to backflood onto the site, yet the berm will retain sufficient water on site when Blue Waters Ditch is pumped out, maintaining a consistent area of wetland hydrology in the former borrow pit by reducing fluctuating water levels. The presence of the berm will also keep water on site to an elevation that is not possible with the current topography, thereby increasing the area of wetland hydrology. With a sufficiently low profile as suggested, this alteration should not significantly reduce the amount of floodwater storage local authorities have come to expect.

- Since a large area [9.6 ha (23.7 ac.)] with wetland hydrology already exists on the northern portion of the site, excavation in the former farm field to increase the amount of wetland hydrology is not recommended due to the presence of sand near the surface. In order to capitalize on water contained in the ditch at the northern end of the site, land-surface elevation would have to be reduced by 0.5-1.0 m (1.6-3.3 ft.), which is not feasible. Immediately south of the former farm road, land-surface elevations would have to be reduced up to 1.4 m (4.5 ft.) in order to capitalize on any additional floodwater storage in the former borrow pit, which is also not feasible. As sand was found at a depth as shallow as 0.4 m (1.2 ft., Appendix A), any attempts at excavation may simply promote drainage.

- No alterations should be made that obstruct drainage from the ditch along the east edge of the site or from the culvert that comes under IL 3 from the west. Any interruption in these drainage pathways will likely result in flooding in the neighborhoods upstream.

CONSIDERATIONS

- Any compensation site design that interrupts the current drainage network must provide a continued means of drainage for adjacent residential areas immediately north and west of the site. Any alterations could have adverse effects on the surrounding areas, with the possibility of liability issues and potential legal ramifications. None of the above recommendations will likely have any offsite impacts.

- Any alterations to the site will require consultation and cooperation with numerous different agencies, including, but not limited to: the Army Corps of Engineers, the Illinois Department of Natural Resources, Union Pacific Railway, East Side Sanitary District, the Village of Cahokia, AmerenIP, Southwestern Bell Telephone Company and Missouri River Fuel Corp. These agencies either have easements on the property that could be negatively impacted with increased flooding, or have interest in uninterrupted drainage in the area.

METHODS

Geology

To characterize the geology of the compensation site, sediments were described from hand auger borings made during the installation of the five M-wells, ranging in depth from 1.37 to 4.55 m (4.6 to 15.1 ft.). Cuttings were described in the field, noting such properties as Munsell color, texture, structure, redoximorphic features, and saturation. The descriptions are provided in Appendix A.

Instrumentation

A total of 45 monitoring wells were installed at 32 locations throughout the compensation site to monitor ground-water levels (Figure 3). The data were used to map the extent of wetland hydrology and identify water sources and locations that might be suitable for wetland restoration.

The deepest wells on site (M-wells) were installed at 5 of the 32 locations at depths between 1.37 and 4.55 m (4.6 and 15.1 ft.) below land surface, and have a screen length of roughly 0.30 m (1.0 ft.). These wells were used to measure the hydraulic head and to determine vertical hydraulic gradients, which may indicate the potential for ground-water discharge.

Soil-zone wells (S-wells) were installed at each of the 32 locations. These wells are generally 0.75 m (2.5 ft.) deep with screens 0.30 m (1.0 ft.) in length. Very shallow wells (VS-wells) were installed at 9 of the 32 locations. These wells are generally 0.40 m (1.3 ft.) deep with screens 0.15 m (0.5 ft.) in length. S- and VS-wells are designed to monitor saturation in the near-surface sediments and delineate areas of wetland hydrology.

The M-wells were constructed using 5.1-cm (2-in.) PVC casings with 10-slot PVC screens, while all the S- and VS-wells were constructed with 2.54-cm (1-in.) PVC casing and 10-slot PVC screens. All screens have a bottom cap with a single drainage hole. Well screens were packed with quartz sand with a grain size of 0.9 mm (0.038 in.), typically #5 Global silica filter pack or equivalent. The annulus was then back-filled to land surface with medium bentonite chips. Well-construction details are provided in Appendix B. Following installation, each well was developed using a manually-cranked peristaltic pump until all water had been vacated from it.

A Remote Data Systems (RDS) water-level datalogger was installed in well 10S and a Global pressure transducer was installed in well 27M to record water-level fluctuations at more closely spaced intervals. In late September 2004, the Global pressure transducer was replaced with an In-Situ pressure transducer, and a second In-Situ unit was installed in well 27S to monitor shallow ground water-level fluctuations.

Three staff gauges were installed on site (Figure 3). Gauge A was installed in the ditch that cuts across the north end of the site. Gauge B was installed immediately south of the railroad access road in the

main ditch that follows the railroad tracks immediately east of the site, and Gauge C was located at the south end of the site in the channel draining the former borrow pit. A Global pressure transducer (D) was also installed at this location to monitor fluctuations in the level of the water exiting the site.
In May 2001, gypsum block soil-moisture probes were installed at depths of 0.15 and 0.40 m (0.5 and 1.3 ft.) at well clusters 26, 27 and 28. They were installed at multiple depths in an effort to identify the level of saturation through the soil zone. Because only discrete measurements could be taken with these instruments, limiting their usefulness, each station was augmented with a Decagon dielectric soil-moisture probe at a depth of 5 cm (2.0 in.) in the spring of 2002 and a datalogger in September of that year. These probes were subsequently lowered to 0.30 m (1.0 ft.) to more accurately reflect the depth at which saturated conditions must be observed to meet the criteria for wetland hydrology.

Site Monitoring and Surveying

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

All pressure transducers were programmed to monitor water levels at 1-hour intervals, the Decagon soil moisture probes at 2-hour intervals, and the RDS water-level datalogger at 3-hour intervals. These intervals helped identify short-term events that might not have been detected by the monthly or biweekly readings.

Onsite precipitation data, measured with a tipping-bucket rain gauge equipped with a datalogger, supplemented the precipitation data recorded at the Southern Illinois University Research Center at Belleville, IL (Station #110510). These data were obtained from the National Water and Climate Center (NWCC) of the NRCS and the Midwestern Regional Climate Center (MRCC) at the Illinois State Water Survey (ISWS). 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 station at Cahokia, IL (Station #111160) were used to determine the length of the growing season for the region. The growing season is defined as the period between the last occurrence of -2.2 °C (28°F) temperatures in the spring and the first occurrence in the fall (Environmental Laboratory 1987) . The median length (5 out of 10 years) of the growing season for the region is 214 days, with the median starting date on April 2 and the median ending date on November 2 (National Water and Climate Center 2005).

The elevations of the monitoring wells, staff gauges, and dataloggers were surveyed every spring with a Sokkia B1 Automatic Level and/or Leica TC702 total station using the NGVD 1929 datum plane. In March 2003, instrument locations were surveyed using a Trimble Pathfinder ProXR GPS unit. To increase position accuracy, these locations were differentially corrected using Trimble Pathfinder software.

In addition to water-level measurements, surface-water samples were collected from four locations on site on three occasions in 2001 to assess water quality. Samples were taken near staff gauge A in the northwest-southeast trending ditch on the north end of the site, near staff gauge B in the ditch along the railroad tracks on the east perimeter of the site, near well 20S in the former borrow pit, and near well 17S in the ditch at a small culvert under IL 3. Parameters including temperature, conductivity, redox and pH were measured in the field before the samples were transported to the lab for analysis at the ISGS. Appendix E lists the parameters that were tested for in these samples.

As part of a study assessing ground-water quality in the vicinity of the Dupo railyard, the consulting companies of Burns & McDonnell and the Forrester Group collected water samples from wells 2M, 23M and 32M in December 2002 and March, June and September 2004. These samples were subsequently submitted to TestAmerica Inc. and Severn Trent Labs for analysis of inorganics (Appendix F).

SITE CHARACTERIZATION

Setting

The site lies in the formerly active portion of the Mississippi River flood plain near St. Louis called the American Bottoms. The pre-development flood plain of the Mississippi River was a poorly-drained area of sloughs, oxbows, lakes, and shallow ponds. The water table was at or near land surface. With the development of drainage pathways such as the Prairie Du Pont Creek, Harding Ditch, and Blue Waters Ditch, and the advent of regional ground-water pumping, the water table dropped between 0.6 and 3.7 m (2 and 12 ft.) (Voelker 1984).

Although drainage improvements facilitated residential and commercial development, flooding of 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 infilled with silt. Furthermore, interior flooding behind levees is common when high stages in the larger canals block gravity drains (Southwestern Illinois Metropolitan and Regional Planning Committee 1975).

As the area surrounding the site was developed for housing and agriculture, artificial or artificially-enhanced drainage pathways were created to drain former depressions and areas of standing water. Currently, several ditches converge near the southern tip of the site and flow into Blue Waters Ditch (see Figure 3): two ditches from the west; the main ditch along the east perimeter of the site; and a ditch that flows along the east flank of the Union Pacific railroad tracks.

Blue Waters Ditch itself drains a significant part of the Cahokia-Centreville area via Goose Canal. At its western limit, the collective discharge of the above ditches is routed south through the levee into Prairie du Pont Creek (Figure 1), via the Union Pacific Railroad drain. Under normal circumstances, the gate is open, allowing Blue Waters Ditch to drain freely. However, when the nearby Mississippi River is 5.5-5.8 m (18-19 ft.) above flood stage, gate valves in the drain are closed so that interior areas will not be back-flooded (A. Carter, per. comm. 2003). In the past, when the drain was closed for long periods of time, water in Blue Waters Ditch was pumped out into Prairie du Pont Creek via the South Pumping Station at the end of Harding Ditch (Figure 1). However, this only occurred after the water in Harding Ditch itself was sufficiently evacuated. Because Harding Ditch also drains a large area and commonly fills very quickly, it was common for Blue Waters Ditch to flood interior areas upstream before it could be pumped in turn (R. Dieckmann, per. comm. 2000). This situation was remedied by the construction of a dedicated Blue Waters Ditch Pumping Station in the late 1980s. Now, when water levels in the ditch reach 121.3-121.6 m (398-399 ft.), pumping begins at the Blue Waters Ditch Pumping Station (A. Carter, per. comm. 2003).

The compensation site itself is bounded by a residential area to the north, the levee of Prairie du Pont Creek to the south, the raised roadbed of IL 3 to the west, and the Union Pacific railroad to the east (Figure 1). A drainage ditch and utility access road lie adjacent to the railroad, extending from the community to the north all the way to the Prairie Du Pont Creek levee in the south. Near the south end of the site, an access road crosses the railroad tracks and joins up with the road on the east perimeter of the site. The site is divided roughly in half by a former farm road that cuts across the center of the site, perpendicular to the railroad tracks, occupying a northwest-southeast trending ridge.

Historic photos and maps indicate that the ditches on site have been in place since at least 1934 (U.S. Geological Survey 1934). While it is assumed that these ditches were created to drain the site for agriculture, they now receive considerable residential runoff from the community north of the site. Despite these drainage features, historic topographic maps suggest that most of the site was marshy until ca. 1968 (U.S. Geological Survey 1968).

Aerial photos (U.S. Department of Agriculture 1940) show that the area north of the farm road was under cultivation from 1940 until at least 1998 (Illinois State Geological Survey 2001b, 2001c), whereas the majority of the area south of the farm road is a former borrow pit, excavated between the years 1954 and 1962 (U.S. Department of Agriculture 1962, U.S. Geological Survey 1954, 1968). Photo 1 shows the channel that connects the former borrow pit to the ditch that comes under IL 3 from the west. This channel is incised 0.5 to 0.6 m (1.5-2 ft.) below the surrounding ground surface.

Topography

The site ranges in elevation from 120.4 m (395 ft.) near Gauge C to a maximum of 122.8 m (403 ft.) along the ridge in the center of the site (Figure 6). This northwest-southeast trending ridge divides the site into north and south halves. Land-surface elevations north of the ridge are generally higher, ranging from 121.6 to nearly 122.8 m (399 to 403 ft.) in the northeast corner, while south of the ridge, elevations generally do not exceed 121.7 m (399 ft.). On the north end of the site, the land-surface slopes down from both the ridge and the northeast corner of the site toward the ditch, reaching a low of 120.8 m (396 ft.) at the base of the ditch. South of the ridge, the land surface slopes down to 120.8 m (396 ft.) in the center of the former borrow pit. Land-surface elevations continue to drop to a low of 120.4 m (395 ft.) at the point where the site drains into the ditch coming from under IL 3.

Geology

The site lies in the floodplain of the Mississippi River Valley (Herzog et al. 1994). Bedrock in the area is mapped as the Middle Valmeyeran Series of the Mississippian System, consisting primarily of limestones, dolomites, and evaporites (Willman et al. 1967). It is overlain by between 30.5 and 61 m (100 and 200 ft.) of Quaternary deposits (Piskin and Bergstrom 1975). Surface sediments on site are mapped as greater than 6 m (19.7 ft.) of Cahokia Formation alluvium over more than 6 m (19.7 ft.) of Henry Formation sand and gravel (Berg and Kempton 1988, Hansel and Johnson 1996). Soil borings with depths ranging between 1.36 and 4.55 m (4.5-14.9 ft.) revealed clayey silt to silty clay with little structure through most of their depth. All the boreholes terminated in sand at depths ranging from 1.05 m to 2.85 m (3.4-9.4 ft.). The materials described in the borehole logs (Appendix A) are consistent with the lithologic description of Cahokia Formation alluvium (Berg and Kempton 1988).

Soils

Although the U.S. Department of Agriculture maps the site as containing Darwin silty clay, Fults silty clay and Fluvaquents, all of which are classified as hydric (U.S. Department of Agriculture 1995a, 1995b, 1995c, 2000, 2004), soil scientists from the INHS found Karnak silty clay present over most of the site with the exception of the former borrow pit which was mapped as undetermined/excavated (Figure 4; Illinois Natural History Survey 2000, A. Plocher per. comm. 2005a). They determined that all the soils observed were hydric.

The Karnak silty clay is a poorly drained soil that is frequently flooded for long durations from March through May and has an apparent high water table that lies between 0.0 and 0.3 m (0 and 1 ft.) below land surface during the period from April to June (U.S. Department of Agriculture 1978). Karnak soils have low permeability near the land surface, 0.2-0.5 cm/hr (0.06-0.2 in./hr) (U.S. Department of Agriculture 1978).

Precipitation

Average annual precipitation at the nearby Belleville station is 99.5 cm (39.18 in.) (Midwestern Regional Climate Center 2005). Precipitation is typically highest between March and July, peaking in May.

Photo 1. Channel draining the former borrow pit, looking north towards gauges C and D (January 27, 2005).

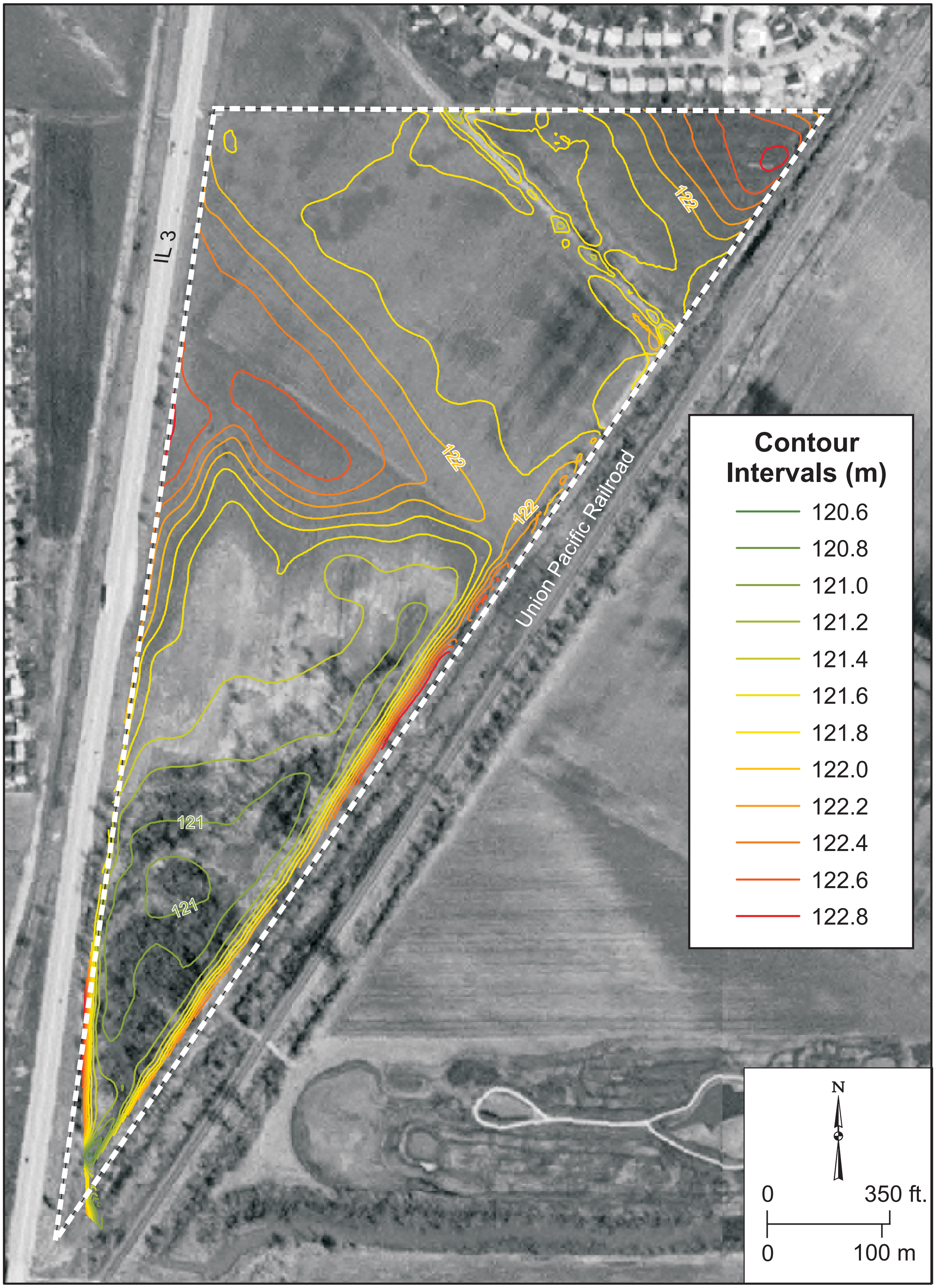


Figure 6. Topographic map of the site (map based on Illinois State Geological Survey 2001b, 2001c, Illinois Department of Transportation 2001). Areas along the embankments at the south end of the site were excluded.

Overall, precipitation in 2000, 2003 and 2004 was above average, 2002 was characterized by average precipitation and 2001 was below average.

Figure 7 shows annual precipitation and monthly precipitation at Belleville from January 2000 through December 2004 expressed as deviation from the average monthly precipitation. For each year, the deviation from the average annual precipitation is summed (Midwestern Regional Climate Center 2005). Relatively dry conditions in the beginning of 2000 continued until substantial precipitation in May through August led to an annual surplus of 10.4 cm (4.1 in.). In 2001, dry conditions in the spring led to an annual deficit of 6.4 cm (2.5 in.). In 2002, high precipitation values in May and October were offset with below average precipitation in June, November and December, resulting in total annual precipitation close to the annual average. In 2003, relatively dry conditions dominated the first half of the year, while above average precipitation prevailed in the latter part of the year, resulting in an overall yearly surplus of 9.9 cm (3.9 in.). Above average precipitation early in 2004 and through most of the summer months offset the drier winter and early fall months and led to an annual surplus of 16.8 cm (6.6 in.). Data from the rain gauge on site indicated overall agreement with the nearby Belleville station. However, since the rain gauge was removed for the winter months, it could not be used to show yearly trends.

Hydrology

Surface-Water Hydrology

Water levels observed at Gauge A indicate that water in the ditch at the north end of the site never reached an elevation sufficient to flood any portion of the former farm field (Appendix C). The maximum water elevation recorded in the ditch was 121.562 m (398.83 ft.) in May 2003, while the banks of the ditch are 121.7 m (399.3 ft.) at minimum. Comparison of the surface-water levels observed at the staff gauges indicates similar patterns among all three. Furthermore, when water levels were high, nearly identical values were reported at each, suggesting continuous inundation between all three.

The hydrograph for Gauge D from April 2002 until December 2004 is shown in Figure 8, along with daily total precipitation at Belleville. The hydrograph shows that for long periods throughout the year the channel that drains the former borrow pit is dry. However, rapid increases in the water level were observed following short duration, high intensity precipitation events and after prolonged periods of precipitation. In most cases, water levels also dropped rapidly.

Closer examination of spring flooding events shows that rapid decreases in water levels coincided with the initiation of pumping at the Blue Waters Ditch Pumping Station (A. Carter per. comm. 2003, 2004). Immediately prior to pumping, the water levels measured in the former borrow pit at Gauge D range from 121.227-121.716 m (397.7-399.3 ft.), with an average value of 121.416 m (398.3 ft.) over the three seasons of record (Figure 9). Although water levels in the borrow pit reached higher levels on several occasions (commonly in the fall), pumping did not occur, possibly because the water level in the Blue Waters Ditch had not reached a critical value.

Ground-Water Hydrology

Figures 10 through 12 show the shallow ground-water levels measured in this study. The shallow ground-water shows an annual fluctuation with water levels peaking in late spring and dropping to their lowest levels in summer and fall. During the period that water is observed in the shallow wells in the former borrow pit (wells 1S through 22S), the overall pattern shows water levels fluctuating rapidly (Figure 10) between the minimum of 120.113 m (394.07 ft.) at well 21S and the maximum of 121.814 m (399.65 ft.) at well 7S. Overall however, the highest ground-water elevations in these wells were generally observed in late spring (late May to June), with quick drops to dry for the remainder of the year.

The pattern observed in the data recorded by the logger in well 10S is consistent with the measurements

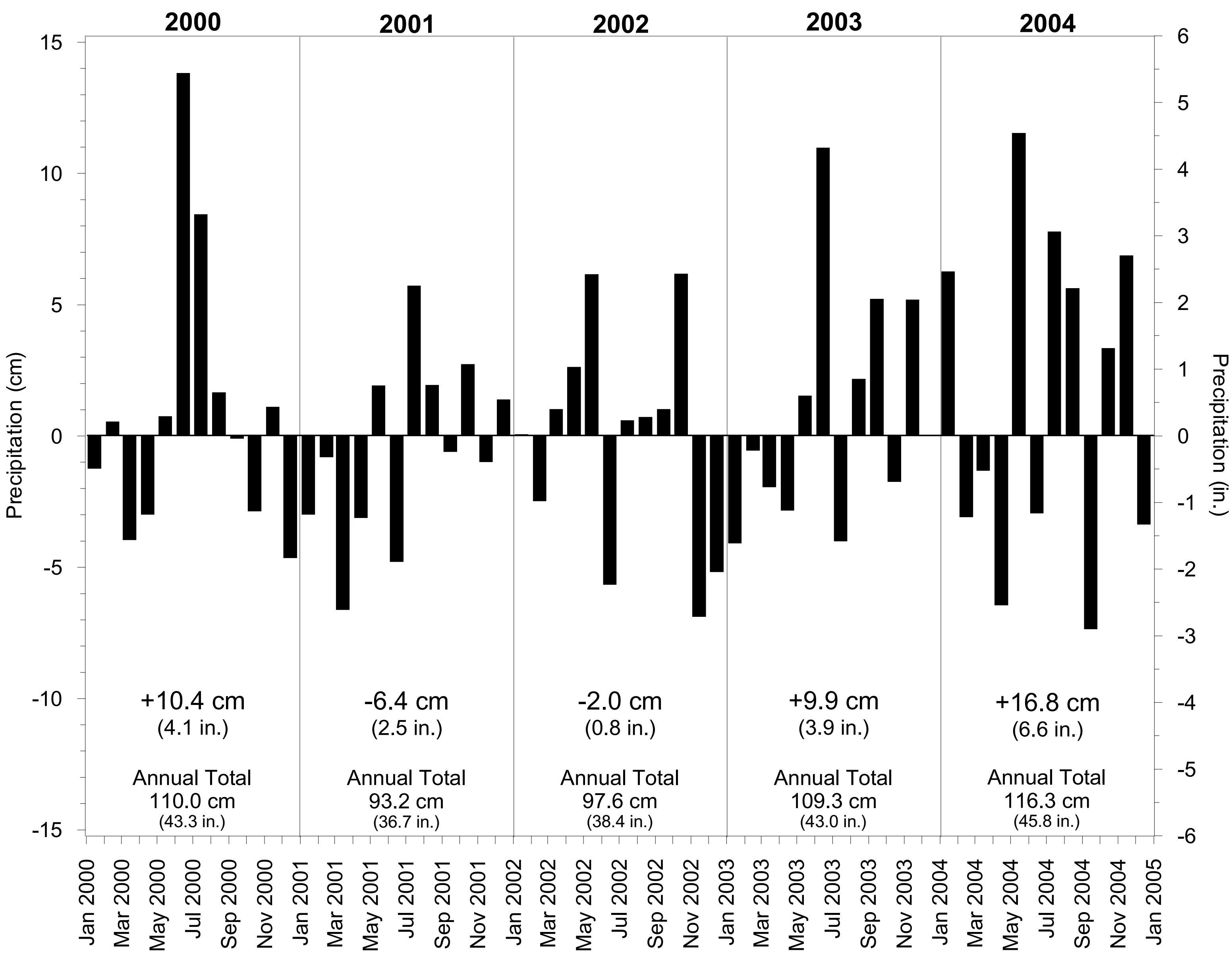


Figure 7. Deviation in monthly average and total annual precipitation for the period 2000 through 2004 (Midwest Regional Climate Center 2005).

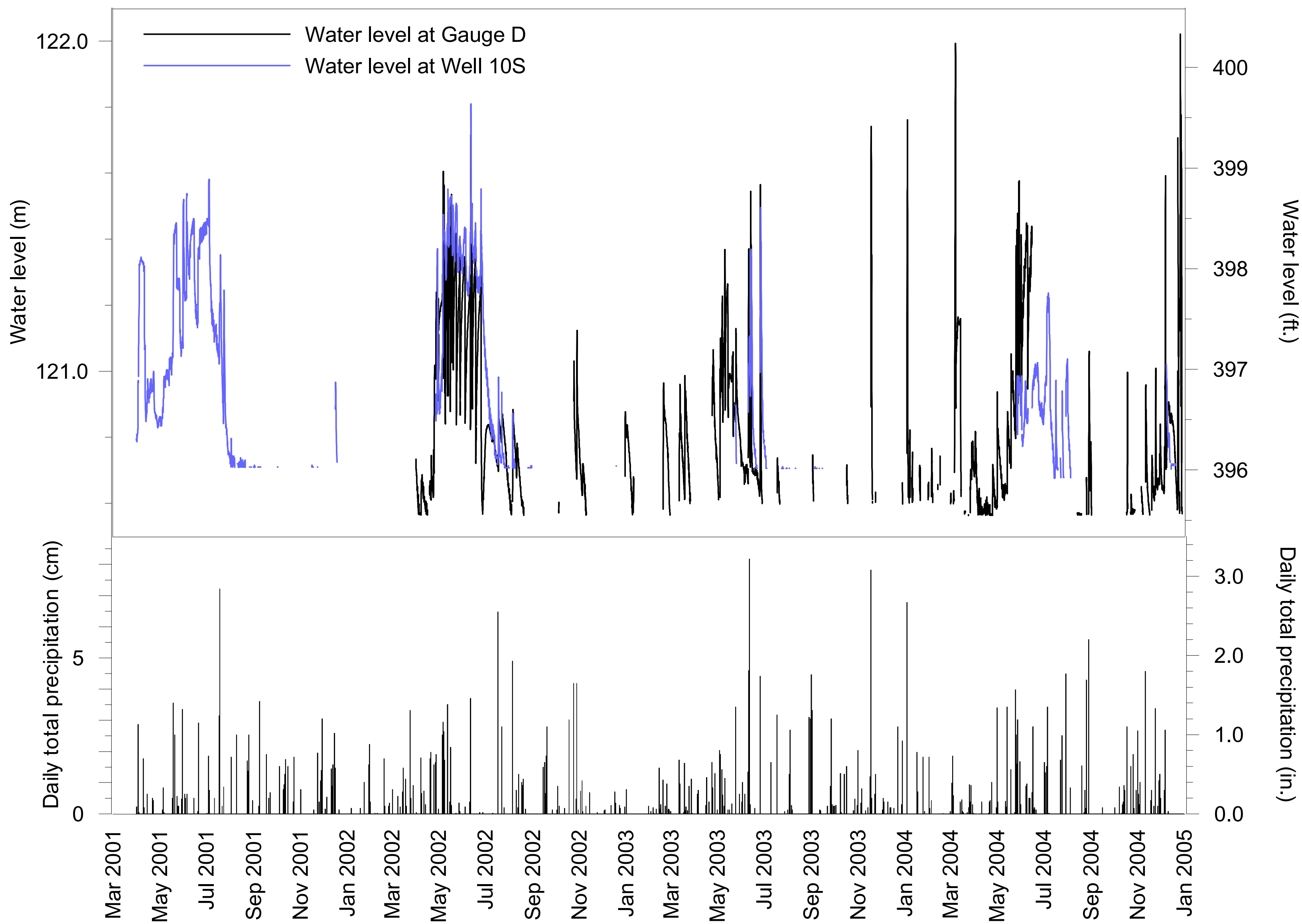


Figure 8. Water levels in the ditch (Gauge D), former borrow pit (Well 10S), and daily total precipitation recorded at Belleville, IL (Midwest Regional Climate Center 2005).

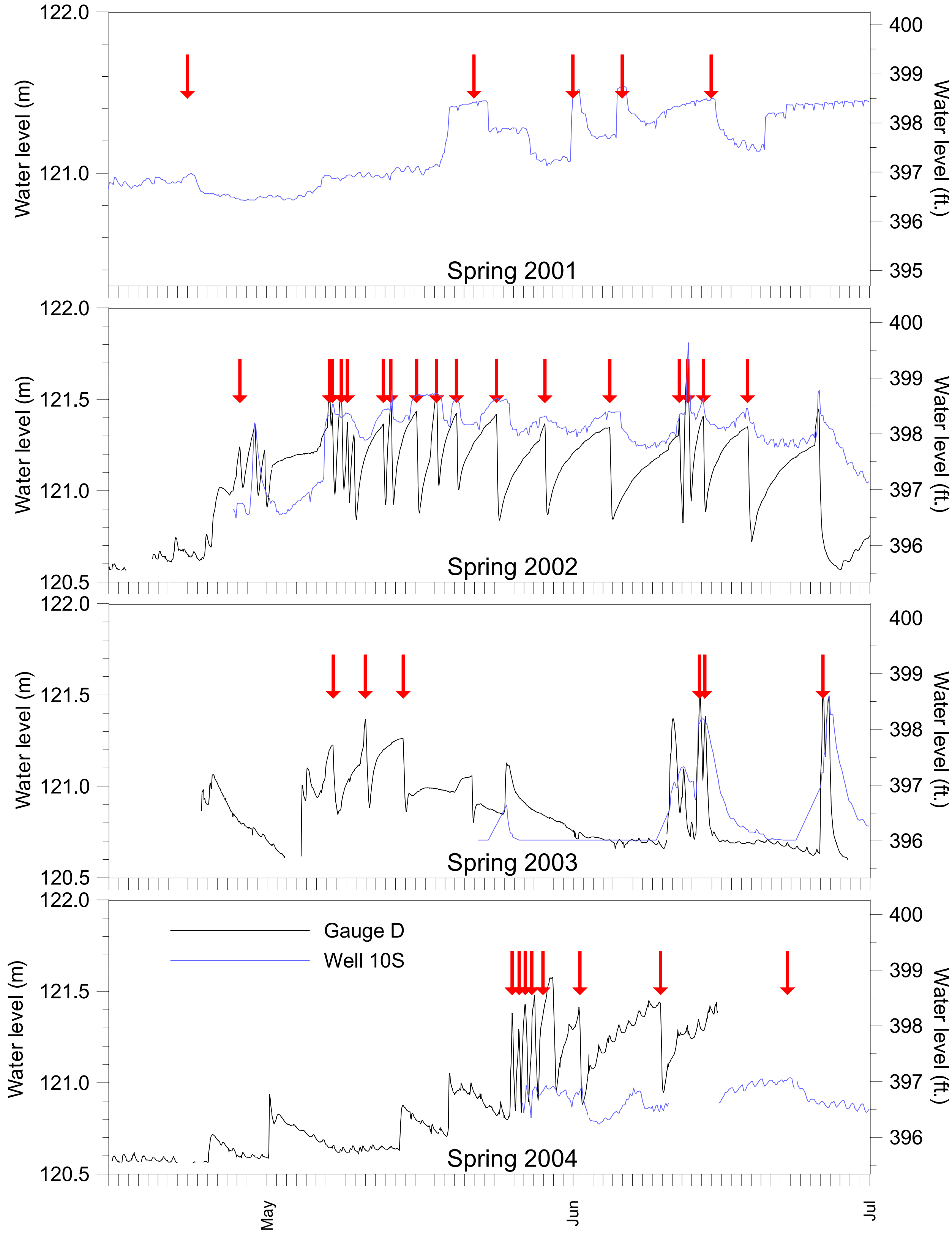


Figure 9. Water levels in the ditch (Gauge D) and former borrow pit (Well 10S) in spring. Red arrows indicate when the Blue Waters Pumping Station initiated pumping.

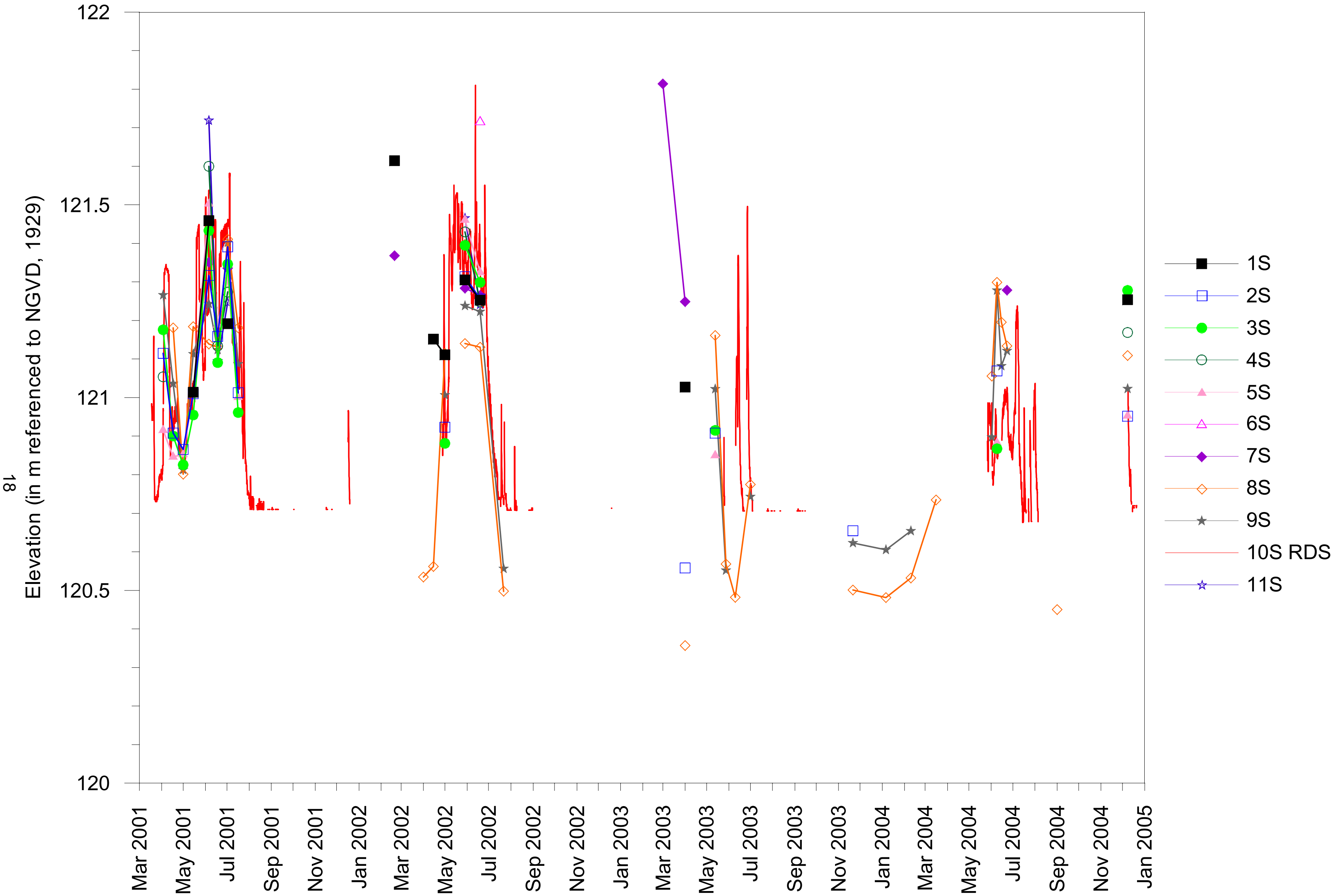


Figure 10a. Water-level elevations in wells 1S through 11S installed in the former borrow pit. Well 10S was equipped with an RDS water-level datalogger.

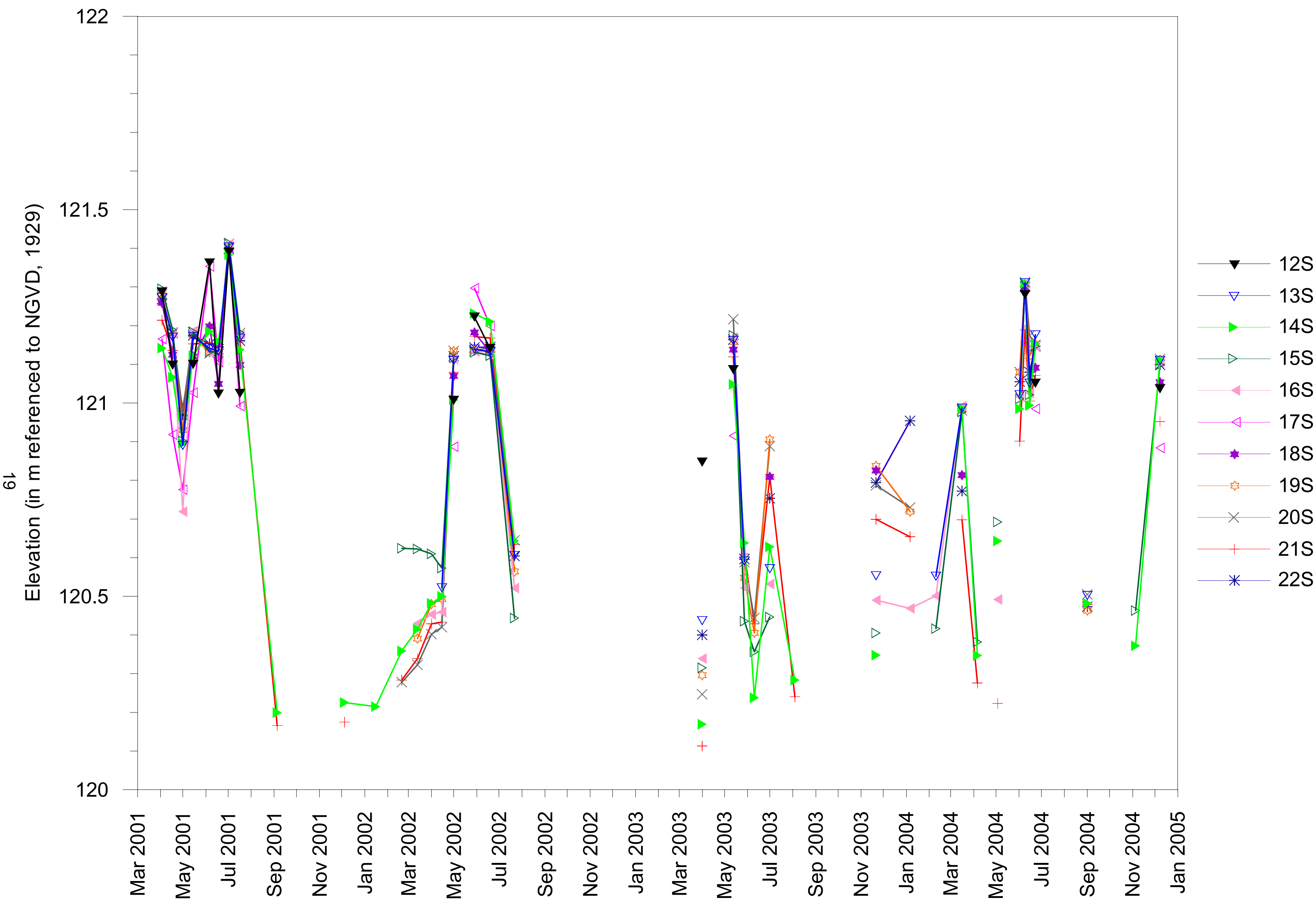


Figure 10b. Water-level elevations in wells 12S through 22S installed in the former borrow pit.

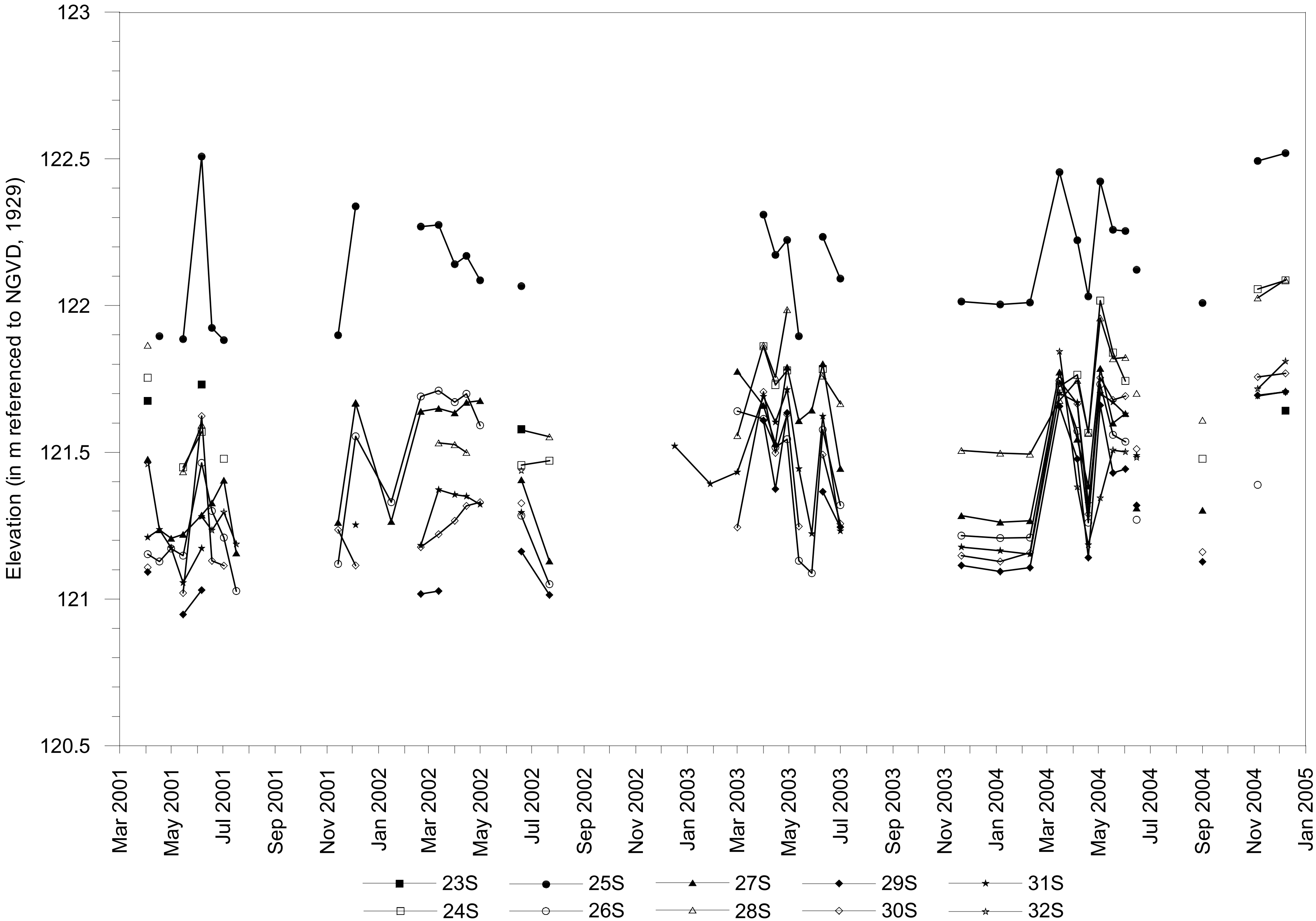


Figure 11. Water-level elevations in the S-wells installed in the farm field.

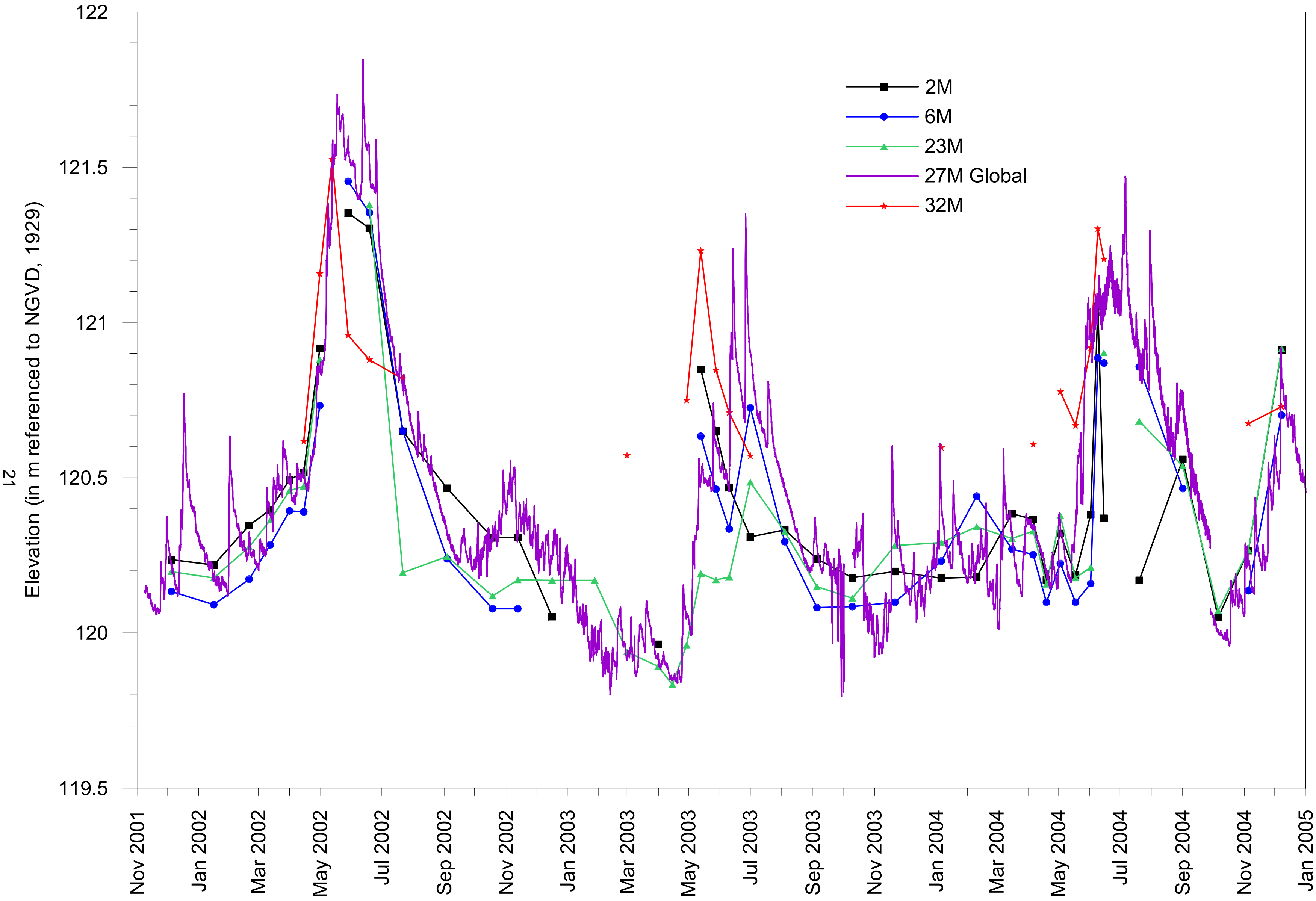


Figure 12. Water-level elevations in all M-wells.

taken manually at the other wells in the former borrow pit and is considered to be representative of the ground-water levels in the former borrow pit. As a result of the 3-hour recording interval of the datalogger at 10S, comparisons between the ground-water levels in the former borrow pit and the surface-water level at Gauge D can be made. Ground-water levels recorded at 10S show variations similar to those observed at Gauge D (Figures 8 and 9). Even though the reductions in the ground-water level do not occur as rapidly as those observed for the surface water, it is apparent that the pumping at Blue Waters Ditch is lowering ground-water levels as well.

Although the range of water levels recorded in the shallow wells in the farm field was greater, ranging from a minimum of 120.947 m (396.81 ft.) to a maximum of 122.519 m (401.97 ft.), the variability between individual readings was smaller. Unlike the pattern observed in the wells in the former borrow pit, water levels in the farm field wells generally begin to rise in February and stay at maximum levels until high summertime evapotranspiration rates cause them to dry out by July (Figure 11). Data from the soil-moisture probes located at well clusters 26, 27 and 28 are in general agreement with the patterns observed in the shallow wells (Figure 13). The soil-moisture values are driest in August through September and generally increase over the winter to a maximum in early spring.

Although the maximum difference between the highest and the lowest water-level measurements in the shallow wells on the south end of the site was 0.60 m (2 ft.), the majority of the water-levels were within 5 mm (0.2 in.) of one another during periods when water was recorded in most of the wells. Aside from the fact that water was observed less frequently in the wells located along the perimeter of the former borrow pit, little overall horizontal gradient was evident in the shallow ground-water at the southern end of the site. This is consistent with the model of a surface-water-driven system where standing surface water often covers the area. Conversely, in the northern half of the site, the average difference between the highest and lowest water-level measurement was 0.9 m (3 ft.), with the maximum reading almost always at well 25S and the lowest at well 29S or 30S. These wells are located at the highest and lowest elevations respectively, suggesting that the horizontal flow in the shallow ground-water mimics the topography: northeast, towards the ditch. These patterns can be observed clearly in Figure 14, which shows the directions of shallow ground-water flow and the approximate extent of inundation on June 19, 2002, a date when water was recorded in every well on site.

The deeper wells (all in the farm field) respond more slowly to seasonal precipitation, reaching a peak in late June/early July and dropping through the fall and winter. Water levels in different wells mimic each other closely (Figure 15). The difference between the highest and lowest water-level measurement was typically less than 0.46 m (1.5 ft.). The water level in well 32M was generally the highest, whereas 6M generally had the lowest levels, indicating ground-water flow towards the south and west, towards the Mississippi River. Figure 15 shows that there is no vertical hydraulic gradient in any of the well clusters, which indicates that upward flow and discharge to land surface is unlikely.

Wetland Hydrology

Inundation and/or saturation to land surface must occur for at least 5 percent of the growing season to satisfy wetland hydrology criteria as outlined in the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Water levels within 30 cm (1 ft.) of land surface in wells are interpreted to show saturation to land surface due to the presence of a capillary fringe, as suggested by informal Corps guidance. Interpolation and/or extrapolation were performed to determine the duration of saturation for wells where manual water-level measurements were collected.

Water-level data collected indicate that a minimum of 16.0 ha (39.5 ac.) of the entire site satisfied the criteria for jurisdictional wetland hydrology for at least 5 percent of the growing season in at least two out of four years (Figure 2; Illinois State Geological Survey 2001a, 2002, 2003, 2004). With the exception of wells 1S, 4S, 6S, 7S, 12S, 18S, 23S, 23VS, 32S and 32VS, water levels in all the shallow and very shallow wells satisfied the criteria for wetland hydrology (Figure 2). All of this area satisfies the soils,

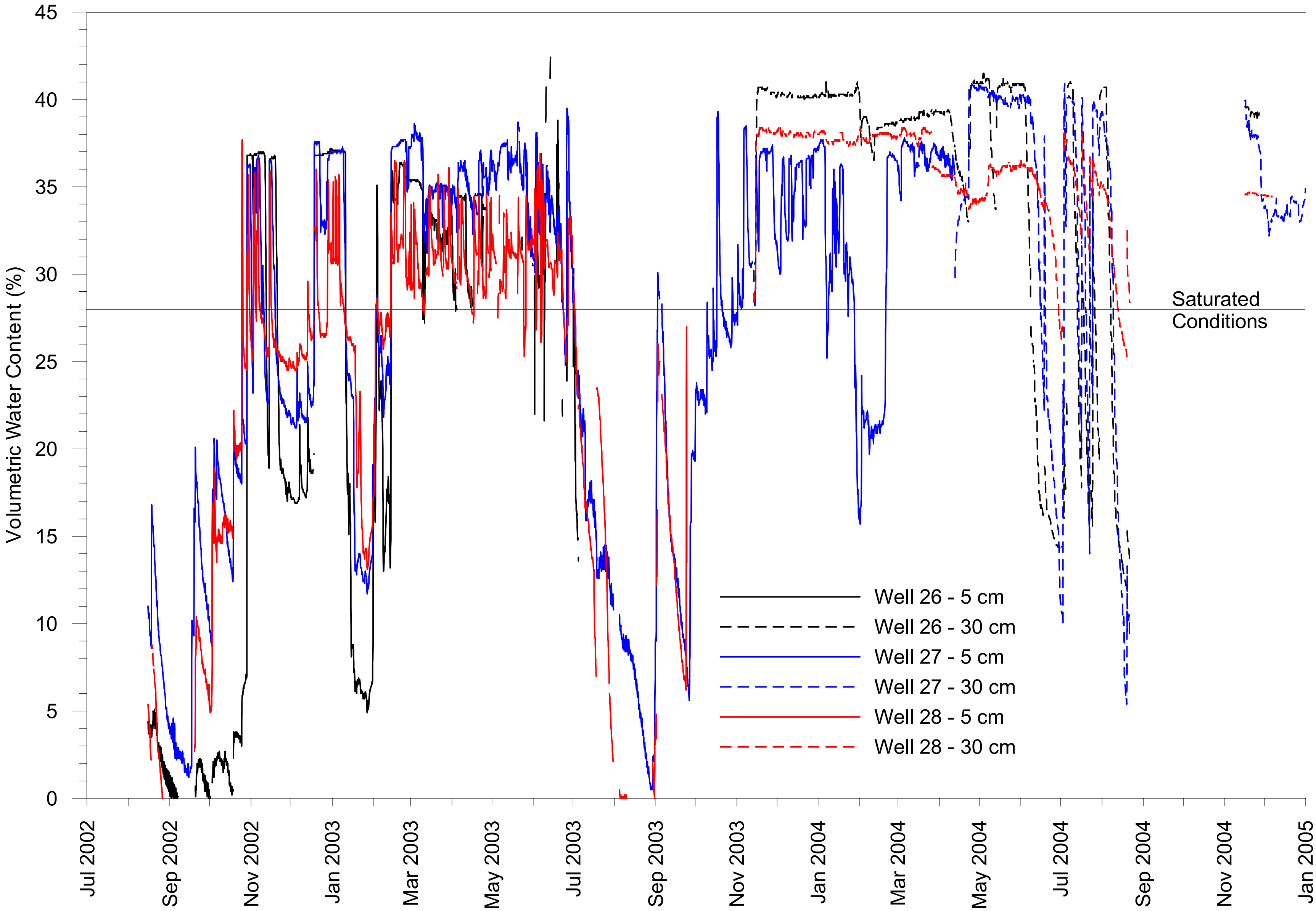


Figure 13. Soil-moisture content at wells 26, 27 and 28.

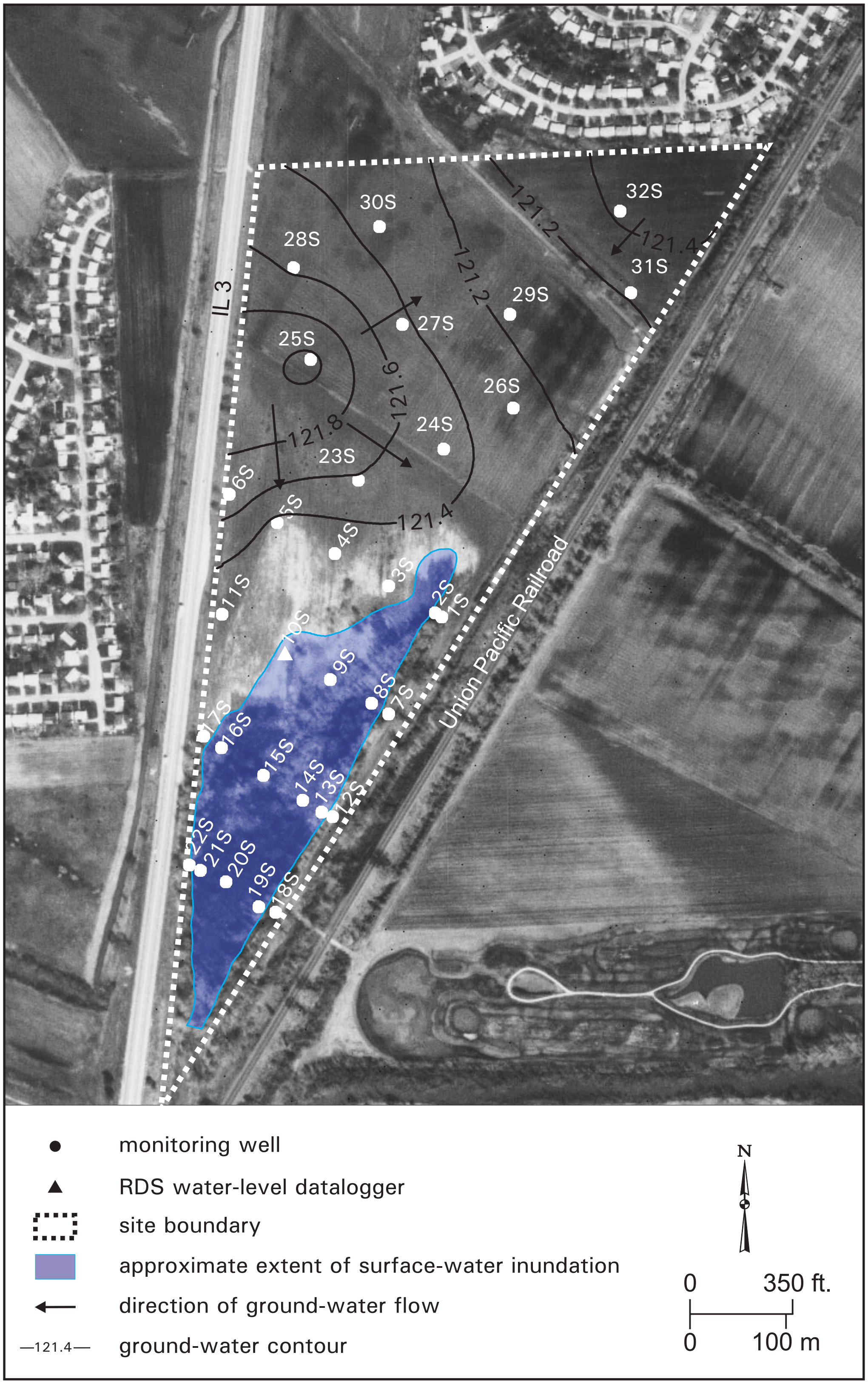


Figure 14. Shallow ground-water flow directions from water levels recorded on June 19, 2002 (map based on Illinois State Geological Survey 2001b, 2001c, 2002).

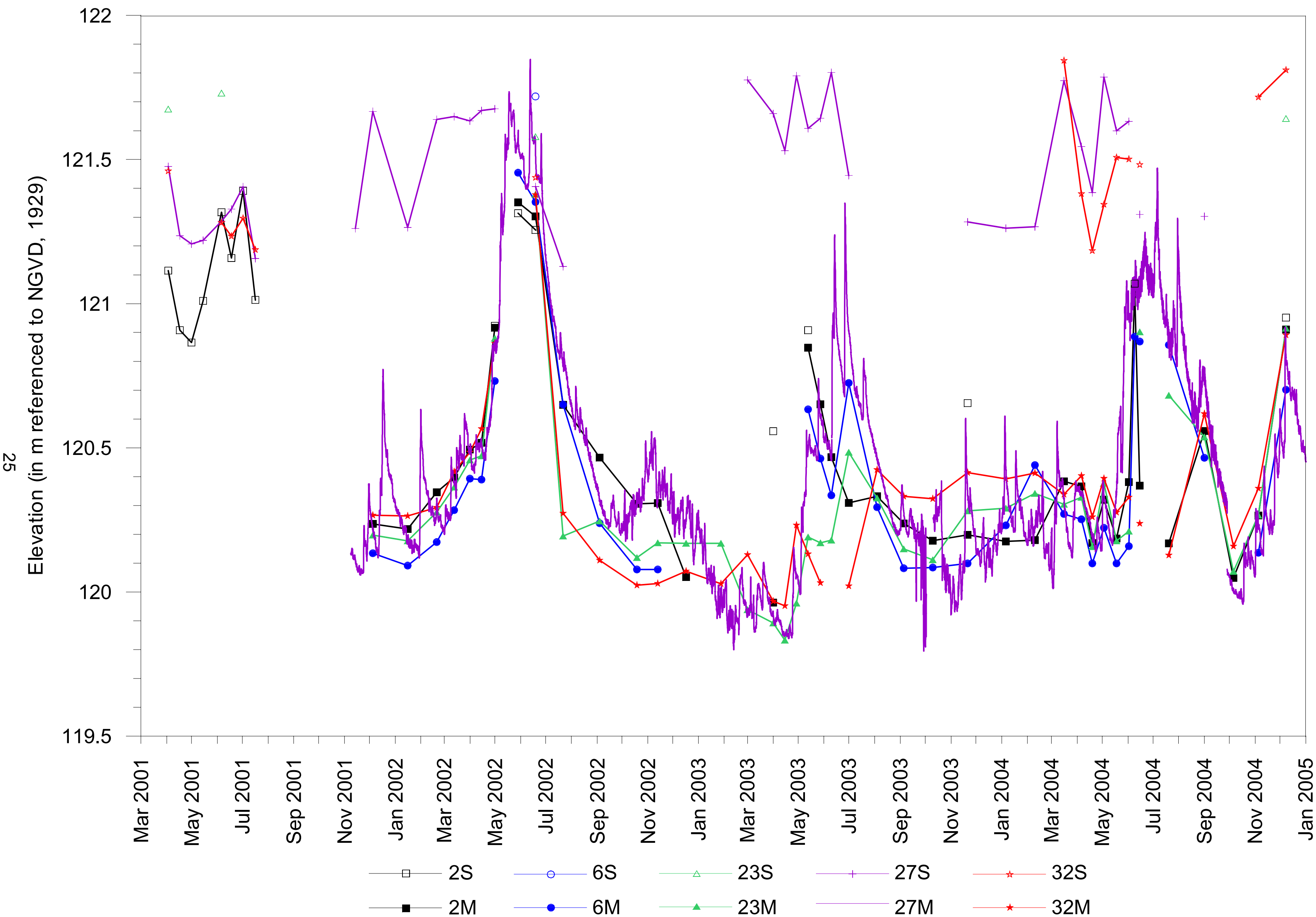


Figure 15. Water-level elevations in all well clusters with M- and S-wells.

vegetation and hydrologic criteria for a jurisdictional wetland (A. Plocher per. comm. 2005a, 2005b). This includes the 1.1 ha (2.7 ac.) of drainage ditch in the northern portion of the site, 8.5 ha (21.0 ac.) of the former farm field that was previously mapped by the NRCS as prior converted wetland (Illinois Natural History Survey 2000) and was being actively farmed until the spring of 2000 (Ketterling et al. 2000), and 6.4 ha (15.8 ac.) on the southern portion of the site that was previously mapped as wetland by the INHS (Illinois Natural History Survey 2000).

The area that met the criteria for wetland hydrology north of the farm road was directly correlated to the overall amount of precipitation recorded during the spring (Figure 7 and Appendix G). In 2001, spring precipitation was 6.0 cm (2.4 in.) below normal, and the area in the former farm field that satisfied the criteria for wetland hydrology was minimal. Conversely, nearly the entire area north of the farm road met the criteria for wetland hydrology in 2002, 2003, and 2004 during years when spring precipitation was above normal [3.1 cm (1.2 in.), 9.7 cm (3.8 in.), and 2.1 cm (0.8 in.), respectively]. This implies that the saturated conditions in the farm field are caused by localized ponding on the surface in response to precipitation. Since water levels in the ditch did not reach an elevation sufficient to overtop the banks of the ditch, any surface-water inputs from the ditch at the north end of the site are minimal.

On the southern end of the site, the timing of precipitation events is more critical in determining the amount of wetland hydrology than the overall amount of precipitation. In 2001, although spring precipitation was 6.0 cm (2.4 in.) below normal, it was characterized by numerous closely spaced events of moderate intensity that caused sustained high water levels in the ditch and former borrow pit and resulted in the largest area with wetland hydrology (Figure 8 and Appendix G). Conversely, overall spring precipitation in 2003 was the greatest of all the years monitored [9.7 cm (3.8 in.) above normal] but the area with wetland hydrology was the smallest. Precipitation events during that spring were either too small and too far apart to result in a sustained increase in the water levels at the southern end of the site (such as was observed that May), or were so extreme that water levels rose rapidly and then dropped just as quickly when pumping was initiated at the Blue Waters Ditch Pumping Station, as occurred on several occasions that June (Figures 8 and 9). This is consistent with the idea that water-levels on the south end of the site are dominantly controlled by backflooding onto the site when runoff overwhelms Blue Waters Ditch.

Water Quality

Limited surface-water sampling conducted by the ISGS in the spring of 2001 and ground-water sampling conducted by Burns and McDonnell in 2002 and the Forrester Group in 2004 indicate no levels of inorganics on site that exceed the general use water quality standards outlined by the Illinois Environmental Protection Agency (Appendices E & F, Illinois Environmental Protection Agency 2005).

CONCLUSIONS AND RECOMMENDATIONS

Two distinct water sources were observed on the site. In the northern portion of the site, precipitation is the primary hydrologic input, where low permeability of the surface sediments produces localized ponding in response to precipitation. The southern portion of the site receives backflooding from Blue Waters Ditch and runoff from the subdivisions to the west.

On the northern end of the site, a total of 9.6 ha (23.7 ac.) meets all three criteria for jurisdictional wetland; 1.1 ha (2.7 ac.) of ditches and 8.5 ha (21.0 ac.) that has developed following the cessation of farming in 2000. Because the farmed area was previously mapped by the NRCS as prior converted wetland, it is likely eligible for restoration mitigation credit.

There are limited options for increasing the amount of wetland hydrology on the northern end of the site. The lack of any upward hydraulic gradient observed in any of the well clusters suggests that limited groundwater inputs are available. Furthermore, any excavation in order to increase surface inundation is not suggested because sand was found at depths as shallow as 1.3 m (4.3 ft.) in the farm field (Appendix A). Therefore, any attempt at excavation may result in improved drainage and could be detrimental to the areas with existing wetland hydrology.

On the southern end of the site, although the entire 6.4 ha (15.8 ac.) area that has been mapped in this study as jurisdictional wetland was previously classified as NWI-mapped wetland (U.S. Fish and Wildlife Service 1996), construction of a berm at the outlet of the former borrow pit, roughly 50 m (165 ft.) south of gauges C and D, would make the area eligible for enhancement credit by stabilizing water levels. It could also potentially increase the area of wetland hydrology by 2.4 ha (6.0 ac.) in an area where hydrophytic vegetation and hydric soils already exist.

When pumping occurs frequently, such as during periods characterized by short events with extremely high volumes of precipitation, water levels in the former borrow pit fluctuate significantly (Figure 9). If this pattern dominates the entire growing season, there is a very good chance that water levels will not be sustained at a high enough level for a sufficient period to satisfy wetland hydrology criteria or may impact the vegetation community. Therefore, if the water can be maintained on site longer, a larger area of the site would satisfy the criteria for wetland hydrology on a more regular basis. The construction of a berm would serve to limit the drainage of water from the southern portion of the site (Figure 3). An elevation of 121.7 m (399.3 ft.) was selected as the maximum height of the berm because it would maximize the amount of water retained on site during pumping, but would not significantly limit the backflooding of excess water from Blue Waters Ditch. Although the loss of floodwater storage capacity will be negligible as a result of the construction of this small berm, consultation with the Village of Cahokia and the East Side Sanitary District likely would be required to address any concerns.

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 the residential areas immediately north and west of the site.

ACKNOWLEDGMENTS

Funding for this study was provided by the Illinois Department of Transportation. People at the ISGS who have contributed to the success of this study include: Brad Ketterling, Marshall Lake, Geoff Pociask, Kelli Weaver, Greg Shofner, Paula Sabatini, Christine Fucciolo, Jim Miner and Dave Larson.

REFERENCES

Berg, R. C., and J.P. Kempton, 1988, Stack Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters: Illinois State Geological Survey Circular 542, Champaign, Illinois, 23 p.

Carter, Al, May 2003, Electrical Foreman, Department of Water and Sewer, Village of Cahokia, personal communication.

Carter, Al, September 2004, Electrical Foreman, Department of Water and Sewer, Village of Cahokia, personal communication.

Dieckmann, Ronald, May 31st 2000, Technical Lead, Hydrologic Engineering Branch East St. Louis and Vicinity Interior Flood Control and Ecosystem Restoration Project, U.S. Army Corps of Engineers, St. Louis District, telephone conversation.

Environmental Laboratory, 1987, Corps of Engineers Wetlands Delineation Manual: U. S. Army Corps of Engineers Technical Report Y-87-1, Washington, D.C., 100 p. Available online at http://www.saj.usace.army.mil/permit/documents/87manual.pdf.

Hansel, A. and W.H. Johnson, 1996, Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area: Illinois State Geological Survey Bulletin 104, 116 p.

Herzog, B., B. Stiff, C. Chenoweth, K. Warner, J. Sieverling, and C. Avery, 1994, Buried Bedrock Surface of Illinois: Illinois State Geological Survey, Illinois Map 5, Champaign, Illinois, map scale 1:500,000, 1 sheet.

Illinois Department of Transportation, 2001, Wetland Mitigation New Mississippi River Crossing St. Clair County, D-2067, 1:50 scale topographic maps: Aerial surveys, Illinois Department of Transportation, Division of Highways, Springfield, IL, 5 sheets.

Illinois Environmental Protection Agency, May 2005, Title 35: Environmental Protection Subtitle C: Water Pollution Chapter I: Pollution Control Board Part 302 Water Quality Standards, available online at http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.asp.

Illinois Natural History Survey, 2000, Mitigation Site Assessment, Tiernan Property, unpublished contract report presented to the Illinois Department of Transportation, Illinois Natural History Survey, Champaign, Illinois, 3 p.

Illinois State Geological Survey, 2001a, Annual Report for Active IDOT Wetland Compensation and Hydrologic Monitoring Sites, September 1, 2000 to September 1, 2001, Submitted Under Contract Number IDOT SW WIP FY02 ANT to Illinois Department of Transportation, Illinois State Geological Survey Open File Series 2001-5, Champaign, Illinois, 298 p.

Illinois State Geological Survey, 2001b, Illinois Natural Resources Geospatial Data Clearinghouse, Cahokia SE Digital Orthophoto Quarter Quadrangle, 1998 Data: Illinois State Geological Survey, Champaign, Illinois, available for download on line at http://www.isgs.uiuc.edu/nsdihome/webdocs/doqs/.

Illinois State Geological Survey, 2001c, Illinois Natural Resources Geospatial Data Clearinghouse, Cahokia SW Digital Orthophoto Quarter Quadrangle, 1998 Data: Illinois State Geological Survey, Champaign, Illinois, available for download on line at http://www.isgs.uiuc.edu/nsdihome/webdocs/doqs/.

Illinois State Geological Survey, 2002, Annual Report for Active IDOT Wetland Compensation and Hydrologic Monitoring Sites, September 1, 2001 to September 1, 2002: Submitted Under Contract Number IDOT SW WIP FY03 ANTC to Illinois Department of Transportation, Illinois State Geological Survey Open File Series 2002-3, Champaign, Illinois, 341 p.

Illinois State Geological Survey, 2003, Annual Report for Active IDOT Wetland Compensation and Hydrologic Monitoring Sites, September 1, 2002 to September 1, 2003: Submitted Under Contract Number IDOT SW WIP FY04 to Illinois Department of Transportation, Illinois State Geological Survey Open File Series 2003-16, Champaign, Illinois, 300 p.

Illinois State Geological Survey, 2004, Annual Report for Active IDOT Wetland Compensation and Hydrologic Monitoring Sites, September 1, 2003 to September 1, 2004: Submitted Under Contract Number IDOT SW WIP FY05 to Illinois Department of Transportation, Illinois State Geological Survey Open File Series 2004-17, Champaign, Illinois, 279 p.

Ketterling, D.B, S.E. Benton, and K.W. Carr, 2000, Initial Site Evaluation , Proposed Wetland Compensation Site, St. Clair County, Cahokia, IL, FAP 999 (New River Crossing) P98-088-91: Illinois State Geological Survey unpublished contract report to the Illinois Department of Transportation, Champaign, Illinois, 32 p.

Midwestern Regional Climate Center, February 2005, Midwestern Climate Information System: Illinois State Water Survey, Champaign, Illinois, available online at http://sisyphus.sws.uiuc.edu/index.jsp

National Water and Climate Center, February 2005, National Resource Conservation Service, Climate Analysis for Wetlands by County, available online at http://www.wcc.nrcs.usda.gov/climate/wetlands.html.

Piskin, K., and R. Bergstrom, 1975, Thickness of Glacial Drift in Illinois: Illinois State Geological Survey Circular 490, Champaign, Illinois, 34 p.

Plocher, Allen, February 16th 2005a, INHS/IDOT Project Coordinator, Illinois Natural History Survey, email correspondence.

Plocher, Allen, March 25th 2005b, INHS/IDOT Project Coordinator, Illinois Natural History Survey, email correspondence.

Southwestern Illinois Metropolitan and Regional Planning Committee, 1975, Plan for Major Drainage: The American Bottoms and Hillside Drainage Area Planning Basin. Southwestern Illinois Metropolitan and Regional Planning Committee, Collinsville, Illinois, 291 p.

U.S. Department of Agriculture, 1940, Aerial Photographs, Line SK-10A, 51-52.

U.S. Department of Agriculture, 1962, Aerial photographs, Line SK-3CC, 40, 41, 198, 199.

U.S. Department of Agriculture, 1978, Soil Survey of St. Clair County, Illinois, Soil Conservation Service, Washington D.C., 116 p.

U.S. Department of Agriculture, 1995a, Hydric Soils of Illinois (revised December 15, 1995), Hydric Soils of the United States, National Resources Conservation Service, National Soil Data Access Facility, available online at http://soils.usda.gov/use/hydric/.

U.S. Department of Agriculture, 1995b, County List of Hydric Soils in Illinois, National Resources Conservation Service.

U.S. Department of Agriculture, 1995c, County List of Soils with Hydric Inclusions in Illinois, National Resources Conservation Service.

U.S. Department of Agriculture, 2000, Soil Survey of St. Clair County, Illinois, Soil Conservation Service, Washington D.C., 194 p.

U.S. Department of Agriculture, 2004, Soil Survey Geographic (SSURGO) database for St. Clair County, Illinois, Fort Worth, Texas, available online at http://soildatamart.nrcs.usda.gov/.

U.S. Fish and Wildlife Service, 1996, National Wetlands Inventory Map, Cahokia Quadrangle, Illinois, map scale 1:24,000, 1 sheet, available for download online at http://www.isgs.uiuc.edu/nsdihome/.

U.S. Geological Survey, 1934, Cahokia, Illinois, 7.5-Minute Series (Topographic): U.S. Department of the Interior, Geological Survey, Reston, Virginia, map scale 1:24,000, 1 sheet.

U.S. Geological Survey, 1954, Cahokia, Illinois, 7.5-Minute Series (Topographic): U.S. Department of the Interior, Geological Survey, Reston, Virginia, map scale 1:24,000, 1 sheet.

U.S. Geological Survey, 1968, Cahokia, Illinois, 7.5-Minute Series (Topographic): U.S. Department of the Interior, Geological Survey, Reston, Virginia, map scale 1:24,000, 1 sheet.

U.S. Geological Survey, 1993, Cahokia, Illinois, 7.5-Minute Series (Topographic): U.S. Department of the Interior, Geological Survey, Reston, Virginia, map scale 1:24,000. 1 sheet, available for download online at http://www.isgs.uiuc.edu/nsdihome/.

Voelker, D.C. 1984, Quality of the Water in the Alluvial Aquifer, American Bottoms, East St. Louis, Illinois: United States Geological Survey Water-Resources Investigations Report 84-4180, Urbana, Illinois, 51 p.

Willman, H., J. Frye, J. Simon, K. Clegg, D. Swann, E. Atherton, C. Collinson, J. Lineback, and T. Buschbach, 1967, Geologic map of Illinois: Illinois State Geological Survey, Champaign, Illinois, map scale 1:500,000, 1 sheet.

Appendix A: Geologic descriptions

Boring	New River / Tiernan 2M
Location	W ½, Section 10, T1N, R10W, Cahokia, Illinois
Date / Time	11/15/01
Field Crew	Brad Ketterling
Comments	Hand Auger
Well Construction	(see Appendix B)

Depth	Unit Descriptions	
0 - 0.18 m (0 - 0.6 ft.)	*Geologic material:* **clayey silt** (0% gravel / tr sand / 65% silt / 35% clay)	*Color of matrix:* black (10YR 4/2)
	Notes: Many fine to medium, prominent dark reddish brown (5YR 3/4) redox masses, oxidized root channels.	
0.18 - 0.36 m (0.6 - 1.2 ft.)	*Geologic material:* **silty clay** (0%/tr/85%/15%)	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes: Many fine to medium, prominent dark brown (7.5YR 3/4) redox masses	
0.36 - 0.47 m (1.2 - 1.5 ft.)	*Geologic material:* **fine sand**	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes:	
0.47 - 1.05 m (1.5 - 3.4 ft.)	*Geologic material:* **silt**	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes: Possible laminae, dark yellowish brown (10YR 3/4) redox lines along bed, decreasing with depth. Saturated at 0.50 m.	
1.05 - 1.36 m (3.4 - 4.5 ft.)	*Geologic material:* **fine sand**	*Color of matrix:* olive brown (2.5Y 4/3)
	Notes: Saturated, subrounded structure.	

Appendix A: Geologic descriptions

Boring	New River / Tiernan 6M
Location	W ½, Section 10, T1N, R10W, Cahokia, Illinois
Date / Time	11/15/01
Field Crew	Brad Ketterling
Comments	Hand auger
Well Construction	(see Appendix B)

Depth	**Unit Descriptions**	
0 - 0.2 m (0 - 0.7 ft.)	*Geologic material:* **clayey silt** (0% gravel / 0% sand/ 55% silt / 45% clay)	*Color of matrix:* very dark grayish brown (10YR 3/2)
	Notes: Plowed zone. No redox masses. Many roots.	
0.2 - 0.4 m (0.7 - 1.3 ft.)	*Geologic material:* **clayey silt** (0%/0%/55%/45%)	*Color of matrix:* dark grayish brown (10YR 4/2)
	Notes: Common to many, prominent, fine to many dark brown (7.5YR 3/4) redox concentrations. Silt increases with depth.	
0.4 - 0.75 m (1.3 - 2.5 ft.)	*Geologic material:* **clayey silt** (0%/tr/85%/15%) **grading to silt** (0%/tr/90%/10%)	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes: Many fine to medium, many (50/50) distinct dark yellowish brown (10YR 4/6) redox concentrations as masses.	
0.75 - 1.38 m (2.5 - 4.5 ft.)	*Geologic material:* **silt**	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes: Fine to medium, many (50/50) dark yellowish brown (10YR 4/6) mottles. No structure. Occasional Mn nodule. Contact with underlying sand is sharp, even in hand-augered hole.	
1.38 - 2.63 m (4.5 - 8.6 ft.)	*Geologic material:* **fine sand**	*Color of matrix:* light olive brown (2.5Y 5/3) to olive brown (2.5Y 4/3) by 1.65 m
	Notes: Subrounded. Prominent quantity of feldspar fragments and Mn nodules.	

Appendix A: Geologic descriptions

Boring	New River / Tiernan 23M
Location	W ½, Section 10, T1N, R10W, Cahokia, Illinois
Date / Time	11/15/01
Field Crew	Brad Ketterling
Comments	Hand auger
Well Construction	(see Appendix B)

Depth	**Unit Descriptions**	
0 - 0.28 m (0 - 0.9 ft.)	*Geologic material:* **clayey silt** (0% gravel / tr sand /65% silt / 35% clay)	*Color of matrix:* very dark grayish brown (10YR 3/2)
	Notes: Plowed zone, live roots. Fine, few to many dark yellowish brown (10YR 4/6) redox concentrations as masses start at 0.2 m.	
0.28 - 0.68 m (0.9 - 2.2 ft.)	*Geologic material:* **clayey silt** (0%/tr/65%/35%)	*Color of matrix:* grayish brown (2.5Y 5/2)
	Notes: Fine to medium, many to common (50/50) dark yellowish brown (10YR 4/6) redox concentrations as masses and pore linings. Clay fraction decreasing with depth.	
0.68 - 1.48 m (2.2 - 4.9 ft.)	*Geologic material:* **clayey silt to silt**	*Color of matrix:* dark grayish brown (2.5Y 4/2)
	Notes: Fine to medium, many to common (50/50) dark yellowish brown (10YR 4/6) redox concentrations as masses and pore linings. Between 0.84 and1.10 m, redox concentrations down to few, then resume then increase to 50/50 to end of section. Free water at 1.25-1.3 m.	
1.48 - 1.91 m (4.9 - 6.3 ft.)	*Geologic material:* **fine sand**	*Color of matrix:* olive brown (2.5Y 4/3)
	Notes: Structureless, loose. Redox concentrations difficult to discern.	
1.91 - 2.69 m (6.3 - 8.8 ft.)	*Geologic material:* **silt, traces of clay**	*Color of matrix:* grayish brown (2.5Y 5/2)
	Notes: Saturated. Possible bedding (does not break along laminations). Many fine, prominent dark yellowish brown (10YR 4/6 -3/6) redox concentrations and fine Mn nodules. Occasional mottling.	
2.69 - 2.85 m (8.8 - 9.4 ft.)	*Geologic material:* **clayey silt**	*Color of matrix:* grayish brown (2.5Y 5/2)
	Notes: Small layer of increased clay in the silt. Prominent, medium to coarse dark yellowish brown (10YR 4/6 -3/6) redox concentrations.	
2.85 - 3.10 m (9.4 - 10.2 ft.)	*Geologic material:* **fine sand**	*Color of matrix:* olive brown (2.5Y 4/3)
	Notes: Saturated.	

Appendix A: Geologic descriptions

Boring	New River / Tiernan 27M
Location	W ½, Section 10, T1N, R10W, Cahokia, Illinois
Date / Time	8/23/02
Field Crew	Brad Ketterling, Keith Carr
Comments	Hand auger
Well Construction	(see Appendix B)

Depth	**Unit Descriptions**	
0 - 0.40 m (0 - 1.3 ft.)	*Geologic material:* **clayey silt** (0 % gravel / 80% sand / 20% silt / 0% clay)	*Color of matrix:* very dark gray (10YR 3/1)
	Notes: Many fine dark yellowish brown (10YR 3/6) redox concentrations. Occasionally large (> 3 mm) dark reddish brown (10YR 3/4) concentrations. Dry, blocky.	
0.40 - 0.95 m (1.3 - 3.1 ft.)	*Geologic material:* **clayey silt** (0%/90%/10%/0%)	*Color of matrix:* dark gray (10YR 4/1)
	Notes: Blocky and dry. Common, fine to medium dark reddish brown (5YR 3/4) redox concentrations as masses and as oxidized root channels, in areas up to 50/50, mixing possibly by worms, etc. Fracture planes with both dark and light mineralizations.	
0.95 - 1.30 m (3.1 - 4.3 ft.)	*Geologic material:* **clayey silt** (0%/90%/10%/0%)	*Color of matrix:* black (2.5Y 2.5/1)
	Notes: Notable drop in redox concentrations to none or few, fine and distinct. Some oxidized root channels. Moist.	
1.30 - 2.90 m (4.3 - 9.5 ft.)	*Geologic material:* **clayey silt with trace of sand grading to silt by the bottom**	*Color of matrix:* very dark gray (10YR 3/1)
	Notes: Return to many, medium, distinct strong brown (7.5YR 5/8) redox concentrations as masses and well developed pore linings along roots. Mn nodules localized, 1-2 mm.	
2.90 - 4.55 m (9.5 - 14.9 ft.)	*Geologic material:* **silt grading to fine sand**	*Color of matrix:* very dark gray (2.5Y 3/1)
	Notes: Saturated below 3.20 m.	

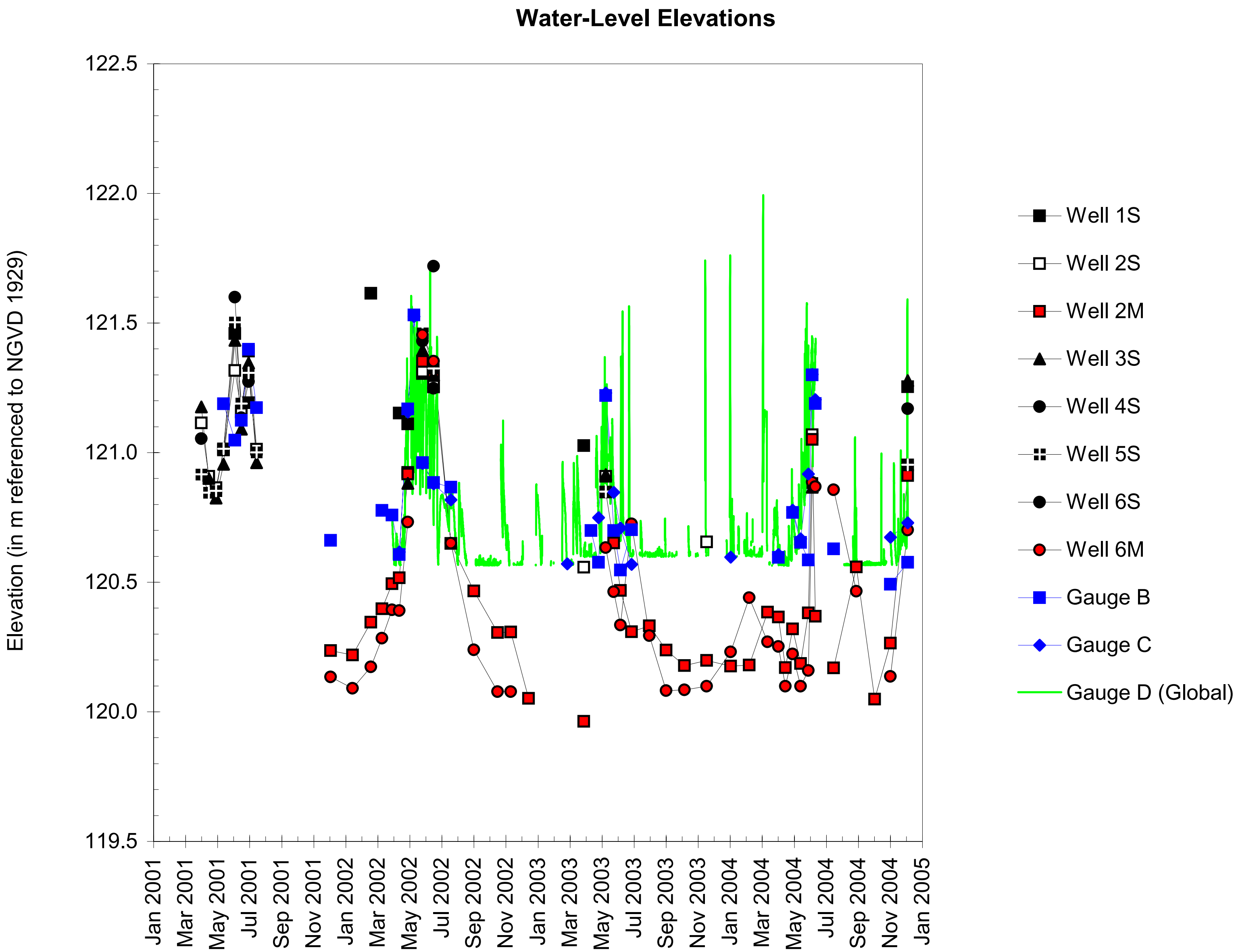
Appendix A: Geologic descriptions

Boring	New River / Tiernan 32M
Location	W ½, Section 10, T1N, R10W, Cahokia, Illinois
Date / Time	11/15/01
Field Crew	Brad Ketterling
Comments	Hand auger
Well Construction	(see Appendix B)

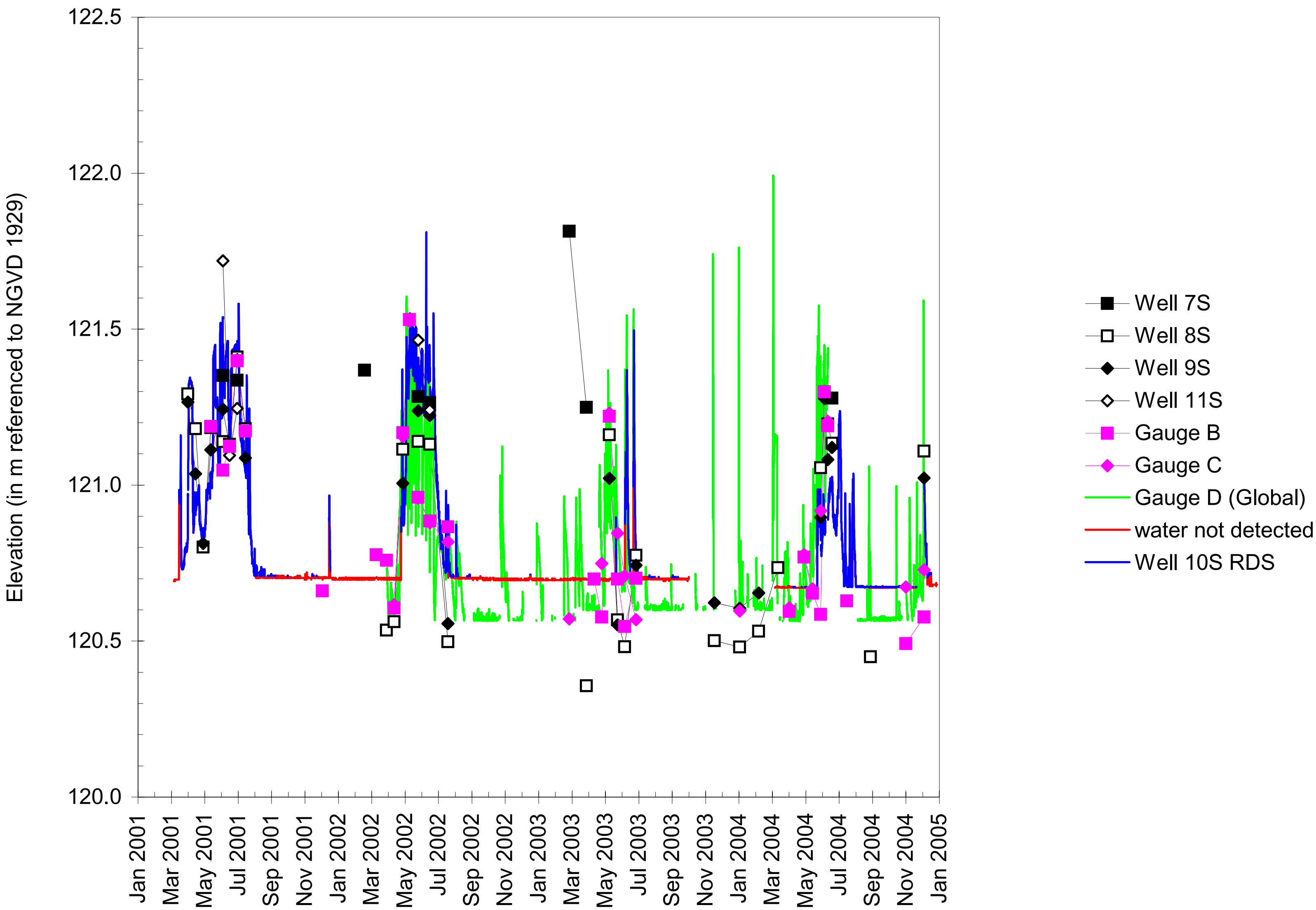
Depth	**Unit Descriptions**	
0 - 0.23 m (0 - 0.8 ft.)	*Geologic material:* **silty clay** (0% gravel / tr sand / 40% silt / 60% clay)	*Color of matrix:* very dark grayish brown (10YR 3/2)
	Notes: Plowed zone. No redox concentrations.	
0.23 - 0.47 m (0.8- 1.5 ft.)	*Geologic material:* **silty clay** (0%/tr/40%/60%)	*Color of matrix:* grayish brown (2.5Y 5/2)
	Notes: Steadily increasing strong brown (7.5YR 4/6) redox concentrations to many, fine and prominent. No oxidized root channels, but redox depletions noted along root channels with oxidized coronas.	
0.47 - 0.67 m (1.5 - 2.2 ft.)	*Geologic material:* **silty clay** (0%/tr/40%/60%)	*Color of matrix:* grayish brown (2.5Y 5/2)
	Notes: Heavily oxidized zone, easily >50% of mass in places. Many fine to coarse and even coarse, prominent yellowish red (5YR 4/6) redox masses. Live roots with redox depletions. Redox masses started as finely disseminated masses, then become more localized coarse masses, (up to 15 mm) associated with clay skins.	
0.67 - 1.30 m (2.2 - 4.3 ft.)	*Geologic material:* **silty clay** (0%/tr/40%/60%)	*Color of matrix:* grayish brown (2.5Y 5/2) grades to very dark gray (2.5Y 3/1)
	Notes: Coarse redox masses, but not as plentiful (down to 20-40%), live roots with some redox depletions found. Sample from ~1.20 m shows reduced gray clay along live roots.	
1.30 - 3.36 m (4.3 - 11.0 ft.)	*Geologic material:* **silt, trace of fine sand**	*Color of matrix:* dark gray (2.5Y 4/1) grading to dark grayish brown (2.5Y 4/2) below 2.5 m.
	Notes: Saturated.	

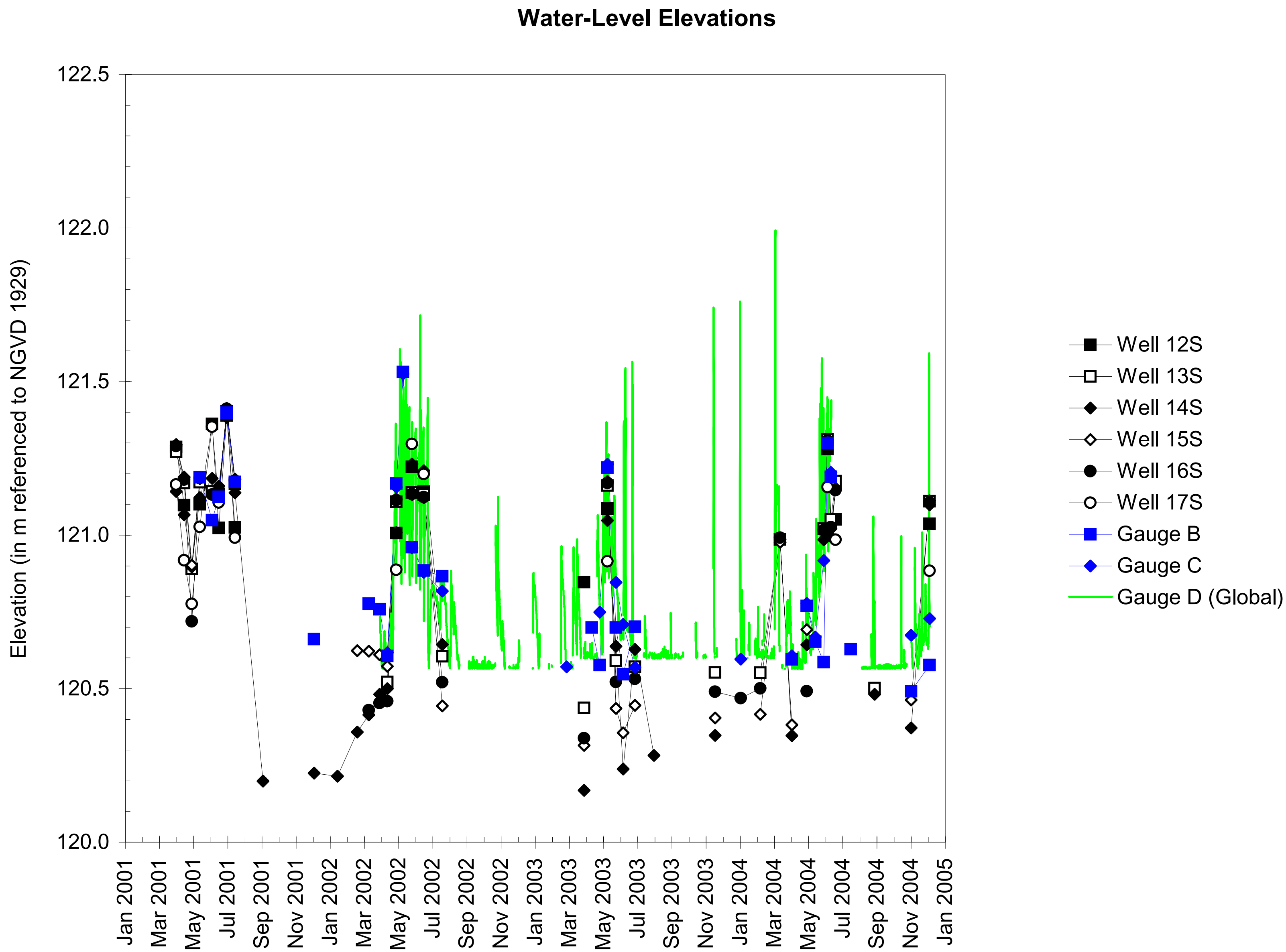
Appendix B: Well Construction

Well Number	Elevation of well top (m)*	Land surface elevation (m)*	Total length of well (m)	Bottom of well **	Well seal - top **	Well seal - bottom**	Sand pack - top **	Sand pack - bottom **	Top of screen **	Bottom of screen **
1S	122.967	121.783	1.970	0.786	0.000	0.230	0.230	0.786	0.428	0.746
2S	122.487	121.341	1.946	0.800	0.000	0.290	0.290	0.800	0.462	0.764
2M	121.880	121.341	1.933	1.394	0.100	0.940	0.940	1.394	1.027	1.326
3S	122.648	121.475	1.934	0.761	0.000	0.300	0.300	0.761	0.404	0.712
4S	122.916	121.720	1.938	0.742	0.000	0.270	0.270	0.742	0.432	0.736
5S	122.669	121.555	1.903	0.789	0.000	0.260	0.260	0.789	0.440	0.736
6S	123.641	122.468	1.929	0.756	0.000	0.240	0.240	0.756	0.417	0.719
6M	123.358	122.468	3.456	2.566	0.200	1.650	1.650	2.566	2.292	2.589
7S	123.154	122.006	1.914	0.766	0.000	0.300	0.300	0.766	0.410	0.722
8S	122.181	120.984	1.955	0.758	0.000	0.300	0.300	0.758	0.404	0.727
9S	122.399	121.200	1.951	0.752	0.000	0.270	0.270	0.752	0.415	0.725
10S (RDS)	121.858	121.344	1.253	0.739	0.000	0.240	0.240	0.739	0.394	0.697
11S	122.883	121.742	1.924	0.783	0.000	0.300	0.300	0.783	0.419	0.733
12S	122.742	121.587	1.906	0.751	0.000	0.300	0.300	0.751	0.388	0.684
13S	122.232	121.077	1.925	0.770	0.000	0.300	0.300	0.770	0.393	0.713
14S	122.025	120.833	1.936	0.744	0.000	0.290	0.290	0.744	0.385	0.697
15S	122.112	120.924	1.910	0.722	0.000	0.300	0.300	0.722	0.388	0.706
16S	122.217	121.086	1.891	0.760	0.000	0.300	0.300	0.760	0.427	0.724
17S	122.532	121.364	1.949	0.781	0.000	0.300	0.300	0.781	0.425	0.730
18S	122.602	121.480	1.896	0.774	0.000	0.290	0.290	0.774	0.412	0.696
19S	122.132	120.986	1.913	0.767	0.000	0.300	0.300	0.767	0.386	0.714
20S	122.085	120.927	1.898	0.740	0.000	0.300	0.300	0.740	0.404	0.704
21S	122.006	120.843	1.940	0.777	0.000	0.300	0.300	0.777	0.427	0.733
22S	122.281	121.160	1.897	0.776	0.000	0.300	0.300	0.776	0.430	0.729
23S	123.454	122.319	1.899	0.764	0.000	0.300	0.300	0.764	0.422	0.719
23VS	122.870	122.319	0.980	0.429	0.000	0.150	0.150	0.429	0.228	0.377
23M	122.681	122.319	3.450	3.088	0.200	2.550	2.550	3.088	2.760	3.058
24S	123.264	122.108	1.923	0.767	0.000	0.290	0.290	0.767	0.431	0.737
24VS	122.678	122.108	1.008	0.438	0.000	0.150	0.150	0.438	0.213	0.361
25S	123.733	122.524	1.943	0.734	0.000	0.260	0.260	0.734	0.396	0.696
25VS	123.091	122.524	0.962	0.395	0.000	0.150	0.150	0.395	0.222	0.371
26S	122.837	121.713	1.906	0.782	0.000	0.300	0.300	0.782	0.437	0.731
26VS	122.398	121.713	1.005	0.320	0.000	0.160	0.160	0.320	0.205	0.356
27S	122.964	121.814	1.924	0.774	0.000	0.290	0.290	0.774	0.411	0.710
27VS	122.376	121.814	1.021	0.459	0.000	0.150	0.150	0.459	0.191	0.340
27M	122.791	121.814	5.602	4.625	0.200	2.230	2.230	4.625	4.216	4.517
28S	123.302	122.088	1.898	0.684	0.000	0.300	0.300	0.684	0.366	0.669
28VS	122.665	122.088	0.982	0.405	0.000	0.150	0.150	0.405	0.211	0.359
29S	122.830	121.702	1.910	0.782	0.000	0.300	0.300	0.782	0.402	0.702
29VS	122.269	121.702	0.964	0.397	0.000	0.160	0.160	0.397	0.172	0.320
30S	122.922	121.739	1.941	0.758	0.000	0.300	0.300	0.758	0.419	0.717
30VS	122.312	121.739	0.970	0.397	0.000	0.160	0.160	0.397	0.193	0.342
31S	122.900	121.697	1.927	0.724	0.000	0.300	0.300	0.724	0.404	0.702
31VS	122.262	121.697	0.967	0.402	0.000	0.150	0.150	0.402	0.209	0.353
32S	123.019	121.870	1.918	0.769	0.000	0.300	0.300	0.769	0.429	0.727
32SR	122.989	121.871	1.911	0.793	0.000	0.300	0.300	0.793	0.444	0.743
32VS	122.450	121.870	0.963	0.383	0.000	0.160	0.160	0.383	0.212	0.358
32M	122.639	121.871	4.149	3.381	0.200	1.470	1.470	3.381	3.020	3.318
* NGVD 1929										
** reported in m below land surface										

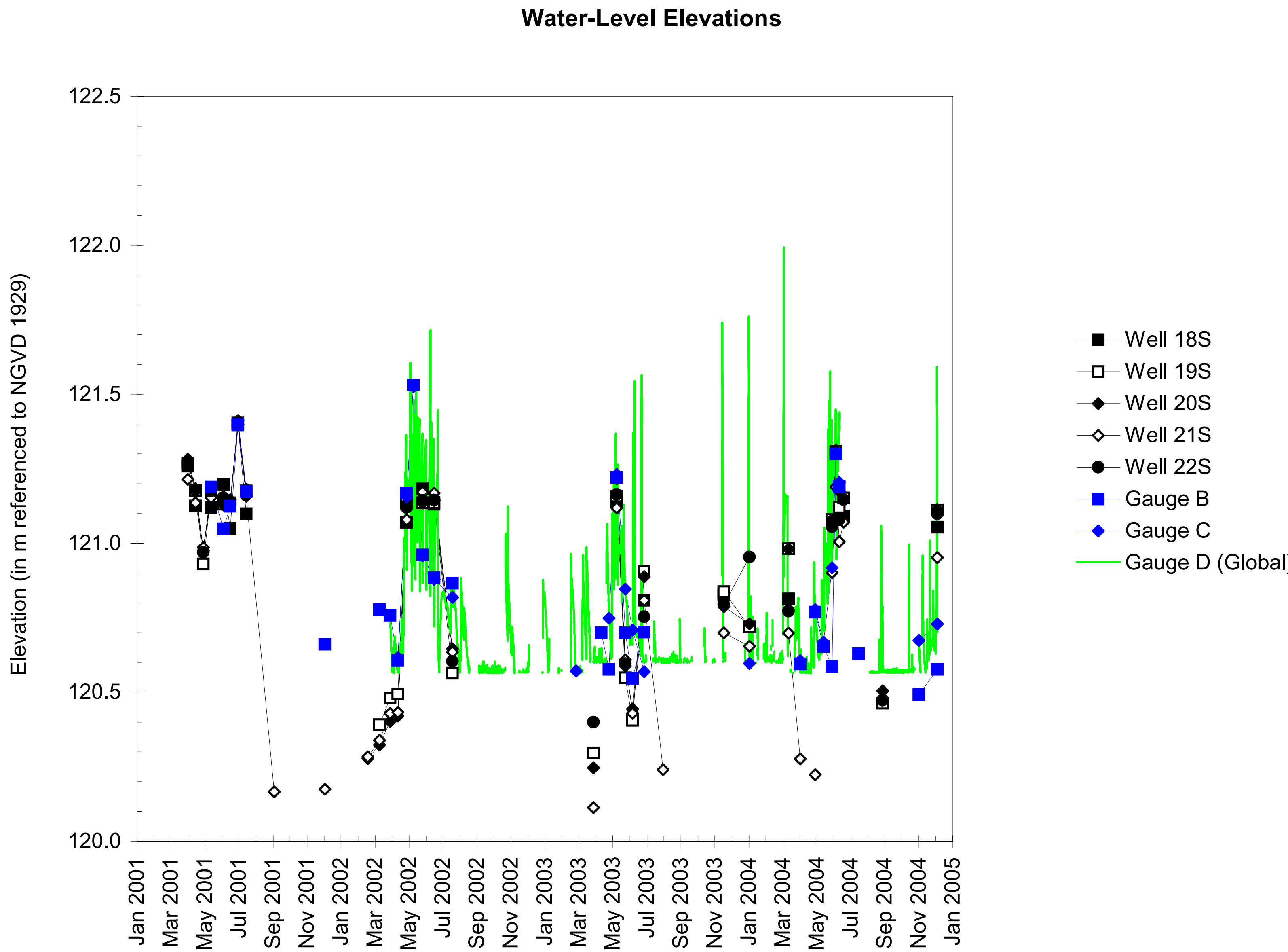

Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
122.5
122.0
121.5
121.0
120.5
120.0
119.5
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Well 1S
Well 2S
Well 2M
Well 3S
Well 4S
Well 5S
Well 6S
Well 6M
Gauge B
Gauge C
Gauge D (Global)

Water-Level Elevations

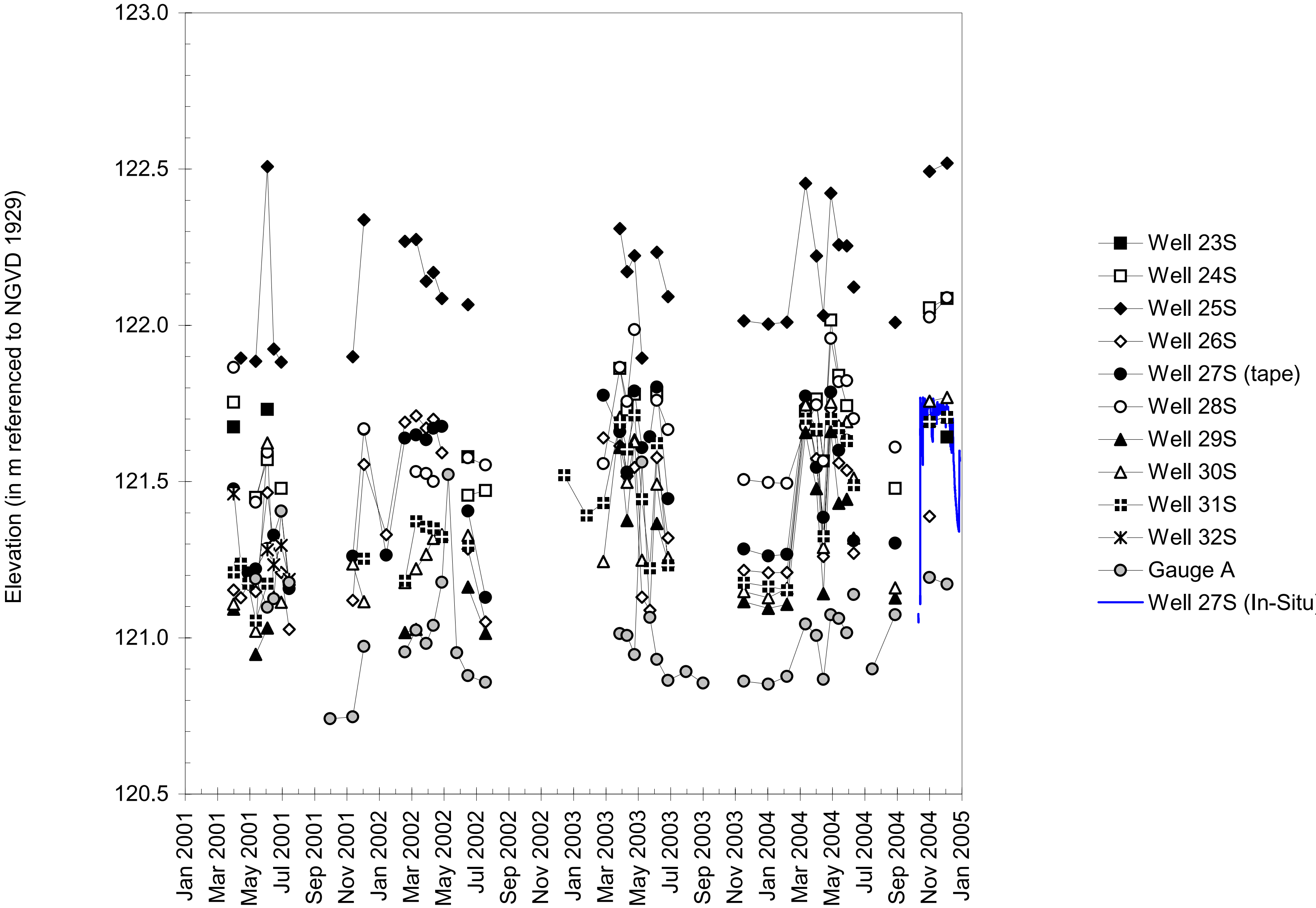


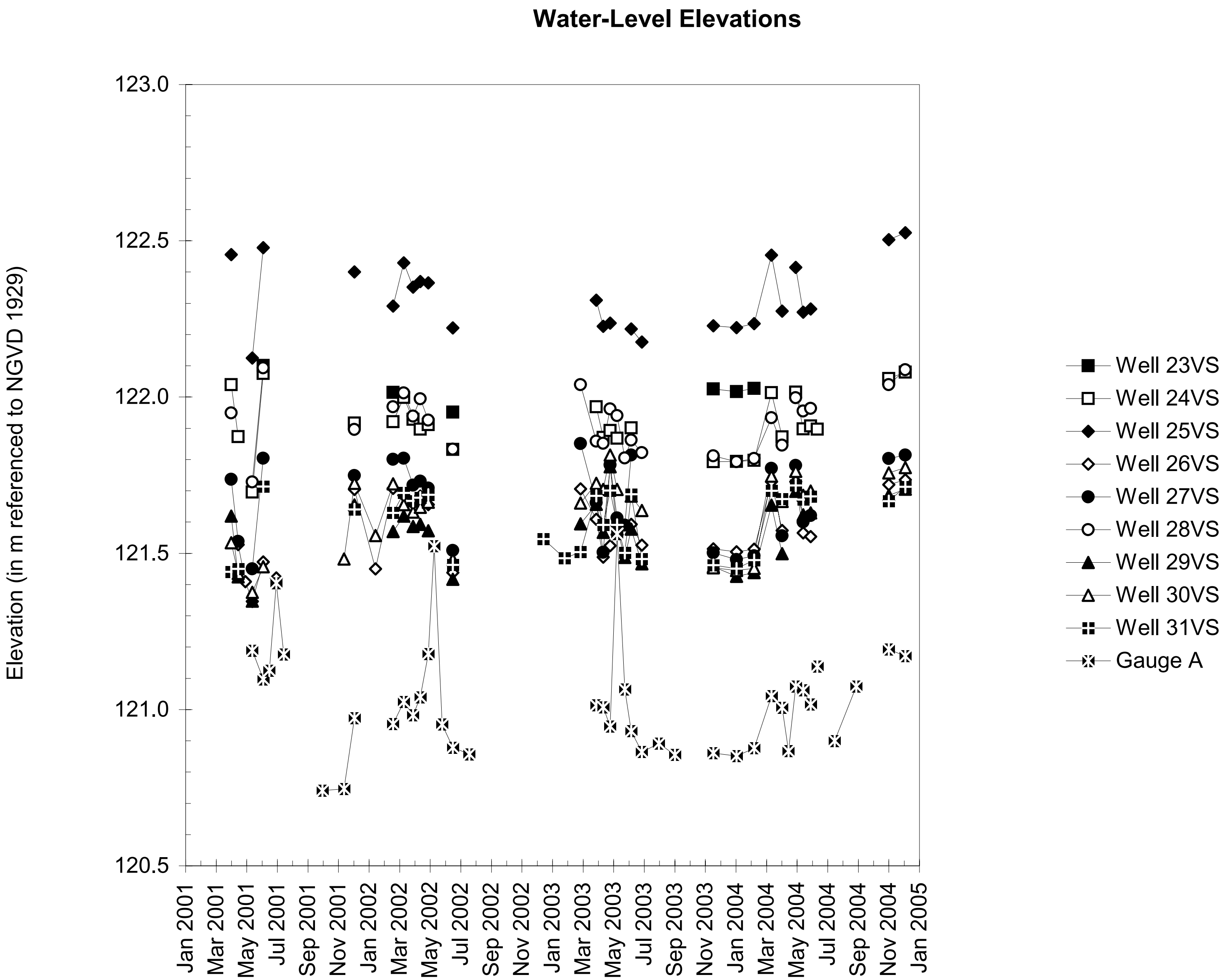


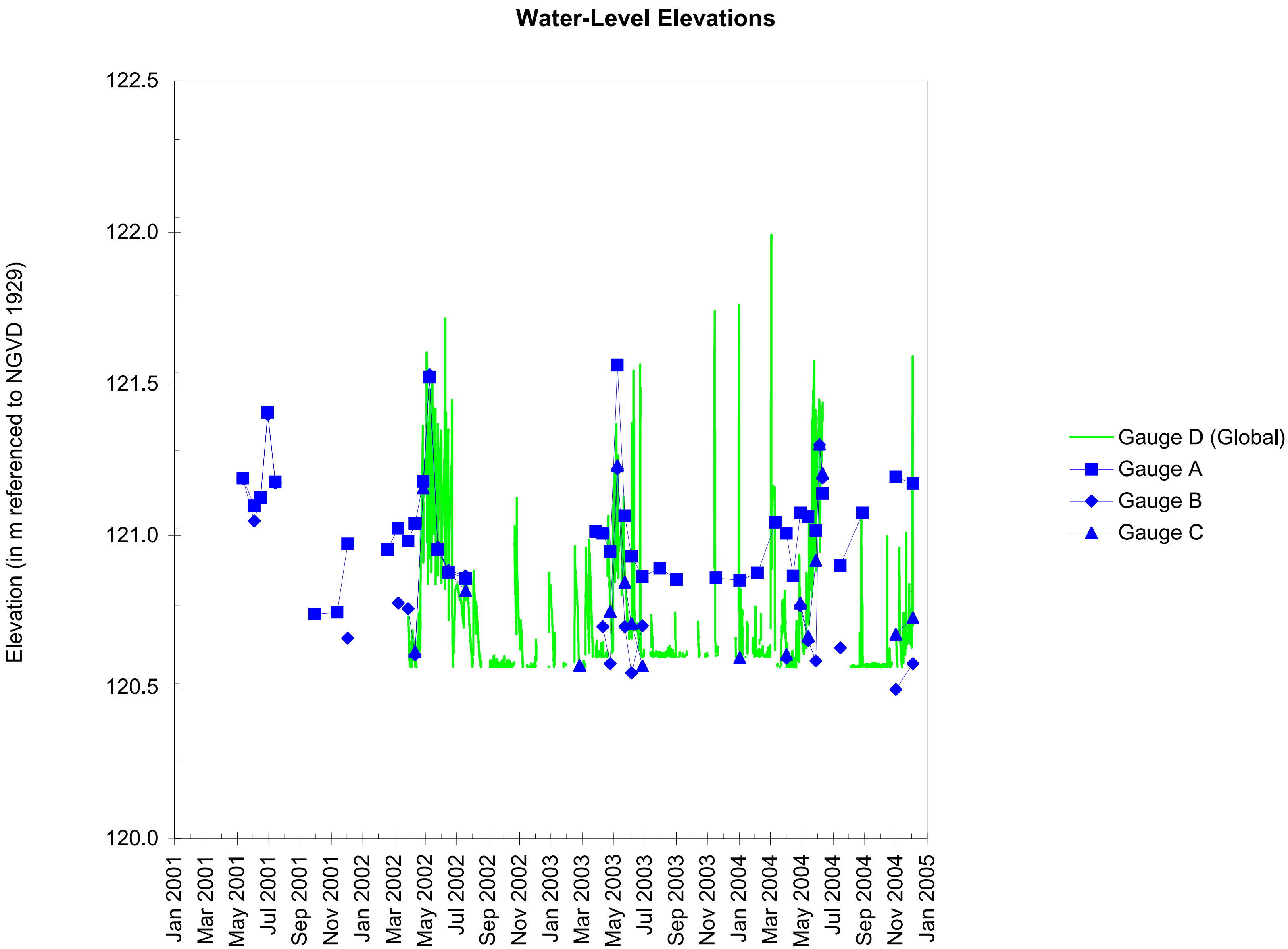
Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
122.5
122.0
121.5
121.0
120.5
120.0
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Well 12S
Well 13S
Well 14S
Well 15S
Well 16S
Well 17S
Gauge B
Gauge C
Gauge D (Global)

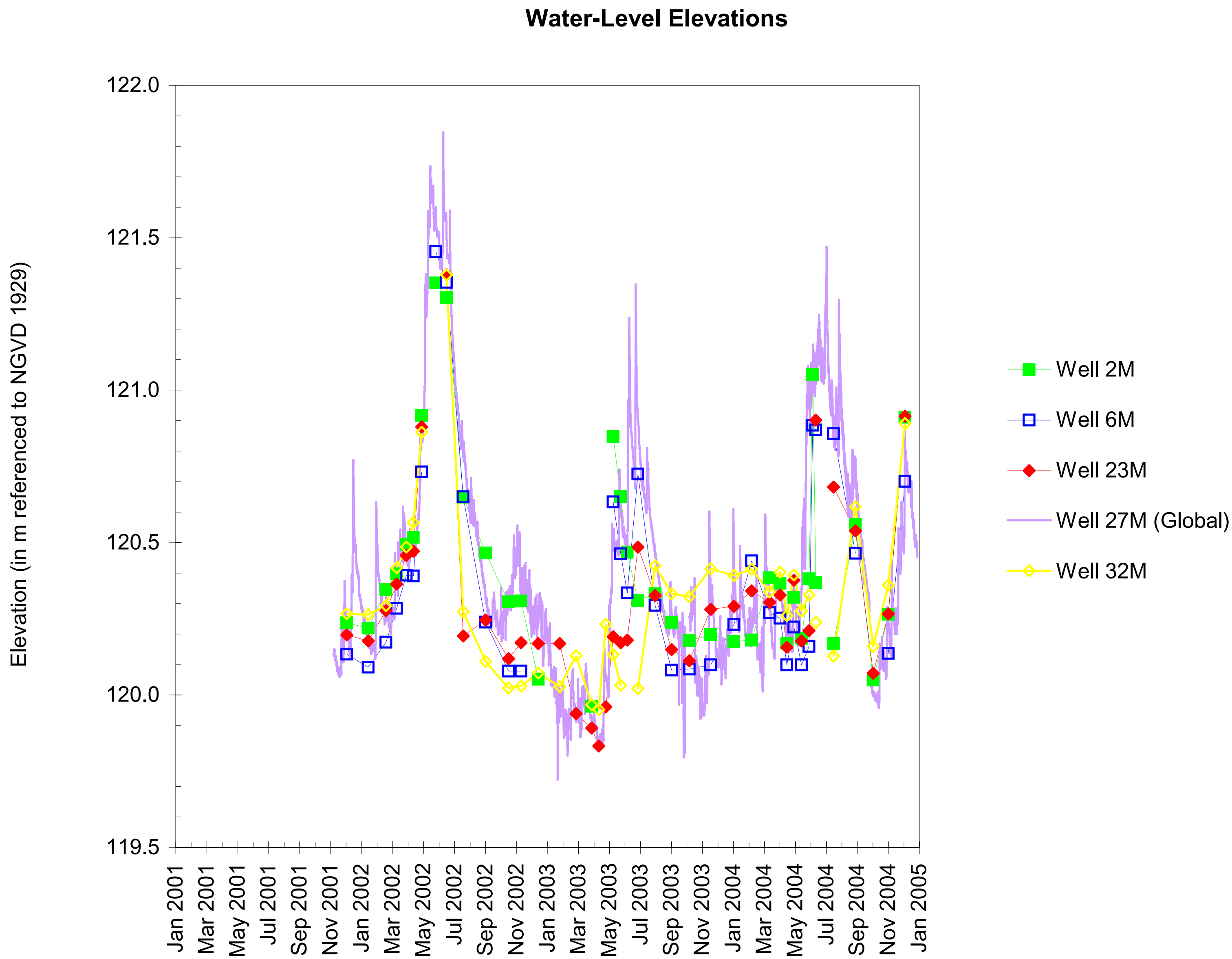

Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
122.5
122.0
121.5
121.0
120.5
120.0
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Well 18S
Well 19S
Well 20S
Well 21S
Well 22S
Gauge B
Gauge C
Gauge D (Global)

Water-Level Elevations




Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
123.0
122.5
122.0
121.5
121.0
120.5
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Well 23VS
Well 24VS
Well 25VS
Well 26VS
Well 27VS
Well 28VS
Well 29VS
Well 30VS
Well 31VS
Gauge A


Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
122.5
122.0
121.5
121.0
120.5
120.0
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Gauge D (Global)
Gauge A
Gauge B
Gauge C


Water-Level Elevations
Elevation (in m referenced to NGVD 1929)
122.0
121.5
121.0
120.5
120.0
119.5
Jan 2001
Mar 2001
May 2001
Jul 2001
Sep 2001
Nov 2001
Jan 2002
Mar 2002
May 2002
Jul 2002
Sep 2002
Nov 2002
Jan 2003
Mar 2003
May 2003
Jul 2003
Sep 2003
Nov 2003
Jan 2004
Mar 2004
May 2004
Jul 2004
Sep 2004
Nov 2004
Jan 2005
Well 2M
Well 6M
Well 23M
Well 27M (Global)
Well 32M

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site
2001 to 2004

Water-Level Elevations (in m referenced to NGVD, 1929)

Date	04/03/01	04/17/01	05/01/01	05/15/01	06/06/01	06/18/01	07/02/01	07/17/01	09/05/01	10/02/01	11/14/01	12/05/01	01/16/02	02/20/02	03/13/02	04/01/02	04/15/02	05/01/02	05/13/02
Well 1S	dry	dry	dry	121.01	121.46	dry	121.19	dry	dry	dry	dry	dry	dry	121.62	dry	dry	121.15	121.11	*
Well 2S	121.12	120.91	120.87	121.01	121.32	121.16	121.39	121.01	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.92	*
Well 2M	**	**	**	**	**	**	**	**	**	**	**	120.24	120.22	120.35	120.40	120.49	120.52	120.92	*
Well 3S	121.18	120.90	120.83	120.96	121.43	121.09	121.35	120.96	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.88	*
Well 4S	121.05	dry	dry	dry	121.60	121.13	121.27	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 5S	120.92	120.85	120.85	121.02	121.50	121.19	121.31	121.00	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 6M	**	**	**	**	**	**	**	**	**	**	**	120.13	120.09	120.17	120.28	120.39	120.39	120.73	*
Well 7S	dry	dry	dry	dry	121.35	dry	121.34	dry	dry	dry	dry	dry	dry	121.37	dry	dry	dry	dry	*
Well 8S	121.29	121.18	120.80	121.18	121.14	121.13	121.41	121.18	dry	dry	dry	dry	dry	dry	dry	120.54	120.56	121.12	*
Well 9S	121.27	121.04	120.81	121.11	121.24	121.12	121.40	121.09	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.01	*
Well 11S	dry	dry	dry	dry	121.72	121.10	121.25	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 12S	121.29	121.10	dry	121.10	121.36	121.02	121.39	121.03	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.01	*
Well 13S	121.27	121.17	120.89	121.17	121.14	121.13	121.40	121.17	dry	dry	dry	dry	dry	dry	dry	dry	120.52	121.11	*
Well 14S	121.14	121.07	120.90	121.12	121.19	121.16	121.38	121.14	120.20	dry	dry	120.23	120.22	120.36	120.42	120.48	120.50	121.01	*
Well 15S	121.30	121.19	120.90	121.18	121.13	121.13	121.41	121.18	dry	dry	dry	dry	dry	120.62	120.62	120.61	120.57	121.12	*
Well 16S	121.29	121.18	120.72	121.19	121.13	121.14	121.41	121.18	dry	dry	dry	dry	dry	dry	120.43	120.45	120.46	121.11	*
Well 17S	121.17	120.92	120.78	121.03	121.35	121.11	121.40	120.99	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.89	*
Well 18S	121.26	121.13	dry	121.12	121.20	121.05	121.40	121.10	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.07	*
Well 19S	121.27	121.18	120.93	121.17	121.13	121.14	121.41	121.18	dry	dry	dry	dry	dry	dry	120.39	120.48	120.49	121.13	*
Well 20S	121.28	121.18	120.98	121.18	121.13	121.13	121.41	121.18	dry	dry	dry	dry	dry	120.28	120.32	120.40	120.42	121.14	*
Well 21S	121.21	121.14	120.99	121.15	121.16	121.15	121.40	121.16	120.17	dry	dry	120.18	dry	120.28	120.34	120.43	120.43	121.08	*
Well 22S	121.27	121.18	120.97	121.18	121.15	121.14	121.40	121.16	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.12	*
Well 23S	121.68	dry	dry	dry	121.73	dry	dry	dry	*	*	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 23VS	dry	dry	dry	dry	122.10	dry	dry	dry	*	*	dry	dry	dry	122.02	dry	dry	dry	dry	*
Well 23M	**	**	**	**	**	**	**	**	**	**	**	120.20	120.18	120.28	120.36	120.46	120.47	120.88	*
Well 24S	121.75	dry	dry	121.45	121.57	dry	121.48	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 24VS	122.04	121.87	dry	121.70	122.08	dry	dry	dry	dry	dry	dry	121.92	dry	121.92	122.00	121.93	121.90	121.91	*
Well 25S	dry	121.90	dry	121.89	122.51	121.92	121.88	dry	dry	dry	121.90	122.34	dry	122.27	122.28	122.14	122.17	122.09	*
Well 25VS	122.46	dry	dry	122.13	122.48	dry	dry	dry	dry	dry	dry	122.40	dry	122.29	122.43	122.35	122.37	122.37	*
Well 26S	121.15	121.13	121.17	121.15	121.46	121.30	121.21	121.03	dry	dry	121.12	121.56	121.33	121.69	121.71	121.67	121.70	121.59	*
Well 26VS	dry	121.53	121.41	121.35	121.47	dry	121.42	dry	dry	dry	dry	121.70	121.45	121.71	121.69	121.66	121.68	121.66	*
Well 27S	121.48	121.24	121.21	121.22	121.29	121.33	121.41	121.16	*	dry	121.26	121.67	121.26	121.64	121.65	121.63	121.67	121.68	*
Well 27VS	121.74	121.54	dry	121.45	121.80	dry	dry	dry	*	dry	dry	121.75	dry	121.80	121.80	121.72	121.73	121.71	*
Well 27M	**	**	**	**	**	**	**	**	*	120.130	*	*	*	*	*	*	*	*	*
Well 28S	121.87	dry	dry	121.43	121.59	dry	dry	dry	dry	dry	dry	121.67	dry	dry	121.53	121.53	121.50	dry	*
Well 28VS	121.95	dry	dry	121.73	122.09	dry	dry	dry	dry	dry	dry	121.90	dry	121.97	122.01	121.94	121.99	121.93	*
Well 29S	121.09	dry	dry	120.95	121.03	dry	dry	dry	dry	dry	dry	dry	dry	121.02	121.03	dry	dry	dry	*
Well 29VS	121.62	121.43	dry	121.35	dry	dry	dry	dry	dry	dry	dry	121.66	dry	121.57	121.62	121.59	121.59	121.57	*
Well 30S	121.11	dry	dry	121.02	121.62	121.13	121.11	dry	dry	dry	121.24	121.12	dry	121.18	121.22	121.27	121.32	121.33	*
Well 30VS	121.53	121.44	dry	121.38	121.46	dry	dry	dry	dry	dry	121.48	121.72	121.56	121.72	121.66	121.63	121.65	121.66	*
Well 31S	121.21	121.24	121.17	121.06	121.17	dry	dry	dry	dry	dry	dry	121.25	dry	121.18	121.37	121.36	121.35	121.32	*
Well 31VS	121.44	121.45	dry	dry	121.71	dry	dry	dry	dry	dry	dry	121.64	dry	121.63	121.69	121.67	121.68	121.69	*
Well 32S	121.46	dry	dry	dry	121.28	121.23	121.30	121.19	dry	dry	destroyed	dry	dry	dry	dry	dry	dry	dry	*
Well 32VS	121.80	dry	dry	121.57	dry	dry	dry	dry	dry	dry	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	**	**	**	**	**	**	**	**	**	**	**	120.27	120.26	120.29	120.42	120.49	120.57	120.86	*
Gauge A	**	**	**	121.19	121.10	121.12	121.41	121.18	dry	120.74	120.75	120.97	dry	120.95	121.02	120.98	121.04	121.18	121.52
Gauge B	**	**	**	121.19	121.05	121.12	121.40	121.17	dry	dry	dry	120.66	dry	dry	120.78	120.76	120.61	121.17	121.53
Gauge C	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	120.62	121.16	121.53

* no measurement
** not yet installed
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site

2001 to 2004

	Water-Level Elevations (in m referenced to NGVD, 1929)																		
Date	05/29/02	06/19/02	07/22/02	09/04/02	10/19/02	11/13/02	12/17/02	01/28/03	03/01/03	04/01/03	04/15/03	04/29/03	05/13/03	05/28/03	06/10/03	07/01/03	08/04/03	09/05/03	10/10/03
Well 1S	121.31	121.25	dry	dry	dry	dry	dry	dry	dry	121.03	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 2S	121.31	121.26	dry	dry	dry	dry	dry	dry	dry	120.56	dry	dry	120.91	dry	dry	dry	dry	dry	dry
Well 2M	121.35	121.30	120.65	120.47	120.31	120.31	120.05	dry	dry	119.96	dry	dry	120.85	120.65	120.47	120.31	120.33	120.24	120.18
Well 3S	121.40	121.30	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.92	dry	dry	dry	dry	dry	dry
Well 4S	121.43	121.25	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 5S	121.46	121.33	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.85	dry	dry	dry	dry	dry	dry
Well 6S	dry	121.72	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 6M	121.45	121.35	120.65	120.24	120.08	120.08	dry	dry	dry	dry	dry	dry	120.63	120.46	120.34	120.73	120.29	120.08	120.09
Well 7S	121.28	121.27	dry	dry	dry	dry	dry	dry	121.81	121.25	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 8S	121.14	121.13	120.50	dry	dry	dry	dry	dry	dry	120.36	dry	dry	121.16	120.57	120.48	120.78	dry	dry	dry
Well 9S	121.24	121.22	120.56	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.02	120.55	dry	120.74	dry	dry	dry
Well 11S	121.47	121.24	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 12S	121.22	121.14	dry	dry	dry	dry	dry	dry	dry	120.85	dry	dry	121.09	dry	dry	dry	dry	dry	dry
Well 13S	121.14	121.13	120.61	dry	dry	dry	dry	dry	dry	120.44	dry	dry	121.16	120.59	dry	120.57	dry	dry	dry
Well 14S	121.23	121.21	120.64	dry	dry	dry	dry	dry	dry	120.17	dry	dry	121.05	120.64	120.24	120.63	120.28	dry	dry
Well 15S	121.13	121.12	120.44	dry	dry	dry	dry	dry	dry	120.32	dry	dry	121.18	120.44	120.36	120.45	dry	dry	dry
Well 16S	121.13	121.12	120.52	dry	dry	dry	dry	dry	dry	120.34	dry	dry	121.17	120.52	dry	120.53	dry	dry	dry
Well 17S	121.30	121.20	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.92	dry	dry	dry	dry	dry	dry
Well 18S	121.18	121.13	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.14	dry	dry	120.81	dry	dry	dry
Well 19S	121.14	121.14	120.56	dry	dry	dry	dry	dry	dry	120.30	dry	dry	121.16	120.55	120.41	120.91	dry	dry	dry
Well 20S	121.14	121.14	120.65	dry	dry	dry	dry	dry	dry	120.25	dry	dry	121.22	120.59	120.44	120.89	dry	dry	dry
Well 21S	121.17	121.17	120.64	dry	dry	dry	dry	dry	dry	120.11	dry	dry	121.12	120.61	120.43	120.81	120.24	dry	dry
Well 22S	121.14	121.15	120.60	dry	dry	dry	dry	dry	dry	120.40	dry	dry	121.16	120.60	dry	120.75	dry	dry	dry
Well 23S	*	121.58	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 23VS	*	121.95	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 23M	*	121.38	120.19	120.25	120.12	120.17	120.17	120.17	119.94	119.89	119.83	119.96	120.19	120.17	120.18	120.49	120.33	120.15	120.11
Well 24S	*	121.46	121.47	dry	dry	dry	dry	dry	dry	121.86	121.73	121.78	dry	dry	121.78	dry	dry	dry	dry
Well 24VS	*	121.83	dry	dry	dry	dry	dry	dry	dry	121.97	121.87	121.89	121.87	dry	121.90	dry	dry	dry	dry
Well 25S	*	122.07	dry	dry	dry	dry	dry	dry	dry	122.31	122.17	122.22	121.90	dry	122.23	122.09	dry	dry	dry
Well 25VS	*	122.22	dry	dry	dry	dry	dry	dry	dry	122.31	122.23	122.24	dry	dry	122.22	122.18	dry	dry	dry
Well 26S	*	121.28	121.05	dry	dry	dry	dry	dry	121.64	121.61	121.52	121.55	121.13	121.09	121.58	121.32	dry	dry	dry
Well 26VS	*	121.44	dry	dry	dry	dry	dry	dry	121.71	121.61	121.49	121.52	121.59	dry	121.59	121.53	dry	dry	dry
Well 27S	*	121.41	121.13	dry	dry	dry	dry	dry	121.78	121.66	121.53	121.79	121.61	121.64	121.80	121.45	dry	dry	dry
Well 27VS	*	121.51	dry	dry	dry	dry	dry	dry	121.85	121.66	121.50	121.78	121.61	121.59	121.81	dry	dry	dry	dry
Well 27M	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Well 28S	*	121.58	121.55	dry	dry	dry	dry	dry	121.56	121.87	121.76	121.99	dry	dry	121.76	121.67	dry	dry	dry
Well 28VS	*	121.83	dry	dry	dry	dry	dry	dry	122.04	121.86	121.85	121.96	121.94	121.81	121.86	121.82	dry	dry	dry
Well 29S	*	121.16	121.01	dry	dry	dry	dry	dry	dry	121.61	121.38	121.63	dry	dry	121.37	121.25	dry	dry	dry
Well 29VS	*	121.42	dry	dry	dry	dry	dry	dry	121.59	121.66	121.57	121.78	121.58	121.49	121.58	121.47	dry	dry	dry
Well 30S	*	121.33	dry	dry	dry	dry	dry	dry	121.24	121.71	121.50	121.63	121.25	dry	121.49	121.26	dry	dry	dry
Well 30VS	*	121.48	dry	dry	dry	dry	dry	dry	121.66	121.72	121.70	121.81	121.70	dry	121.68	121.64	dry	dry	dry
Well 31S	*	121.30	dry	dry	dry	dry	121.52	121.39	121.43	121.69	121.60	121.71	121.44	121.22	121.62	121.23	dry	dry	dry
Well 31VS	*	121.46	dry	dry	dry	dry	121.55	121.48	121.50	121.68	121.59	121.70	121.59	121.50	121.69	121.48	dry	dry	dry
Well 32S	*	121.44	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry
Well 32VS	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	*	121.38	120.27	120.11	120.02	120.03	120.07	120.03	120.13	119.97	119.95	120.23	120.13	120.03	*	120.02	120.42	120.33	120.32
Gauge A	120.95	120.88	120.86	dry	dry	dry	dry	dry	dry	121.01	121.01	120.95	121.56	121.07	120.93	120.86	120.89	120.85	dry
Gauge B	120.96	120.88	120.87	dry	dry	dry	dry	dry	dry	*	120.70	120.58	121.22	120.70	120.55	120.70	dry	dry	dry
Gauge C	120.96	120.88	120.82	dry	dry	dry	dry	dry	120.57	dry	dry	120.75	121.23	120.85	120.71	120.57	dry	dry	dry

* no measurement
** not yet installed
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site
2001 to 2004

	Water-Level Elevations (in m referenced to NGVD, 1929)																
Date	11/21/03	01/06/04	02/10/04	03/16/04	04/06/04	04/19/04	05/03/04	05/18/04	06/02/04	06/09/04	06/15/04	06/23/04	07/20/04	09/01/04	10/06/04	11/05/04	12/08/04
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	121.25
Well 2S	120.66	dry	dry	dry	dry	dry	dry	dry	dry	121.07	dry	*	dry	dry	dry	dry	120.95
Well 2M	120.20	120.18	120.18	120.38	120.37	120.17	120.32	120.19	120.38	121.05	120.37	*	120.17	120.56	120.05	120.27	120.91
Well 3S	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.87	dry	*	dry	dry	dry	dry	121.28
Well 4S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	121.17
Well 5S	dry	dry	dry	dry	dry	dry	dry	dry	dry	120.88	dry	*	dry	dry	dry	dry	120.95
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 6M	120.10	120.23	120.44	120.27	120.25	120.10	120.22	120.10	120.16	120.89	120.87	*	120.86	120.47	dry	120.14	120.70
Well 7S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.28	dry	dry	dry	dry	dry
Well 8S	120.50	120.48	120.53	120.74	dry	dry	dry	dry	121.06	121.30	121.20	121.13	dry	120.45	dry	dry	121.11
Well 9S	120.62	120.61	120.65	dry	dry	dry	dry	dry	120.90	121.28	121.08	121.12	dry	dry	dry	dry	121.02
Well 11S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 12S	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.28	dry	121.05	dry	dry	dry	dry	121.04
Well 13S	120.55	dry	120.55	120.99	dry	dry	dry	dry	121.02	121.31	121.05	121.18	dry	120.50	dry	dry	121.11
Well 14S	120.35	dry	dry	120.99	120.35	dry	120.64	dry	120.99	121.31	120.99	121.15	dry	120.48	dry	120.37	121.11
Well 15S	120.41	dry	120.42	120.98	120.38	dry	120.69	dry	121.01	121.30	121.02	121.15	dry	dry	dry	120.46	121.10
Well 16S	120.49	120.47	120.50	120.99	dry	dry	120.49	dry	121.02	121.31	121.03	121.15	dry	dry	dry	dry	121.11
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	121.16	dry	120.99	dry	dry	dry	dry	120.88
Well 18S	120.83	dry	dry	120.81	dry	dry	dry	dry	dry	121.30	dry	121.09	dry	dry	dry	dry	121.05
Well 19S	120.84	120.72	dry	120.98	dry	dry	dry	dry	121.08	121.31	121.12	121.15	dry	120.46	dry	dry	121.11
Well 20S	120.79	120.73	dry	120.98	dry	dry	dry	dry	121.08	121.31	121.17	121.15	dry	120.51	dry	dry	121.11
Well 21S	120.70	120.65	dry	120.70	120.28	dry	120.22	dry	120.90	121.19	121.01	121.07	dry	120.48	dry	dry	120.95
Well 22S	120.79	120.95	dry	120.77	dry	dry	dry	dry	121.06	121.30	121.08	121.15	dry	120.47	dry	dry	121.10
Well 23S	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	*	dry	dry	dry	dry	121.64
Well 23VS	122.03	122.02	122.03	dry	dry	dry	dry	dry	dry	*	dry	*	dry	dry	dry	dry	dry
Well 23M	120.28	120.29	120.34	120.30	120.33	120.16	120.38	120.18	120.21	*	120.90	*	120.68	120.54	120.07	120.27	120.92
Well 24S	dry	dry	dry	121.72	121.76	121.57	122.02	121.84	121.74	*	dry	*	dry	121.48	dry	122.06	122.09
Well 24VS	121.79	121.79	121.80	122.01	121.87	dry	122.02	121.90	121.91	*	121.90	*	dry	dry	dry	122.06	122.08
Well 25S	122.01	122.00	122.01	122.45	122.22	122.03	122.42	122.26	122.25	*	122.12	*	dry	122.01	dry	122.49	122.52
Well 25VS	122.23	122.22	122.24	122.45	122.28	dry	122.42	122.27	122.28	*	dry	*	dry	dry	dry	122.50	122.53
Well 26S	121.22	121.21	121.21	121.74	121.57	121.26	121.73	121.56	121.54	*	121.27	*	dry	dry	dry	121.39	dry
Well 26VS	121.51	121.51	121.51	121.73	121.57	dry	121.73	121.57	121.55	*	dry	*	dry	dry	dry	121.72	121.74
Well 27S	121.28	121.26	121.27	121.77	121.55	121.39	121.79	121.60	121.63	*	121.31	*	dry	121.30	*	*	*
Well 27VS	121.50	121.48	121.49	121.77	121.56	dry	121.78	121.60	121.62	*	dry	*	dry	dry	dry	121.80	121.81
Well 27M	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Well 28S	121.51	121.50	121.49	121.68	121.75	121.57	121.96	121.82	121.82	*	121.70	*	dry	121.61	dry	122.03	122.09
Well 28VS	121.81	121.79	121.80	121.93	121.85	dry	122.00	121.96	121.96	*	dry	*	dry	dry	dry	122.04	122.09
Well 29S	121.12	121.09	121.11	121.66	121.48	121.14	121.66	121.43	121.44	*	121.32	*	dry	121.13	dry	121.69	121.71
Well 29VS	121.46	121.43	121.44	121.65	121.50	dry	121.70	121.62	121.63	*	dry	*	dry	dry	dry	121.69	121.71
Well 30S	121.15	121.13	121.16	121.75	121.67	121.29	121.75	121.68	121.69	*	121.51	*	dry	121.16	dry	121.76	121.77
Well 30VS	121.45	121.45	121.45	121.75	121.67	dry	121.76	121.69	121.70	*	dry	*	dry	dry	dry	121.76	121.77
Well 31S	121.18	121.16	121.15	121.70	121.67	121.33	121.70	121.67	121.63	*	121.49	*	dry	dry	dry	121.69	121.71
Well 31VS	121.46	121.45	121.48	121.70	121.67	dry	121.72	121.67	121.68	*	dry	*	dry	dry	dry	121.67	121.71
Well 32S	dry	dry	dry	121.84	121.38	121.18	121.34	121.51	121.50	*	121.48	*	dry	dry	dry	121.72	121.81
Well 32VS	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	120.41	120.39	120.41	120.34	120.40	120.26	120.39	120.28	120.33	*	120.24	*	120.13	120.62	120.16	120.36	120.89
Gauge A	120.86	120.85	120.88	121.04	121.01	120.87	121.07	121.06	121.02	*	121.14	*	120.90	121.07	dry	121.19	121.17
Gauge B	dry	dry	dry	dry	120.60	dry	120.77	120.65	120.59	121.30	121.19	*	120.63	dry	dry	120.49	120.58
Gauge C	dry	120.60	dry	dry	120.61	dry	120.78	120.67	120.92	121.30	121.20	*	dry	dry	dry	120.67	120.73

* no measurement
** not yet installed
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site
2001 to 2004

	Depth to Water (in m referenced to land surface)																		
Date	04/03/01	04/17/01	05/01/01	05/15/01	06/06/01	06/18/01	07/02/01	07/17/01	09/05/01	10/02/01	11/14/01	12/05/01	01/16/02	02/20/02	03/13/02	04/01/02	04/15/02	05/01/02	05/13/02
Well 1S	dry	dry	dry	0.76	0.31	dry	0.58	dry	dry	dry	dry	dry	dry	**0.16**	dry	dry	0.62	0.65	*
Well 2S	**0.23**	0.44	0.48	0.34	**0.03**	**0.19**	**-0.04**	0.33	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.42	*
Well 2M	**	**	**	**	**	**	**	**	**	**	**	1.10	1.12	0.99	0.94	0.84	0.82	0.43	*
Well 3S	**0.29**	0.57	0.64	0.51	**0.04**	0.38	**0.12**	0.51	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.60	*
Well 4S	0.66	dry	dry	dry	**0.12**	0.58	0.44	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 5S	0.59	0.66	0.66	0.49	**0.01**	0.32	**0.20**	0.51	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 6M	**	**	**	**	**	**	**	**	**	**	**	2.33	2.37	2.29	2.18	2.07	2.07	1.72	*
Well 7S	dry	dry	dry	dry	0.60	dry	0.62	dry	dry	dry	dry	dry	dry	0.58	dry	dry	dry	dry	*
Well 8S	**-0.28**	**-0.17**	**0.21**	**-0.18**	**-0.13**	**-0.12**	**-0.40**	**-0.17**	dry	dry	dry	dry	dry	dry	dry	0.47	0.45	**-0.11**	*
Well 9S	**-0.06**	**0.17**	0.40	**0.10**	**-0.03**	**0.09**	**-0.19**	**0.12**	dry	dry	dry	dry	dry	dry	dry	dry	dry	**0.22**	*
Well 11S	dry	dry	dry	dry	**0.02**	0.64	0.49	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 12S	**0.30**	0.49	dry	0.49	**0.22**	0.56	**0.20**	0.56	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.58	*
Well 13S	**-0.20**	**-0.09**	**0.19**	**-0.10**	**-0.07**	**-0.06**	**-0.33**	**-0.09**	dry	dry	dry	dry	dry	dry	dry	dry	0.55	**-0.02**	*
Well 14S	**-0.33**	**-0.25**	**-0.08**	**-0.31**	**-0.37**	**-0.35**	**-0.57**	**-0.32**	0.61	dry	dry	0.59	0.60	0.45	0.40	0.33	0.31	**-0.17**	*
Well 15S	**-0.33**	**-0.22**	**0.06**	**-0.22**	**-0.17**	**-0.17**	**-0.45**	**-0.22**	dry	dry	dry	dry	dry	0.34	0.34	0.35	0.39	**-0.18**	*
Well 16S	**-0.20**	**-0.09**	0.37	**-0.09**	**-0.04**	**-0.04**	**-0.32**	**-0.08**	dry	dry	dry	dry	dry	dry	0.66	0.64	0.63	**-0.02**	*
Well 17S	**0.21**	0.45	0.60	0.34	**0.02**	**0.27**	**-0.03**	0.38	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.47	*
Well 18S	**0.22**	0.35	dry	0.36	**0.28**	0.43	**0.08**	0.38	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.44	*
Well 19S	**-0.30**	**-0.20**	**0.04**	**-0.20**	**-0.16**	**-0.16**	**-0.43**	**-0.20**	dry	dry	dry	dry	dry	dry	0.58	0.49	0.48	**-0.13**	*
Well 20S	**-0.37**	**-0.27**	**-0.06**	**-0.27**	**-0.22**	**-0.22**	**-0.50**	**-0.27**	dry	dry	dry	dry	dry	0.63	0.59	0.51	0.49	**-0.24**	*
Well 21S	**-0.38**	**-0.30**	**-0.15**	**-0.32**	**-0.32**	**-0.31**	**-0.56**	**-0.32**	0.67	dry	dry	0.66	dry	0.55	0.50	0.41	0.40	**-0.23**	*
Well 22S	**-0.08**	**0.01**	**0.22**	**0.01**	**0.04**	**0.05**	**-0.21**	**0.03**	dry	dry	dry	dry	dry	dry	dry	dry	dry	**0.05**	*
Well 23S	0.63	dry	dry	dry	0.57	dry	dry	dry	*	*	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 23VS	dry	dry	dry	dry	**0.20**	dry	dry	dry	*	*	dry	dry	dry	**0.29**	dry	dry	dry	dry	*
Well 23M	**	**	**	**	**	**	**	**	**	**	**	2.11	2.13	2.03	1.94	1.85	1.84	1.45	*
Well 24S	0.33	dry	dry	0.64	0.51	dry	0.61	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*
Well 24VS	**0.05**	**0.21**	dry	0.39	**0.01**	dry	dry	dry	dry	dry	dry	**0.17**	dry	**0.16**	**0.09**	**0.16**	**0.19**	**0.14**	*
Well 25S	dry	0.63	dry	0.64	**0.01**	0.60	0.64	dry	dry	dry	0.62	**0.18**	dry	**0.25**	**0.25**	0.38	0.35	0.46	*
Well 25VS	**0.06**	dry	dry	0.40	**0.04**	dry	dry	dry	dry	dry	dry	**0.12**	dry	**0.23**	**0.09**	**0.17**	**0.15**	**0.18**	*
Well 26S	0.56	0.58	0.54	0.56	**0.25**	0.41	0.50	0.68	dry	dry	0.59	**0.16**	0.38	**0.02**	**0.00**	**0.04**	**0.01**	**0.12**	*
Well 26VS	dry	**0.18**	**0.30**	0.36	**0.24**	dry	**0.29**	dry	dry	dry	dry	**0.01**	**0.26**	**0.00**	**0.02**	**0.05**	**0.03**	**0.05**	*
Well 27S	0.32	0.56	0.59	0.57	0.51	0.47	0.39	0.64	*	dry	0.53	**0.13**	0.53	**0.15**	**0.14**	**0.16**	**0.12**	**0.13**	*
Well 27VS	**0.06**	**0.26**	dry	0.34	**-0.01**	dry	dry	dry	*	dry	dry	**0.04**	dry	**-0.01**	**-0.01**	**0.08**	**0.06**	**0.10**	*
Well 27M	**	**	**	**	**	**	**	**	*	1.68	*	*	*	*	*	*	*	*	*
Well 28S	**0.22**	dry	dry	0.65	0.49	dry	dry	dry	dry	dry	dry	0.41	dry	dry	0.55	0.56	0.58	dry	*
Well 28VS	**0.13**	dry	dry	0.35	**-0.01**	dry	dry	dry	dry	dry	dry	**0.19**	dry	**0.11**	**0.07**	**0.14**	**0.09**	**0.18**	*
Well 29S	0.58	dry	dry	0.72	0.64	dry	dry	dry	dry	dry	dry	dry	dry	0.65	0.64	dry	dry	dry	*
Well 29VS	**0.05**	**0.24**	dry	0.32	dry	dry	dry	dry	dry	dry	dry	**0.01**	dry	**0.10**	**0.05**	**0.08**	**0.07**	**0.11**	*
Well 30S	0.60	dry	dry	0.69	**0.09**	0.58	0.60	dry	dry	dry	0.47	0.60	dry	0.53	0.49	0.44	0.39	0.39	*
Well 30VS	**0.18**	**0.28**	dry	0.34	**0.25**	dry	dry	dry	dry	dry	**0.23**	**-0.01**	**0.15**	**-0.01**	**0.06**	**0.08**	**0.06**	**0.06**	*
Well 31S	0.50	0.47	0.54	0.65	0.54	dry	dry	dry	dry	dry	dry	0.46	dry	0.53	0.34	0.35	0.36	0.39	*
Well 31VS	**0.27**	**0.26**	dry	dry	**-0.01**	dry	dry	dry	dry	dry	dry	**0.07**	dry	**0.08**	**0.02**	**0.04**	**0.03**	**0.03**	*
Well 32S	0.41	dry	dry	dry	0.59	0.64	0.57	0.68	dry	dry	destroyed	dry	dry	dry	dry	dry	dry	dry	*
Well 32VS	**0.07**	dry	dry	**0.30**	dry	dry	dry	dry	dry	dry	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	**	**	**	**	**	**	**	**	**	**	**	1.60	1.60	1.57	1.44	1.38	1.30	1.01	*

* no measurement
** not yet installed
\- indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well
bold depth values less than or equal to 0.304 m

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site

2001 to 2004

	Depth to Water (in m referenced to land surface)																		
Date	05/29/02	06/19/02	07/22/02	09/04/02	10/19/02	11/13/02	12/17/02	01/28/03	03/01/03	04/01/03	04/15/03	04/29/03	05/13/03	05/28/03	06/10/03	07/01/03	08/04/03	09/05/03	10/10/03
Well 1S	0.46	0.51	dry	dry	dry	dry	dry	dry	dry	0.74	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 2S	**0.03**	**0.09**	dry	dry	dry	dry	dry	dry	dry	0.78	dry	dry	0.43	dry	dry	dry	dry	dry	dry
Well 2M	**-0.01**	**0.04**	0.70	0.88	1.04	1.04	1.29	dry	dry	1.37	dry	dry	0.49	0.69	0.87	1.03	1.01	1.10	1.16
Well 3S	**0.09**	**0.18**	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.59	dry	dry	dry	dry	dry	dry
Well 4S	**0.29**	0.48	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 5S	**0.05**	**0.19**	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.68	dry	dry	dry	dry	dry	dry
Well 6S	dry	0.74	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 6M	1.00	1.10	1.81	2.22	2.38	2.38	dry	dry	dry	dry	dry	dry	1.81	1.98	2.10	1.71	2.15	2.36	2.35
Well 7S	0.73	0.75	dry	dry	dry	dry	dry	dry	**0.20**	0.76	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 8S	**-0.14**	**-0.13**	0.50	dry	dry	dry	dry	dry	dry	0.63	dry	dry	**-0.17**	0.42	0.50	**0.21**	dry	dry	dry
Well 9S	**-0.02**	**0.00**	0.67	dry	dry	dry	dry	dry	dry	dry	dry	dry	**0.19**	0.66	dry	0.47	dry	dry	dry
Well 11S	**0.28**	0.50	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 12S	0.37	0.45	dry	dry	dry	dry	dry	dry	dry	0.72	dry	dry	0.48	dry	dry	dry	dry	dry	dry
Well 13S	**-0.05**	**-0.04**	0.49	dry	dry	dry	dry	dry	dry	0.65	dry	dry	**-0.08**	0.49	dry	0.51	dry	dry	dry
Well 14S	**-0.39**	**-0.37**	**0.20**	dry	dry	dry	dry	dry	dry	0.66	dry	dry	**-0.22**	**0.19**	0.59	**0.20**	0.54	dry	dry
Well 15S	**-0.19**	**-0.18**	0.49	dry	dry	dry	dry	dry	dry	0.62	dry	dry	**-0.24**	0.50	0.58	0.49	dry	dry	dry
Well 16S	**-0.04**	**-0.03**	0.57	dry	dry	dry	dry	dry	dry	0.75	dry	dry	**-0.09**	0.56	dry	0.55	dry	dry	dry
Well 17S	**0.06**	**0.16**	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.45	dry	dry	dry	dry	dry	dry
Well 18S	0.33	0.38	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.35	dry	dry	0.68	dry	dry	dry
Well 19S	**-0.13**	**-0.13**	0.44	dry	dry	dry	dry	dry	dry	0.69	dry	dry	**-0.17**	0.44	0.58	**0.08**	dry	dry	dry
Well 20S	**-0.24**	**-0.25**	**0.25**	dry	dry	dry	dry	dry	dry	0.66	dry	dry	**-0.31**	0.32	0.47	**0.02**	dry	dry	dry
Well 21S	**-0.32**	**-0.32**	**0.21**	dry	dry	dry	dry	dry	dry	0.73	dry	dry	**-0.28**	**0.23**	0.41	**0.03**	0.60	dry	dry
Well 22S	**0.03**	**0.03**	0.57	dry	dry	dry	dry	dry	dry	0.77	dry	dry	**0.00**	0.57	dry	0.41	dry	dry	dry
Well 23S	*	0.75	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 23VS	*	0.38	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 23M	*	0.95	2.14	2.09	2.21	2.16	2.16	2.16	2.39	2.42	2.48	2.35	2.12	2.14	2.13	1.82	1.98	2.16	2.20
Well 24S	*	0.60	0.59	dry	dry	dry	dry	dry	dry	**0.24**	0.37	0.32	dry	dry	0.32	dry	dry	dry	dry
Well 24VS	*	**0.22**	dry	dry	dry	dry	dry	dry	dry	**0.13**	**0.23**	**0.21**	**0.23**	dry	**0.20**	dry	dry	dry	dry
Well 25S	*	0.48	dry	dry	dry	dry	dry	dry	dry	**0.19**	0.32	**0.27**	0.60	dry	**0.26**	0.40	dry	dry	dry
Well 25VS	*	0.33	dry	dry	dry	dry	dry	dry	dry	**0.19**	**0.27**	**0.26**	dry	dry	**0.28**	0.32	dry	dry	dry
Well 26S	*	0.43	0.66	dry	dry	dry	dry	dry	**0.07**	**0.11**	**0.20**	**0.18**	0.59	0.63	**0.14**	0.40	dry	dry	dry
Well 26VS	*	**0.27**	dry	dry	dry	dry	dry	dry	**0.00**	**0.11**	**0.23**	**0.20**	**0.13**	dry	**0.13**	**0.19**	dry	dry	dry
Well 27S	*	0.40	0.68	dry	dry	dry	dry	dry	**0.03**	**0.15**	**0.27**	**0.01**	**0.20**	**0.16**	**0.00**	0.36	dry	dry	dry
Well 27VS	*	**0.30**	dry	dry	dry	dry	dry	dry	**-0.04**	**0.14**	**0.30**	**0.02**	**0.19**	**0.21**	**-0.01**	dry	dry	dry	dry
Well 27M	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Well 28S	*	0.53	0.55	dry	dry	dry	dry	dry	0.55	**0.22**	0.32	**0.09**	dry	dry	0.32	0.41	dry	dry	dry
Well 28VS	*	**0.27**	dry	dry	dry	dry	dry	dry	**0.06**	**0.22**	**0.23**	**0.12**	**0.14**	**0.28**	**0.22**	**0.26**	dry	dry	dry
Well 29S	*	0.52	0.67	dry	dry	dry	dry	dry	dry	**0.11**	0.34	**0.08**	dry	dry	0.35	0.47	dry	dry	dry
Well 29VS	*	**0.27**	dry	dry	dry	dry	dry	dry	**0.09**	**0.06**	**0.15**	**-0.06**	**0.14**	**0.23**	**0.14**	**0.25**	dry	dry	dry
Well 30S	*	0.40	dry	dry	dry	dry	dry	dry	0.48	**0.03**	**0.24**	**0.11**	0.49	dry	**0.24**	0.48	dry	dry	dry
Well 30VS	*	**0.24**	dry	dry	dry	dry	dry	dry	**0.06**	**0.01**	**0.03**	**-0.08**	**0.03**	dry	**0.05**	**0.10**	dry	dry	dry
Well 31S	*	0.42	dry	dry	dry	dry	**0.19**	0.32	**0.28**	**0.02**	**0.11**	**0.00**	**0.27**	0.49	**0.09**	0.48	dry	dry	dry
Well 31VS	*	**0.25**	dry	dry	dry	dry	**0.17**	**0.23**	**0.21**	**0.03**	**0.12**	**0.01**	**0.12**	**0.21**	**0.02**	**0.23**	dry	dry	dry
Well 32S	*	0.43	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry
Well 32VS	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	*	0.49	1.60	1.76	1.85	1.84	1.80	1.84	1.74	1.91	1.93	1.65	1.75	1.85	*	1.86	1.46	1.55	1.56

* no measurement
** not yet installed
\- indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well
bold depth values less than or equal to 0.304 m

Former Tiernan Property, New River Crossing Potential Wetland Compensation Site

2001 to 2004

	Depth to Water (in m referenced to land surface)																
Date	11/21/03	01/06/04	02/10/04	03/16/04	04/06/04	04/19/04	05/03/04	05/18/04	06/02/04	06/09/04	06/15/04	06/23/04	07/20/04	09/01/04	10/06/04	11/05/04	12/08/04
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	0.53
Well 2S	0.68	dry	dry	dry	dry	dry	dry	dry	dry	**0.27**	dry	*	dry	dry	dry	dry	0.39
Well 2M	1.14	1.16	1.16	0.96	0.97	1.17	1.02	1.16	0.96	**0.29**	0.97	*	1.17	0.78	1.29	1.08	0.43
Well 3S	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.61	dry	*	dry	dry	dry	dry	**0.20**
Well 4S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	0.55
Well 5S	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.67	dry	*	dry	dry	dry	dry	0.60
Well 6S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	dry	dry	dry	dry
Well 6M	2.34	2.21	2.00	2.20	2.22	2.37	2.25	2.37	2.31	1.58	1.60	*	1.61	2.00	dry	2.33	1.77
Well 7S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.73	dry	dry	dry	dry	dry
Well 8S	0.49	0.51	0.45	**0.25**	dry	dry	dry	dry	**-0.07**	**-0.32**	**-0.21**	**-0.15**	dry	0.53	dry	dry	**-0.13**
Well 9S	0.59	0.61	0.56	dry	dry	dry	dry	dry	**0.30**	**-0.08**	**0.12**	**0.08**	dry	dry	dry	dry	**0.18**
Well 11S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 12S	dry	dry	dry	dry	dry	dry	dry	dry	dry	0.31	dry	0.54	dry	dry	dry	dry	0.55
Well 13S	0.53	dry	0.53	**0.09**	dry	dry	dry	dry	**0.06**	**-0.23**	**0.03**	**-0.10**	dry	0.57	dry	dry	**-0.03**
Well 14S	0.48	dry	dry	**-0.15**	0.49	dry	**0.19**	dry	**-0.15**	**-0.48**	**-0.16**	**-0.32**	dry	0.35	dry	0.46	**-0.28**
Well 15S	0.53	dry	0.52	**-0.05**	0.54	dry	**0.23**	dry	**-0.09**	**-0.38**	**-0.10**	**-0.22**	dry	dry	dry	0.46	**-0.17**
Well 16S	0.59	0.62	0.58	**0.09**	dry	dry	0.59	dry	**0.07**	**-0.22**	**0.06**	**-0.06**	dry	dry	dry	dry	**-0.02**
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	**0.21**	dry	0.38	dry	dry	dry	dry	0.48
Well 18S	0.66	dry	dry	0.67	dry	dry	dry	dry	dry	**0.18**	dry	0.39	dry	dry	dry	dry	0.43
Well 19S	**0.15**	**0.27**	dry	**0.00**	dry	dry	dry	dry	**-0.09**	**-0.32**	**-0.14**	**-0.17**	dry	0.52	dry	dry	**-0.13**
Well 20S	**0.12**	**0.18**	dry	**-0.05**	dry	dry	dry	dry	**-0.15**	**-0.38**	**-0.25**	**-0.22**	dry	0.42	dry	dry	**-0.19**
Well 21S	**0.14**	**0.19**	dry	**0.15**	0.57	dry	0.62	dry	**-0.06**	**-0.35**	**-0.16**	**-0.23**	dry	0.36	dry	dry	**-0.11**
Well 22S	0.37	**0.21**	dry	0.39	dry	dry	dry	dry	**0.10**	**-0.14**	**0.08**	**0.01**	dry	0.69	dry	dry	**0.06**
Well 23S	dry	dry	dry	dry	dry	dry	dry	dry	dry	*	dry	*	dry	dry	dry	dry	0.68
Well 23VS	**0.28**	**0.29**	**0.28**	dry	dry	dry	dry	dry	dry	*	dry	*	dry	dry	dry	dry	dry
Well 23M	2.03	2.02	1.97	2.02	1.99	2.16	1.94	2.14	2.11	*	1.42	*	1.64	1.78	2.25	2.05	1.40
Well 24S	dry	dry	dry	0.38	0.34	0.54	**0.09**	**0.27**	0.37	*	dry	*	dry	0.63	dry	**0.05**	**0.02**
Well 24VS	0.31	0.31	0.31	**0.09**	**0.24**	dry	**0.09**	**0.21**	**0.20**	*	**0.21**	*	dry	dry	dry	**0.05**	**0.03**
Well 25S	0.48	0.49	0.49	**0.07**	**0.30**	0.49	**0.10**	**0.27**	**0.27**	*	0.40	*	dry	0.51	dry	**0.03**	**0.00**
Well 25VS	**0.27**	**0.28**	**0.26**	**0.07**	**0.25**	dry	**0.11**	**0.25**	**0.24**	*	dry	*	dry	dry	dry	**0.02**	**0.00**
Well 26S	0.50	0.51	0.51	**-0.03**	**0.14**	0.45	**-0.02**	**0.15**	**0.18**	*	0.44	*	dry	dry	dry	0.32	dry
Well 26VS	**0.21**	**0.21**	**0.21**	**-0.02**	**0.14**	dry	**-0.02**	**0.15**	**0.16**	*	dry	*	dry	dry	dry	**-0.01**	**-0.02**
Well 27S	0.52	0.54	0.54	**0.04**	**0.27**	0.43	**0.03**	**0.21**	**0.18**	*	0.50	*	dry	0.51	*	*	*
Well 27VS	**0.30**	0.32	0.31	**0.04**	**0.26**	dry	**0.03**	**0.21**	**0.19**	*	dry	*	dry	dry	dry	**0.01**	**0.00**
Well 27M	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Well 28S	0.57	0.58	0.59	0.41	0.34	0.52	**0.13**	**0.27**	**0.26**	*	0.39	*	dry	0.48	dry	**0.06**	**0.00**
Well 28VS	**0.27**	**0.29**	**0.28**	**0.15**	**0.24**	dry	**0.09**	**0.13**	**0.12**	*	dry	*	dry	dry	dry	**0.05**	**0.00**
Well 29S	0.60	0.62	0.61	**0.04**	**0.23**	0.56	**0.04**	**0.27**	**0.26**	*	0.38	*	dry	0.58	dry	**0.01**	**0.00**
Well 29VS	**0.26**	**0.29**	**0.28**	**0.05**	**0.20**	dry	**0.00**	**0.08**	**0.07**	*	dry	*	dry	dry	dry	**0.02**	**0.00**
Well 30S	0.59	0.61	0.58	**-0.01**	**0.07**	0.45	**-0.01**	**0.06**	**0.05**	*	**0.23**	*	dry	0.58	dry	**-0.02**	**-0.03**
Well 30VS	**0.28**	**0.29**	**0.28**	**-0.01**	**0.07**	dry	**-0.02**	**0.05**	**0.04**	*	dry	*	dry	dry	dry	**-0.02**	**-0.03**
Well 31S	0.53	0.55	0.56	**-0.01**	**0.03**	0.37	**0.00**	**0.03**	**0.07**	*	**0.21**	*	dry	dry	dry	**0.00**	**-0.01**
Well 31VS	**0.25**	**0.26**	**0.23**	**0.00**	**0.02**	dry	**-0.02**	**0.03**	**0.02**	*	dry	*	dry	dry	dry	**0.03**	**-0.02**
Well 32S	dry	dry	dry	**0.03**	0.49	0.69	0.53	0.36	0.37	*	0.39	*	dry	dry	dry	**0.15**	**0.06**
Well 32VS	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed	destroyed
Well 32M	1.47	1.49	1.47	1.53	1.47	1.61	1.48	1.60	1.54	*	1.63	*	1.74	1.25	1.71	1.51	0.98

* no measurement
** not yet installed
\- indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
M indicates middle monitoring well
bold depth values less than or equal to 0.304 m

Appendix E: Water quality results for surface-water samples

Laboratory Number	W05607	W05605	W05608	W05606	W05609	%	General Use
	TR3	TR1	TR4	TR2	TR5		
	Gauge A	Gauge B	near 20S	near 17S	Fld. Dup.	Difference	Water Quality
Sampling Date	3/22/2001	3/22/2001	3/22/2001	3/22/2001	3/22/2001	of Dups	Standards
Total Dissolved Carbon	57.9	53.4	58.0	58.1	59.3	-2.2%	
Inorganic Dissolved Carbon	40	37.6	40.5	41.6	42.1	-4.0%	
Dissolved Organic Carbon	17.9	15.8	17.5	16.5	17.2	1.7%	
Total Nitrogen	1.54	1.68	1.88	2.44	1.81	3.7%	
Total Kjeldahl Nitrogen	1.08	0.72	1.34	1.38	1.27	5.2%	
Ammonia Nitrogen	0.28	0.30	0.45	0.59	0.32	28.9%	1.5
Nitrite Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1		
Nitrate Nitrogen	0.46	0.96	0.54	1.06	0.54	0.0%	
Ortho Phosphorus	<0.1	<0.1	<0.1	<0.1	<0.1		
Total Phosphorus	0.13	0.12	0.16	0.18	0.17	-6.3%	
Sulfate	62.9	57.3	64.2	67.4	64.9	-1.1%	500.0
Fluoride	0.17	0.18	0.22	0.18	0.22	0.0%	1.4
Chloride	36	34	37	38	37	-1.1%	500.0
Bromide	<0.05	<0.05	<0.05	<0.05	<0.05		
Total Alkalinity	159	157	168	176	168	0.0%	
Hardness by Calculation	253	247	263	287	263	0.1%	
Specific Conductivity	565	555	575	596	596	-3.7%	
Conductivity	610	560	630	570			
pH	6.5	6.3	6.6	6.5			6.5 - 9.0
Redox (eV)							
Temperature (C)	9.5	15.5	9.2	10.4			
Aluminium	<0.3	<0.3	<0.3	<0.3	<0.3		
Arsenic	<0.1	<0.1	<0.1	<0.1	<0.1		0.36
Boron	0.05	0.05	0.05	0.06	0.05	0.0%	1.0
Barium	0.09	0.08	0.09	0.09	0.09	0.0%	5.0
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001		
Calcium	65.2	64.1	67.2	71.3	67.3	-0.1%	
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.01		0.05
Cobalt	<0.01	<0.01	<0.01	<0.01	<0.01		
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01		4.0
Copper	<0.003	<0.003	<0.003	<0.003	0.005		1.0
Iron	0.05	0.05	0.05	0.01	0.01	80.0%	1.0
Potassium	7	5	6	5	6	0.0%	
Lanthanum	<0.002	<0.002	<0.002	<0.002	<0.002		
Lithium	<0.01	<0.01	<0.01	<0.01	<0.01		
Magnesium	21.9	21	23.1	26.4	23	0.4%	
Manganese	0.007	0.034	0.006	0.078	0.006	0.0%	1.0
Molybdenum	<0.02	<0.02	<0.02	<0.02	<0.02		
Sodium	26.4	25.8	27.0	28.2	27.1	-0.4%	
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01		1.0
Lead	<0.05	<0.05	<0.05	<0.05	<0.05		0.1
Antimony	<0.1	<0.1	<0.1	<0.1	<0.1		
Scandium	<0.003	<0.003	<0.003	<0.003	<0.003		
Selenium	<0.1	<0.1	<0.1	<0.1	<0.1		1.0
Silicon	4.86	4.02	5.28	4.02	5.22	1.1%	
Strontium	0.153	0.146	0.156	0.164	0.156	0.0%	
Titanium	<0.01	<0.01	<0.01	<0.01	<0.01		
Thallium	<0.1	<0.1	<0.1	<0.1	<0.1		
Vanadium	<0.01	<0.01	<0.01	<0.01	<0.01		
Zinc	0.01	0.01	0.01	0.01	0.01	0.0%	1.0
ICP SS	25.4	23.6	26.0	26.7	25.8	0.8%	
ICP as SO4	63.2	58.8	64.7	66.5	64.2	0.8%	
Isgs, IC, SO4	62.9	57.3	64.2	67.4	64.9	-1.1%	
	1%	3%	1%	-1%	-1%		
Balance	5.9%	6.7%	5.8%	7.5%	5.5%	3.7%	
Na/Cl)	1.13	1.17	1.14	1.15	1.13	0.7%	
Ca/ SO4	2.48	2.68	2.51	2.54	2.49	0.9%	
Mg/ Ca	0.56	0.55	0.57	0.62	0.57	0.6%	
K/ Na	0.022	0.023	0.022	0.021	0.022	0.4%	

Appendix E: Water quality results for surface-water samples

Laboratory Number	W05657	W05655	W05658	W05656	W05659	%	General Use
	TR3	TR1	TR4	TR2	TR5		
	Gauge A	Gauge B	near 20S	near 17S	Fld. Dup.	Difference	Water Quality
Sampling Date	5/1/2001	5/1/2001	5/1/2001	5/1/2001	5/1/2001	of Dups	Standards
Total Dissolved Carbon	51.00	92.00	76.30	80.90	85.90	-7.1%	
Inorganic Dissolved Carbon	33.50	66.70	60.80	64.40	70.20	5.0%	
Dissolved Organic Carbon	17.50	25.30	15.50	16.50	15.70	-61.1%	
Total Nitrogen	1.14	0.40	1.03	0.69	1.49	73.2%	
Total Kjeldahl Nitrogen	1.14	0.40	1.03	0.69	1.49	73.2%	
Ammonia Nitrogen	0.2	0.20	0.31	0.18	0.63	68.3%	1.5
Nitrite Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1		
Nitrate Nitrogen	<0.02	<0.02	<0.02	<0.02	<0.02		
Ortho Phosphorus	0.02	<0.1	0.02	<0.1	<0.1		
Total Phosphorus	0.13	0.12	0.16	0.18	0.17	29.4%	
Sulfate	5.8	47.6	52.3	50.2	48.0	0.8%	500.0
Fluoride	0.40	0.20	0.20	0.20	0.30	33.3%	1.4
Chloride	12	27	21	21	22	-23.5%	500.0
Bromide	<0.05	<0.05	<0.05	<0.05	<0.05		
Total Alkalinity	138	265	259	266	275	3.6%	
Hardness by Calculation	147	347	326	358	332	-4.4%	
Specific Conductivity	319	676	636	656	687	1.6%	
Conductivity	330	670	660	670	670	0.0%	
pH	7.1	7.2	7.1	7.1	7.3	1.0%	6.5 - 9.0
Redox (eV)	25	13	16	10	25	48.0%	
Temperature (C)	59.5	41.0	41.4	54.1	48.5	15.5%	
Aluminium	<0.02	<0.02	<0.02	<0.02	<0.02		
Arsenic	<0.1	<0.1	<0.1	<0.1	<0.1		0.36
Boron	0.03	0.08	0.08	0.08	0.07	-14.3%	1.0
Barium	0.05	0.16	0.15	0.19	0.16	-5.1%	5.0
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001		
Calcium	45.5	95	89.1	98.4	91.6	-3.7%	
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.01		0.05
Cobalt	<0.01	<0.01	<0.01	<0.01	<0.01		
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01		4.0
Copper	<0.01	<0.01	<0.01	<0.01	<0.01		1.0
Iron	<0.01	<0.01	<0.01	<0.01	<0.01		1.0
Potassium	11	9	8	8	6	-50.0%	
Lanthanum	<0.002	<0.002	<0.002	<0.002	<0.002		
Lithium	<0.01	0.01	<0.01	0.02	<0.01		
Magnesium	8	26.5	25	27.2	25	-6.0%	
Manganese	<0.002	0.099	<0.002	0.510	<0.002		1.0
Molybdenum	<0.02	<0.02	<0.02	<0.02	<0.02		
Sodium	12.1	20.8	17.6	17.7	16.8	-23.8%	
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01		1.0
Lead	<0.05	<0.05	<0.05	<0.05	<0.05		0.1
Antimony	<0.1	<0.1	<0.1	<0.1	<0.1		
Scandium	<0.003	<0.003	<0.003	<0.003	<0.003		
Selenium	<0.1	<0.1	<0.1	<0.1	<0.1		1.0
Silicon	3.37	4.84	4.58	5.11	4.64	-4.3%	
Strontium	0.087	0.323	0.29	0.343	0.31	-4.2%	
Titanium	<0.01	<0.01	<0.01	<0.01	<0.01		
Thallium	<0.1	<0.1	<0.1	<0.1	<0.1		
Vanadium	<0.01	<0.01	<0.01	<0.01	<0.01		
Zinc	<0.005	<0.005	<0.005	<0.005	<0.005		1.0
ICP SS	3.1	19.7	21.0	21.1	19.0	9.5%	
ICP as SO4	7.7	49.1	52.3	52.5	47.3	9.5%	
Isgs, IC, SO4	5.8	47.6	52.3	50.2	48	8.2%	
	33%	3%	0%	5%	-1%		
Balance	3.4%	5.3%	2.8%	6.5%	1.7%		
Na/Cl)	1.52	1.20	1.27	1.29	1.19		
Ca/ SO4	18.80	4.78	4.08	4.70	4.57		
Mg/ Ca	0.29	0.47	0.47	0.46	0.46		
K/ Na	0.049	0.028	0.033	0.033	0.035		

Appendix E: Water quality results for surface-water samples

Laboratory Number / Sampling Date	W05743 TR1 Gauge A 6/6/2001	W05744 TR2 Gauge B 6/6/2001	W05746 TR4 near 20S 6/6/2001	W05747 TR5 near 17S 6/6/2001	W05748 TR6 Fld. Dup. 6/6/2001	% Difference of Dups	General Use Water Quality Standards
Total Dissolved Carbon	43.3	49.1	65.6	65.6	54.0	-21.5%	
Inorganic Dissolved Carbon	16.0	24.3	33.2	33.2	54.0	38.5%	
Dissolved Organic Carbon	27.3	24.8	32.4	32.4	35.8	9.5%	
Total Nitrogen	1.66	1.32	1.01	2.07	1.05	3.8%	
Total Kjeldahl Nitrogen	1.36	1.30	1.01	1.46	1.05	3.8%	
Ammonia Nitrogen	0.13	0.19	0.05	0.12	0.04	-25.0%	1.5
Nitrite Nitrogen	<0.02	<0.02	<0.02	<0.02	<0.02		
Nitrate Nitrogen	0.3	0.02	<0.02	0.61	<0.02		
Ortho Phosphorus	<0.1	0.3	<0.1	0.3	<0.1		
Total Phosphorus	0.09	0.28	0.12	0.52	0.17	29.4%	
Sulfate	5.5	7.2	10.3	15.3	10.2	-1.0%	500.0
Fluoride	0.30	0.30	0.20	0.20	0.20	0.0%	1.4
Chloride	5	5	14	131	14	0.7%	500.0
Bromide	<0.05	<0.05	<0.05	<0.05	<0.05		
Total Alkalinity	66	104	229	139	232	1.3%	
Hardness by Calculation	65	92	246	119	245	-0.4%	
Specific Conductivity	172	236	474	546	339	-39.8%	
Conductivity	460	200	490	730	490		
pH	7.5	7.2	7.1	6.8	7.1		6.5 - 9.0
Redox (eV)	223	224	207	215	207		
Temperature (C)	21.8	26.4	26.5	26.7	26.7		
Aluminium	0.04	<0.01	<0.01	<0.01	<0.01		
Arsenic	<0.1	<0.1	<0.1	<0.1	<0.1		0.36
Boron	0.05	0.04	0.04	0.04	0.05	20.0%	1.0
Barium	0.04	0.04	0.10	0.05	0.10	0.0%	5.0
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001		
Calcium	20.2	29.4	66.7	37.8	66.5	-0.3%	
Cadmium	<0.04	<0.04	<0.04	<0.04	<0.04		0.05
Cobalt	<0.01	<0.01	<0.01	<0.01	<0.01		
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01		4.0
Copper	<0.01	<0.01	<0.01	0.01	<0.01		1.0
Iron	0.12	0.09	0.13	0.03	0.12	-8.3%	1.0
Potassium	7	7	6	9	6	0.0%	
Lanthanum	<0.002	<0.002	<0.002	<0.002	<0.002		
Lithium	<0.01	<0.01	<0.01	<0.01	<0.01		
Magnesium	3.5	4.4	19.1	5.9	19	-0.5%	
Manganese	0.032	0.196	0.117	0.010	0.106	-10.4%	1.0
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01		
Sodium	5	5.3	12.2	94.6	12.2	0.0%	
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01		1.0
Lead	<0.05	<0.05	<0.05	<0.05	<0.05		0.1
Antimony	<0.1	<0.1	<0.1	<0.1	<0.1		
Scandium	<0.003	<0.003	<0.003	<0.003	<0.03		
Selenium	<0.1	<0.1	<0.1	<0.1	<0.1		1.0
Silicon	4.88	4.18	4.93	6.78	4.95	0.4%	
Strontium	0.05	0.06	0.22	0.12	0.22	0.0%	
Titanium	<0.01	<0.01	<0.01	<0.01	<0.01		
Thallium	<0.1	<0.1	<0.1	<0.1	<0.1		
Vanadium	<0.01	<0.01	<0.01	<0.01	<0.01		
Zinc	0.009	0.004	<0.002	0.015	0.05		1.0
ICP SS	2.8	3.4	4.7	6.7	4.6	-2.2%	
ICP as SO4	7.0	8.5	11.7	16.7	11.5	-2.2%	
Isgs, IC, SO4	5.5	7.2	10.3	15.3	10.2	-1.0%	
	27%	18%	14%	9%	12%	-10.8%	
Balance	-1.9%	-6.9%	2.4%	-2.2%	1.6%	-46.1%	
Na/Cl)	1.51	1.70	1.37	1.11	1.36	-0.7%	
Ca/ SO4	8.80	9.79	15.52	5.92	15.63	0.7%	
Mg/ Ca	0.29	0.25	0.48	0.26	0.48	-0.2%	
K/ Na	0.118	0.111	0.048	0.006	0.048	0.0%	

TestAmerica
INCORPORATED

ANALYTICAL REPORT

Paul Christian
UNION PACIFIC RAILROAD
c/o Burns & McDonnell
17 Cassens Court
St. Louis, MO 63026

01/03/2003

TestAmerica Job Number: 02.16433

Client Project ID: Burns-UP Dupo #19820

Analyte	Result	Flag	Units	Adjusted PQL	Date Analyzed	Analyst	Prep Batch No.	Run Batch No.	Method Reference

SAMPLE NO. 713907 — SAMPLE DESCRIPTION PZ-45 (Phillips) — DATE-TIME TAKEN 12/19/2002 09:12

Analyte	Result	Flag	Units	Adjusted PQL	Date Analyzed	Analyst	Prep Batch No.	Run Batch No.	Method Reference
Cyanide, Total	<0.010		mg/L	0.010	12/27/2002	tlz		1455	EPA 335.4
ICP Metals Prep	D		mg/L		12/23/2002	llw	3237		
Arsenic, GFAA	0.0674		mg/L	0.0010	01/02/2003	lmc	2575	766	SW 7060A
GFAA Total Metals Digestion	D				12/30/2002	tdo	2575		
ICP Metals - SW-6010B	Complete		mg/L		12/26/2002	llw		4203	SW 6010B
Manganese, ICP	1.3		mg/L	0.010	12/26/2002	llw	3237	5030	SW 6010B

SAMPLE NO. 713908 — SAMPLE DESCRIPTION 2M (ISGS) — DATE-TIME TAKEN 12/19/2002 12:02

Analyte	Result	Flag	Units	Adjusted PQL	Date Analyzed	Analyst	Prep Batch No.	Run Batch No.	Method Reference
Cyanide, Total	<0.010		mg/L	0.010	12/27/2002	tlz		1455	EPA 335.4
ICP Metals Prep	D		mg/L		12/23/2002	llw	3237		
Arsenic, GFAA	0.0146		mg/L	0.0010	01/02/2003	lmc	2575	766	SW 7060A
GFAA Total Metals Digestion	D				12/30/2002	tdo	2575		
ICP Metals - SW-6010B	Complete		mg/L		12/26/2002	llw		4203	SW 6010B
Manganese, ICP	1.0		mg/L	0.010	12/26/2002	llw	3237	5030	SW 6010B

TestAmerica
INCORPORATED

ANALYTICAL REPORT

Paul Christian
UNION PACIFIC RAILROAD
c/o Burns & McDonnell
17 Cassens Court
St. Louis, MO 63026

01/03/2003

TestAmerica Job Number: 02.16433

Client Project ID: Burns-UP Dupo #19820

Analyte	Result	Flag	Units	Adjusted PQL	Date Analyzed	Analyst	Prep Batch No.	Run Batch No.	Method Reference
SAMPLE NO. 713909	**SAMPLE DESCRIPTION 23M (ISGS)**						**DATE-TIME TAKEN 12/19/2002 11:45**		
Cyanide, Total	<0.010		mg/L	0.010	12/27/2002	tlz		1455	EPA 335.4
ICP Metals Prep	D		mg/L		12/23/2002	llw	3237		
Arsenic, GFAA	0.0114		mg/L	0.0010	01/02/2003	lmc	2575	766	SW 7060A
GFAA Total Metals Digestion	D				12/30/2002	tdo	2575		
ICP Metals - SW-6010B	Complete		mg/L		12/26/2002	llw		4203	SW 6010B
Manganese, ICP	1.0		mg/L	0.010	12/26/2002	llw	3237	5030	SW 6010B
SAMPLE NO. 713910	**SAMPLE DESCRIPTION 32M (ISGS)**						**DATE-TIME TAKEN 12/19/2002 12:32**		
Cyanide, Total	0.052		mg/L	0.010	12/27/2002	tlz		1455	EPA 335.4
ICP Metals Prep	D		mg/L		12/23/2002	llw	3237		
Arsenic, GFAA	0.0086		mg/L	0.0010	01/02/2003	lmc	2575	766	SW 7060A
GFAA Total Metals Digestion	D				12/30/2002	tdo	2575		
ICP Metals - SW-6010B	Complete		mg/L		12/26/2002	llw		4203	SW 6010B
Manganese, ICP	3.3		mg/L	0.010	12/26/2002	llw	3237	5030	SW 6010B

704 ENTERPRISE DRIVE / CEDAR FALLS, IOWA 50613 / 319-277-2401 / FAX: 319-277-2425 / 800-750-2401

Appendix F: Water quality results for ground-water samples

Groundwater Analytical Results March 2004

	SDG Number	270341	270341	270341
	Sample ID	270341-017	270341-019	270341-018
	Location ID	23M	2M	32M
	Sample Date	3/16/2004	3/16/2004	3/16/2004
Chemical Name	Unit			
Arsenic (total)	ug/l	< 20 U	< 20 U	< 20 U
Iron (total)	ug/l	< 400 U	< 400 U	506
Lead (total)	ug/l	< 10 U	< 10 U	< 10 U
Manganese (total)	ug/l	< 30 U	430	362

Appendix F: Water quality results for ground-water samples

SEVERN TRENT STL

LABORATORY TEST RESULTS

Job Number: 270341

Date: 03/30/2004

CUSTOMER: The Forrester Group PROJECT: UPRR -DUPO ILLINOIS ATTN: Matt Shurtliff

Customer Sample ID: 2M
Date Sampled......: 03/16/2004
Time Sampled......: 14:21
Sample Matrix.....: Water

Laboratory Sample ID: 270341-19
Date Received.......: 03/17/2004
Time Received.......: 08:55

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	03/26/04	twr
SW-846 6010B	Iron (Fe), Water	ND		0.400	mg/L	03/26/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.010	mg/L	03/26/04	twr
SW-846 6010B	Manganese (Mn), Water	0.430		0.030	mg/L	03/26/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				03/24/04	dme

* In Description = Dry Wgt.

Page 20

6310 Rothway Drive • Houston, TX 77040 • Tel: 713 690 4444 • Fax: 713 690 5646 • www.stl-inc.com

SEVERN TRENT STL

LABORATORY TEST RESULTS

Job Number: 270341

Date: 03/30/2004

CUSTOMER: The Forrester Group PROJECT: UPRR -DUPO ILLINOIS ATTN: Matt Shurtliff

Customer Sample ID: 23M
Date Sampled......: 03/16/2004
Time Sampled......: 16:00
Sample Matrix.....: Water

Laboratory Sample ID: 270341-17
Date Received.......: 03/17/2004
Time Received.......: 08:55

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	03/26/04	twr
SW-846 6010B	Iron (Fe), Water	ND		0.400	mg/L	03/26/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.010	mg/L	03/26/04	twr
SW-846 6010B	Manganese (Mn), Water	ND		0.030	mg/L	03/26/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				03/24/04	dme

* In Description = Dry Wgt.

Page 18

6310 Rothway Drive • Houston, TX 77040 • Tel: 713 690 4444 • Fax: 713 690 5646 • www.stl-inc.com

SEVERN TRENT STL

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 270341

Date: 03/30/2004

CUSTOMER: The Forrester Group   PROJECT: UPRR -DUPO ILLINOIS   ATTN: Matt Shurtliff

Customer Sample ID: 32M
Date Sampled......: 03/16/2004
Time Sampled......: 17:15
Sample Matrix.....: Water

Laboratory Sample ID: 270341-18
Date Received.......: 03/17/2004
Time Received.......: 08:55

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	03/26/04	twr
SW-846 6010B	Iron (Fe), Water	0.506		0.400	mg/L	03/26/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.010	mg/L	03/26/04	twr
SW-846 6010B	Manganese (Mn), Water	0.362		0.030	mg/L	03/26/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				03/24/04	dme

* In Description = Dry Wgt.

Page 19

6310 Rothway Drive • Houston, TX 77040 • Tel: 713 690 4444 • Fax: 713 690 5646 • www.stl-inc.com

Appendix F: Water quality results for ground-water samples

Groundwater Analytical Results June 2004

	SDG Number	276034	276034	276034
	Sample ID	276034-10	276034-11	276034-12
	Location ID	2M	23M	32M
	Sample Date	6/21/2004	6/21/2004	6/21/2004
Chemical Name	Unit			
Arsenic (total)	ug/l	< 20 U	< 20 U	< 20 U
Iron (total)	ug/l	3140	< 400 U	470
Lead (total)	ug/l	< 7 U	< 7 U	< 7 U
Manganese (total)	ug/l	907	< 30	658

LABORATORY TEST RESULTS

Job Number: 276034 Date: 07/06/2004

CUSTOMER: The Forrester Group PROJECT: UPRR -DUPO ILLINOIS ATTN: Matt Shurtliff

Customer Sample ID: 2M
Date Sampled......: 06/21/2004
Time Sampled......: 11:50
Sample Matrix.....: Water

Laboratory Sample ID: 276034-10
Date Received.......: 06/22/2004
Time Received.......: 08:49

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	07/06/04	twr
SW-846 6010B	Iron (Fe), Water	3.14		0.400	mg/L	07/06/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.007	mg/L	07/06/04	twr
SW-846 6010B	Manganese (Mn), Water	0.907		0.030	mg/L	07/06/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				07/01/04	twr

* In Description = Dry Wgt.

Page 11

LABORATORY TEST RESULTS

Job Number: 276034

Date: 07/06/2004

CUSTOMER: The Forrester Group

PROJECT: UPRR -DUPO ILLINOIS

ATTN: Matt Shurtliff

Customer Sample ID: 23M
Date Sampled......: 06/21/2004
Time Sampled......: 11:02
Sample Matrix.....: Water

Laboratory Sample ID: 276034-11
Date Received.......: 06/22/2004
Time Received.......: 08:49

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	07/06/04	twr
SW-846 6010B	Iron (Fe), Water	ND		0.400	mg/L	07/06/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.007	mg/L	07/06/04	twr
SW-846 6010B	Manganese (Mn), Water	ND		0.030	mg/L	07/06/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				07/01/04	twr

* In Description = Dry Wgt.

Page 12

Appendix F: Water quality results for ground-water samples

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 276034

Date: 07/06/2004

CUSTOMER: The Forrester Group   PROJECT: UPRR -DUPO ILLINOIS   ATTN: Matt Shurtliff

Customer Sample ID: 32M
Date Sampled......: 06/21/2004
Time Sampled......: 12:25
Sample Matrix.....: Water

Laboratory Sample ID: 276034-12
Date Received.......: 06/22/2004
Time Received.......: 08:49

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	07/06/04	twr
SW-846 6010B	Iron (Fe), Water	0.470		0.400	mg/L	07/06/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.007	mg/L	07/06/04	twr
SW-846 6010B	Manganese (Mn), Water	0.658		0.030	mg/L	07/06/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				07/01/04	twr

* In Description = Dry Wgt.

Page 13

Appendix F: Water quality results for ground-water samples

Groundwater Analytical Results
September 2004

	SDG Number	281947	281947
	Sample ID	281947-7	281947-8
	Location ID	23M-os	32M-os
	Sample Date	9/28/2004	9/28/2004
Chemical Name	Units		
Arsenic (total)	ug/L	20 U	20 U
Iron (total)	ug/L	400 U	412
Lead (total)	ug/L	7 U	7 U
Manganese (total)	ug/L	48.1	1350

Appendix F: Water quality results for ground-water samples

SEVERN TRENT STL

LABORATORY TEST RESULTS

Job Number: 281947

Date: 12/07/2004

CUSTOMER: The Forrester Group PROJECT: UPRR -DUPO ILLINOIS ATTN: Matt Shurtliff

Customer Sample ID: 23 M-OS
Date Sampled......: 09/28/2004
Time Sampled......: 13:33
Sample Matrix.....: Water

Laboratory Sample ID: 281947-7
Date Received.......: 09/30/2004
Time Received.......: 08:50

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	10/04/04	twr
SW-846 6010B	Iron (Fe), Water	ND		0.400	mg/L	10/04/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.007	mg/L	10/04/04	twr
SW-846 6010B	Manganese (Mn), Water	0.0481		0.030	mg/L	10/04/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				09/30/04	drl

* In Description = Dry Wgt.

Page 8

6310 Rothway Drive • Houston, TX 77040 • Tel: 713 690 4444 • Fax: 713 690 5646 • www.stl-inc.com

SEVERN TRENT STL

LABORATORY TEST RESULTS

Job Number: 281947

Date: 12/07/2004

CUSTOMER: The Forrester Group PROJECT: UPRR -DUPO ILLINOIS ATTN: Matt Shurtliff

Customer Sample ID: 32 M-OS
Date Sampled......: 09/28/2004
Time Sampled......: 14:45
Sample Matrix.....: Water

Laboratory Sample ID: 281947-8
Date Received.......: 09/30/2004
Time Received.......: 08:50

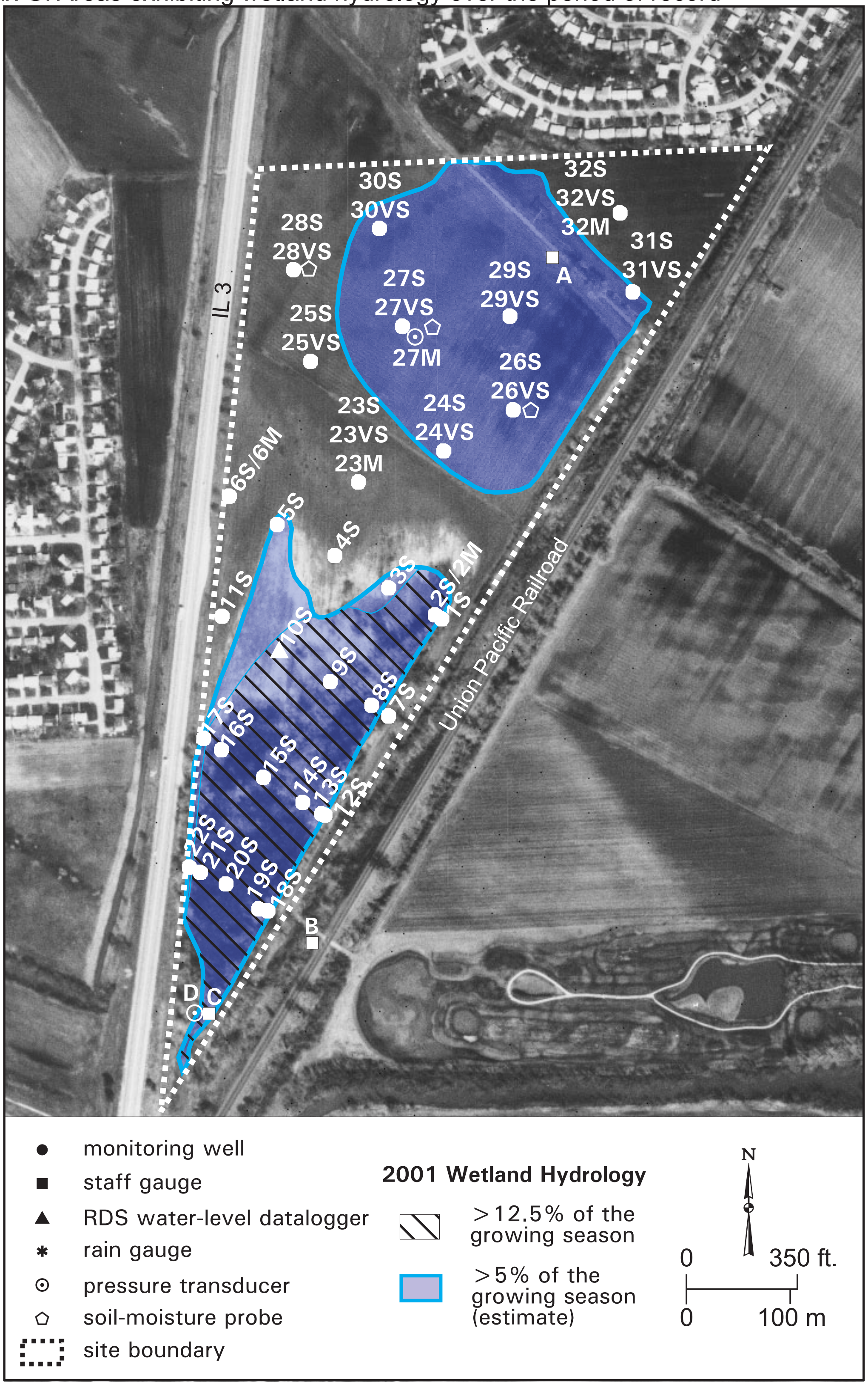
TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	FLAGS	REPORTING LIMIT	UNITS	DATE	TECH
SW-846 6010B	Arsenic (As), Water	ND		0.020	mg/L	10/04/04	twr
SW-846 6010B	Iron (Fe), Water	0.412		0.400	mg/L	10/04/04	twr
SW-846 6010B	Lead (Pb), Water	ND		0.007	mg/L	10/04/04	twr
SW-846 6010B	Manganese (Mn), Water	1.35		0.030	mg/L	10/04/04	twr
SW-846 3010A	Acid Digestion, Water	Complete				09/30/04	drl

* In Description = Dry Wgt.

Page 9

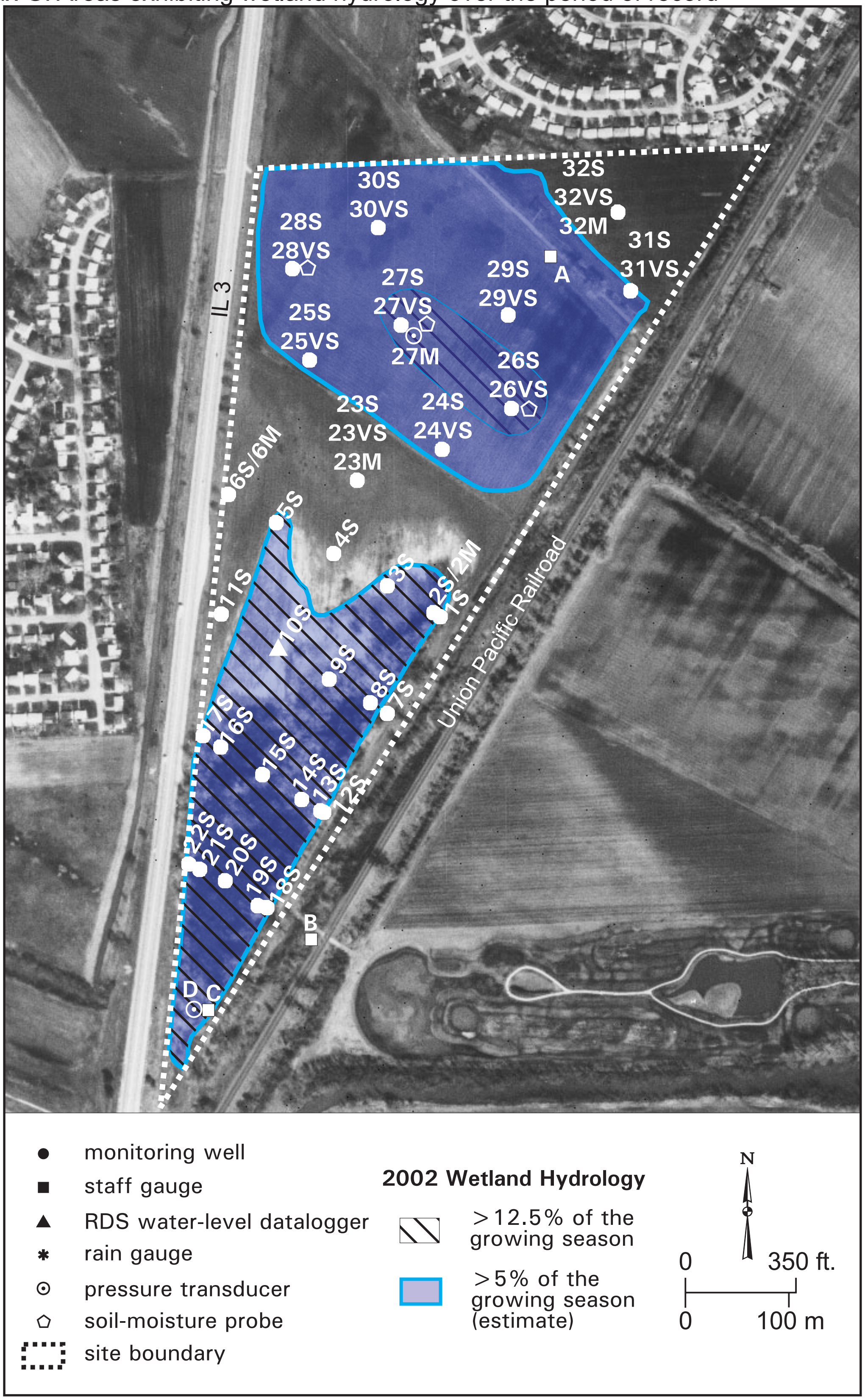
6310 Rothway Drive • Houston, TX 77040 • Tel: 713 690 4444 • Fax: 713 690 5646 • www.stl-inc.com

Appendix G: Areas exhibiting wetland hydrology over the period of record



Areas exhibiting wetland hydrology in 2001 (map based on Illinois State Geological Survey 2001a, 2001b, 2001c).

Appendix G: Areas exhibiting wetland hydrology over the period of record

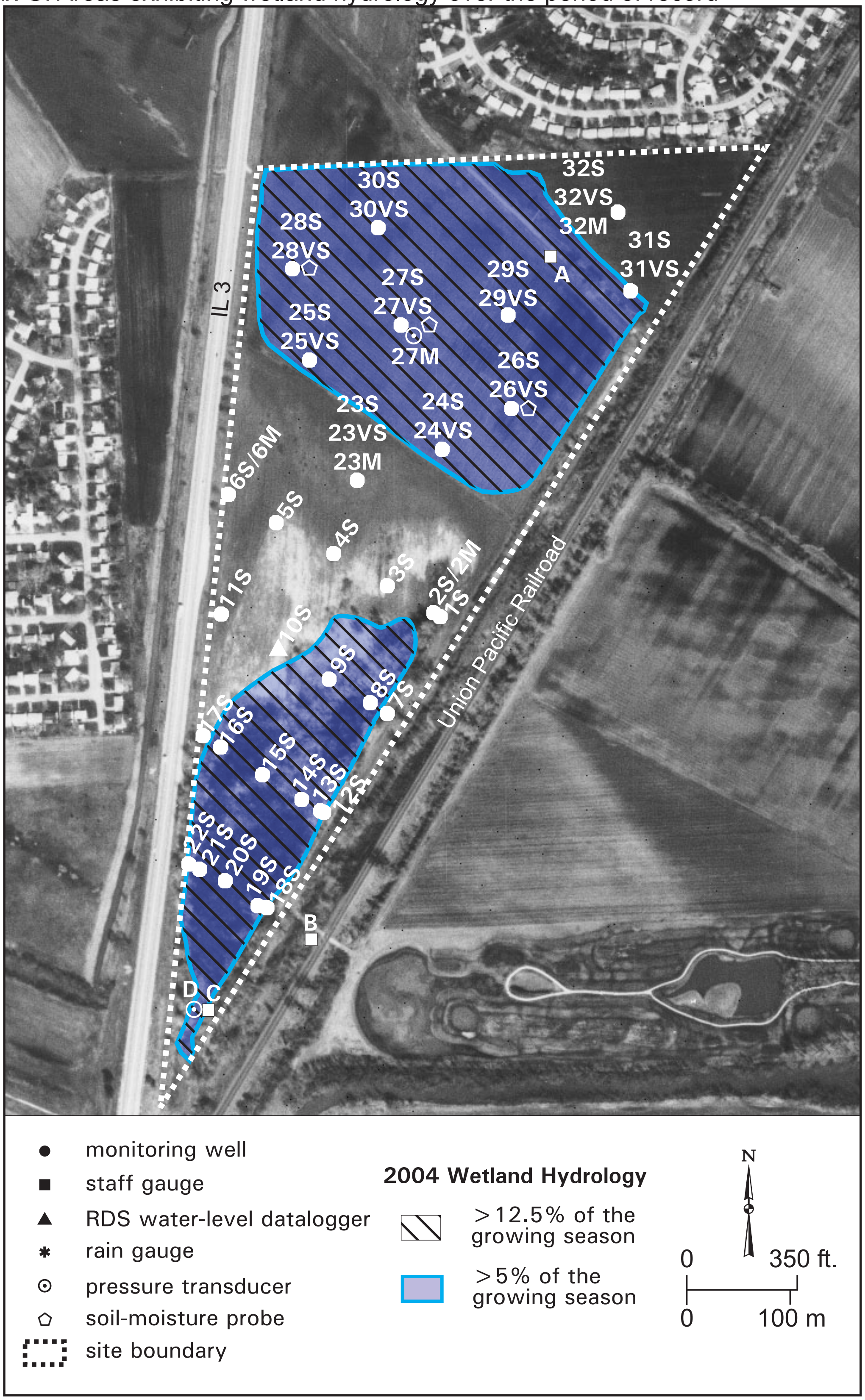


Areas exhibiting wetland hydrology in 2002 (map based on Illinois State Geological Survey 2001b, 2001c, 2002).

Appendix G: Areas exhibiting wetland hydrology over the period of record

Areas exhibiting wetland hydrology in 2003 (map based on Illinois State Geological Survey 2001b, 2001c, 2003).

Appendix G: Areas exhibiting wetland hydrology over the period of record



Areas exhibiting wetland hydrology in 2004 (map based on Illinois State Geological Survey 2001b, 2001c, 2004).