LEVEL II HYDROGEOLOGIC CHARACTERIZATION REPORT: MORRIS WETLAND BANK SITE

Grundy County, Illinois

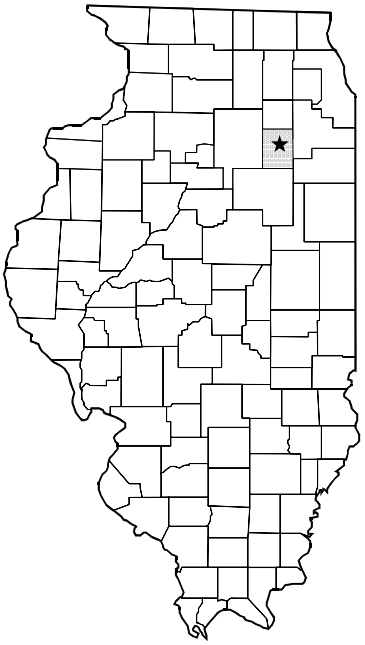
Keith W. Carr

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 PESA WIP B FY07
to
Illinois Department of Transportation
Bureau of Design and Environment, Wetlands Unit
2300 South Dirksen Parkway
Springfield, IL 62764-0002

March 27, 2007

Illinois State Geological Survey
Open File Series 2007-3



EXECUTIVE SUMMARY

In March 1999, the Illinois Department of Transportation (IDOT) tasked the Illinois State Geological Survey (ISGS) to conduct a hydrogeologic characterization of a potential wetland bank site near Morris, in Grundy County, Illinois. The area of the site is approximately 342 hectares (ha) or 844 acres (ac). The goals of this study were to describe the geology and hydrology of the site, quantify areas of existing wetland, and determine methods by which wetlands may be restored or created.

River flooding is the major water source for the site. Floods have to attain an elevation of 150.1 meters (m) or 492.5 feet (ft) to inundate most of the areas of the site slated by IDOT for wetland restoration, preservation, or enhancement. Stage records show that a flood of this elevation only occurred once per year (on average) within the growing season, and did not exceed nine days in duration (5% of the growing season) in any year since 1949. When floods do inundate the site, the inundation period is brief and infiltration is rapid, although very limited areas of the site can hold water for periods long enough to meet the minimum threshold for wetland hydrology. This is a result of generally coarse-textured surface materials on site that preclude widespread areas of persistent shallow saturation, thus preventing establishment of wetland hydrology. The limited areas that do hold water long enough are small closed depressions that have infilled naturally with fine-grained materials that retard infiltration rates, or some low-lying areas adjacent to stream channels. Ground-water discharge also does not contribute significantly to wetland hydrology because the on-site water table is typically over 2.0 m (6.6 ft) below ground surface during the growing season.

In the six years of record, the area that met wetland hydrology criteria at the 5% threshold ranged from a minimum of 0.33 ha (0.82 ac) in 2000 to a maximum of 8.9 ha (22.11 ac) in 2002. At the 12.5% threshold, the area that met wetland hydrology criteria ranged from a minimum of 0 ha (0 ac) in 2000 to a maximum of 3.69 ha (9.1 ac) in 2004.

Options to increase the area of wetland hydrology include removal of hydrologic alterations (including field tile and ditches) and excavation. Despite an extensive search, agricultural tile was only found in one field on the site. This tile was removed, and the expansion of wetland hydrology as a result is still being evaluated. Excavation is not recommended because the deep water table on site could only be intersected for wetland creation by excavating significant thicknesses of material. The small closed depressions noted above cannot be easily replicated via excavation, because a lining would need to be installed to retard downward water percolation through the thick vadose zone. Altering the flood regime of the Illinois River is not possible, and the installation of check dams in the on-site river channels would flood only limited areas due to the presence of alternate flow pathways that would drain away dammed waters.

In conclusion, except as already implemented in limited areas, there are no practical methods available to restore or create wetlands. Habitat improvement, however, could be accomplished by planting an assemblage of hydrophytic plants in the areas which are mapped as hydric soil but have been shown to lack wetland hydrology.

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INTRODUCTION

This report was prepared by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with final conclusions regarding the hydrogeologic conditions of a potential wetland banking site in Grundy County, Illinois. The study site, which is owned by IDOT, is located in Sections 2, 10 and 11, T33N, R7E roughly 0.8 kilometers (km) or 0.5 miles (mi) southeast of the town of Morris, IL (Figure 1). The site is bounded by the Illinois River to the north, private property to the east, Pine Bluff Road on the south, and IL 47 on the west. The area of the site is approximately 342 ha (844 ac). Water bodies within the site include the Mazon River and Mud Slough, both of which discharge into the Illinois River near the northwest corner of the site.

In March 1999, IDOT tasked the ISGS to conduct a hydrogeologic characterization of the site. The goals of this study were to describe the geology and hydrology of the site, quantify areas of existing wetland, and determine methods by which wetlands may be restored or created. This report includes ground- and surface-water level data collected from August 1999 through November 2004.

SUMMARY

Based upon the following, the potential for wetland compensation activities at the site is **LOW**.

- Jurisdictional wetland hydrology on site only occurs in a few closed depressions and at the lowest site elevations that are subject to longer-duration flooding. Although precipitation and runoff from areas adjacent to the depressions may provide some water input, the depressions generally require an overbank flood event to fill. Soil borings in and near these depressions reveal that they are underlain by fine-grained (silty and clayey) sediments that slow the infiltration rate enough to result in wetland hydrology in these depressions during most monitoring years.

- Water sources for wetlands found on site include the following. An overbank flood event from the Illinois River and the river channels on site can generally be expected to occur only once per year during the growing season, and for a period generally insufficient to satisfy the criteria for jurisdictional wetland hydrology. Further, due to the widespread presence of permeable surface materials on site (and corresponding high infiltration rates), the site lacks the ability to retain water after the flood for periods sufficient to meet wetland hydrology criteria. Ground-water discharge, if it occurs, is limited to the base of the bluff along the southern boundary, where a small wetland in an excavated depression is currently found. Runoff from adjacent uplands to the south is also limited by coarse materials exposed at the surface, thus limiting overland flow.

- In the six years of record, the area that met wetland hydrology criteria at the 5% threshold ranged from a minimum of 0.33 ha (0.82 ac) in 2000 to a maximum of 8.9 ha (22.11 ac) in 2002. At the 12.5% threshold, the area that met wetland hydrology criteria ranged from a minimum of 0 ha (0 ac) in 2000 to a maximum of 3.69 ha (9.1 ac) in 2004. Given this, the potential for wetland preservation credit is limited. Despite significant instrumentation within some of the 101.8 ha (251.3 ac) of INHS-mapped wetlands on site, the presence of jurisdictional wetland hydrology in these areas was not observed by ISGS.

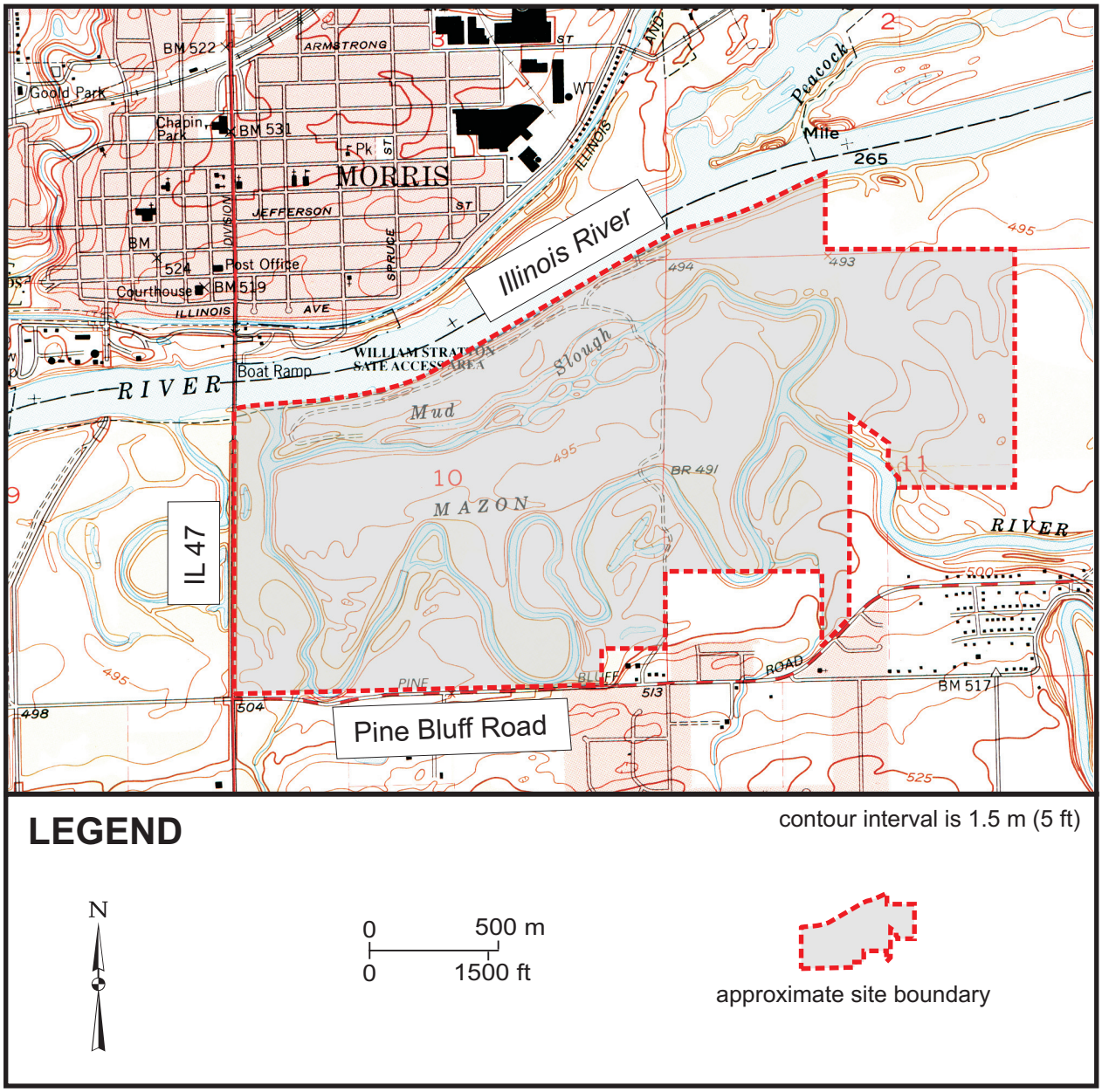

Figure 1 Location of the Morris wetland bank site (from the USGS Topographic Series, Morris, IL 7.5-minute Quadrangle [USGS 1993]).

- The only reversible hydrologic alteration present was a single, branched drainage tile found in the easternmost field (termed the “spider” field, Figure 2). This tile was removed, and any effects of the removal are not discernible at this point due to subsequent climatically dry periods. There are no known additional tiles to deactivate, ditches to fill, or streams to route onto the site. The flood regime of the Illinois River is partially manipulated by the Illinois River lock and dam system and is therefore not controllable for the sake of wetland restoration.

OPTIONS FOR RESTORATION OR CREATION OF WETLANDS ON THE SITE

- Options for further expansion of wetland area in the “spider” field are limited, as restoration by tile removal has already been performed and the closed depressions that demonstrate the conditions necessary to perch water are all currently doing so. Tile removal may continue to expand the area of wetland, and monitoring is ongoing to determine if an effect is discernible.

- The only conceivable way to retain more water on site would be to create excavations that duplicate the hydrologic regime of the “spider” field and the slough at SW7. With a typical depth to intersect the water table during the growing season of over 2.0 m (6.6 ft), significant thicknesses of material would need to be removed to expose saturated material. Any shallower excavations would need to be lined with finer-textured sediments or an artificial impermeable membrane due to high infiltration rates typical of the site as a whole. This method is expected to be infeasible for the creation of large acreages of wetland on site.

- It is not possible to alter the flood regime of the Illinois River. Further, the site is at least 3.0 m (10.0 ft) higher than an elevation that would receive more regular flooding, so excavation to match the flood regime is not feasible over large areas. Check dams or similar structures in the Mazon River or Mud Slough would not flood significant portions of the site. Numerous overflow channels on the site provide short-cuts to the Illinois River that would preclude significant ponding behind such a dam.

METHODS

Geologic Characterization

The geology of the study area was characterized by drilling 11 borings at nine separate locations (Figure 2) using a CME 75 truck-mounted drilling rig utilizing both 10.2-centimeter (cm) or 4.0-inch (in) diameter solid-flight and 10.8-cm (4.25-in) diameter hollow-stem augers. The hollow-stem augers were used when formation materials began to collapse. In the deepest boring at each of the nine locations, a split-spoon sampler, 0.61 m (2.0 ft) in length, was driven at 0.76-m (2.5-ft) intervals for the purpose of collecting geologic samples. Deposits were described in the field for texture, color (Munsell Color 2000), sedimentary structures, mineralogy, and other characteristics. Logs of geologic materials encountered in each boring are presented in Appendix A and shown graphically in Appendix B. Cross-sections, oriented along three south-to-north transects, were constructed to show the geologic units encountered in the borings (Figures 3–5).

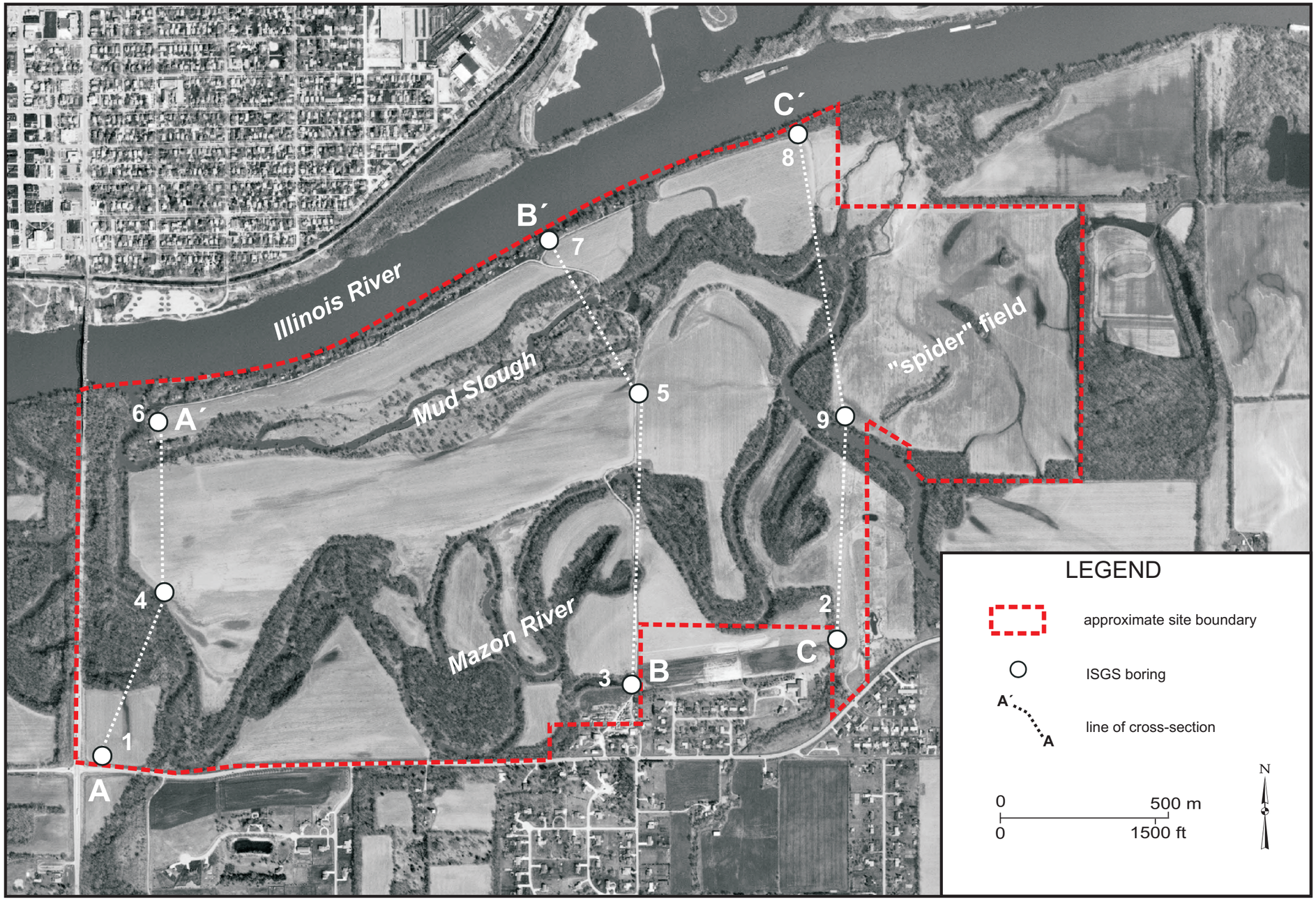

Figure 2 ISGS boring locations and lines of cross-section (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

Climate and Precipitation Monitoring

Precipitation data for the site are derived from two sources. The first is a weather station located at the Channahon/Dresden Island power station, roughly 9.6 km (6.0 mi) east of the site. Data from this site are received and entered into an online database maintained by the Illinois State Water Survey's Midwestern Regional Climate Center (MRCC). The second source is an ISGS tipping-bucket rain gauge with an on-board logger, installed on site in March 2000. The MRCC station records daily precipitation totals and is monitored year round. It is therefore the primary source of data for determining general precipitation input to the bank site. The on-site rain gauge, generally operational only during the growing season, is useful for precise documentation of the time of onset, magnitude, and duration of localized rainfall events that may affect site hydrology.

The MRCC also provides data regarding the median length and the median start/end dates of the growing season at the weather station. The growing season is defined as the time period between the last occurrence of −2.2 degrees Celsius (°C) or 28 degrees Fahrenheit (°F) air temperatures in the spring to the first occurrence of −2.2°C (28°F) air temperatures in the fall. From these data, the growing season in the area has a median length of 187 days, beginning on April 13 and ending on October 17 (Midwestern Regional Climate Center 2004).

Ground-Water Monitoring

The hydrogeologic investigation of the site employed three well types. Initially, nine L-wells ("Lower" wells), completed at depths ranging from approximately 2.5 to 6.7 m (8.2 to 22 ft) were installed to determine if any significant water-bearing zones were present at depth, to investigate the interaction between the rivers on the site and ground water, and to establish the geologic framework for the site (wells 1L to 9L). Secondly, two U-wells ("Upper" wells), completed in borings drilled to approximately 1.5 and 2.0 m (4.9 and 6.6 ft) in depth, were installed next to L-wells to make nests along the south site margin (wells 1U and 3U). The purpose of these wells was to identify hydraulic gradients and determine if there was a potential for ground-water discharge in these two areas near the base of the off-site bluffs. Both L-wells and U-wells were constructed of 5.1-cm (2.0-in) diameter PVC.

Soil-zone water levels were determined via an array of 43 S-wells (or "Shallow" wells) and six VS-wells (or "Very-Shallow" wells) that were emplaced with a 7.5-cm (3.0-in) diameter hand-auger. Both S-wells and VS-wells were constructed of 2.5-cm (1.0-in) diameter PVC and were installed to depths of 0.75 m (2.5 ft) and 0.375 m (1.25 ft), respectively. These shallow ground-water wells were spread widely over the site, in differing materials and differing landscape positions. Well-construction information for all 60 wells is presented in Appendix C.

The monitoring wells were typically read biweekly (using a Solinst electronic measuring tape) during the early growing season months (April through June) and monthly during other months, beginning in August 1999 and continuing through November 2004. Data collected after November 2004 are not included in this report. The locations of all monitoring wells and nests of wells are shown on Figure 6. Water-level elevation above sea level (asl) is determined by subtracting the water level reading on the measurement tape from the surveyed elevation of the top of the well casing (the measuring point). The data are also calculated to depth to water below ground surface (DTW) by subtracting the water-level elevation from the elevation of land surface at each well. The measuring-point elevations (top-of-casing) of all on-site wells were optically surveyed each spring

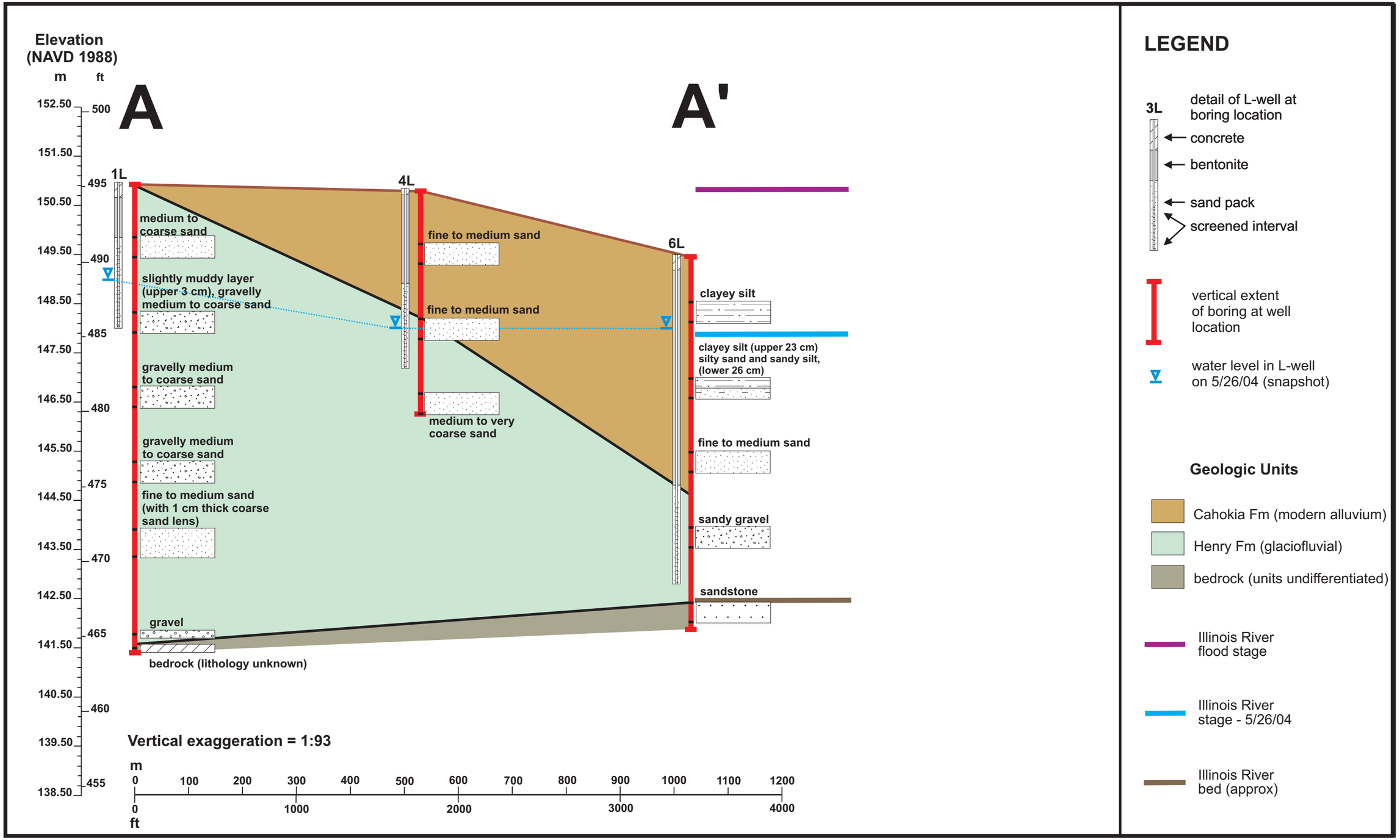

Figure 3 Geologic cross-section from A to A' along transect of ISGS wells 1L-4L-6L. Lines of cross-section are shown in Figure 2.

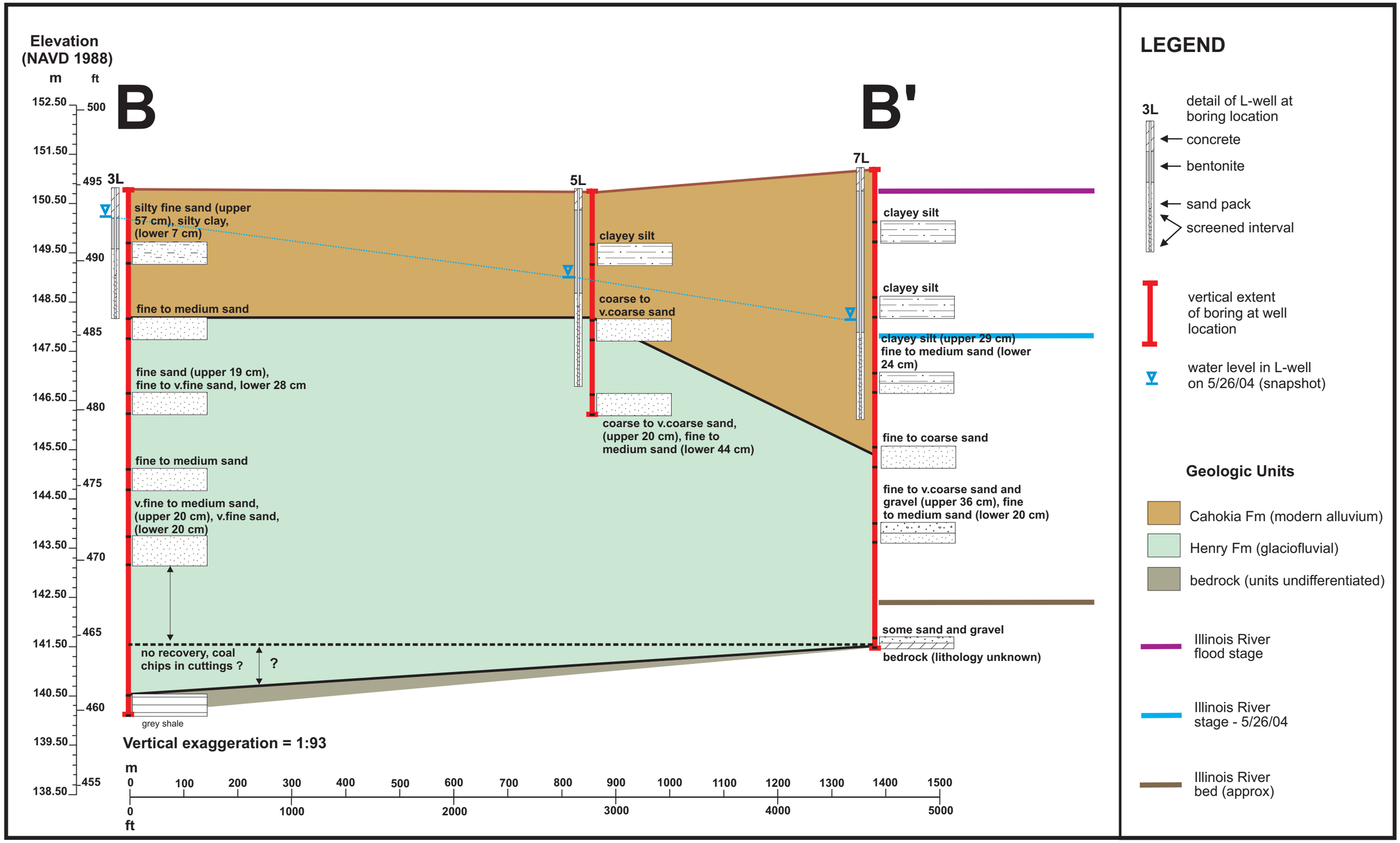

Figure 4 Geologic cross-section from B to B' along transect of ISGS wells 3L-5L-7L. Lines of cross-section are shown in Figure 2.

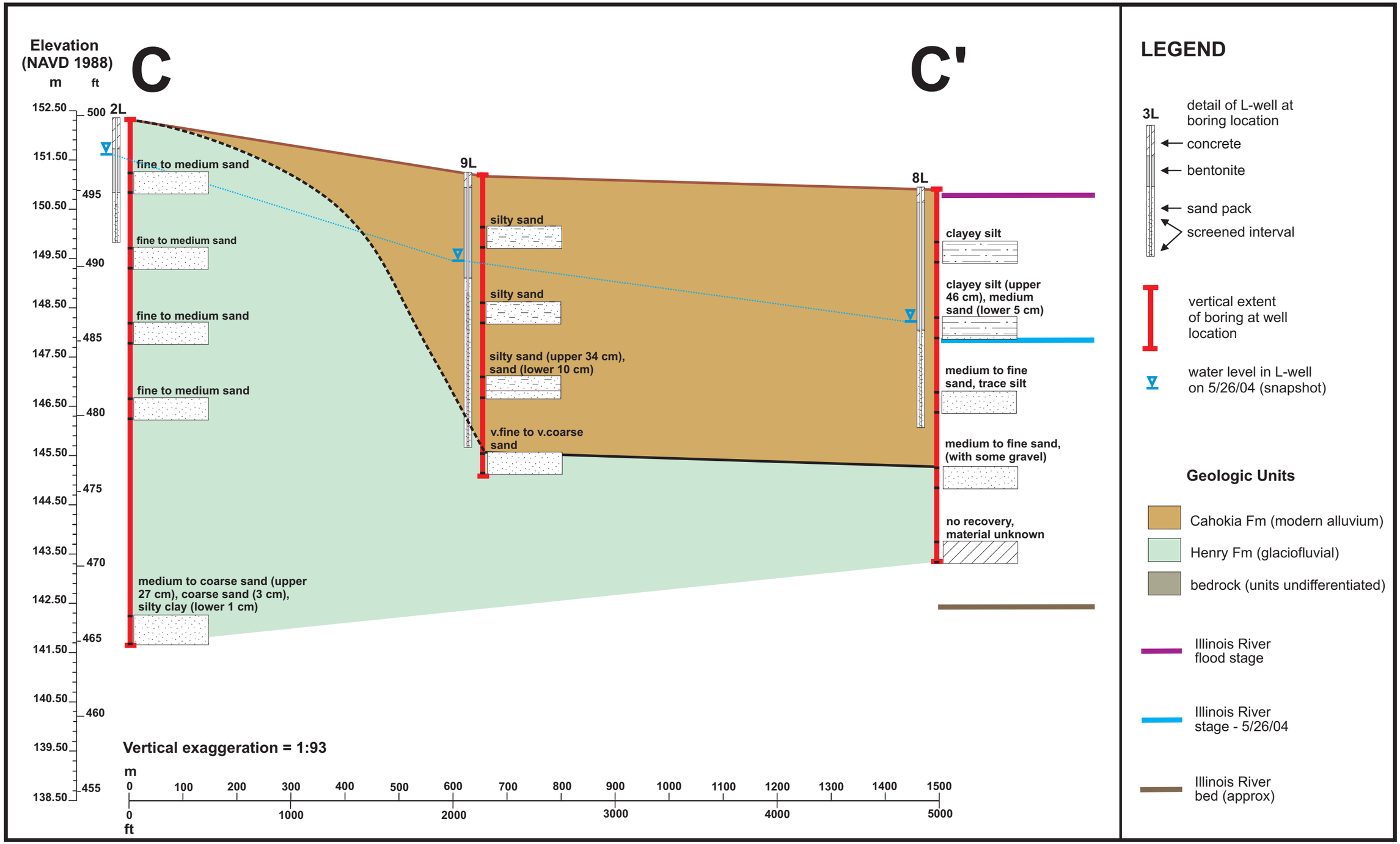

Figure 5 Geologic cross-section from C to C' along transect of ISGS wells 2L-9L-8L. Lines of cross-section are shown in Figure 2.

to determine if wells had heaved or settled, primarily due to freeze-thaw cycles or ice damage from river flooding.

Surface-Water Monitoring

Surface-water levels were measured at nine stage gauges and nine water-level data loggers installed by ISGS. These gauges were augmented by water-level data for the Illinois River from a U.S. Army Corps of Engineers (USACE) river gauging station located less than 0.5 km (0.3 mi) downstream from the site. The manual stage-gauge data were from standard metal staff gauges and in one case, a depth to water reading from a fixed (marked) position on a bridge over the Mazon River. The data collection frequency for the stage gauges was the same as for the wells above. The surface-water data loggers included pressure transducers, ultra-sonic data loggers, and capacitance-type data loggers, all generally recording on one-hour or three-hour intervals. The locations of all surface-water stage gauges and data loggers are shown on Figure 6. All instruments with “SW” designations were surface-water stations, while the modifier “F” denotes a staff gauge or bridge measurement, “G” denotes a Global brand pressure transducer, “R” indicates an RDS-brand capacitance-type data logger, and “I” denotes an Infinity-brand ultra-sonic data logger. All water-level data are presented as elevation (asl), determined by adjusting the water-level reading as recorded on the data logger or staff gauge to the surveyed elevation of a known measuring point on the instrument.

Elevation and Topographic Surveying

The locations of wells and surface-water gauges were determined with a differentially-corrected Trimble GPS unit, capable of sub-decimeter (< 4.0-in) horizontal accuracy. Instrument elevations were initially determined either with a Sokkia B-1 optical level or a Leica TCR703 total station. Each instrument was re-surveyed every spring in order to check for any heave or subsidence due to frost or ice action. All instruments on site are tied to the North American Vertical Datum of 1988 (NAVD 1988) and are projected in the State Plane North American Datum of 1983 (NAD 1983) coordinate system.

On-site elevation control was derived from a network of 28 benchmarks set out on site by IDOT in 1999. The benchmarks were assigned elevations with a survey-grade GPS unit and used as reference points for an aerial topographic survey of the site. This survey, undertaken by IDOT Division of Aerial Surveys, was used to generate a topographic map (Figure 7, Illinois Natural History Survey, 2000a) at a contour interval of 0.3 m (1.0 ft). All subsequent ISGS optical surveys (described above) were conducted using the same benchmarks used by IDOT to anchor the aerial survey, so instrument elevations correspond well to the topographic mapping. In addition, elevations for wells along the east side of IL 47 were surveyed by ISGS relative to optically-derived benchmark elevations provided by IDOT sub-contractors American Surveying Consultants and Chamlin Associates. These benchmarks were also tied to NAVD 1988 in the vertical dimension and State Plane NAD 1983 in the horizontal direction.

Figure 6 ISGS instrumentation locations (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

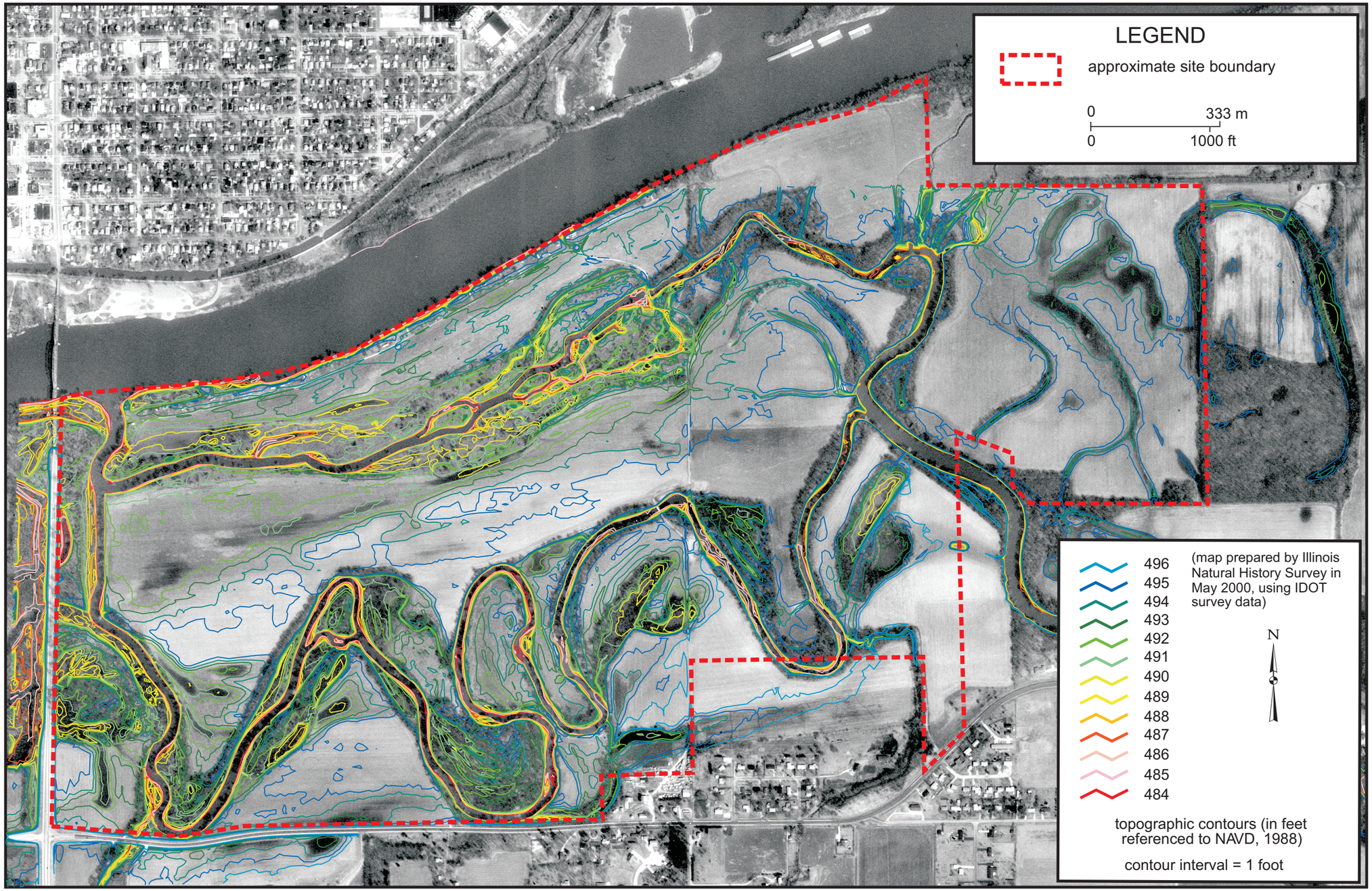

Figure 7 Site topographic map (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

GEOLOGY

Regional Geologic Setting

The sediments along the Illinois River generally reflect glacial and post-glacial conditions as well as modern fluvial action (Phillips and Shilts 2001). A bedrock valley was carved by glacial meltwaters, and the resulting channel subsequently infilled with coarse deposits typical of a broad, high-energy braided stream environment. These well-sorted sands and gravels of the Henry Formation (Willman et al. 1975) were deposited in a broad outwash plain and on terraces in the meltwater channel, which was much wider than the current Illinois River. The fine, uniform sand deposits of the bluff along the southern site margin are likely reworked sand picked up from the exposed outwash and deposited as dunes along the terrace margins. Because the post-glacial Illinois River lacked the flow volume that carved the wider channel, accelerated sediment deposition occurred all along the Illinois River (Bhowmik and Demissie 1989). Sands, silts and clays of the Cahokia Formation were, and continue to be, deposited over the better-sorted and more massively-bedded Henry Formation deposits.

On-site sediments also reflect fluvial deposition from the Mazon River (and Mud Slough) because their gradients drop significantly at the southeast corner of the site where the Mazon River passes from a bedrock canyon down onto the floodplain. As a result of the interplay of the two rivers at the site, the sand, silt, and clay alluvial deposits of the Cahokia Formation are expected to be discontinuous and intertwined due to the erratic nature of river channel migration and flooding activity.

Characterization of Site Geology

Bedrock

In the eastern half of the site, the uppermost bedrock units in the study area are mapped as limestones, dolomites, and shales of the Ordovician-age Galena-Platteville Group (Kolata 2005). On the western half of the site, the uppermost units are mapped as limestones, shales and coals of the Pennsylvanian-age Spoon Formation of the Kewanee Group. Structurally, the site is located on the northernmost flank of a bedrock valley that more or less parallels the modern Illinois River (Herzog et al. 1994).

Based upon ISGS borings along the southern site margin (Borings 1, 2, and 3, see Figures 3–5 and Appendix A and B), bedrock likely lies between 7.6 and 10.7 m (25.0 and 35.0 ft) in depth in this area and is likely shale. Along the northern site margin and next to the Illinois River (Borings 6, 7, and 8, see Figures 3–5 and Appendix A and B), bedrock likely lies between 7.2 and 9.6 m (23.5 and 31.5 ft) below land surface and may be sandstone.

Sediments

Deposits mapped in the site and environs support the stated regional geologic setting. Along the southern site margin, stack-unit mapping (Berg and Kempton 1988) shows a thin unit (<6.0 m [19.7 ft]) of sands and gravels of the Henry Formation overlying Pennsylvanian-age bedrock (mostly shales). Also along the southern site margin, a unit of Parkland Sand, a windblown dune deposit, may overlie the Henry Formation in some areas (Lineback 1979). The remainder of the site area is mapped as a thin unit (<6.0 m [19.7 ft]) of the more recent Cahokia Formation alluvium overlying a thin unit (<6.0 m [19.7 ft]) of the Henry Formation, overlying Pennsylvanian shales.

Data from the nine ISGS borings are summarized in cross-sections showing the interpreted site geology (bedrock and unlithified sediments). Figure 2 shows boring locations and lines of cross-section, while the cross-sections themselves are presented as Figures 3, 4, and 5. In general, the three cross-sections are consistent with both published mapping and the preceding description of the regional geologic setting: a bedrock-floored channel backfilled with clastic glaciofluvial deposits, overlain by a mantle of more recent finer-grained interbedded alluvium that thickens as one approaches the Illinois River. With increasing depth, the more silt- and clay-rich materials of the modern Cahokia Formation transition to coarser, more gravelly, and more massively-bedded materials of the Henry Formation. An aeolian sand unit along the southern valley margin is also suggested at the southernmost two transects, likely coincident in age with the older outwash deposits. Sands in the medium to fine size fraction, along with the thickly bedded character support a possible aeolian origin, as does the presence of mapped wind-deposited units in the area. The previously described clastic materials directly overlie bedrock.

Cross-section A–A′ (Figure 3) is located along the western site margin (Figure 2). This line of borings (borings 1–4–6 and wells 1L, 4L, and 6L) depicts a thin veneer of generally finer-grained Cahokia Formation thickening northward over a wedge of coarser Henry Formation glaciofluvial materials that thickens southward toward the bluffs. A consistent depth to refusal on rock shows an essentially flat-bottomed bedrock valley along this transect.

Cross-section B–B′ (Figure 4) is centrally located on the site (Figure 2). This line of borings (borings 3–5–7 and wells 3L, 5L, and 7L) also depicts a unit of finer-grained Cahokia Formation becoming thicker approaching the Illinois River. At borings 5 and 7, the Henry Formation is clearly seen by its coarser texture. However, at boring 3 (along the bluff margin), a thick unit of generally fine sand may represent the aeolian dune sands discussed previously.

Cross-section C–C′ (Figure 5) is located in the eastern third of the site (Figure 2). In this line of borings (borings 2–9–8 and wells 2L, 9L, and 8L) , the two river-ward borings (9 and 8) also contacted a unit of Cahokia Formation over coarser Henry Formation. As with transect B–B′, the Henry Formation at the bluff margin (boring 2) consists of a possibly aeolian facies of uniform fine to medium sands, with coarser, water-lain glaciofluvial materials only appearing at the bottom of the boring. The modern alluvium likely thins southward until only a very thin veneer of Cahokia Formation materials is present in the area of boring 2 due to the less frequent flooding in this area. Bedrock was not encountered in this transect, although borings 2 and 8 may have terminated close to the bedrock interface given the reasonably consistent depths to bedrock in the other transects.

Topography

The total relief of the site is approximately 4.6 m (15.0 ft). Excluding a small area within the creek channels that is below 149.4 m (490.0 ft) in elevation and a similarly small area along the southern bluff that exceeds 151.2 m (496.0 ft) in elevation, the majority of the site lies between 149.4 and 151.2 m (490.0 and 496.0 ft) and would be characterized as floodplain. The entire parcel is within the 100-year floodplain of the Illinois River (Federal Emergency Management Agency 1985).

The general slope of the site is from south to north, from a bluff line along the southern site margin to the Illinois River. Some subtle closed depressions are present, including sloughs, floodwater scour channels, and meander cut-offs (oxbows). Where present, the depressions are generally 0.6 to 0.9 m (2.0 to 3.0 ft) below the land surface, although some depressions approach a depth of 1.5 m (5.0 ft). Both the main stem of the Mazon River and Mud Slough are significantly incised,

with low water between 2.1 and 3.0 m (7.0 and 10.0 ft) below the top of the banks. The stream banks are generally steep and exhibit well-developed natural levees in some areas of the site. In other areas, some of the slight rises along the stream channels may be old dredge spoil, most notably in the straight segment where the Mazon River was artificially connected to Mud Slough in the northwest corner of the site.

Soils

Soils on the site mapped by the U.S. Department of Agriculture (1980) and confirmed on site by the Illinois Natural History Survey are the Ross silt loam, Lawson silt loam and Sawmill silty clay loam. Of these three units, only the Sawmill soil is on both the state and county hydric soils lists (U.S. Department of Agriculture 1995). The Ross soils are nearly level, well-drained soils found on the floodplains of creeks and rivers (U.S. Department of Agriculture 1980). The Lawson soils are nearly level, somewhat poorly-drained soils, also found on floodplains. The Sawmill soils are nearly level, poorly-drained to very poorly-drained soils found in broad, level or slightly depressional areas on floodplains.

Data from the on-site soil surveys by INHS personnel were digitized to create a soil map of the site (Figure 8, Illinois Natural History Survey 2000b). From these data, Ross soils cover 24.3 ha (60.0 ac), Lawson soils cover 150.6 ha (371.9 ac), and the Sawmill soils cover 140.6 ha (347.2 ac). As INHS scientists confirmed the hydric status of the Sawmill soils, 140.6 ha (347.2 ac) or 41% of the site is therefore mapped as hydric soil. The remaining 26.3 ha (65.0 ac) of the site was mapped as “open water”, yielding a total site area of 342 ha (844 ac).

During emplacement of S-wells by ISGS, redoximorphic features were noted in a few areas, including soil-chroma values of 2 or below (suggesting reduced iron), oxidized root channels, and buried organic materials. These conditions, suggesting possible hydric soils and past wetland conditions, were mostly found in slight depressional areas mapped as Sawmill silty clay loam but were more the exception than the rule. Also, saturated sediments or free water were not encountered in any of the shallow soil borings emplaced on site for S-well construction.

Wetlands

Wetlands mapped on the site in the National Wetlands Inventory (U.S. Fish and Wildlife Service 1988) are primarily palustrine floodplain forests and cover roughly 1/3 of the site. These mapped wetlands are found primarily along the channels, oxbows, and backwater sloughs associated with the Mazon River and Mud Slough. County-level NRCS wetland mapping is in general agreement, listing most of the forested areas along the river channels as “existing wetland”, and some of the non-forested areas within the meander bends of the Mazon River as “farmed wetlands” (Illinois Department of Transportation 2000, Wetland Bank Prospectus: Morris Site). The NRCS mapping does not indicate the presence of any “prior converted” wetlands on the site.

To test the mapped wetland acreages, on-site wetland determinations were conducted by INHS personnel at 44 separate locations that were subsequently grouped into 28 different categories (locations of determinations are shown on Figure 9). Of these 28, 19 were determined to be wetland and 9 were found to be non-wetland. Based upon these determinations, INHS scientists plotted polygons (Figure 9, Illinois Natural History Survey, 2000c) which were in general agreement

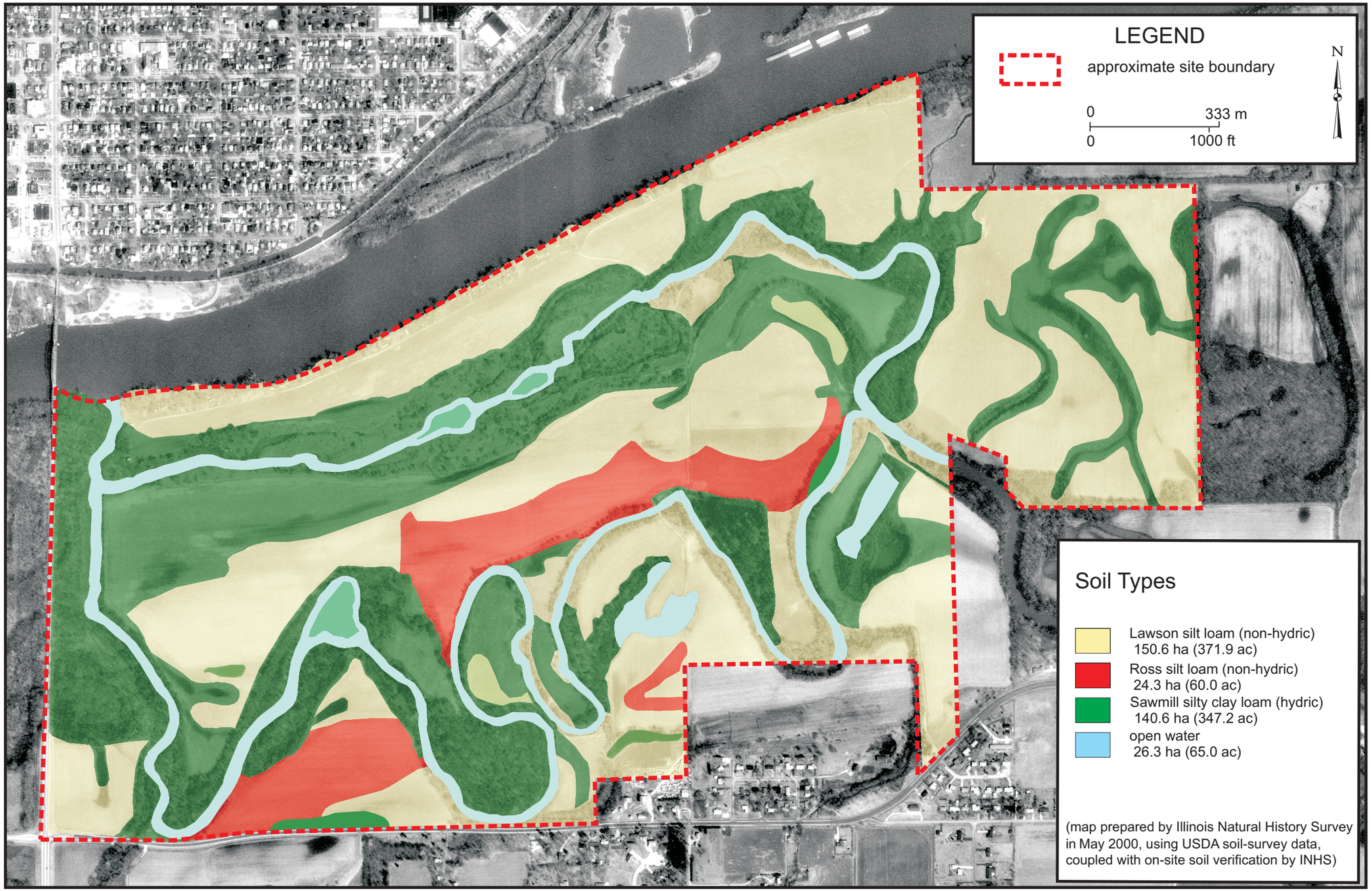

Figure 8 Soil types on site (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

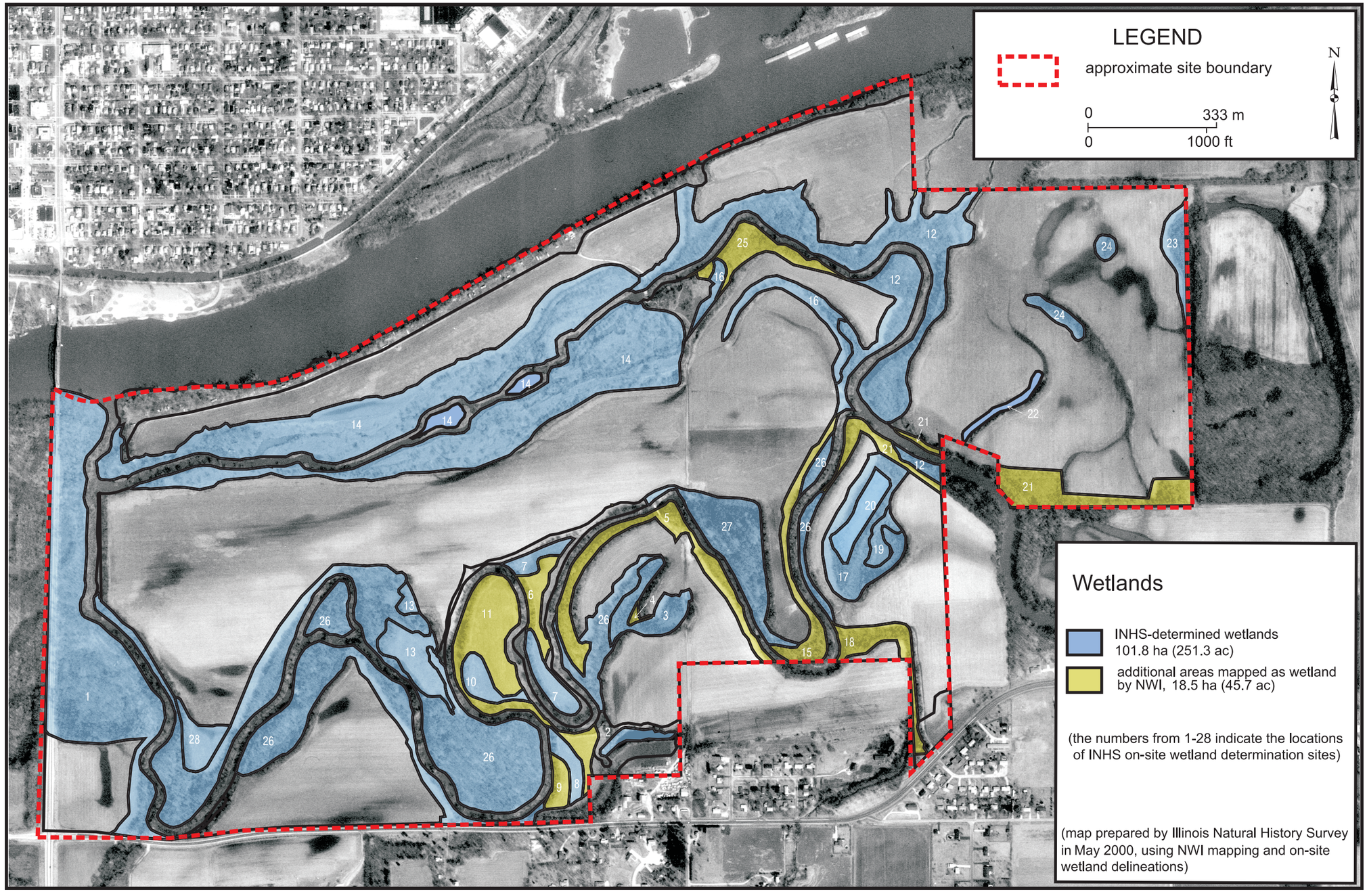

Figure 9 Mapped wetlands on site (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

with the previously noted NWI and NRCS mapping, although 18.5 ha (45.7 ac) of the site mapped as wetlands on NWI maps were determined by INHS to be non-wetland. These areas are shown as green polygons on Figure 9. Some limited additional wetlands were also found by INHS which were not mapped by NRCS. The total wetland acreage determined by INHS is 101.8 ha (251.3 ac), or 30% of the total site area. These areas are shown as blue polygons on Figure 9 and are termed "INHS-determined wetlands" on the legend. The remaining land area of the site, outside the polygons on Figure 9, were deemed non-wetland.

HYDROLOGY

Regional Hydrologic Setting

Regional land-surface slope and surface-water flow is generally from the bluff along the southern site margin northwards to the Illinois River. Total topographic relief between the crest of the bluff south of the site to the Illinois River is roughly 19.8 m (65 ft) over about 3.3 km (2.0 mi). Local surface-water flow is toward the bank site from the south. The Mazon River and Mud Slough follow a meandering path across the site from southeast to northwest. Another intermittent stream enters the site from the south (shown as "intermittent stream" on Figure 10), and is likely fed by localized ground-water discharge and limited runoff.

Within the site, overland water flow is toward the channels of the Mazon River and Mud Slough, as well as toward some limited closed depressions. However, organized or concentrated overland flow is rare on the site due to coarse surface materials and correspondingly high infiltration rates. During flooding events that exceed bankfull conditions in the two major channels, several overflow channels are activated, although most act as meander cutoffs that direct floodwaters back into the main creek channels a short distance downstream. The most hydrologically significant of these are three overflow channels located in the northeast portion of the site (shown as "flood overflow channels" on Figure 10). These three channels, the two easternmost of which are active almost continuously, direct water from the Mud Slough channel directly northward to the Illinois River. This short-cut limits the degree to which Mud Slough waters can back up in the channel during the large log-jam events that often occur in the area of the cutoffs. It is also likely that the three cutoff channels were actually formed as a result of the persistent log jams.

Climate Data

Precipitation totals for the site are derived from two sources: data from a weather station located at the Channahon/Dresden Island power station (obtained from MRCC), and on-site data from an ISGS tipping-bucket rain gauge (data are presented here in inches due to the data collection convention of the MRCC). Despite being roughly 9.6 km (6.0 mi) east of the site, the MRCC data compared reasonably well with on-site ISGS data (Figure 11). Totaling the 29 months of the study, the MRCC station recorded 108.93 inches of precipitation (Midwestern Regional Climate Center 2004) and the ISGS gauge recorded 103.89 inches. The within-month variation between the ISGS gauge and the MRCC station averaged about 23%, although neither gauge trended consistently higher or lower than the other. The MRCC Channahon/Dresden Island station records daily precipitation totals and is maintained year round. Given this and the general agreement noted above, the MRCC station is used as the primary source of data for determining general precipitation input to the bank site. The MRCC also provides growing season data. The growing season in Grundy County has a mean length of 187 days and typically starts on April 13 and ends on October 17 (Midwestern Regional Climate Center 2004).

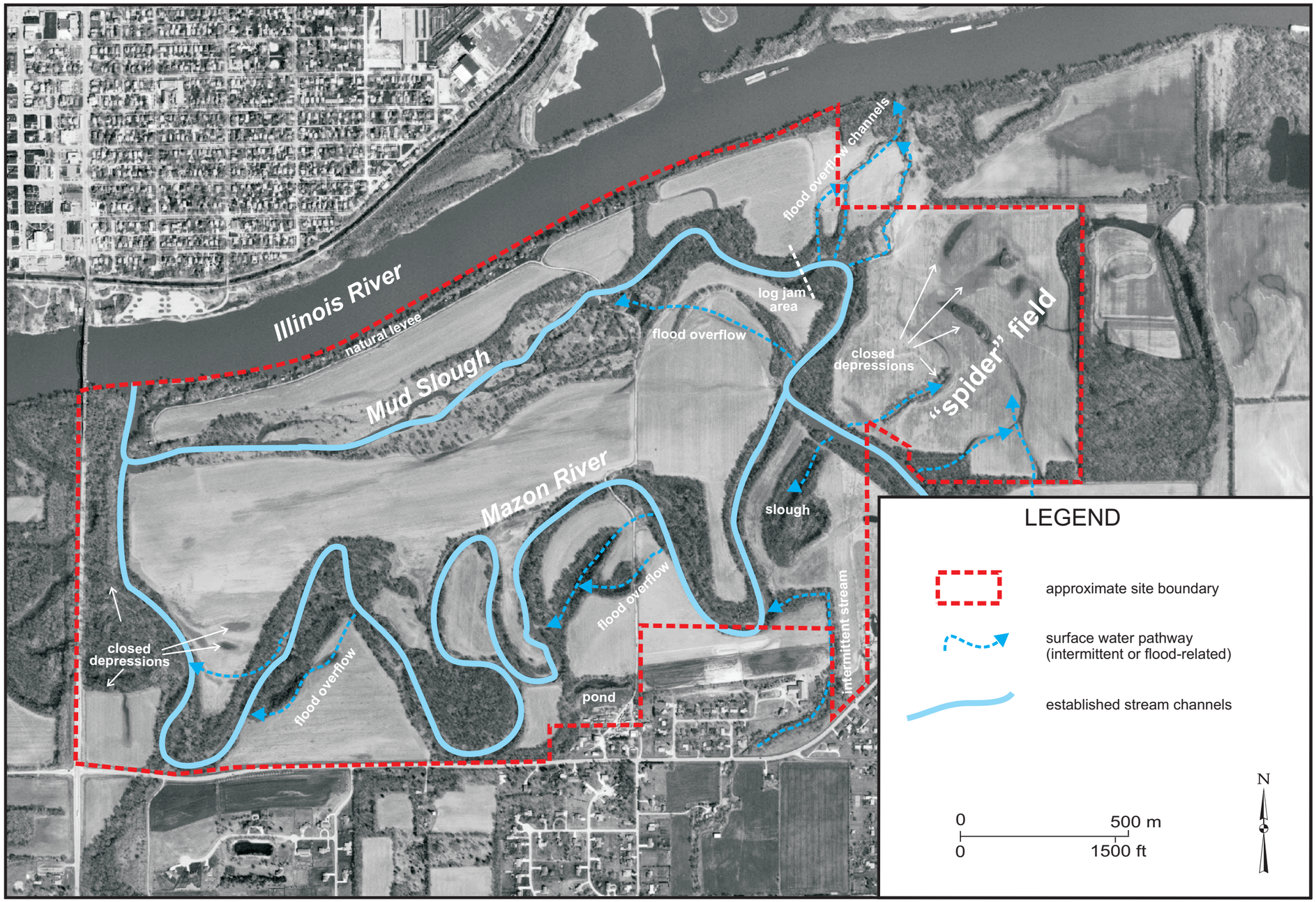

Figure 10 Site hydrologic and landscape features (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

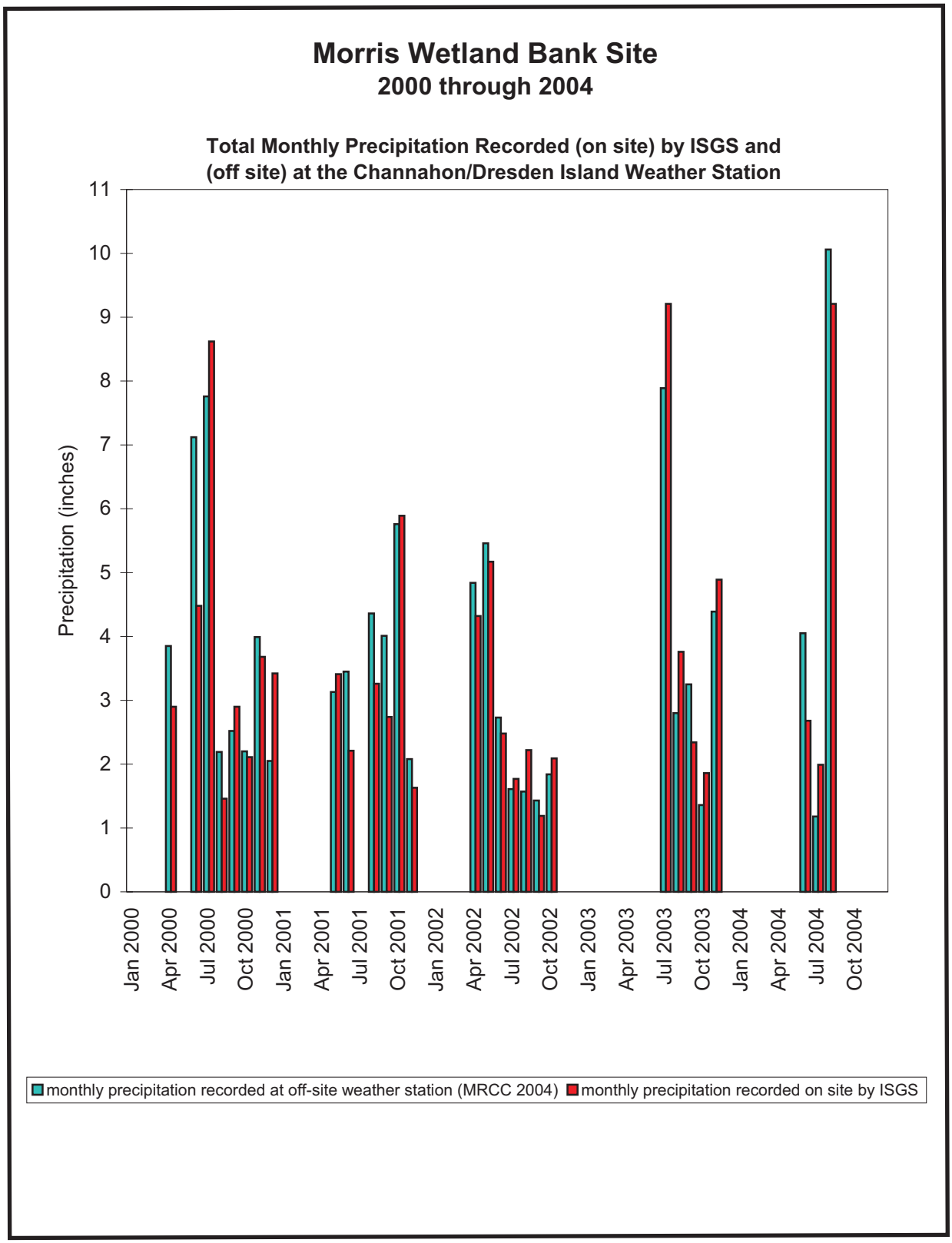

Figure 11 A comparison of monthly on-site and off-site precipitation values (Midwestern Regional Climate Center [2004], Midwest Climate Information System: Illinois State Water Survey, Champaign, IL, http://mcc.sws.uiuc.edu/.)

Based upon archival Channahon/Dresden data for the period between 1971 and 2000, total annual precipitation in the site area averaged 37.2 inches, and in general, the highest rainfall totals are in the spring and summer months. During the 1999 to 2004 monitoring period, precipitation was somewhat variable. Figure 12 shows monthly precipitation totals for the study period recorded at the Channahon/Dresden Island weather station (grey bars on the graph). For comparison, the average monthly precipitation is also shown (red line). The period preceding the start of the growing season (January to March) typically helps determine eventual attainment of wetland hydrology. Steady or above-average precipitation during this late-winter to early-spring period recharges shallow ground water and soil moisture, helps pond water on the land surface, and may cause flooding from rivers. Water arriving on site during this period is generally more likely to persist in the absence of high evapotranspiration losses more characteristic of the late-spring and summer months. This is followed by the critical period, the first two months of the growing season (April and May), which is when most sites in Illinois attain wetland hydrology.

On an annual basis, precipitation during the monitoring period of Sept 1 to Aug 31 in monitoring years ending in 2000, 2001, 2002, and 2003 was slightly below the 30 year average (89%, 87%, 92% and 80% of normal, respectively). The 2004 monitoring year was 100.1% of normal. In the late-winter to early-spring period (January to March), precipitation was below average in all five monitoring years. In 2000, 2001, 2003, and 2004, precipitation in this period varied from 72% to 88% of normal, while this period in 2003 was especially dry, with precipitation only 49% of normal. During the critical months of April and May, precipitation rebounded to normal or above normal levels (ranging from 101% to 134% of normal) in all years except 2004, which remained below average at 74%. In the later spring and summer months (June–August), precipitation was above average (ranging from 105% to 142% of normal) in 2001, 2002, and 2004, while in 2001 and 2002, precipitation remained below average at 91% and 49%, respectively. In general, any late-spring and summer rebound to above average precipitation levels has a limited effect on overall site wetness, primarily due to higher evapotranspiration rates in summer that diminish the retention of direct precipitation and limit runoff and flooding.

A general conclusion is that during the period of this study, precipitation inputs to the site have been slightly below normal in total, although not extremely so. However, some portions of individual years have been quite dry. As with other riverine sites, these below-average precipitation years do have some effect on the extent and duration of wetland hydrology at the Morris site. However, more important is the timing of rainfall or snowmelt in the basin, which drives the flooding that supports wetland hydrology in the floodplain.

Ground-Water Data

Water-level elevations and depths to water for the period of study (1999–2004) are reported in tabular form in Appendix D. Plots for groups of monitoring wells are also provided in Appendix E. Water-level data are provided as elevation and depth to water. On the depth to water tables on Appendix D, some cells are depicted with a grey background. These cells represent water levels that are less than or equal to 0.304 m (1.0 ft) below ground surface, which are considered to indicate saturation to land surface according to informal USACE guidance.

Henry Formation (Deeper Wells)

Of the wells installed in the nine deeper soil borings (wells 1L to 9L), the well with the shallowest screened interval is 1L at 1.33 to 2.8 m (4.4 to 9.2 ft) and the deepest screened interval is 6L at

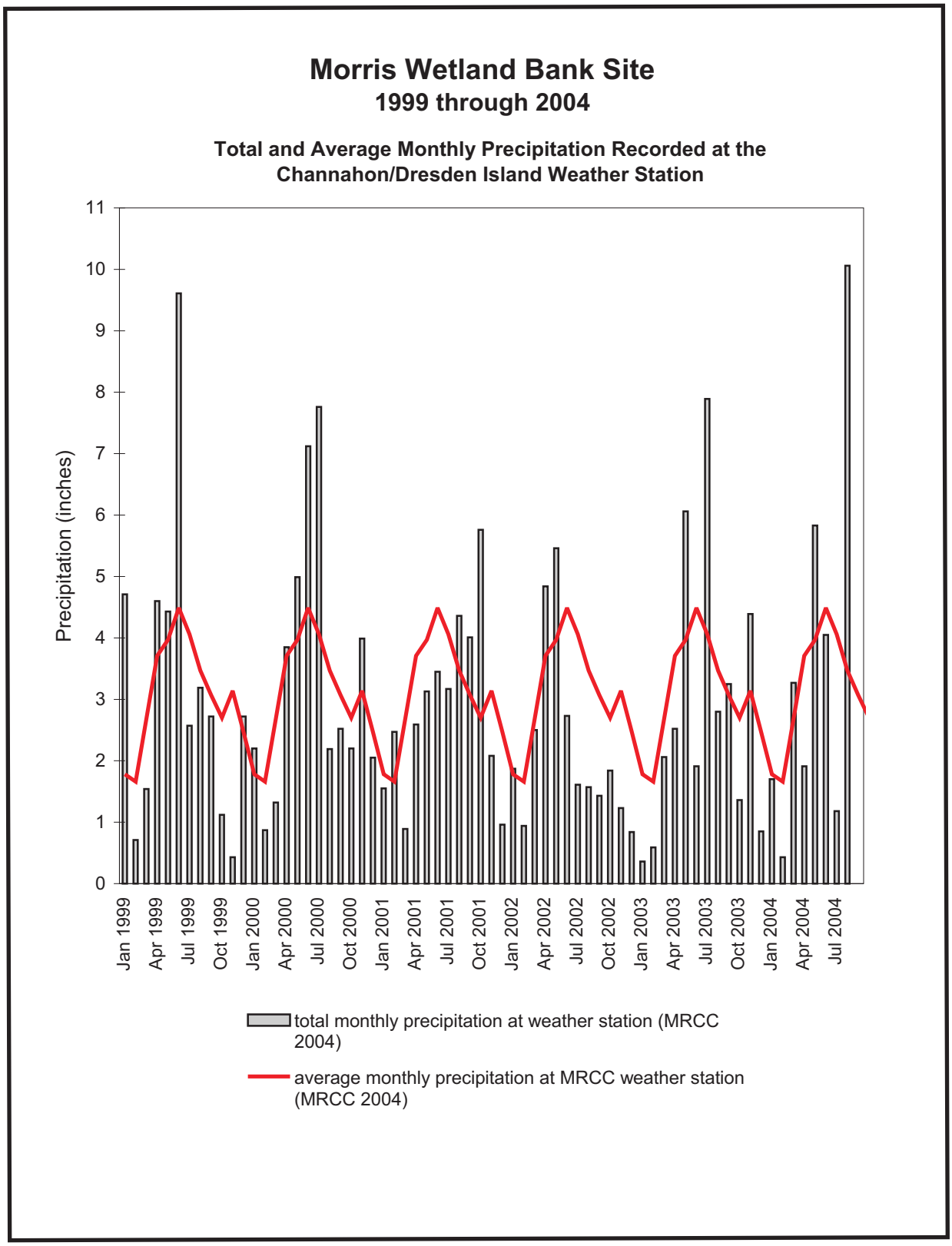

Figure 12 Total monthly precipitation at the off-site weather station, 1999-2004 (Midwestern Regional Climate Center [2004], Midwest Climate Information System: Illinois State Water Survey, Champaign, IL, http://mcc.sws.uiuc.edu/.)

5.13 to 6.43 m (16.8 to 21.1 ft). In all cases, the nine L-wells are completed either fully or partially in sandy or gravelly materials. They are not all completed in the unit interpreted to be Henry Formation (glaciofluvial) materials, although the lack of fine-grained sediments (aquitards) evident in the profiles suggests that the coarser Henry Formation materials are likely hydraulically connected to the sandy units of the more modern alluvium located stratigraphically above (Cahokia Formation) where the remaining wells are screened. Given this connection, all deeper wells are grouped and interpreted together.

As expected, water levels in this unit show a gradient from south to north toward the Illinois River. In general, water levels drop from 1 to 3 m (3.3 to 9.8 ft) from south to north along the transects shown in Figure 2. Given this gradient and the generally coarse texture of the materials, the potential for significant ground-water flow rates exists. Within the growing season, depths to water in these nine wells typically range from about 1.0 to 3.0 m (3.3 to 9.8 ft) below land surface. The typical trend of water levels in these lower wells (L-wells) is a slow decline over the fall and winter followed by a gentle rise over the spring and early summer. This sandy aquifer can also respond sharply to Illinois River floods, with all nine wells often spiking 1.0 to 1.5 m (3.3 to 4.9 ft) in response to such events. From 1999 to 2001, a data logger was installed in well 7L, which is roughly 20 m (66 ft) from the Illinois River (Figure 6). When compared to a data logger record from a nearby station monitoring the Illinois River (SW1-G, for location, see Figure 6), the water-level record in this well showed an identical and nearly immediate response to river fluctuations (Figure 13), indicating a strong connection between the Illinois River and the deeper sandy aquifer materials on site.

Data from these nine wells also show that the potentiometric surface of this widespread sand body never intersects the ground surface, except in the case of well 3L, which is located near the base of the sandy southern bluff, where a small area exists that meets wetland hydrology criteria. Therefore, ground-water discharge from the Henry Formation is not a potential water source for wetlands across the great majority of the site. Further, in areas where the sand is close to land surface, this deep and permeable vadose zone likely promotes rapid infiltration and is an impediment to the retention of precipitation or flood-derived water at land surface or in the soil zone.

It is also likely that the Henry Formation aquifer does not operate independently of the river channels on site. Over most areas of the site, the channels of the Mazon River and Mud Slough are significantly incised, with low water typically between 2.1 to 3.0 m (7.0 to 10.0 ft) below the average site elevation. Significant units of sandy materials were encountered between 1.5 and 3 m (5 and 10 ft) in eight of the borings. Given that the typical growing season depths to water in the Henry Formation range from 1.0 to 3.0 m (3.3 to 9.8 ft), these streams certainly intersect the coarse clastic materials at depth and interact with this deeper ground-water flow system. Ground water may discharge into these streams at many locations on site, and the streams may recharge the ground-water regime during floods. These deeply incised streams likely de-water the site and depress ground-water levels to the point where deeper ground waters are not available as a water source for wetlands.

Cahokia Formation (Shallow Wells)

The 43 S-wells and six VS-wells were installed at shallow depths (<0.75 m [2.52 ft]) in the Cahokia Formation for the purpose of monitoring shallow soil saturation (Figure 6). Generally, saturated conditions in the soil zone of the Cahokia Formation either do not occur or are quite brief. Of these 49 wells, there were 18 in total that did not show a single measured water level during the entire

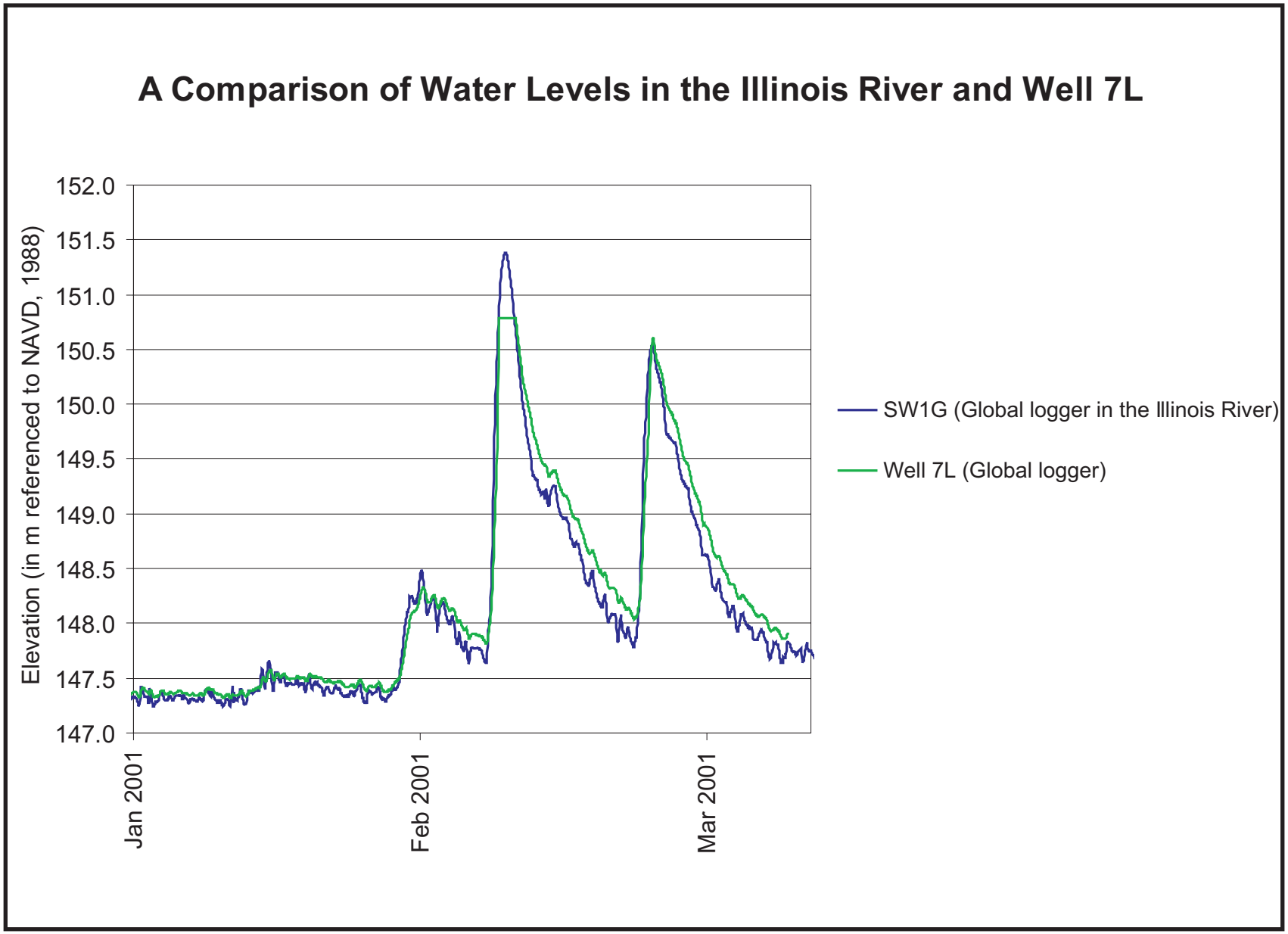

Figure 13 A comparison of water levels in the Illinois River and well 7L.

monitoring period, and an additional four where only a single water-level reading was recorded during the same period. The remaining 27 wells did not show sustained water-level readings for any appreciable periods. When readings occurred at all, they were commonly in the spring or early summer. For water to appear in these wells, generally a flood event must inundate the area around the well, or a significant rainfall or snowmelt event must saturate the area around the well.

In most areas of the site, the shallow soil zone monitored by the S-wells does not stay saturated long enough to develop a discernible ground-water flow system. The thick and relatively permeable unsaturated zone below suggests that any ground-water readings in the S-wells likely represent a lens of flood-derived or precipitation-derived water moving downward toward the deeper water table or nearby streams and depressions.

Because permeable surficial materials on this site are either at or near land surface, shallow wells will typically go dry within a period of less than two weeks after an influx of water. The exceptions are wells that are either within or adjacent to closed depressions, which, due to their past history of trapping floodwaters, typically have somewhat finer-grained materials deposited within them that perch ground water. In several cases, wells that stayed wet for slightly longer periods benefitted from the fortuitous timing of multiple flooding events. Of the 49 soil-zone wells on site, only 12 wells have stayed saturated for a period longer than nine days at least once during the monitoring period. These wells are 11S, 12S, 16S, 18S, 21S, 42S, 43S, 43S, 44S, 46S and 48S (Figure 6), all of which are in or adjacent to closed depressions or in low-lying areas adjacent to stream channels.

Perhaps the most graphic illustration of the inability of the site as a whole to retain water after a flood is the response of the shallow soil-zone wells to large floods, as shown in Table 1. The two chosen floods, which occurred within the ISGS monitoring period, attained an elevation that was high enough to flood most or all of the site. The chosen floods also were single-peak events that lacked a prolonged rainy period or large single rain events (over 1.0 inch) after the flood had passed. The data demonstrate, in general, that even though a large overbank flood event occurs at least once per year on average, the surficial materials on the site are generally too permeable to perch water over wide areas of the site or otherwise maintain saturation for periods sufficient to meet requirements for wetland hydrology, except in very limited areas.

Table 1 Response of shallow soil-zone wells to large floods.

Flood Date	Flood Elevation	Response of Soil-Zone Wells after the Flood Peak Had Passed
2002 May 15	152.16 m (499.21 ft)	After 5 days; 15 (of 40 total) S-wells were dry, and 15 of the remaining 25 wells had a reading within the wetland hydrology range. *
		After 19 days; 32 (of 40 total) S-wells were dry, and none of the 8 remaining wells had a reading within the wetland hydrology range. *

Flood Date	Flood Elevation	Response of Soil-Zone Wells after the Flood Peak Had Passed
2004 June 13	151.01 m (495.43 ft)	After 8 days; 28 (of 49 total) S-wells were dry, and 15 of the remaining 21 wells had a reading within the wetland hydrology range. *
		After 19 days; 43 (of 49 total) S-wells were dry, and 2 of the remaining 6 wells had a reading within the wetland hydrology range. *

* 0.304 m (1.0 ft) below ground surface

Vertical Ground-Water Gradients

Because the site generally lacks relief, significant vertical hydraulic gradients were presumed to be unlikely. Nevertheless, at two of the deeper boring locations that are closer to the bluff along the south site margin, an Upper-well (or "U-well") was added next to the Lower-well (or "L-well") to check for indications of upward ground-water gradients. These two nests are denoted as wells 1U/1L and 3U/3L (Figure 6). From 2000 to 2004, the water-level elevations in well 1U and 1L were always within 1.0 to 2.0 cm (0.4 to 0.8 in) of one another, and were often identical. Similar conditions also exist at nest 3U/3L, also located along the south site margin, with water levels seldom varying between the two wells. This indicates no significant vertical gradient exists at the site, and therefore, no significant ground-water discharge to land surface is likely to occur, other than into topographic lows as discussed earlier.

Surface-Water Data

Discrete surface-water elevation readings for the period of study (1999–2004) for all manual stage gauges are reported in tabular form in Appendix D and as graphs in Appendix E. On the site, two data loggers and three staff gauges were installed to monitor ponding in closed depressions (SW5F, SW7F, SW7LF, SW7R, and SW8R [Figure 6]). The remainder were deployed to monitor creek and river stage at various locations on Mud Slough, the Mazon River, and the Illinois River (SW1G/F, SW2I/G/F, SW3G/F, SW4I/G/F, and SW6G/F [Figure 6]).

Flood Frequency

Lacking shallow ground water or local runoff inputs, river flooding is one of the few available water sources for the site. USACE stage records for the Illinois River gauging station adjacent to the site were examined for the period 1949 to 1999 (U.S. Army Corps of Engineers 2004). The flat pool river stage for this reach is 147.2 m (482.8 ft), roughly 3.0 m (9.9 ft) below the approximate median site elevation of 150.3 m (493.0 ft). The river is considered to be at flood stage when the water level reaches 150.73 m (494.50 ft).

Floods need to attain a height of roughly 149.50 m (490.5 ft) to exceed the bankfull elevations of the Mazon River and Mud Slough and begin to spread out over wider non-channelized areas of the site. Floods would have to be an additional 0.6 m (2.0 ft) higher in elevation (150.1 m [492.5 ft]) to encompass most areas slated by IDOT for wetland restoration, preservation and enhancement in the Wetland Banking Instrument (Illinois Department of Transportation 2002). This elevation also encompasses most of the hydric soils mapped on site as well as the areas targeted for hydrophytic vegetation restoration.

For direct inundation to yield areas of jurisdictional wetland hydrology on the site in the absence of all other water sources, the period of inundation would need to exceed 5% of the growing season, or 9 days, if hydrophytic vegetation and hydric soils are present, or 12.5% of the growing season, or 23 days, if the vegetation and soils criteria are not met.

During the period from 1949 to 2000, periods of inundation above the critical elevation of 150.1 m (492.5 ft) exceeded 9 days in length in 0 of 52 years. Two floods of 10 and 13 days duration did occur, but they occurred prior to the start date of the growing season (April 13). Despite the short duration, the 1949–2000 records nevertheless show that flooding exceeded this critical elevation and delivered water to these areas of the site an average of 1.06 times per year within the growing season, although in 19 of the 52 years of record, there was no growing season flood above this threshold elevation. On-site ISGS surface-water data collected since 2000 were then examined for comparison to these long-term flood frequency data. Combined peaks from the Illinois River and the Mazon River, during the study period for this report (2000–2004), exceeded the critical elevation of 150.1 m (492.5 ft) during the growing season in three of five years (0.6 floods per year) and the average duration that the floodwaters remained above that elevation was just 3.3 days.

Surface-Water Retention

The preceding analysis of historical stage records clearly demonstrates that flood duration itself cannot support wetland hydrology over the majority of the site. However, from the preceding data, floodwaters are delivered to the critical areas of the site important for wetlands about once per year based upon the long-term average. However, the ability of the site to retain these floodwaters for the requisite 9 days is critical.

As discussed earlier, monitoring shows that several limited areas of the site do retain water for periods that are longer than the site as a whole. These areas generally are closed depressions where slightly finer-grained materials have been deposited at land surface. These depressions, although not areally extensive, do result in some small areas of jurisdictional wetland hydrology on the site, as reported previously by ISGS in annual monitoring reports for the site.

In the easternmost area of the site, termed the “spider” field, a multi-limbed area of closed depressions is present (see Figures 2 and 7). Total relief in this field is minimal (less than 0.9 m [3.0 ft]), and along the “limbs”, hydric soils are mapped in the depressions. Data collected reveal that a combination of inundation and shallow saturation yielded several acres of jurisdictional wetland hydrology in this area annually during the monitoring period, excluding 2000. These areas of wetland hydrology ranged in size from less than 0.4 ha (1.0 ac) to roughly 4.0 ha (10 ac).

Although significant local rain events undoubtedly deliver some water to this field, ISGS surface- and ground-water monitoring data show that a significant overbank flooding event is required to deliver an influx of water to this field sufficient to persist for greater than 9 days. Figure 14 shows a July 2003 flood pulse in the adjacent Mazon River that was high enough to flood the “spider” field. The Mazon River logger (SW3G) shows that the flood had receded in approximately three days, but the surface-water logger (SW8F) shows that shallow inundation persisted for about a week. Monitoring well data from wells 42S and 44S show saturation to land surface persisted for roughly one additional week. Even with a subsequent precipitation event (5.1 cm [2.0 in] on August 1), the surface and subsurface water in this field disappeared relatively rapidly, although it was sufficient

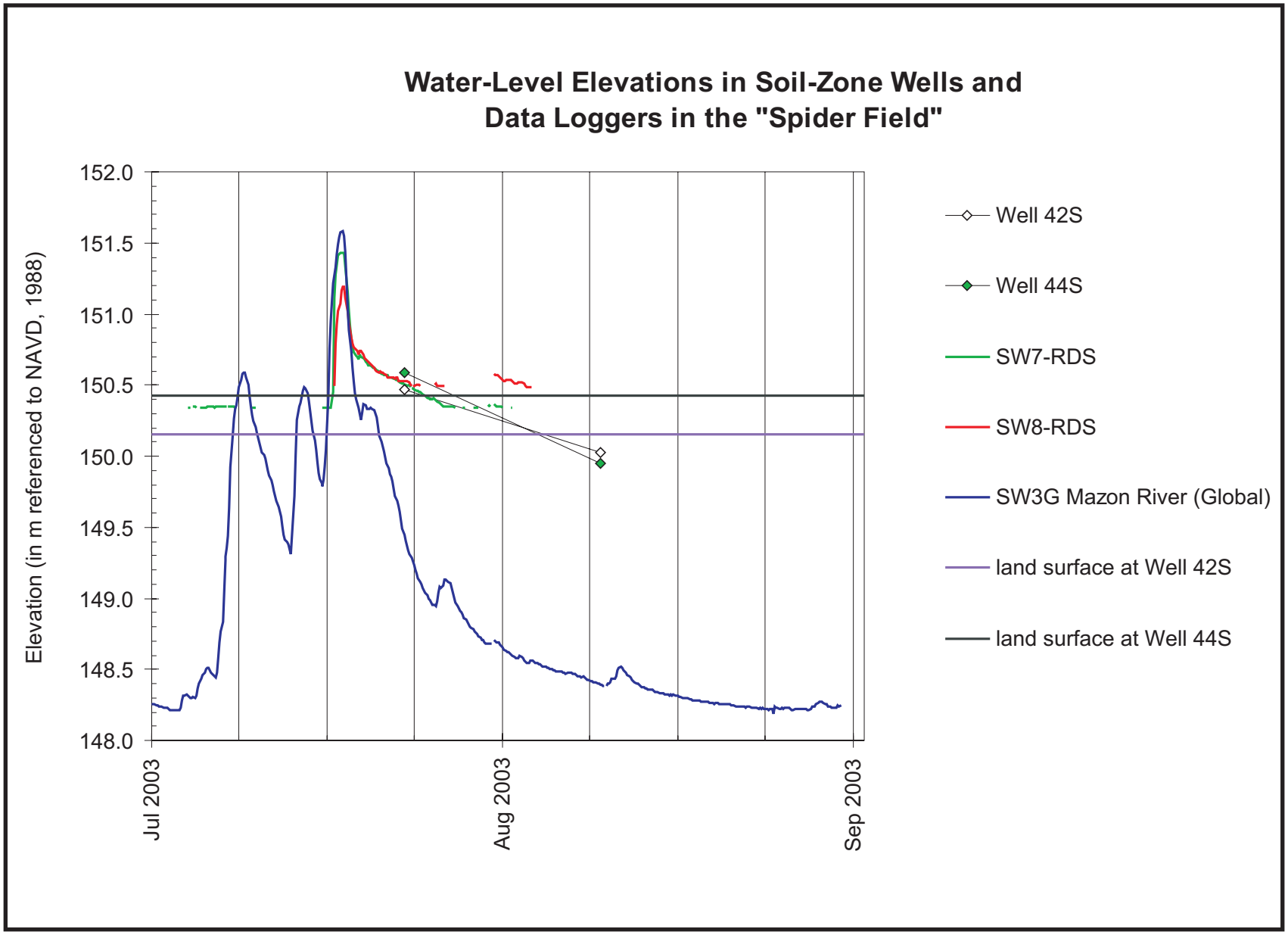

Figure 14 Water-level elevations in soil-zone wells and data loggers in closed depressions on site.

to produce some small acreages of wetland hydrology in that year. Well 42S stayed wet long enough to meet the 12.5% wetland hydrology criteria, while well 44S only met wetland hydrology at the 5% threshold.

In April of 2003, an active agricultural tile system was removed from this field. Although the acreage of jurisdictional hydrology in this field increased slightly (at the 12.5% threshold) for the monitoring year after tile removal (2004), acreages had increased site-wide due to climatic influences. Hence, the effect of the tile removal remains unclear. Monitoring for additional years should aid in determining if the tile removal had any positive effect on water retention that is discernible from the relative dryness elsewhere.

A second closed depression encompassing SW7 (Figures 7 and 10), a few acres in size, also holds water for sustained periods every year. This artificially deepened fragment of abandoned river channel (slough) requires an influx of floodwater to fill. The slough has a similar spillover elevation and floodwater response to the “spider” field depression, as shown in the hydrograph from the SW7-R logger emplaced in the depression (also shown on Figure 14). The presence of generally fine-grained materials at land surface in this basin was confirmed via soil probing during a late season dry period in 2002. An area of at least 1.6 ha (3.96 ac) has remained ponded for greater than nine days in each year the slough was monitored (2001–2004, inclusive), thus meeting wetland hydrology criteria at the threshold of 5% of the growing season.

The pond at SW5F (Figures 6 and 10) is one location that does not generally require an influx of floodwaters, and it generally contains water for some period every spring. Ponding in this closed depression, roughly 0.31 ha (0.78 ac) in size, is likely maintained by the throughflow of localized shallow ground-water levels in the area, shown by the water-level record from an adjacent well nest (wells 3U and 3L, see Figure 6). The average water level for the period of record in wells 3U and 3L is 149.96 m (492.0 ft), while the bottom elevation of the basin ranges from approximately 149.66 to 149.96 m (491 to 492 ft). It would appear that the depression was likely excavated in the past to a depth that intersected the laterally moving shallow ground water noted in the adjacent wells (3U/3L). These wells have never gone dry, and similarly, the pond is often the only place on the site with water present, long after other shallow depressions have gone dry. It is noteworthy, however, that this pond was likely not a natural feature and was likely emplaced for campsites that were formerly located just to the south of the pond. This artificially created pond is the only location on site where ground-water discharge is expected to satisfy wetland hydrology criteria. Similar excavations elsewhere on site cannot feasibly be created because this location is unique with respect to the shallow water table.

The three areas of closed depressions described here, coupled with a few similar depressions adjacent to stream channels, are more of an exception than the rule site-wide. In total, they typically represent less than 8.1 ha (20 ac) of wetland hydrology on a site totaling 342 ha (844 ac). Despite extensive reconnaissance of the site since 1999, no other areas of significant size have been noted that persistently hold water.

Wetland Hydrology

An area that conclusively satisfies wetland hydrology criteria will be inundated or saturated for no less than 5% of the growing season (if hydrophytic vegetation and hydric soils are present), or 12.5% of the growing season if the characteristic soils and vegetation are absent, as stated in the

online version of the U.S. Army Corps of Engineers Wetland Delineation Manual (http://www.saj.usace.army.mil/permit/documents/87manual.pdf, Environmental Laboratory 1987). At the Morris site, these periods correspond to 9 days (5%) and 23 days (12.5%). Inundation occurs when surface water is present at depths no greater than 2.0 m (6.6 ft). Saturation occurs when the water table is no deeper than 0.304 m (1.0 ft) below land surface.

The areas meeting wetland hydrology criteria were determined using two methods. For closed depressions with standing water, discrete measurements from staff gauges, coupled with continuous readings from data loggers, were examined to determine the highest water-level elevation that was maintained for the period of concern (5% or 12.5% of the growing season). This elevation was applied to the contours on the topographic map of the site to determine the acreage represented. Where a number of soil-zone wells showed shallow saturation that met the criteria, polygons were created to contain these wells, using topographic contours and other site features to guide the polygons. Surface-water elevations from gauges and loggers were also used to identify the duration and extent of flooding events and the resulting effect upon areas of wetland hydrology. The areas that met wetland hydrology criteria in the six years of record are summarized in the following table (Table 2) and on Figures 15 and 16.

Table 2 Areas that met wetland hydrology criteria (2000–2005).

Monitoring Year	Area of the Site Meeting Wetland Hydrology Criteria *		Number of Soil Zone Wells Meeting Wetland Hydrology Criteria	
	5%**	12.5%	5%**	12.5%
2000	0.33 ha (0.82 ac)	0 ha (0 ac)	1 of 31 (3.2%)	0 of 31 (0%)
2001	3.5 ha (8.52 ac)	0.33 ha (0.82 ac)	6 of 40 (15.0%)	0 of 40 (0%)
2002	8.9 ha (22.11 ac)	2.9 ha (7.13 ac)	11 of 40 (27.5%)	3 of 40 (7.5%)
2003	5.58 ha (13.78 ac)	2.0 ha (4.92 ac)	11 of 43 (25.6%)	3 of 43 (7.0%)
2004	5.52 ha (13.62 ac)	3.69 ha (9.10 ac)	14 of 49 (28.6%)	8 of 49 (16.3%)
2005 ***	1.75 ha (4.32 ac)	1.13 ha (2.78 ac)	3 of 49 (6.1%)	0 of 49 (0%)

* not including stream channels

** In 2004, ISGS began reporting the area of the site that remained inundated or saturated for no less than 5% (9 days) of the growing season, as well as the original threshold of 12.5% (23 days) of the growing season. The 2000–2003 data were re-examined to determine the 5% acreages.

*** Although outside the study period encompassed by this report, 2005 monitoring data are included for comparative purposes

In the six years of record, the area that met wetland hydrology criteria at the 5% threshold ranged from a minimum of 0.33 ha (0.82 ac) in 2000 to a maximum of 8.9 ha (22.11 ac) in 2002. At the 12.5% threshold, the area that met wetland hydrology criteria ranged from a minimum of 0 ha (0 ac) in 2000 to a maximum of 3.69 ha (9.1 ac) in 2004. Most of these areas that met wetland hydrology criteria were areas that generally have both mapped hydric soils (verified by INHS) and a predominance of hydrophytic vegetation (M.A. Feist, INHS, pers. comm. 2007). Further, these areas of wetland hydrology are generally limited to closed depressions and areas of low-lying

floodplain forest adjacent to stream channels. These acreages meeting wetland hydrology are much less than the relatively large acreage of hydric soils mapped by INHS on the site (140.6 ha [347.2 ac]). This supports the notion that the hydric soils are “relict”, or formed in a past wetter hydrological regime likely related to longer duration or more frequent river flooding.

DISCUSSSION AND CONCLUSIONS

Water Sources

Good candidate sites for wetland restoration generally have multiple water sources, other than direct precipitation, that can augment one another. This site lacks persistent shallow ground water or ground-water discharge, other than a few very localized examples, discussed previously. The site also lacks a significant runoff source, due to the general lack of relief and high local infiltration rates.

The primary water source for the site is overbank flooding from the Illinois River and the Mazon River/Mud Slough waterways. In general, however, the site is topographically too high for large areas to be flooded for long durations. Data show that flooding from the Illinois River and the on-site waterways can only be expected approximately once per year, and the duration of the flood peaks is not sufficient to satisfy wetland hydrology criteria. After flooding, floodwaters are retained in depressions and in low-lying forested wetlands adjacent to the rivers where the flooding duration is slightly longer. Across most of the site, however, water levels measured in soil-zone wells indicate a generally rapid infiltration rate, primarily due to the coarse texture of the sediments. Hence, floodwaters, as well as precipitation-derived waters, are not held on widespread areas of the site for periods sufficient enough to satisfy wetland hydrology criteria. Existing wetlands are generally isolated and small in area (generally 0.4 to 2.0 ha [1.0 to 5.0 ac] in size) and comprise less than 8.1 ha (20.0 ac) of the total site area.

Soils and Vegetation

The 140.6 ha (347.2 ac) of hydric soils mapped on site likely are “relict” (not formed under current hydrologic conditions). The lack of widespread hydrologic alterations to areas of hydric soil on the site suggests that these soils generally did not require drainage for farming in the past century. According to ISGS monitoring data, the moisture regime in most of these areas of hydric soils does not currently satisfy wetland hydrology criteria and hence, these areas are unlikely to support a dominance of hydrophytic vegetation. Even if hydrophytic plant assemblages were to be successfully established, it is unlikely that the great majority of these hydric soil areas will meet the three-parameter description of a wetland. The exception here may be low-lying forested wetlands and the previously described closed depressions.

Reversal of Hydrologic Alterations

There is only one field (the “spider” field) where a single, branched drainage tile was found. Even in this field, the tile was apparently only emplaced to drain the “spider-shaped” lower-lying areas that include less than half of the field. This tile, which was observed by ISGS to be actively draining the field, was removed and deactivated by IDOT in April 2003. The first full year of post-tile data for the field (2004) did not conclusively show a widening area of wetland hydrology that could be attributed to this tile removal, possibly due to a late-spring arrival of the flood and a prolonged post-flooding dry period. In 2005, an atypically dry year reduced wetland hydrology acreages site-wide,

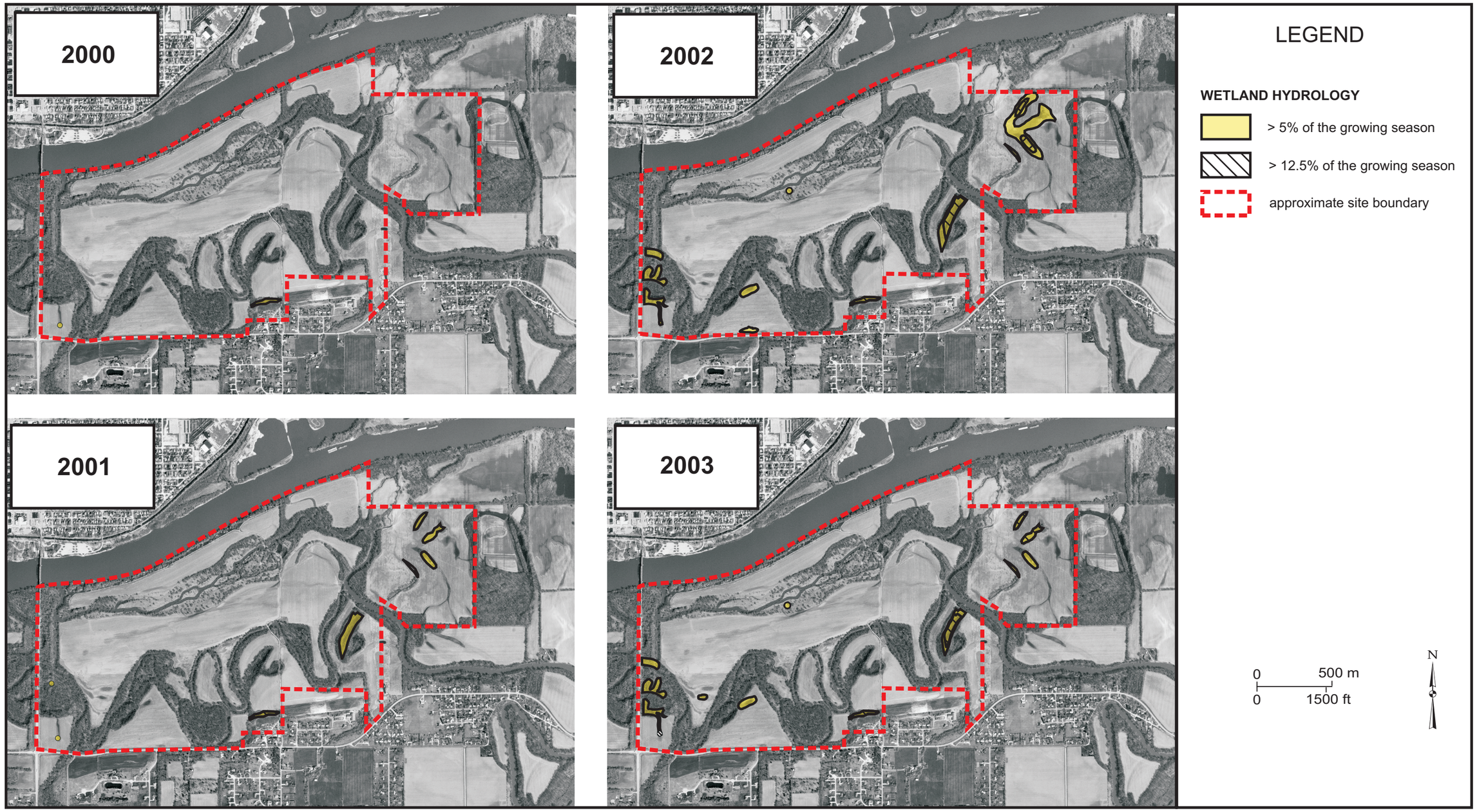

Figure 15 Estimated areal extent of wetland hydrology, 2000-2003 (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

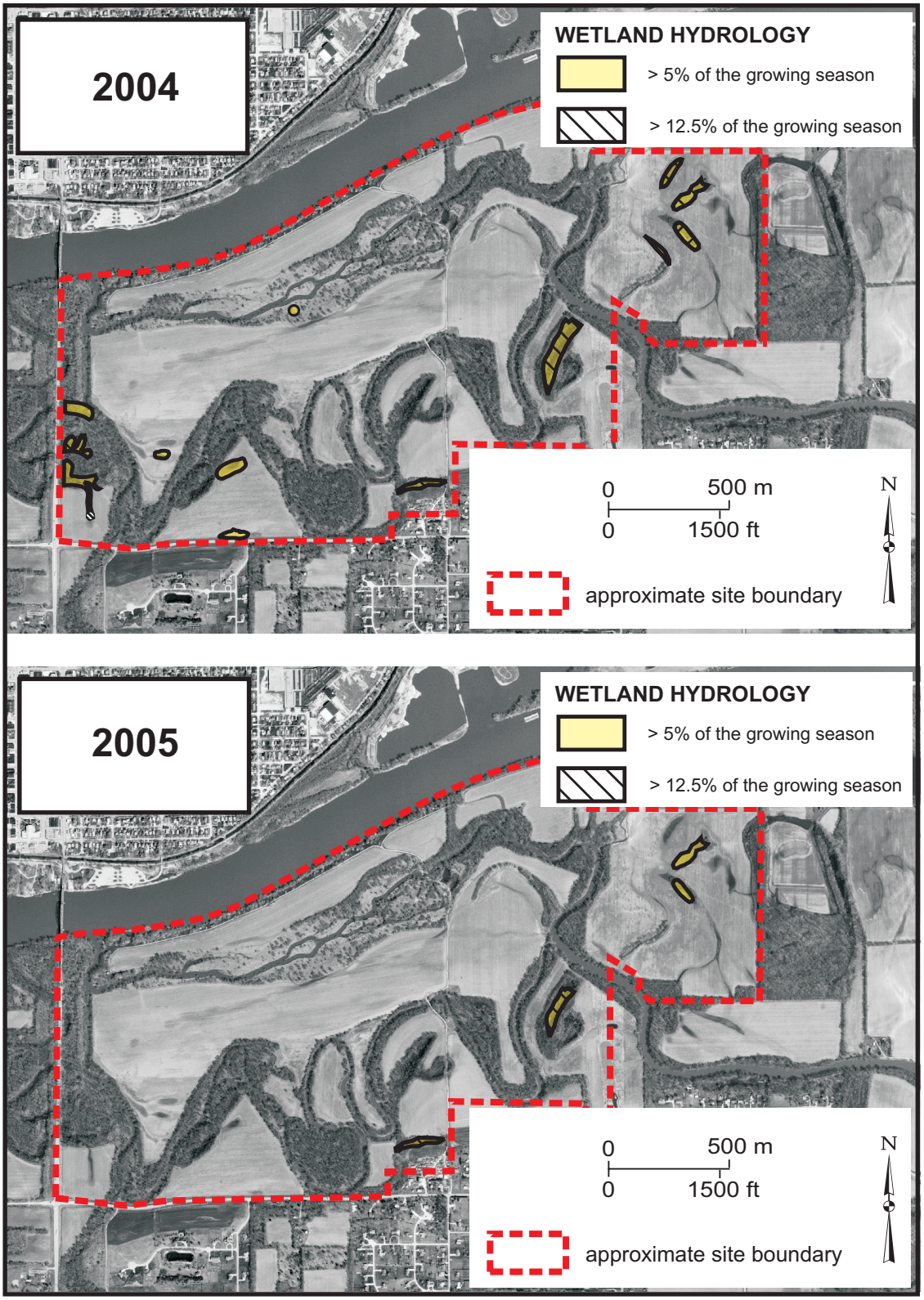

Figure 16 Estimated areal extent of wetland hydrology, 2004-2005 (map based on USGS digital orthophotograph, Morris NE quarter quadrangle, from 4/5/1998 aerial photography [ISGS 2001]).

again concealing any effect of the tile removal if present. Monitoring for additional years should aid in determining if the tile removal had any positive effect on water retention.

Wetland Restoration or Creation

Wetland restoration requires the establishment of a hydrologic regime favorable for both hydric-soil formation and for the growth of a plant assemblage dominated by hydrophytic vegetation. ISGS investigations have shown that wetland hydrology currently exists over a very limited area of the site. Further, the major water source, overbank flooding, does not have the required duration to supply additional wetlands on the site. Coarse sediments that underlie the site and unfavorable topography prevent the site from retaining floodwaters after they are delivered.

In the portion of the site ("spider" field) that contained both hydric soils and a reversible hydrologic alteration, the only appropriate restoration measure has been applied. It is possible that the area of hydric soil in this field is also relict, so pulling the tile does not guarantee that the entire hydric soil area will revert to exhibiting wetland hydrology. Nevertheless, the removal of an actively flowing drain tile is expected to have some positive effect on the extent and duration of ponding in this field, and continued monitoring is required.

Artificially increasing the stage height of flood peaks, as well as both the areal extent and duration of floodwater ponding, is not considered feasible. The installation of check dams in waterways is possible but problematic. Firstly, a check dam emplaced in the channels of the Mazon River or Mud Slough would have to be a large structure (3.0 m [10.0 ft] deep and over 30 m [100 ft wide]). The numerous flood overflow channels, such as the three deeply incised drainageways noted on Figure 10, would make retention of water behind a dam difficult because floodwaters would simply exploit one of these channels as a short-cut to the Illinois River. Also, a check dam would effectively block the migration of Illinois River fauna upstream into the Mazon River basin, and would cause additional log-jams, enhance sediment deposition upstream, and create scour and channel erosion downstream.

Artificially creating closed depressions that mimic the few depressions (or sloughs) is also not considered feasible. Most areas of the site have sandy materials very close to the land surface. Any waters delivered to these basins would simply infiltrate downward through the deep unsaturated zone. Therefore, a clay or artificial liner would have to be emplaced, a process that may be costly over large acreages. Deeper excavation to intersect ground water for the purpose of wetland creation without liners would require removal of a large thickness of material, which is not feasible.

Except in limited areas, there are no practical methods available to make wide areas of the site wetter than they currently are, primarily due to rapid infiltration. There are no additional tiles to deactivate, ditches to fill, or streams to route onto the site. The flood regime of the Illinois River is partially manipulated by the Illinois River lock and dam system and is therefore not controllable for the sake of wetland restoration. Further, the land surface at the site is approximately 3.0 m (10.0 ft) higher than an elevation that would receive more regular flooding, so excavation of wide areas of the site to match the flood regime is not feasible.

ACKNOWLEDGMENTS

This study was funded by the Illinois Department of Transportation (IDOT) under contract number IDOT SW PESA WIP B FY07. Geoffrey Pociask and James Miner aided with site management, well installation, and miscellaneous field work. Significant efforts in data collection, instrumentation installation, and surveying were undertaken by Kelli Weaver-Miner, Bonnie Robinson, Blaine Watson, Bradley Ketterling, Gregory Shofner, Eric Plankell, Kara Hart-Carstens, and Paula Sabatini. The large database for the site was managed by Christine Fucciolo, who also produced data charts and tables for this report.

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APPENDIX A Geologic Logs

Boring #:	Boring 1
Site:	Morris (Grundy County)
Hole location:	NE corner of IL 47 and Pine Bluff Road
Date start:	8/2/99
Weather conditions:	sunny, 80°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 30 cm **Saturation:** moist **% gr/sa/si/cl:** tr/100/tr/0 **HCl:** none **Stiffness:** low **Porosity:** high **Geologic materials:** medium to coarse sand **Color:** 10YR 5/4 **Description:** sand is well-sorted, sub-angular to sub-rounded, quartz plus rare rock fragments and feldspar, no visible structure
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 26 cm **Saturation:** saturated **% gr/sa/si/cl:** 1/99/tr/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Geologic materials:** gravelly medium to coarse sand **Color:** 10YR 6/2 **Description:** sand is well-rounded quartz and rock fragments and high % bright white fragments 1-2 mm (chert?), no visible structure, slightly muddy layer 3 cm thick at top of spoon, gravel is less than 1 cm in diameter, well rounded, crystalline
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 40 cm **Geologic materials:** same as above **Description:** contains rare, rounded clay balls 1cm in diameter
18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 50 cm **Geologic materials:** same as above

APPENDIX A Geologic Logs (continued)

23 -25 ft (7.01 - 7.62 m)	**Recovery:** **Saturation:** saturated **%gr/sa/si/cl:** tr/100/tr/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Other notes:** one 1cm thick slightly coarse sand lens **Geologic materials:** fine to medium sand **Color:** 10YR 5/4
30 ft (9.1 m)	**Geologic materials:** gravel
31.5 ft (9.60 m)	**Geologic materials:** bedrock, no sample due to collapse

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 2
Site:	Morris (Grundy County)
Hole location:	100 yds north of Pine Bluff Road @ east end of site, next to hen house
Date start:	8/2/99
Weather conditions	sunny, 80°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 42 cm **Saturation:** saturated **% gr/sa/si/cl:** 0/100/tr/0 **HCl:** none **Stiffness:** low **Porosity:** high **Geologic materials:** fine to medium sand **Description:** sand is well-rounded and well-sorted quartz, with 5% rock fragments
8.5 - 10 ft (2.59 - 3.05 m)	**Geologic materials:** same as above
13.5 - 15 ft (4.11 - 4.57 m)	**Geologic materials:** same as above
18.5 - 20 ft (5.64 - 6.10 m)	**Geologic materials:** same as above
33 - 35 ft (10.06 - 10.67 m)	**Recovery:** 31 cm **Saturation:** saturated **Geologic materials:** top 27cm is medium to coarse sand, lower 3 cm is rusty coarse sand (Pennsylvanian?) over a 1 cm lens of tight silty clay (just above bedrock?)

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 3
Site:	Morris (Grundy County)
Hole location:	100 yards north of farmhouse at south end of site center line
Date start:	8/2/99
Weather conditions:	sunny, 85°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 64 cm **Saturation:** saturated **% gr/sa/si/cl:** 0/95/5/0 **HCl:** none **Stiffness:** low **Porosity:** high **Geologic materials:** silty fine sand **Color:** 10YR 5/4 **Description:** sorted sub-angular to rounded quartz with ~5% silt matrix, last 7 cm in spoon are laminated silty clay (mottled, some fine sand)
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 31 cm **Saturation:** saturated **% gr/sa/si/cl:** tr/100/0/0 **HCl:** weak **Stiffness:** low **Porosity:** high **Geologic materials:** fine to medium sand **Description:** sand is fine to medium, well rounded well sorted quartz and rare rock fragments, contains some white chert or dolomite fragments, 0.5-1cm beds (with coarser, more numerous white fragments) present
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 47 cm **Saturation:** saturated **%gr/sa/si/cl:** 0/100/tr/0 **HCl:** none to weak **Stiffness:** low **Porosity:** high **Other notes:** artesian conditions, water coming up out of boring **Geologic materials:** fine sand **Color:** 10YR 5/4 with 10YR 4/6 laminae 0.5 - 1cm thick, no grain size change **Description:** top 19 cm is same as above, lower 28 cm described: sharp lower contact, sand is very fine to fine, round to angular quartz and significant percentage of rock fragments too small to identify

APPENDIX A Geologic Logs (continued)

18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 46 cm **Saturation:** saturated **%gr/sa/si/cl:** tr/100/tr/0 **HCl:** low **Stiffness:** low **Porosity:** high **Geologic materials:** fine to medium sand (same as interval 8.5- 10') **Description:** occasional laminae shows sample is good
23 -25 ft (7.01 - 7.62 m)	**Recovery:** 20 cm, good sample **Saturation:** saturated **%gr/sa/si/cl:** tr/100/tr/0 **HCl:** low to moderate **Stiffness:** low **Porosity:** high **Geologic materials:** sand, very fine to medium **Color:** 10YR 5/4 **Description:** sand is slightly laminated (by grain size and color, 10YR 6/8), last 10 cm is very fine sand
25 - 30 ft (7.62 - 9.14 m)	**Recovery:** no recovery, drilled down **Geologic materials:** coal chips in cuttings
33.5 - 35 ft (10.21 - 10.67 m)	**Saturation:** dry **HCl:** none **Stiffness:** moderate **Porosity:** low **Geologic materials:** grey shale **Color:** 10YR 3/1 **description:** friable micaceous shale

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 4
Site:	Morris (Grundy County)
Hole location:	west end of center island
Date start:	8/3/99
Weather conditions:	sunny, 75°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 30 cm **Saturation:** dry to moist **% gr/sa/si/cl:** 0/100/0/0 **HCl:** none **Stiffness:** low **Porosity:** high **Geologic material:** fine to medium sand **Color:** 10YR 6/6 **Description:** sand is well-sorted, rounded to sub-angular quartz with rare rock fragments
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 60 cm **Saturation:** saturated below 40 cm in spoon **% gr/sa/si/cl:** tr/100/tr/0 **HCl:** low **Stiffness:** low **Porosity:** high **Geologic materials:** same as above **Description:** shelly concretions at 35 - 36 cm in spoon, 1 cm gravelly layer 42 - 43 cm
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 33 cm **Saturation:** saturated **% gr/sa/si/cl:** 3/97/0/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Geologic materials:**.medium to very coarse sand **Description:** contains quartz and rock fragments and white fragments (chert/dolomite) well-rounded to sub-angular, sorted gravel is 1-2 cm diameter, well-rounded, crystalline

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 5
Site:	Morris (Grundy County)
Hole location:	center line, center well
Date start:	8/3/99
Weather conditions:	sunny, 80°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 60 cm **Saturation:** moist **% gr/sa/si/cl:** tr/5/80/15 **HCl:** none to 45 cm, moderate below **Stiffness:** low to moderate **Porosity:** low to moderate **Geologic materials:** clayey silt **Color:** 2.5YR 5/4 in top 35 cm, grading to 10YR 5/4 with 10YR 5/8 and 10YR 6/4 mottles less than 2 mm in diameter
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 39 cm **Saturation:** saturated **% gr/sa/si/cl:** tr/100/0/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Geologic materials:** coarse to very coarse sand **Color:** 10YR 5/4 **Description:** sand is well-rounded to sub-rounded quartz and rock fragments, with dispersed shell fragments in top 20 cm
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 64 cm **Geologic materials:** same as above except fine to medium sand from 20 - 64 cm in spoon

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 6
Site:	Morris (Grundy County)
Hole location:	west line, north boring, north island, west end
Date start:	8/3/99
Weather conditions:	sunny, 85°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 42 cm **Saturation:** moist **% gr/sa/si/cl:** 0/0/75/25 **HCl:** none **Stiffness:** low to moderate **Geologic materials:** clayey silt **Color:** 10YR 4/2 **Description:** structureless, coarse crumb texture
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 49 cm **Saturation:** saturated in last 2 cm, water at 8.5 cm **HCl:** none, moderate below 42 cm in spoon **Stiffness:** low to moderate **Porosity:** low to moderate **Geologic materials:** same as above in top 23 cm in spoon, below, bedded silty sand and sandy silt **Color:** 10YR 4/1 with 10YR 3/4 mottles (1 cm diameter) **Description:** several 0.5-cm laminae rich in shell fragments, mottled below 23 cm in spoon, rare coal fragments
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery** 30cm **Saturation:** saturated **% gr/sa/si/cl:** tr/100/0/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Geologic materials:** fine to medium sand **Color:** 10YR 5/2 **Description:** sand is well-rounded, sorted quartz and significant percentage black rock fragments (coal, shale, crystalline)

APPENDIX A Geologic Logs (continued)

18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 32 cm **Saturation:** saturated **% gr/sa/si/cl:** 40/50/10/tr **HCl:** moderate to high **Stiffness:** high **Porosity:** moderate to high **Geologic materials:**. sandy gravel **Color:** 2.5Y 5/2 **Description:** gravel is well-rounded dolomite, shale, and crystalline rocks up to 3 cm in diameter, sand is clast-supported in interstices of gravel, rounded to well-rounded, sorted quartz and shale, crystalline rocks
23.5 -25 ft (7.16 - 7.62 m)	**Recovery:** 5 cm **% gr/sa/si/cl:** 0/100/0/0 **HCl:** none **Stiffness:** very high **Porosity:** moderate **Geologic materials:** sandstone **Color:** 2.5Y 4/1 **Description:** very fine quartz and dark grains, sorted

APPENDIX A Geologic Logs (continued)

Boring #:	Boring 7
Site:	Morris (Grundy County)
Hole location:	center line, north boring, 20 ft south of Illinois River
Date start:	8/3/99
Weather conditions:	
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24 inch split-spoon sampler, 4"and 4.25" augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 35 cm **Saturation:** moist **% gr/sa/si/cl:** 0/tr/85/15 **HCl:** high **Stiffness:** low to moderate **Porosity:** low to moderate **Geologic materials:** clayey silt **Color:** 10 yr 4/3 **Description:** structureless
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 15 cm **Saturation:** moist **Description:** same as above
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 53 cm **Saturation:** saturated **% gr/sa/si/cl:** tr/100/0/0 **HCl:** low **Stiffness:** low **Porosity:** high **Geologic materials:** top 29 cm same as above, below is fine to medium sand **Color:** 10 yr 5/4 **Description:** sand is sorted, well rounded sub-angular quartz and rare rock fragments (black shale or crystalline) contains shell fragments, some layering @ base by color change (to 10 yr 6/8)

APPENDIX A Geologic Logs (continued)

18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 33 cm **Saturation:** saturated **% gr/sa/si/cl:** 1/99/tr/0 **HCl:** low to moderate **Stiffness:** low **Porosity:** high **Geologic materials:** same as above, fine to coarse sand **Color:** 10 yr 5/3 **Description:** sand is quartz and rock fragments, sorted and well-rounded to angular
23.5 -25 ft (7.16 - 7.62 m)	**Recovery:** 56 cm **Saturation:** saturated **% gr/sa/si/cl:** 1/95/4/tr **HCl:** low **Stiffness:** low **Porosity:** moderate to high **Geologic materials:** upper 36 cm: poorly-sorted, fine to very coarse sand and gravel, silt-and clast-supported, lower 20 cm well-sorted fine to medium sand, quartz, well-rounded to sub-angular **Color:** 10 yr 4/3 above, 10 yr 5/3 below
31.5 ft (9.6 m)	**Recovery:** some sand and gravel recovery, not sure if representative **Geologic materials:** bedrock, unknown lithology

APPENDIX A Geologic Logs (continued)

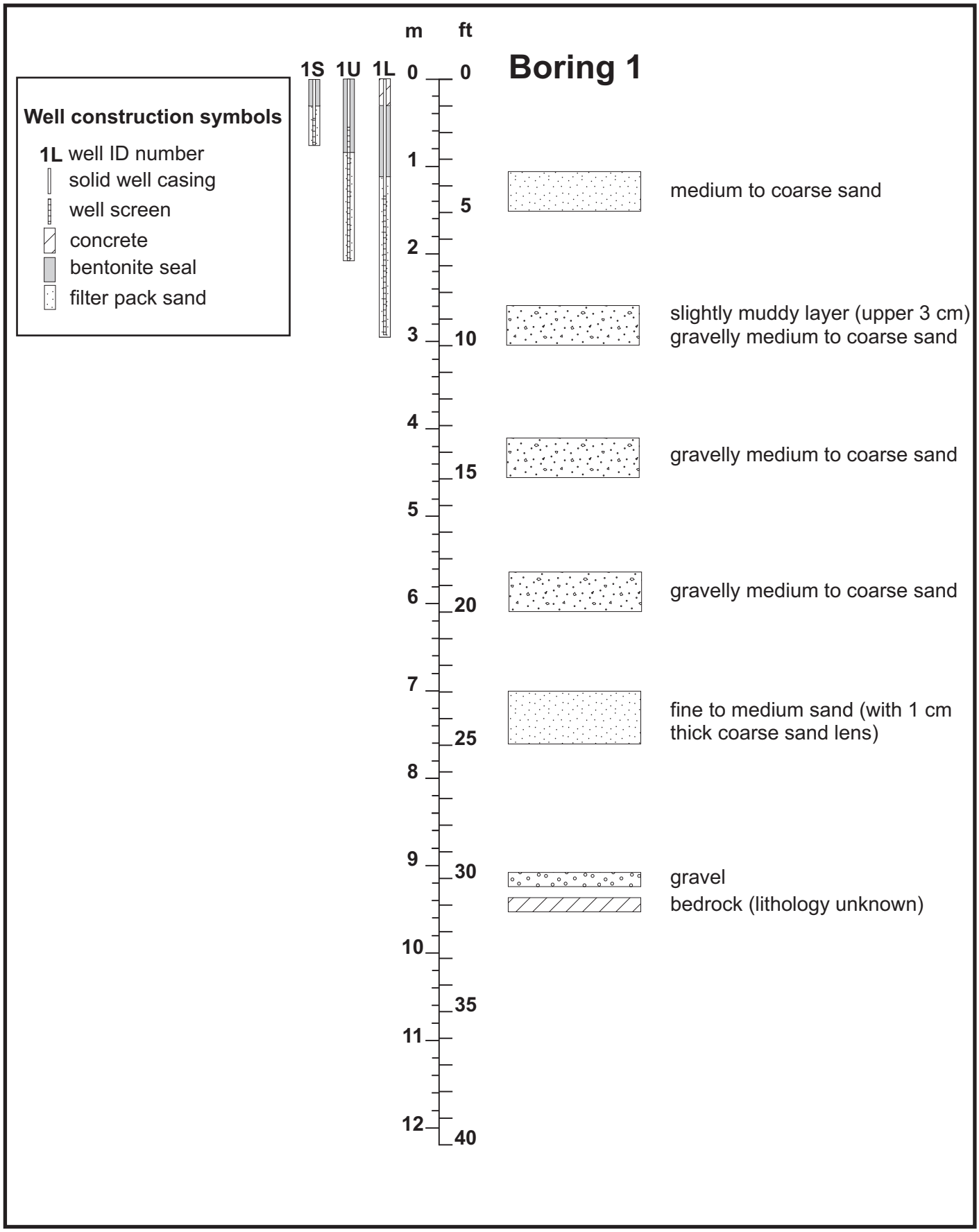
Boring #:	Boring 8
Site:	Morris (Grundy County)
Hole location:	east line, north boring
Date start:	8/3/99
Weather conditions:	sunny, 85°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 41 cm **Saturation:** moist **% gr/sa/si/cl:** 0/tr/80/20 **HCl:** none to weak **Stiffness:** low to moderate **Porosity:** low to moderate **Geologic materials:** clayey silt **Color:** 10YR 4/3 **Description:** structureless, contains small shell fragments
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 51 cm **Saturation:** saturated **% gr/sa/si/cl:** 0/100/0/0 **HCl:** none to weak **Stiffness:** low **Porosity:** high **Geologic materials:** top 46 cm same as above, some dispersed organics, saturated?, lower 30 cm possibly laminated (10-30 cm) in spoon **Color:** 10YR 5/4 **Description:** bottom 5 cm medium sand: well-rounded and sorted quartz, and rare rock fragments (granitics and black aphanitics)
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 35 cm **Saturation:** saturated **% gr/sa/si/cl:** 0/100/tr/0 **HCl:** none to weak **Stiffness:** low **Porosity:** high **Geologic materials:** medium to fine sand **Color:** sand is 10YR 5/4 in top 13 cm, 2.5Y 3/1 in 13-28 cm, 5YR 3/4 from 28-29 cm, then 10YR 5/4 in the last 6 cm, reduced zone contains wood fragments 2 cm in diameter, **Description:** sand is well-rounded and sub-angular, quartz and rare rock fragments. In reduced zone, trace silt in matrix.

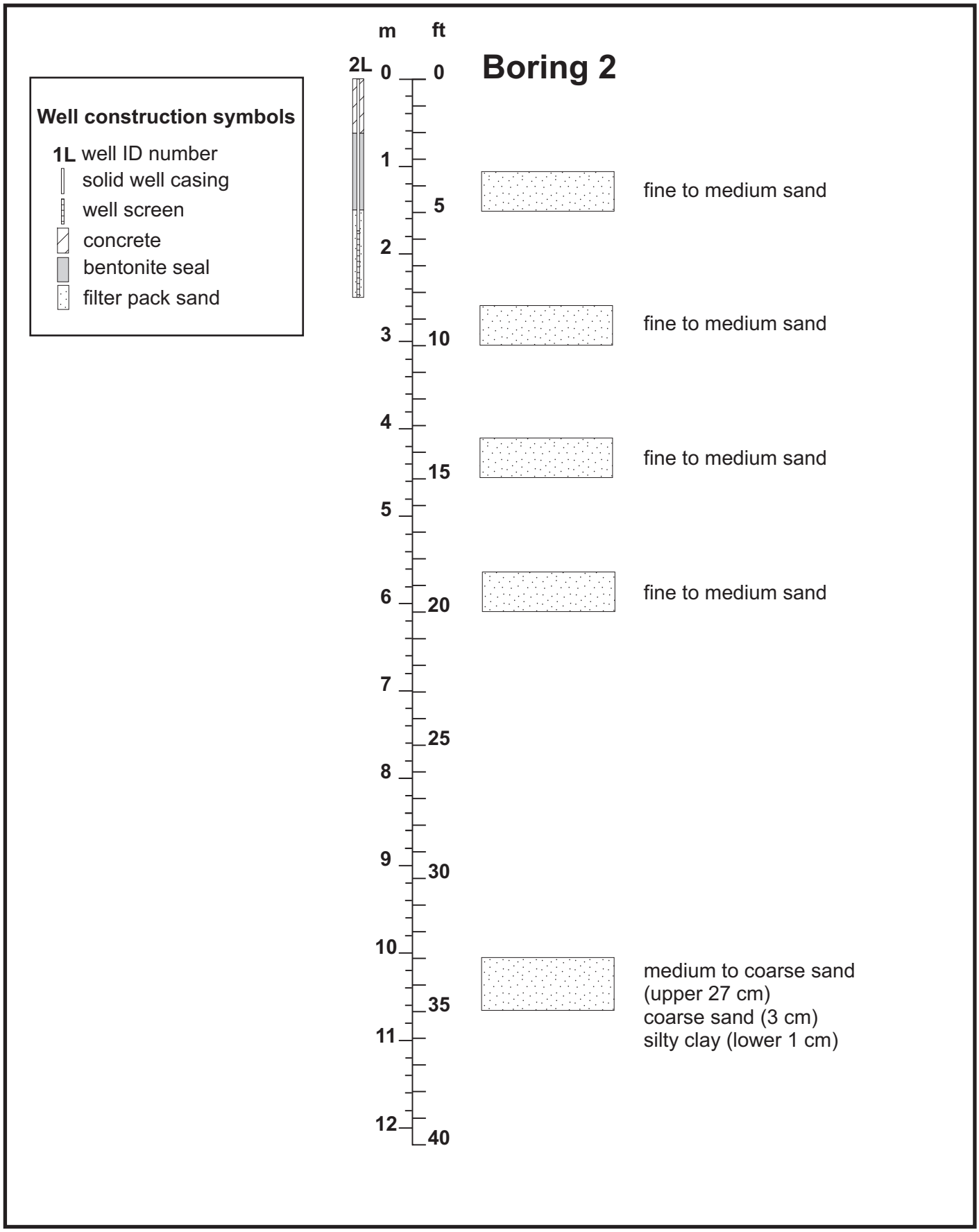
APPENDIX A Geologic Logs (continued)

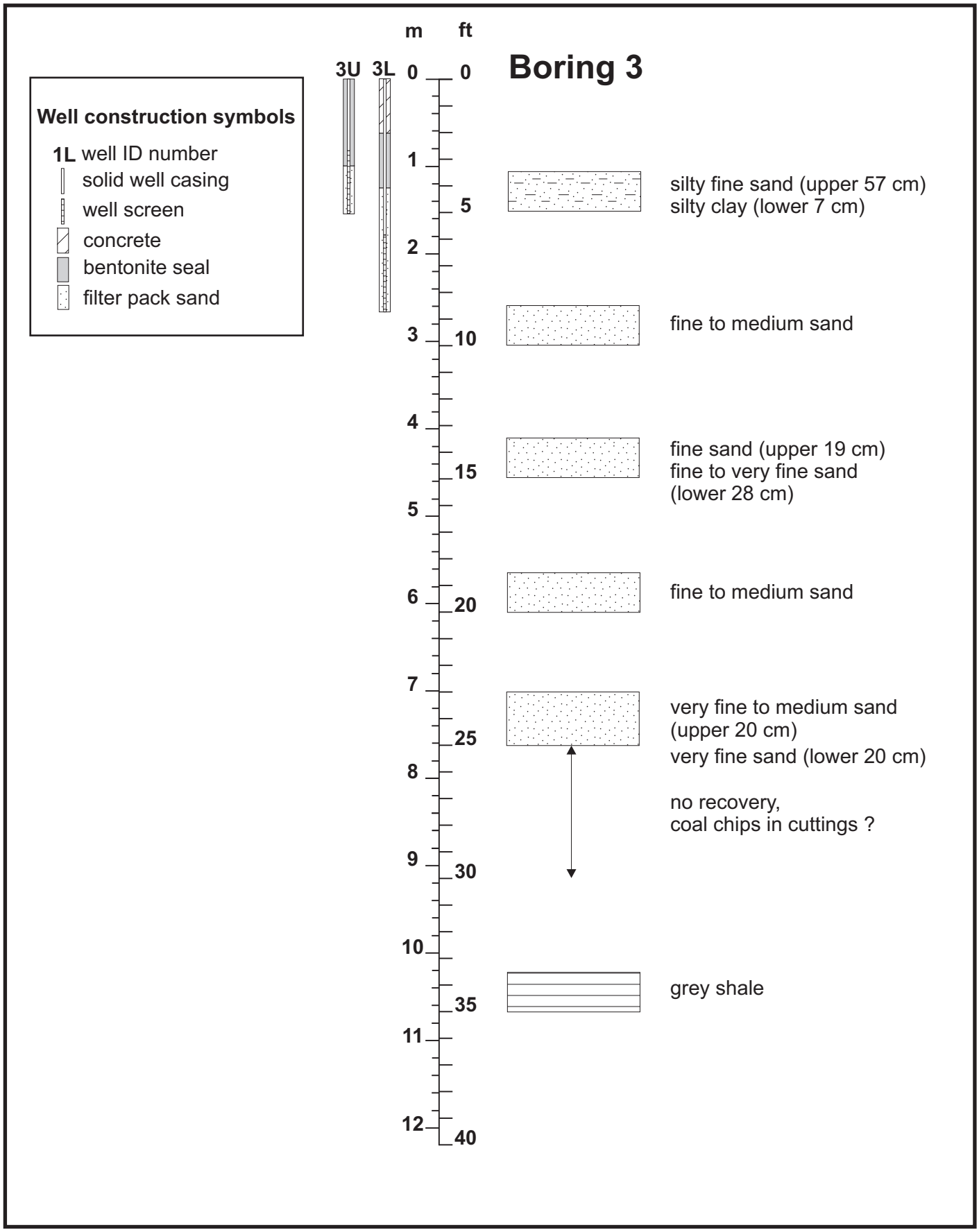
18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 41 cm **Saturation:** saturated **% gr/sa/si/cl:** 1/99/0/0 **HCl:** moderate **Stiffness:** low **Porosity:** high **Geologic materials:** sand, fine to medium **Description:** structureless, contains rare gravel (well-rounded 2 cm diameter dolomite) sand is well-rounded well-sorted, quartz with a trace shale /crystalline rocks)
23.5 -25 ft (7.16 - 7.62 m)	**Recovery:** no sample

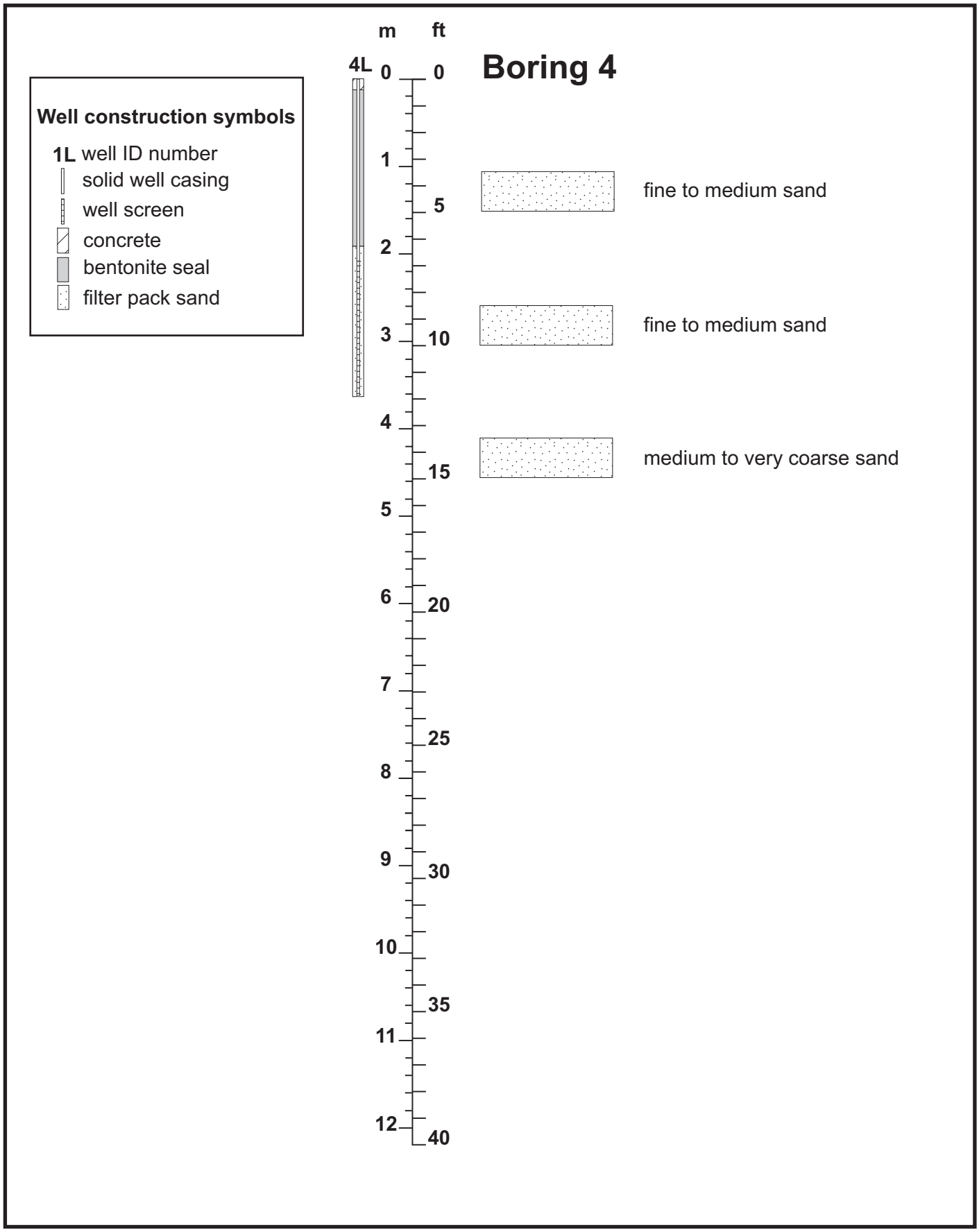
APPENDIX A Geologic Logs (continued)

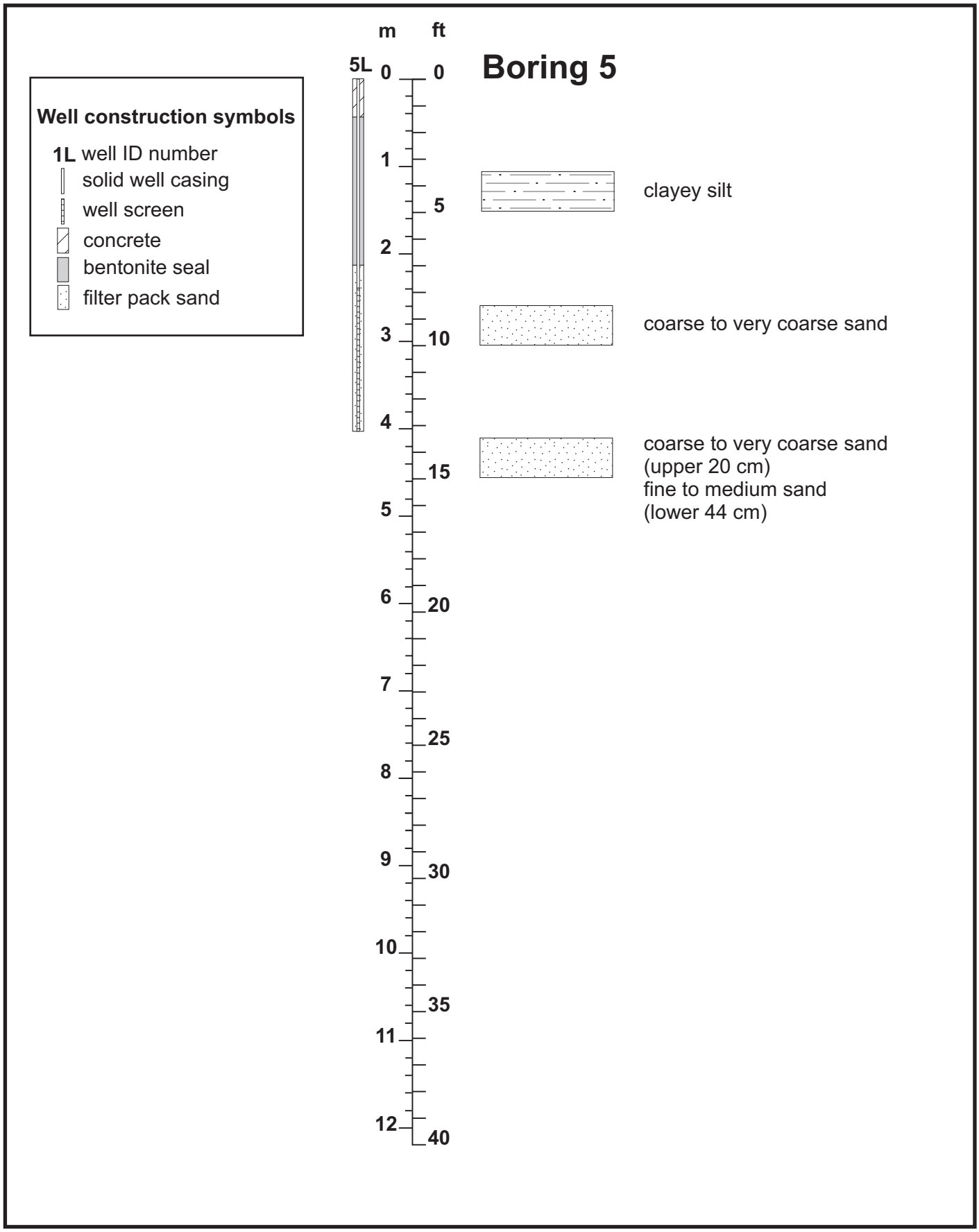
Boring #:	Boring 9
Site:	Morris (Grundy County)
Hole location:	east line, center boring
Date start:	8/3/99
Weather conditions:	sunny, 85°F
Field crew:	Dan and Bob (Terracon), Jim Miner (ISGS)
Equipment:	CME 750 ATV rig, 24-in diameter split-spoon sampler, 4-in and 4.25-in diameter augers
Depth interval	**Unit descriptions and notes**
3.5 - 5 ft (1.07 - 1.52 m)	**Recovery:** 54 cm **Saturation:** moist **% gr/sa/si/cl:** 0/50/50/tr **HCl:** none **Stiffness:** low to moderate **Porosity:** low to moderate **Geologic materials:** silty sand **Color:** 10YR 4/2 **Description:** structureless, clast supported
8.5 - 10 ft (2.59 - 3.05 m)	**Recovery:** 56 cm **Saturation:** wet to saturated **% gr/sa/si/cl:** 0/50/50/tr **HCl:** none **Stiffness:** low **Porosity:** low to moderate **Geologic materials:** silty sand **Color:** 10YR 4/3 with 10YR 4/1 (depleted zones) **Description:** same as above except softer, saturated, and contains some roots and depleted root zones
13.5 - 15 ft (4.11 - 4.57 m)	**Recovery:** 44 cm **Saturation:** saturated **% gr/sa/si/cl:** 0/50/50/tr **HCl:** none **Geologic materials:** top 34 cm same as above with last 10 cm all sand, reddish mottles throughout **Color:** gley diagram1, 4/N **Description:** last 13 cm 5Y 3/4, H_2S smell is strong, laminated silty sand
18.5 - 20 ft (5.64 - 6.10 m)	**Recovery:** 22 cm **Saturation:** saturated **% gr/sa/si/cl:** **Geologic materials**: very fine to very coarse sand **Color:** 10YR 4/1 over 10YR 5/4 in last 5 cm **Description:** poorly-sorted sand is well-rounded to sub-angular quartz and significant rock fragments (shale, granitics),H_2S smell

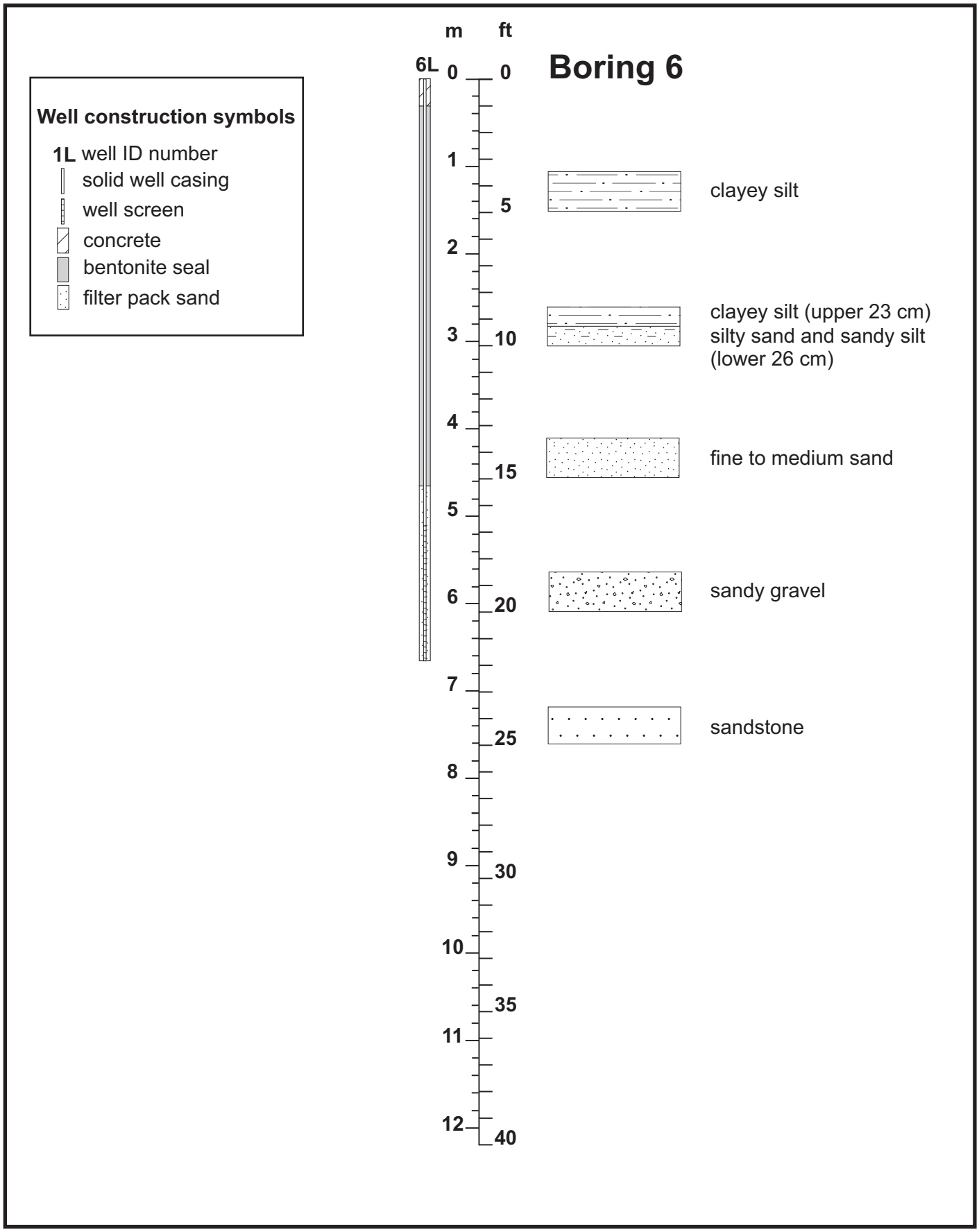

Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
1S
1U
1L
m
ft
Boring 1
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
medium to coarse sand
slightly muddy layer (upper 3 cm)
gravelly medium to coarse sand
gravelly medium to coarse sand
gravelly medium to coarse sand
fine to medium sand (with 1 cm thick coarse sand lens)
gravel
bedrock (lithology unknown)

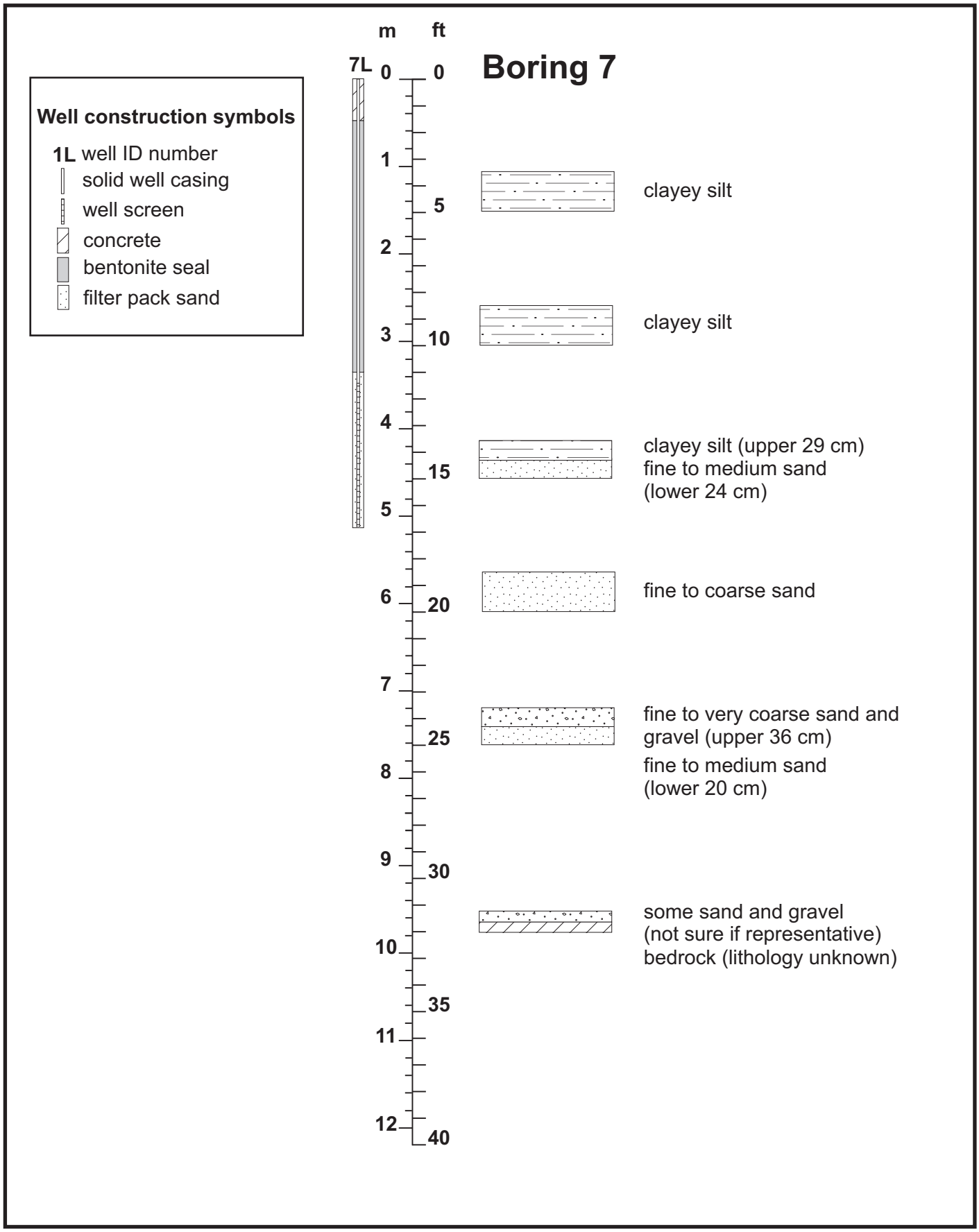

Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
2L
Boring 2
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
fine to medium sand
fine to medium sand
fine to medium sand
fine to medium sand
medium to coarse sand
(upper 27 cm)
coarse sand (3 cm)
silty clay (lower 1 cm)

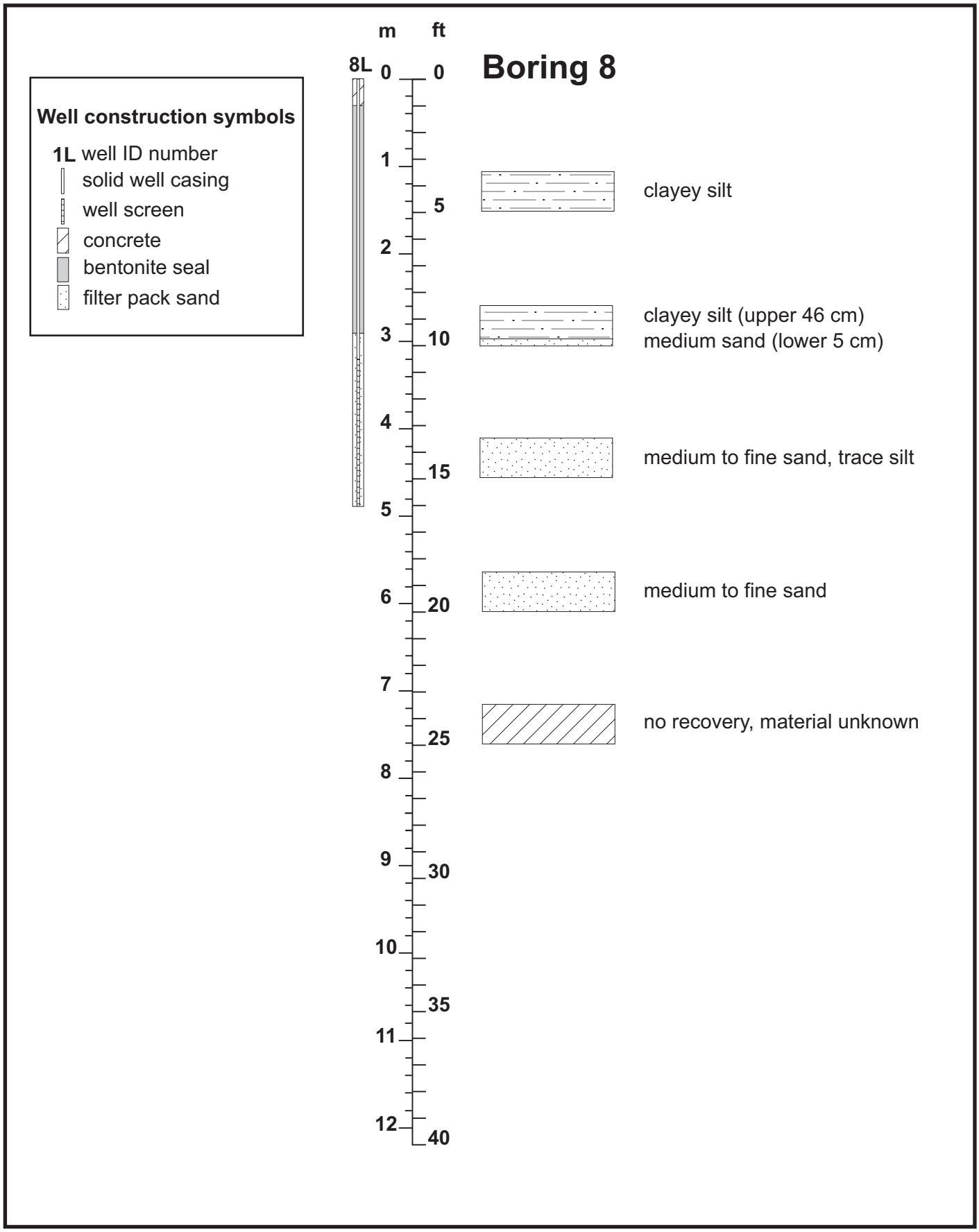

Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
3U
3L
m
ft
Boring 3
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
silty fine sand (upper 57 cm)
silty clay (lower 7 cm)
fine to medium sand
fine sand (upper 19 cm)
fine to very fine sand
(lower 28 cm)
fine to medium sand
very fine to medium sand
(upper 20 cm)
very fine sand (lower 20 cm)
no recovery,
coal chips in cuttings ?
grey shale

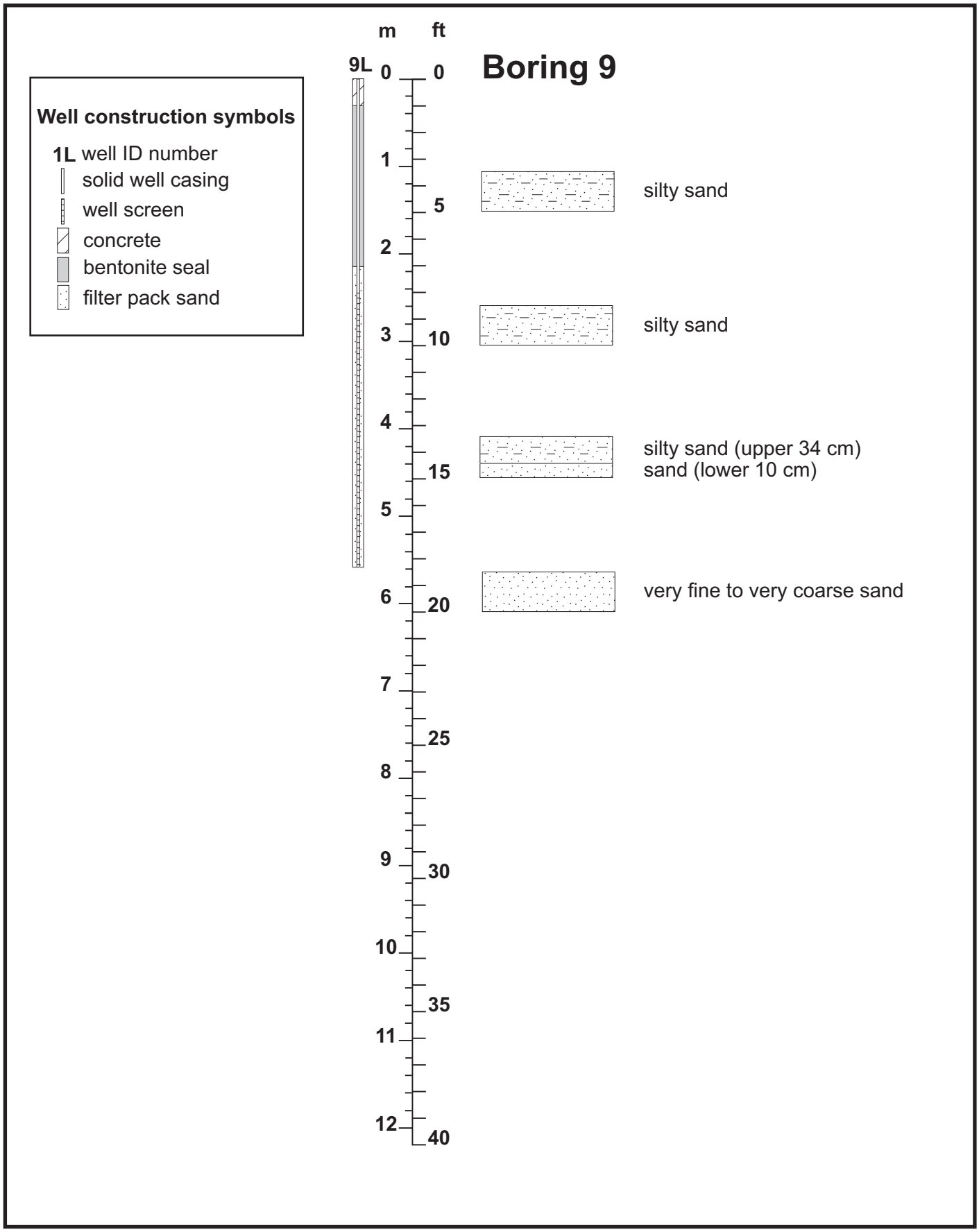

Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
4L
Boring 4
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
fine to medium sand
fine to medium sand
medium to very coarse sand


Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
5L
Boring 5
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
clayey silt
coarse to very coarse sand
coarse to very coarse sand
(upper 20 cm)
fine to medium sand
(lower 44 cm)


Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
6L
Boring 6
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
clayey silt
clayey silt (upper 23 cm)
silty sand and sandy silt
(lower 26 cm)
fine to medium sand
sandy gravel
sandstone


Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
7L
Boring 7
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
clayey silt
clayey silt
clayey silt (upper 29 cm)
fine to medium sand
(lower 24 cm)
fine to coarse sand
fine to very coarse sand and
gravel (upper 36 cm)
fine to medium sand
(lower 20 cm)
some sand and gravel
(not sure if representative)
bedrock (lithology unknown)


Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
8L
Boring 8
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
clayey silt
clayey silt (upper 46 cm)
medium sand (lower 5 cm)
medium to fine sand, trace silt
medium to fine sand
no recovery, material unknown


Well construction symbols
1L well ID number
solid well casing
well screen
concrete
bentonite seal
filter pack sand
m
ft
9L
Boring 9
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
40
silty sand
silty sand
silty sand (upper 34 cm)
sand (lower 10 cm)
very fine to very coarse sand

APPENDIX C Well Construction Information

Morris Wetland Bank Site

Installation Notes - Monitoring Wells

Well #.	Installation date	Land surface elevation (m) *	Well top elevation (m) *	Stick-up (m)	Borehole depth (m)	Screened interval (m)	Sand pack depth (m)	Bentonite seal (m)
1S	11/8/1999	150.898	151.941	1.043	0.750	0.452 to 0.697	0.300	to surface
1U	11/8/1999	150.898	151.843	0.945	~2.100	0.553 to 2.017	0.870	to surface
1L	8/22/1999	150.898	151.517	0.619	~3.660	1.330 to 2.795	1.120	0.300
2L	8/22/1999	152.398	153.291	0.893	~2.440	1.753 to 2.451	1.520	0.610
3U	11/8/1999	150.777	151.410	0.633	~1.600	0.826 to 1.532	1.000	to surface
3L	8/22/1999	150.777	151.532	0.755	~2.440	1.794 to 2.494	1.220	0.610
4L	8/23/1999	150.780	151.860	1.080	~4.570	2.077 to 3.387	1.905	0.150
5L	8/23/1999	150.736	151.394	0.658	~4.570	2.399 to 3.864	2.130	0.460
6L	8/23/1999	149.474	150.376	0.902	~7.620	5.125 to 6.425	4.825	0.300
7L	8/23/1999	151.268	151.993	0.725	~6.100	3.450 to 4.974	3.350	0.460
8L	8/23/1999	150.910	151.659	0.749	~6.100	3.201 to 4.725	2.901	0.300
9L	8/23/1999	151.190	152.216	1.026	~6.100	2.458 to 5.413	2.158	0.300
10S	11/8/1999	151.068	152.140	1.072	0.750	0.442 to 0.706	0.300	to surface
11S	11/8/1999	149.529	150.564	1.035	0.750	0.502 to 0.734	0.300	to surface
12S	11/8/1999	149.783	150.815	1.032	0.750	0.482 to 0.718	0.300	to surface
13S	11/8/1999	150.117	151.196	1.079	0.750	0.437 to 0.708	0.300	to surface
14S	11/8/1999	150.615	151.668	1.053	0.750	0.458 to 0.723	0.300	to surface
15S	11/8/1999	149.895	150.969	1.074	0.750	0.485 to 0.716	0.300	to surface
16S	11/8/1999	150.282	151.352	1.070	0.750	0.460 to 0.720	0.300	to surface
17S	11/8/1999	151.063	152.166	1.103	0.750	0.450 to 0.715	0.300	to surface
18S	11/8/1999	149.546	150.592	1.046	0.750	0.477 to 0.734	0.300	to surface
19S	11/8/1999	150.755	151.884	1.129	0.750	0.569 to 0.801	0.300	to surface
20S	11/8/1999	151.103	152.210	1.107	0.750	0.489 to 0.720	0.280	to surface
21S	11/8/1999	150.371	151.491	1.120	0.750	not measured	0.300	to surface
22S	11/8/1999	150.954	152.075	1.121	0.750	0.461 to 0.697	0.300	to surface
22VS	5/26/2004	150.929	151.940	1.011	0.375	0.190 to 0.339	0.150	to surface
23S	11/8/1999	151.078	152.218	1.140	0.750	0.472 to 0.732	0.300	to surface
24S	11/8/1999	149.766	150.809	1.043	0.750	0.504 to 0.728	0.300	to surface
25S	3/13/2000	150.683	151.794	1.111	0.750	0.466 to 0.696	0.300	to surface
26S	3/13/2000	149.835	150.839	1.004	0.750	0.481 to 0.716	0.300	to surface
27S	3/13/2000	150.759	151.776	1.017	0.750	0.492 to 0.729	0.300	to surface
28S	3/13/2000	150.450	151.493	1.043	0.750	0.458 to 0.728	0.300	to surface
29S	3/13/2000	151.143	152.122	0.979	0.800	0.505 to 0.505	0.285	to surface
30S	3/13/2000	150.321	151.412	1.091	0.750	0.423 to 0.723	0.290	to surface
31S	3/14/2000	150.759	151.828	1.069	0.770	0.459 to 0.716	0.300	to surface
32S	3/14/2000	150.597	151.696	1.099	0.750	0.467 to 0.704	0.300	to surface
33S	3/14/2000	150.855	151.932	1.077	0.750	0.438 to 0.706	0.300	to surface
34S	3/14/2000	150.754	151.869	1.115	0.750	0.389 to 0.651	0.300	to surface
35S	3/14/2000	149.115	150.214	1.099	0.750	0.452 to 0.714	0.300	to surface
36S	3/14/2000	150.235	151.306	1.071	0.750	0.426 to 0.685	0.300	to surface
37S	3/14/2000	151.218	152.369	1.151	0.750	0.431 to 0.691	0.300	to surface
38S	3/14/2000	149.115	150.197	1.082	0.750	0.477 to 0.719	0.300	to surface
39S old	3/14/2000	NA	NA	NA	0.750	0.448 to 0.680	0.300	to surface
39S new	8/30/2002	150.110	151.269	1.159	0.750	0.378 to 0.691	0.300	to surface
40S old	2/20/2001	NA	NA	NA	0.750	0.475 to 0.771	0.300	to surface
40S new	6/17/2003	150.550	151.700	1.150	0.750	0.396 to 0.710	0.300	to surface
41S	2/20/2001	151.417	152.582	1.165	0.750	0.442 to 0.694	0.300	to surface
42S	3/13/2001	150.153	151.302	1.149	0.750	0.457 to 0.706	0.300	to surface
43S	3/13/2001	150.154	151.290	1.136	0.750	0.440 to 0.691	0.300	to surface
43VS	5/26/2004	150.159	151.096	0.937	0.375	0.223 to 0.357	0.150	to surface
44S old	3/13/2001	NA	NA	NA	0.750	0.475 to 0.737	0.300	to surface

* survey data from 7/1/03 and 7/7/04

APPENDIX C Well Construction Information (continued)

Morris Wetland Bank Site

Installation Notes - Monitoring Wells

Well #	Installation date	Land surface elevation (m) *	Well top elevation (m) *	Stick-up (m)	Borehole depth (m)	Screened interval (m)	Sand pack depth (m)	Bentonite seal (m)
44VS	5/26/2004	150.420	151.376	0.956	0.375	0.177 to 0.321	0.150	to surface
45S	3/13/2001	150.530	151.661	1.131	0.750	0.485 to 0.728	0.300	to surface
45VS	5/26/2004	150.566	151.396	0.830	0.375	0.168 to 0.317	0.150	to surface
46S	3/13/2001	148.968	150.092	1.124	0.750	0.432 to 0.689	0.300	to surface
46VS	5/26/2004	148.970	149.954	0.984	0.375	0.195 to 0.351	0.150	to surface
47S	3/13/2001	150.583	151.728	1.145	0.760	0.441 to 0.694	0.300	to surface
47VS	5/26/2004	150.619	151.524	0.905	0.375	0.224 to 0.359	0.150	to surface
48S	3/13/2001	148.890	150.023	1.133	0.750	0.471 to 0.716	0.300	to surface
49S	8/30/2002	150.416	151.546	1.130	0.730	0.432 to 0.685	0.300	to surface
50S	8/30/2002	149.970	151.133	1.163	0.750	0.430 to 0.674	0.300	to surface
51S	8/30/2002	149.511	150.685	1.174	0.740	0.399 to 0.689	0.300	to surface

* survey data from 7/1/03 and 7/7/04

APPENDIX D Water-Level Elevations and Depths to Water

Table D1 Water-Level Elevations in Upper and Lower Wells

Table D2 Depths to Water in Upper and Lower Wells

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells

Table D5 Water-Level Elevations on Stage Gauges

APPENDIX D Water-Level Elevations and Depths to Water

Table D1 Water-Level Elevations in Upper and Lower Wells

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	08/20/99	09/17/99	10/18/99	11/03/99	12/01/99	01/19/00	02/16/00	03/08/00	04/04/00	04/05/00
Well 1U	*	*	*	*	148.54	148.54	148.52	148.61	148.53	**
Well 1L	147.69	148.59	148.58	148.55	148.53	148.52	148.50	148.61	148.52	**
Well 2L	150.47	150.20	150.04	149.98	149.94	149.91	149.93	dry	149.92	**
Well 3U	*	*	*	*	149.68	149.59	149.52	149.63	**	149.52
Well 3L	150.13	149.92	149.84	149.78	149.68	149.60	149.52	149.62	**	149.53
Well 4L	147.48	147.40	147.41	147.41	147.40	147.44	147.42	147.57	147.50	**
Well 5L	148.21	148.05	147.98	147.96	147.96	148.02	148.01	148.26	148.17	**
Well 6L	147.37	147.31	147.33	147.33	147.33	147.35	147.34	147.46	**	147.40
Well 7L	147.40	147.28	147.29	147.30	147.28	147.29	147.31	147.48	**	147.42
Well 8L	147.53	147.44	147.46	147.47	147.47	147.50	147.48	147.68	147.56	**
Well 9L	148.32	148.25	148.33	148.34	148.39	148.39	148.36	148.51	148.41	**

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/19/00	05/02/00	05/03/00	05/15/00	05/30/00	06/14/00	06/15/00	06/20/00	07/05/00	07/18/00
Well 1U	148.55	148.74	**	148.71	148.68	148.78	**	**	**	**
Well 1L	148.49	148.73	**	148.69	148.67	148.77	**	**	**	**
Well 2L	149.94	150.51	**	151.18	151.35	151.41	**	**	**	**
Well 3U	149.55	149.72	**	149.74	149.79	149.96	**	**	**	150.23
Well 3L	149.55	149.72	**	149.73	149.78	149.94	**	**	**	150.51
Well 4L	147.60	**	147.86	147.87	147.85	148.07	**	**	**	148.37
Well 5L	148.19	**	148.47	148.45	148.42	148.66	**	**	**	149.77
Well 6L	147.57	**	147.68	147.82	147.82	***	***	**	**	147.84
Well 7L	147.62	**	147.63	147.77	147.86	***	***	**	**	147.91
Well 8L	147.67	**	147.99	147.95	147.93	***	***	**	**	148.47
Well 9L	148.50	**	148.78	148.84	148.88	**	149.31	**	**	149.50

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/19/00	08/21/00	09/18/00	10/25/00	10/26/00	11/21/00	01/02/01	01/03/01	01/31/01	02/01/01
Well 1U	149.40	148.78	148.68	148.63	**	148.82	**	**	148.94	**
Well 1L	149.39	148.78	148.67	148.63	**	148.82	**	**	148.93	**
Well 2L	151.62	150.62	150.17	150.02	**	151.29	**	**	151.58	**
Well 3U	**	150.08	149.93	149.85	**	150.11	150.02	**	150.30	**
Well 3L	**	150.08	149.92	149.85	**	150.09	150.04	**	150.29	**
Well 4L	**	147.58	147.56	**	147.44	147.65	147.48	**	147.81	**
Well 5L	**	148.46	148.18	**	148.06	148.52	148.43	**	149.36	**
Well 6L	**	147.40	147.47	**	147.34	147.49	**	**	***	**
Well 7L	**	147.39	147.46	**	147.30	147.53	**	**	***	**
Well 8L	**	147.60	147.59	**	147.47	147.79	147.59	**	***	**
Well 9L	**	148.46	148.26	**	148.32	148.96	**	148.69	**	149.53

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

U indicates upper monitoring well
L indicates lower monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	02/20/01	03/12/01	03/13/01	04/09/01	04/10/01	04/23/01	04/24/01	05/08/01	05/23/01	06/11/01
Well 1U	**	**	149.25	148.93	**	148.97	**	148.86	148.79	149.43
Well 1L	**	**	149.25	148.93	**	148.97	**	148.85	148.79	149.43
Well 2L	**	151.65	**	151.58	**	**	151.65	151.49	151.40	151.73
Well 3U	**	**	150.36	150.28	**	150.28	**	150.17	150.10	150.42
Well 3L	**	**	150.37	150.27	**	150.27	**	150.16	150.11	150.42
Well 4L	**	**	148.23	147.80	**	147.95	**	147.65	147.60	148.81
Well 5L	**	**	149.65	148.98	**	148.92	**	148.74	148.57	150.16
Well 6L	**	147.83	**	**	147.61	**	147.87	147.45	147.47	147.47
Well 7L	**	147.92	**	**	147.64	**	147.89	147.49	147.49	***
Well 8L	**	148.32	**	**	147.90	**	148.05	147.74	147.69	***
Well 9L	**	149.52	**	**	149.20	**	149.26	148.97	148.83	150.30

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	06/25/01	08/02/01	08/03/01	09/11/01	10/23/01	11/27/01	12/11/01	01/24/02	02/28/02	03/18/02
Well 1U	148.99	**	148.74	148.62	149.26	148.87	148.86	148.75	149.03	149.42
Well 1L	148.98	**	148.73	148.60	149.25	148.86	148.86	148.74	149.02	149.41
Well 2L	151.44	150.40	**	dry	151.58	151.37	151.39	150.74	151.57	151.66
Well 3U	150.19	149.96	**	149.73	150.32	150.25	150.23	150.08	150.31	150.39
Well 3L	150.19	149.96	**	149.72	150.30	150.23	150.21	150.07	150.29	150.38
Well 4L	147.84	147.57	**	147.47	148.69	147.77	147.73	147.57	148.16	148.60
Well 5L	149.09	148.34	**	148.08	149.71	148.82	148.87	148.58	149.53	149.97
Well 6L	147.51	147.45	**	147.38	***	147.48	147.50	147.37	147.93	148.12
Well 7L	147.53	147.55	**	147.43	***	147.50	147.51	147.43	147.94	148.19
Well 8L	147.92	147.16	**	147.51	***	147.76	146.40	147.61	148.33	148.63
Well 9L	149.10	148.39	**	148.28	149.83	149.04	147.72	148.78	***	149.89

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/12/02	04/22/02	05/06/02	05/20/02	06/03/02	07/01/02	08/05/02	09/09/02	10/15/02	11/14/02
Well 1U	149.52	149.18	149.14	150.00	149.26	148.89	148.75	148.59	148.53	148.51
Well 1L	149.51	149.17	149.14	150.00	149.25	148.88	148.74	148.58	148.51	148.50
Well 2L	151.83	151.66	151.68	151.82	151.61	**	150.38	150.00	dry	dry
Well 3U	150.54	150.36	150.39	150.65	150.36	**	149.96	149.70	149.60	149.54
Well 3L	150.51	150.35	150.38	150.63	150.36	**	149.95	149.70	149.59	149.53
Well 4L	149.07	148.25	148.31	149.57	148.14	147.67	147.47	147.42	147.37	147.38
Well 5L	150.38	149.62	149.66	150.33	149.47	148.59	148.19	148.01	147.89	147.88
Well 6L	148.98	147.95	148.09	149.16	147.71	147.44	147.42	147.33	147.31	147.33
Well 7L	149.00	148.05	148.10	149.21	147.75	147.47	147.45	147.33	147.33	147.34
Well 8L	149.27	148.30	148.43	149.53	148.12	147.67	147.52	147.44	147.40	147.44
Well 9L	149.62	149.59	149.82	150.31	149.32	148.73	148.24	148.10	148.15	148.25

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

U indicates upper monitoring well
L indicates lower monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	12/16/02	01/15/03	02/11/03	03/12/03	04/17/03	05/01/03	05/15/03	05/30/03	06/11/03	07/09/03
Well 1U	148.51	148.49	148.45	frozen	148.57	148.62	149.02	148.77	148.68	148.66
Well 1L	148.50	148.47	148.43	148.43	148.56	148.61	149.02	148.77	148.67	148.65
Well 2L	dry	dry	dry	dry	dry	dry	150.11	dry	dry	dry
Well 3U	149.46	149.37	149.29	149.31	149.36	149.26	149.69	149.69	149.63	149.46
Well 3L	149.44	149.36	149.28	149.36	149.35	149.26	149.68	149.69	149.62	149.48
Well 4L	147.38	147.38	147.38	147.38	147.53	147.59	148.57	147.80	147.66	147.80
Well 5L	147.90	147.90	147.89	**	148.08	148.03	148.64	148.52	148.44	148.20
Well 6L	147.33	147.31	147.31	147.31	147.40	147.67	148.66	147.55	147.45	148.01
Well 7L	147.35	147.33	147.29	147.33	147.40	147.82	148.55	147.62	147.48	148.18
Well 8L	147.44	147.43	147.40	147.43	147.58	147.64	148.73	147.82	147.68	147.69
Well 9L	148.23	148.27	148.28	148.31	148.35	148.27	149.32	148.83	148.70	148.50

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/25/03	08/11/03	09/08/03	10/08/03	11/13/03	12/16/03	01/23/04	03/08/04	04/16/04	04/29/04
Well 1U	149.53	149.06	148.76	148.60	148.70	149.14	148.77	149.39	148.99	148.99
Well 1L	149.52	149.05	148.75	148.59	148.69	149.13	148.75	149.38	148.99	148.98
Well 2L	151.48	150.67	149.97	dry	dry	151.38	150.29	151.25	151.12	151.41
Well 3U	150.24	150.07	149.71	149.47	149.57	150.18	150.00	150.18	150.20	150.21
Well 3L	150.24	150.06	149.70	149.45	149.55	150.17	149.98	150.16	150.20	150.20
Well 4L	149.15	147.96	147.55	147.41	147.57	148.05	147.57	148.54	147.80	147.73
Well 5L	150.13	149.22	148.37	148.12	148.20	149.17	148.57	149.66	149.14	148.86
Well 6L	148.86	147.58	147.39	147.30	147.50	147.86	147.38	148.95	147.47	147.50
Well 7L	148.87	147.59	147.41	147.33	147.50	147.93	147.35	148.90	147.55	147.51
Well 8L	149.29	148.00	147.53	147.41	147.62	148.19	147.61	148.91	147.89	147.81
Well 9L	149.97	148.86	148.36	148.24	148.53	149.43	148.72	**	149.14	149.35

Table D1 Water-Level Elevations in Upper and Lower Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	05/12/04	05/13/04	05/26/04	06/08/	06/21/04	07/02/04	08/05/04	09/16/04	10/19/04	11/22/04
Well 1U	**	149.01	149.07	149.36	149.64	149.12	148.83	149.05	148.78	148.90
Well 1L	**	149.01	149.06	149.36	149.63	149.11	148.83	149.05	148.77	148.89
Well 2L	151.53	**	151.62	151.60	151.59	151.04	150.21	150.66	150.17	151.28
Well 3U	150.23	**	150.27	150.35	150.50	150.21	149.93	150.15	149.95	150.29
Well 3L	150.22	**	150.26	150.34	150.46	150.21	149.93	150.14	149.93	150.21
Well 4L	147.69	**	148.08	148.52	149.11	147.96	147.60	147.78	147.46	147.69
Well 5L	148.96	**	149.03	149.89	149.92	149.17	148.32	148.76	148.27	148.74
Well 6L	147.44	**	148.03	148.11	148.63	147.51	147.50	147.53	147.31	147.53
Well 7L	147.50	**	148.15	148.19	148.69	147.54	147.05	147.55	147.31	147.56
Well 8L	147.79	**	148.22	148.70	149.04	147.95	147.60	147.79	147.46	147.79
Well 9L	**	149.41	149.44	149.80	149.59	148.97	148.41	148.87	148.56	149.27

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

U indicates upper monitoring well
L indicates lower monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D2 Depths to Water in Upper and Lower Wells

	Depths to Water (in m referenced to land surface)									
Date	08/20/99	09/17/99	10/18/99	11/03/99	12/01/99	01/19/00	02/16/00	03/08/00	04/04/00	04/05/00
Well 1U	*	*	*	*	2.32	2.32	2.34	2.24	2.33	**
Well 1L	3.16	2.26	2.27	2.29	2.32	2.32	2.35	2.24	2.33	**
Well 2L	1.89	2.16	2.32	2.38	2.42	2.45	2.43	dry	2.44	**
Well 3U	*	*	*	*	1.04	1.12	1.20	1.08	**	1.21
Well 3L	0.59	0.81	0.88	0.95	1.05	1.13	1.21	1.10	**	1.23
Well 4L	3.25	3.32	3.32	3.32	3.33	3.29	3.30	3.15	3.25	**
Well 5L	2.47	2.63	2.70	2.72	2.72	2.66	2.67	2.42	2.55	**
Well 6L	2.08	2.14	2.12	2.12	2.13	2.10	2.11	2.00	**	2.04
Well 7L	3.85	3.97	3.96	3.95	3.97	3.96	3.94	3.77	**	3.83
Well 8L	3.33	3.41	3.39	3.39	3.38	3.36	3.37	3.18	3.29	**
Well 9L	2.82	2.89	2.81	2.80	2.75	2.75	2.78	2.63	2.73	**

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	04/19/00	05/02/00	05/03/00	05/15/00	05/30/00	06/14/00	06/15/00	06/20/00	07/05/00	07/18/00
Well 1U	2.31	2.12	**	2.15	2.18	2.08	**	**	**	**
Well 1L	2.36	2.11	**	2.15	2.18	2.08	**	**	**	**
Well 2L	2.46	1.89	**	1.22	1.05	0.99	**	**	**	**
Well 3U	1.18	1.00	**	0.99	0.93	0.76	**	**	**	0.50
Well 3L	1.20	1.04	**	1.02	0.98	0.81	**	**	**	**0.25**
Well 4L	3.15	**	2.89	2.88	2.90	2.69	**	**	**	2.38
Well 5L	2.53	**	2.24	2.27	2.30	2.05	**	**	**	0.95
Well 6L	1.87	**	1.76	1.62	1.62	***	***	**	**	1.59
Well 7L	3.64	**	3.63	3.49	3.40	***	***	**	**	3.36
Well 8L	3.19	**	2.87	2.91	2.94	***	***	**	**	2.39
Well 9L	2.68	**	2.39	2.33	2.30	**	1.87	**	**	1.68

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	07/19/00	08/21/00	09/18/00	10/25/00	10/26/00	11/21/00	01/02/01	01/03/01	01/31/01	02/01/01
Well 1U	1.46	2.08	2.18	2.22	**	2.04	**	**	1.92	**
Well 1L	1.45	2.07	2.17	2.22	**	2.03	**	**	1.91	**
Well 2L	0.78	1.79	2.24	2.38	**	1.11	**	**	0.83	**
Well 3U	**	0.64	0.79	0.87	**	0.61	0.70	**	0.42	**
Well 3L	**	0.68	0.84	0.91	**	0.66	0.71	**	0.47	**
Well 4L	**	3.17	3.19	**	3.31	3.11	3.27	**	2.94	**
Well 5L	**	2.26	2.53	**	2.66	2.20	2.29	**	1.36	**
Well 6L	**	2.04	1.97	**	2.09	1.94	**	**	***	**
Well 7L	**	3.88	3.81	**	3.96	3.73	**	**	***	**
Well 8L	**	3.26	3.27	**	3.39	3.07	3.27	**	***	**
Well 9L	**	2.71	2.91	**	2.86	2.22	**	2.49	**	1.64

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
U indicates upper monitoring well
L indicates lower monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	02/20/01	03/12/01	03/13/01	04/09/01	04/10/01	04/23/01	04/24/01	05/08/01	05/23/01	06/11/01
Well 1U	**	**	1.61	1.92	**	1.89	**	2.00	2.07	1.43
Well 1L	**	**	1.60	1.92	**	1.88	**	1.99	2.05	1.41
Well 2L	**	0.75	**	0.83	**	**	0.76	0.91	1	0.67
Well 3U	**	**	0.36	0.44	**	0.44	**	0.55	0.62	0.31
Well 3L	**	**	0.39	0.48	**	0.49	**	0.59	0.65	0.34
Well 4L	**	**	2.52	2.95	**	2.80	**	3.10	3.15	1.94
Well 5L	**	**	1.07	1.74	**	1.79	**	1.98	2.15	0.56
Well 6L	**	1.60	**	**	1.82	**	1.56	1.99	1.96	1.96
Well 7L	**	3.34	**	**	3.62	**	3.37	3.77	3.77	***
Well 8L	**	2.55	**	**	2.96	**	2.81	3.12	3.17	***
Well 9L	**	1.66	**	**	1.98	**	1.91	2.21	2.35	0.88

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	06/25/01	08/02/01	08/03/01	09/11/01	10/23/01	11/27/01	12/11/01	01/24/02	02/28/02	03/18/02
Well 1U	1.87	**	2.12	2.32	1.68	2.06	2.08	2.18	1.91	1.52
Well 1L	1.86	**	2.12	2.33	1.68	2.08	2.08	2.19	1.91	1.52
Well 2L	0.96	2.00	**	dry	0.80	1.01	1.00	1.65	0.82	0.73
Well 3U	0.53	0.76	**	1.03	0.44	0.52	0.53	0.68	0.46	0.37
Well 3L	0.56	0.80	**	1.04	0.46	0.53	0.55	0.69	0.47	0.38
Well 4L	2.92	3.19	**	3.34	2.11	3.04	3.08	3.23	2.64	2.21
Well 5L	1.63	2.38	**	2.64	1.01	1.91	1.86	2.14	1.20	0.75
Well 6L	1.93	1.98	**	2.07	***	1.98	1.95	2.09	1.53	1.34
Well 7L	3.73	3.71	**	3.83	***	3.77	3.76	3.83	3.32	3.07
Well 8L	2.95	3.70	**	3.36	***	3.11	4.47	3.26	2.54	2.24
Well 9L	2.08	2.79	**	2.90	1.35	2.14	3.46	2.40	***	1.30

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	04/12/02	04/22/02	05/06/02	05/20/02	06/03/02	07/01/02	08/05/02	09/09/02	10/15/02	11/14/02
Well 1U	1.42	1.76	1.80	0.93	1.68	2.05	2.21	2.38	2.43	2.45
Well 1L	1.42	1.77	1.80	0.94	1.68	2.06	2.22	2.38	2.45	2.46
Well 2L	0.56	0.72	0.71	0.56	0.77	**	2.00	2.38	dry	dry
Well 3U	**0.22**	0.40	0.37	**0.12**	0.40	**	0.82	1.08	1.18	1.24
Well 3L	**0.25**	0.41	0.38	**0.13**	0.40	**	0.82	1.07	1.19	1.25
Well 4L	1.73	2.56	2.50	1.24	2.67	3.14	3.30	3.35	3.40	3.39
Well 5L	0.34	1.10	1.06	0.39	1.25	2.13	2.56	2.74	2.86	2.86
Well 6L	0.48	1.51	1.37	**0.29**	1.74	2.02	2.05	2.14	2.16	2.14
Well 7L	2.27	3.22	3.17	2.06	3.51	3.79	3.81	3.93	3.94	3.93
Well 8L	1.60	2.57	2.44	1.34	2.75	3.20	3.39	3.47	3.51	3.47
Well 9L	1.57	1.59	1.36	0.87	1.86	2.45	2.93	3.08	3.03	2.93

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
U indicates upper monitoring well
L indicates lower monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	12/16/02	01/15/03	02/11/03	03/12/03	04/17/03	05/01/03	05/15/03	05/30/03	06/11/03	07/09/03
Well 1U	2.45	2.47	2.51	frozen	2.39	2.34	1.94	2.19	2.28	2.24
Well 1L	2.46	2.49	2.53	2.53	2.40	2.35	1.94	2.19	2.29	2.25
Well 2L	dry	dry	dry	dry	dry	dry	2.27	dry	dry	dry
Well 3U	1.32	1.40	1.49	1.47	1.42	1.52	1.09	1.08	1.15	1.31
Well 3L	1.34	1.42	1.50	1.42	1.43	1.52	1.09	1.09	1.16	1.30
Well 4L	3.40	3.39	3.39	3.39	3.25	3.19	2.20	2.97	3.11	2.98
Well 5L	2.85	2.85	2.85	**	2.67	2.71	2.10	2.22	2.30	2.53
Well 6L	2.14	2.16	2.16	2.16	2.07	1.80	0.81	1.92	2.02	1.47
Well 7L	3.92	3.94	3.98	3.94	3.87	3.45	2.72	3.64	3.78	3.09
Well 8L	3.47	3.48	3.51	3.48	3.33	3.27	2.18	3.09	3.23	3.22
Well 9L	2.95	2.91	2.90	2.87	2.83	2.91	1.86	2.35	2.48	2.69

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	07/25/03	08/11/03	09/08/03	10/08/03	11/13/03	12/16/03	01/23/04	03/08/04	04/16/04	04/29/04
Well 1U	1.37	1.84	2.14	2.30	2.20	1.75	2.13	1.51	1.91	1.91
Well 1L	1.38	1.85	2.15	2.31	2.21	1.76	2.14	1.52	1.91	1.92
Well 2L	0.92	1.73	2.43	dry	dry	1.02	2.10	1.15	1.28	0.99
Well 3U	0.53	0.71	1.07	1.31	1.21	0.60	0.77	0.60	0.58	0.57
Well 3L	0.54	0.72	1.08	1.33	1.23	0.61	0.79	0.61	0.57	0.58
Well 4L	1.63	2.82	3.23	3.37	3.21	2.73	3.21	2.24	2.98	3.05
Well 5L	0.61	1.52	2.36	2.61	2.54	1.57	2.17	1.08	1.60	1.88
Well 6L	0.62	1.89	2.09	2.17	1.97	1.61	2.10	0.52	2.00	1.98
Well 7L	2.40	3.68	3.86	3.94	3.77	3.34	3.92	2.37	3.72	3.76
Well 8L	1.62	2.91	3.38	3.50	3.29	2.72	3.30	2.00	3.02	3.10
Well 9L	1.22	2.33	2.83	2.95	2.66	1.76	2.47	**	2.05	1.84

Table D2 Depths to Water in Upper and Lower Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	05/12/04	05/13/04	05/26/04	06/08/	06/21/04	07/02/04	08/05/04	09/16/04	10/19/04	11/22/04
Well 1U	**	1.89	1.83	1.54	1.26	1.78	2.10	1.88	2.15	2.03
Well 1L	**	1.89	1.84	1.54	1.26	1.78	2.10	1.88	2.16	2.04
Well 2L	0.87	**	0.78	0.80	0.81	1.32	2.15	1.70	2.19	1.08
Well 3U	0.54	**	0.51	0.43	**0.28**	0.58	0.85	0.63	0.84	0.49
Well 3L	0.55	**	0.51	0.44	0.32	0.58	0.86	0.64	0.85	0.58
Well 4L	3.09	**	2.70	2.26	1.67	2.82	3.20	3.02	3.33	3.11
Well 5L	1.78	**	1.71	0.85	0.81	1.56	2.41	1.97	2.46	1.99
Well 6L	2.03	**	1.44	1.36	0.84	1.96	1.97	1.94	2.16	1.94
Well 7L	3.76	**	3.12	3.08	2.58	3.73	4.22	3.72	3.95	3.71
Well 8L	3.13	**	2.69	2.21	1.87	2.95	3.31	3.12	3.45	3.12
Well 9L	**	1.78	1.75	1.39	1.60	2.22	2.78	2.32	2.63	1.92

*	not yet installed	–	indicates water above land surface
**	no measurement	U	indicates upper monitoring well
***	inaccessible due to high water	L	indicates lower monitoring well
****	discontinued	**bold**	values less than or equal to 0.304 m
*****	damaged		

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	08/20/99	09/17/99	10/18/99	11/03/99	12/01/99	01/19/00	02/16/00	03/08/00	04/04/00	04/05/00
Well 1S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 10S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 11S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 12S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 13S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 14S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 15S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 16S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 17S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 18S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 19S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 20S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 21S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 22S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 24S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 25S	*	*	*	*	*	*	*	*	149.97	**
Well 26S	*	*	*	*	*	*	*	*	dry	**
Well 27S	*	*	*	*	*	*	*	*	dry	**
Well 28S	*	*	*	*	*	*	*	*	dry	**
Well 29S	*	*	*	*	*	*	*	*	dry	**
Well 30S	*	*	*	*	*	*	*	*	dry	**
Well 31S	*	*	*	*	*	*	*	*	dry	**
Well 32S	*	*	*	*	*	*	*	*	dry	**
Well 33S	*	*	*	*	*	*	*	*	dry	**
Well 34S	*	*	*	*	*	*	*	*	dry	**
Well 35S	*	*	*	*	*	*	*	*	dry	**
Well 36S	*	*	*	*	*	*	*	*	dry	**
Well 37S	*	*	*	*	*	*	*	*	dry	**
Well 38S	*	*	*	*	*	*	*	*	**	148.32
Well 39S	*	*	*	*	*	*	*	*	**	dry
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/19/00	05/02/00	05/03/00	05/15/00	05/30/00	06/14/00	06/15/00	06/20/00	07/05/00	07/18/00
Well 1S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 10S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 11S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 12S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 13S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 14S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 15S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 16S	149.54	149.54	**	dry	dry	dry	**	**	**	**
Well 17S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 18S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 19S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 20S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 21S	dry	dry	**	dry	dry	**	dry	**	**	150.08
Well 22S	dry	dry	**	dry	dry	**	dry	**	**	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	**	dry	dry	dry	**	dry	**	**	dry
Well 24S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 25S	149.97	**	dry	dry	dry	dry	**	**	**	dry
Well 26S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 27S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 28S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 29S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 30S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 31S	150.01	**	dry	dry	dry	dry	**	**	**	dry
Well 32S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 33S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 34S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 35S	dry	**	dry	dry	dry	dry	**	**	**	**
Well 36S	149.51	dry	**	dry	dry	dry	**	**	**	**
Well 37S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 38S	dry	dry	**	148.32	dry	dry	**	**	**	**
Well 39S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/19/00	08/21/00	09/18/00	10/25/00	10/26/00	11/21/00	01/02/01	01/03/01	01/31/01	02/01/01
Well 1S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 10S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 11S	149.53	dry	dry	dry	**	dry	**	**	dry	**
Well 12S	149.37	dry	dry	dry	**	dry	**	**	dry	**
Well 13S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 14S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 15S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 16S	149.91	dry	dry	dry	**	dry	**	**	149.64	**
Well 17S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 18S	149.11	dry	dry	dry	**	dry	**	**	dry	**
Well 19S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 20S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 21S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 22S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 24S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 25S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 26S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 27S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 28S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 29S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 30S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 31S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 32S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 33S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 34S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 35S	dry	**	**	**	dry	dry	dry	**	dry	**
Well 36S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 37S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 38S	dry	dry	dry	**	dry	dry	dry	**	dry	**
Well 39S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	02/20/01	03/12/01	03/13/01	04/09/01	04/10/01	04/23/01	04/24/01	05/08/01	05/23/01	06/11/01
Well 1S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 10S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 11S	**	**	149.05	dry	**	dry	**	dry	dry	149.73
Well 12S	**	**	149.09	dry	**	dry	**	dry	dry	149.65
Well 13S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 14S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 15S	**	**	dry	dry	**	dry	**	dry	dry	149.27
Well 16S	**	**	dry	149.73	**	149.73	**	149.64	dry	149.84
Well 17S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 18S	**	**	149.05	dry	**	dry	**	dry	dry	149.51
Well 19S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 20S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 21S	**	149.65	**	**	dry	**	dry	dry	dry	150.52
Well 22S	**	dry	**	**	150.27	**	dry	dry	dry	150.47
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	**	dry	**	**	dry	**	dry	dry	dry	150.56
Well 24S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 25S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 26S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 27S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 28S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 29S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 30S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 31S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 32S	**	**	dry	dry	**	dry	**	dry	dry	150.15
Well 33S	**	**	dry	dry	**	dry	**	dry	dry	150.30
Well 34S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 35S	**	**	dry	dry	**	dry	**	dry	dry	149.04
Well 36S	**	**	dry	dry	**	dry	**	dry	dry	149.74
Well 37S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 38S	**	**	dry	dry	**	dry	**	dry	dry	148.50
Well 39S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 40S	*	dry	**	dry	**	**	dry	dry	dry	150.39
Well 41S	*	dry	**	dry	**	**	dry	dry	dry	dry
Well 42S	*	**	149.84	**	dry	**	dry	dry	dry	150.47
Well 43S	*	**	149.57	**	dry	**	dry	dry	dry	150.48
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	**	150.29	**	149.72	**	dry	dry	dry	150.63
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	dry	**	dry	**	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	dry	**	dry	**	dry	dry	148.92
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	dry	**	dry	**	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	dry	**	dry	**	dry	dry	flooded
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	06/25/01	08/02/01	08/03/01	09/11/01	10/23/01	11/27/01	12/11/01	01/24/02	02/28/02	03/18/02
Well 1S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	dry	**	dry	dry	149.30	dry	dry	dry	dry	149.64
Well 12S	dry	**	dry	dry	149.26	dry	dry	dry	dry	149.55
Well 13S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	dry	**	dry	dry	149.25	dry	dry	dry	dry	dry
Well 16S	149.69	**	dry	dry	149.91	149.68	149.63	dry	149.76	149.86
Well 17S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	dry	**	dry	dry	149.35	dry	dry	dry	148.86	149.37
Well 19S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	dry	dry	**	dry	150.39	dry	dry	dry	***	150.45
Well 22S	dry	dry	**	dry	150.36	dry	dry	dry	***	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	dry	**	dry	150.48	dry	dry	dry	***	150.47
Well 24S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	**	***	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	dry	**	dry	150.06	dry	dry	dry	dry	149.95
Well 33S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	dry	**	dry	148.89	dry	dry	dry	dry	148.76
Well 36S	dry	dry	**	**	149.60	dry	dry	dry	dry	dry
Well 37S	dry	dry	**	**	dry	dry	dry	dry	dry	dry
Well 38S	dry	dry	**	dry	148.88	dry	dry	dry	dry	dry
Well 39S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	dry	**	dry	150.10	dry	dry	dry	dry	150.12
Well 41S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 42S	dry	dry	**	dry	150.30	dry	dry	dry	***	150.31
Well 43S	dry	dry	**	dry	150.01	dry	dry	dry	***	149.68
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	dry	dry	**	dry	150.49	dry	dry	dry	***	150.53
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	dry	**	dry	dry	148.98	dry	dry	dry	dry	148.41
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	dry	**	dry	dry	148.87	dry	dry	dry	148.28	149.24
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/12/02	04/22/02	05/06/02	05/20/02	06/03/02	07/01/02	08/05/02	09/09/02	10/15/02	11/14/02
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	149.42	148.89	148.89	149.92	148.93	dry	dry	dry	dry	dry
Well 12S	149.34	dry	dry	149.92	dry	dry	dry	dry	dry	dry
Well 13S	dry	dry	dry	149.63	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	150.16	dry	dry	dry	dry	dry	dry
Well 15S	149.48	dry	dry	149.61	dry	dry	dry	dry	dry	dry
Well 16S	149.99	149.85	149.83	150.52	149.97	149.67	dry	dry	dry	dry
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	149.65	149.03	148.99	149.67	148.93	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	150.47	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	150.54	150.18	150.19	150.53	149.93	dry	dry	dry	dry	dry
Well 22S	150.52	dry	dry	150.50	dry	dry	dry	dry	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	150.61	dry	dry	150.58	dry	dry	dry	dry	dry	dry
Well 24S	dry	dry	dry	149.12	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	149.12	dry	dry	149.84	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	149.74	dry	dry	149.64	dry	**	dry	dry	dry	dry
Well 31S	150.15	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	150.38	dry	dry	150.27	dry	dry	dry	dry	dry	dry
Well 33S	150.50	dry	dry	150.38	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 35S	149.37	dry	dry	149.38	dry	**	dry	dry	dry	dry
Well 36S	150.10	dry	dry	149.99	dry	**	dry	dry	dry	dry
Well 37S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 38S	148.79	dry	dry	148.95	dry	dry	dry	dry	**	dry
Well 39S	dry	dry	dry	dry	*****	*****	*****	dry	**	dry
Well 40S	150.54	dry	150.12	150.40	dry	**	dry	dry	dry	dry
Well 41S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 42S	150.52	149.84	150.13	150.50	149.60	dry	dry	dry	dry	dry
Well 43S	150.53	149.57	149.61	150.52	dry	dry	dry	dry	dry	dry
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	150.68	150.26	150.24	150.61	150.01	dry	*****	dry	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	148.88	dry	dry	149.00	dry	dry	dry	dry	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	149.18	148.33	148.39	flooded	148.31	dry	dry	dry	dry	dry
Well 49S	*	*	*	*	*	*	*	dry	dry	dry
Well 50S	*	*	*	*	*	*	*	dry	dry	dry
Well 51S	*	*	*	*	*	*	*	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	12/16/02	01/15/03	02/11/03	03/12/03	04/17/03	05/01/03	05/15/03	05/30/03	06/11/03	07/09/03
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	dry	dry	dry	dry	dry	148.97	149.09	dry	dry	149.68
Well 12S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 13S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 16S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 22S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	dry	dry	frozen	dry	dry	dry	dry	dry	dry
Well 24S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 33S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	dry	dry	dry	dry	dry	148.76	dry	dry	dry
Well 36S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 37S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	dry	dry	dry	dry	dry	dry	148.65	dry	dry	dry
Well 39S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	dry	dry	dry	dry	dry	dry	*****	*****	dry
Well 41S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 43S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	dry	dry	dry	dry	dry	dry	148.74	dry	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	dry	dry	dry	dry	dry	dry	148.84	dry	dry	dry
Well 49S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/25/03	08/11/03	09/08/03	10/08/03	11/13/03	12/16/03	01/23/04	03/08/04	04/16/04	04/29/04
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	149.79	148.81	dry	dry	dry	148.89	dry	149.54	dry	dry
Well 12S	149.80	dry	dry	dry	dry	dry	dry	149.36	dry	dry
Well 13S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	149.25	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 16S	dry	dry	dry	dry	dry	dry	dry	dry	149.64	149.61
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	149.53	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	150.48	150.00	149.71	dry	dry	dry	dry	**	149.85	dry
Well 22S	150.45	dry	dry	dry	dry	dry	dry	**	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	150.51	dry	dry	dry	dry	dry	dry	**	dry	dry
Well 24S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	149.13	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	150.13	dry	dry	dry	dry	dry	dry	150.15	dry	dry
Well 33S	150.30	dry	dry	dry	dry	dry	dry	150.26	dry	dry
Well 34S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	149.29	dry	dry	dry	dry	dry	dry	148.94	dry	dry
Well 36S	149.63	dry	dry	dry	dry	dry	dry	149.77	dry	dry
Well 37S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	148.74	dry	dry	dry	dry	dry	dry	148.84	dry	dry
Well 39S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	150.24	dry	dry	dry	dry	dry	dry	149.99	dry	dry
Well 41S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	150.47	150.03	dry	dry	dry	dry	dry	**	149.52	dry
Well 43S	150.47	150.29	dry	dry	dry	149.51	dry	**	149.76	149.63
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	150.59	149.95	dry	dry	dry	dry	dry	**	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	148.81	dry	dry	dry	dry	dry	dry	148.85	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	flooded	dry	dry	dry	dry	dry	dry	148.89	dry	dry
Well 49S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	149.54	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D3 Water-Level Elevations in Soil-Zone and Very Shallow Wells *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	05/12/04	05/13/04	05/26/04	06/08/04	06/21/04	07/02/04	08/05/04	09/16/04	10/19/04	11/22/04
Well 1S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	**	dry	148.87	149.58	149.74	dry	dry	148.87	dry	dry
Well 12S	**	dry	dry	149.47	149.77	dry	dry	dry	dry	dry
Well 13S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	**	dry	dry	dry	149.96	dry	dry	dry	dry	dry
Well 15S	**	dry	dry	dry	149.31	dry	dry	dry	dry	dry
Well 16S	**	149.63	149.70	149.89	150.34	149.84	dry	149.70	dry	149.62
Well 17S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	**	dry	dry	149.24	149.57	dry	dry	dry	dry	dry
Well 19S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	**	149.76	149.89	150.47	150.46	150.01	dry	dry	dry	dry
Well 22S	**	dry	dry	150.43	150.44	dry	dry	dry	dry	dry
Well 22VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 23S	**	dry	dry	150.47	150.44	dry	dry	dry	dry	dry
Well 24S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 33S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	**	dry	148.50	149.08	dry	dry	dry	dry	dry
Well 36S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 37S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	**	dry	dry	dry	148.65	dry	dry	dry	dry	dry
Well 39S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	**	dry	150.09	149.97	dry	dry	dry	dry	dry
Well 41S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	**	dry	149.59	150.45	150.45	149.79	dry	dry	dry	dry
Well 43S	**	149.69	149.86	150.45	150.46	150.33	dry	150.02	dry	dry
Well 43VS	*	*	*	150.46	150.46	150.32	dry	150.06	dry	dry
Well 44S	**	dry	149.84	150.49	150.44	149.92	dry	dry	dry	dry
Well 44VS	*	*	*	150.51	150.47	dry	dry	dry	dry	dry
Well 45S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 46S	**	dry	dry	148.31	148.83	dry	dry	dry	dry	dry
Well 46VS	*	*	*	dry	148.87	dry	dry	dry	dry	dry
Well 47S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 48S	**	dry	dry	149.24	149.54	dry	dry	dry	dry	dry
Well 49S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	dry	**	dry	148.88	149.58	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

S indicates soil-zone monitoring well
VS indicates very shallow monitoring well

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells

	Depths to Water (in m referenced to land surface)									
Date	08/20/99	09/17/99	10/18/99	11/03/99	12/01/99	01/19/00	02/16/00	03/08/00	04/04/00	04/05/00
Well 1S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 10S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 11S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 12S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 13S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 14S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 15S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 16S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 17S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 18S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 19S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 20S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 21S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 22S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 24S	*	*	*	*	dry	dry	dry	dry	dry	**
Well 25S	*	*	*	*	*	*	*	*	0.74	**
Well 26S	*	*	*	*	*	*	*	*	dry	**
Well 27S	*	*	*	*	*	*	*	*	dry	**
Well 28S	*	*	*	*	*	*	*	*	dry	**
Well 29S	*	*	*	*	*	*	*	*	dry	**
Well 30S	*	*	*	*	*	*	*	*	dry	**
Well 31S	*	*	*	*	*	*	*	*	dry	**
Well 32S	*	*	*	*	*	*	*	*	dry	**
Well 33S	*	*	*	*	*	*	*	*	dry	**
Well 34S	*	*	*	*	*	*	*	*	dry	**
Well 35S	*	*	*	*	*	*	*	*	dry	**
Well 36S	*	*	*	*	*	*	*	*	dry	**
Well 37S	*	*	*	*	*	*	*	*	dry	**
Well 38S	*	*	*	*	*	*	*	*	**	0.76
Well 39S	*	*	*	*	*	*	*	*	**	dry
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	04/19/00	05/02/00	05/03/00	05/15/00	05/30/00	06/14/00	06/15/00	06/20/00	07/05/00	07/18/00
Well 1S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 10S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 11S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 12S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 13S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 14S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 15S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 16S	0.74	0.75	**	dry	dry	dry	**	**	**	**
Well 17S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 18S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 19S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 20S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 21S	dry	dry	**	dry	dry	**	dry	**	**	0.32
Well 22S	dry	dry	**	dry	dry	**	dry	**	**	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	**	dry	dry	dry	**	dry	**	**	dry
Well 24S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 25S	0.73	**	dry	dry	dry	dry	**	**	**	dry
Well 26S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 27S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 28S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 29S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 30S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 31S	0.77	**	dry	dry	dry	dry	**	**	**	dry
Well 32S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 33S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 34S	dry	**	dry	dry	dry	dry	**	**	**	dry
Well 35S	dry	**	dry	dry	dry	dry	**	**	**	**
Well 36S	0.71	dry	**	dry	dry	dry	**	**	**	**
Well 37S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 38S	dry	dry	**	0.76	dry	dry	**	**	**	**
Well 39S	dry	dry	**	dry	dry	dry	**	**	**	**
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	07/19/00	08/21/00	09/18/00	10/25/00	10/26/00	11/21/00	01/02/01	01/03/01	01/31/01	02/01/01
Well 1S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 10S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 11S	**0.00**	dry	dry	dry	**	dry	**	**	dry	**
Well 12S	0.42	dry	dry	dry	**	dry	**	**	dry	**
Well 13S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 14S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 15S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 16S	0.37	dry	dry	dry	**	dry	**	**	0.64	**
Well 17S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 18S	0.45	dry	dry	dry	**	dry	**	**	dry	**
Well 19S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 20S	dry	dry	dry	dry	**	dry	**	**	dry	**
Well 21S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 22S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	**	dry	dry	**	dry	dry	**	**	**	dry
Well 24S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 25S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 26S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 27S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 28S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 29S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 30S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 31S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 32S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 33S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 34S	**	dry	dry	**	dry	dry	dry	**	dry	**
Well 35S	dry	**	**	**	dry	dry	dry	**	dry	**
Well 36S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 37S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 38S	dry	dry	dry	**	dry	dry	dry	**	dry	**
Well 39S	dry	dry	dry	dry	**	dry	dry	**	dry	**
Well 40S	*	*	*	*	*	*	*	*	*	*
Well 41S	*	*	*	*	*	*	*	*	*	*
Well 42S	*	*	*	*	*	*	*	*	*	*
Well 43S	*	*	*	*	*	*	*	*	*	*
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	*	*	*	*	*	*	*	*	*
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	*	*	*	*	*	*	*
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	*	*	*	*	*	*	*
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	*	*	*	*	*	*	*
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	*	*	*	*	*	*	*
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	02/20/01	03/12/01	03/13/01	04/09/01	04/10/01	04/23/01	04/24/01	05/08/01	05/23/01	06/11/01
Well 1S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 10S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 11S	**	**	0.49	dry	**	dry	**	dry	dry	**-0.19**
Well 12S	**	**	0.71	dry	**	dry	**	dry	dry	**0.15**
Well 13S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 14S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 15S	**	**	dry	dry	**	dry	**	dry	dry	0.64
Well 16S	**	**	dry	0.56	**	0.55	**	0.65	dry	0.45
Well 17S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 18S	**	**	0.51	dry	**	dry	**	dry	dry	**0.05**
Well 19S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 20S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 21S	**	0.74	**	**	dry	**	dry	dry	dry	**-0.12**
Well 22S	**	dry	**	**	0.68	**	dry	dry	dry	0.48
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	**	dry	**	**	dry	**	dry	dry	dry	0.52
Well 24S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 25S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 26S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 27S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 28S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 29S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 30S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 31S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 32S	**	**	dry	dry	**	dry	**	dry	dry	0.42
Well 33S	**	**	dry	dry	**	dry	**	dry	dry	0.52
Well 34S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 35S	**	**	dry	dry	**	dry	**	dry	dry	**0.16**
Well 36S	**	**	dry	dry	**	dry	**	dry	dry	0.48
Well 37S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 38S	**	**	dry	dry	**	dry	**	dry	dry	0.59
Well 39S	**	**	dry	dry	**	dry	**	dry	dry	dry
Well 40S	*	dry	**	dry	**	**	dry	dry	dry	**0.22**
Well 41S	*	dry	**	dry	**	**	dry	dry	dry	dry
Well 42S	*	**	0.35	**	dry	**	dry	dry	dry	**-0.28**
Well 43S	*	**	0.61	**	dry	**	dry	dry	dry	**-0.31**
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	*	**	**0.10**	**	0.67	**	dry	dry	dry	**-0.25**
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	*	*	*	dry	**	dry	**	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	*	*	*	dry	**	dry	**	dry	dry	**0.06**
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	*	*	*	dry	**	dry	**	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	*	*	*	dry	**	dry	**	dry	dry	flooded
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	06/25/01	08/02/01	08/03/01	09/11/01	10/23/01	11/27/01	12/11/01	01/24/02	02/28/02	03/18/02
Well 1S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	dry	**	dry	dry	**0.23**	dry	dry	dry	dry	**-0.11**
Well 12S	dry	**	dry	dry	0.54	dry	dry	dry	dry	**0.25**
Well 13S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	dry	**	dry	dry	0.67	dry	dry	dry	dry	dry
Well 16S	0.60	**	dry	dry	0.39	0.61	0.67	dry	0.54	0.43
Well 17S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	dry	**	dry	dry	**0.22**	dry	dry	dry	0.70	**0.19**
Well 19S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	dry	dry	**	dry	**-0.03**	dry	dry	dry	***	**-0.09**
Well 22S	dry	dry	**	dry	0.55	dry	dry	dry	***	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	dry	**	dry	0.58	dry	dry	dry	***	0.60
Well 24S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	**	***	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	dry	**	dry	0.51	dry	dry	dry	dry	0.62
Well 33S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	dry	**	dry	**0.25**	dry	dry	dry	dry	0.38
Well 36S	dry	dry	**	**	0.62	dry	dry	dry	dry	dry
Well 37S	dry	dry	**	**	dry	dry	dry	dry	dry	dry
Well 38S	dry	dry	**	dry	**0.20**	dry	dry	dry	dry	dry
Well 39S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	dry	**	dry	0.50	dry	dry	dry	dry	0.48
Well 41S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
Well 42S	dry	dry	**	dry	**-0.11**	dry	dry	dry	***	**-0.12**
Well 43S	dry	dry	**	dry	**0.16**	dry	dry	dry	***	0.50
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	dry	dry	**	dry	**-0.10**	dry	dry	dry	***	**-0.14**
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	dry	**	dry	dry	**0.01**	dry	dry	dry	dry	0.58
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	dry	**	dry	dry	**0.05**	dry	dry	dry	0.64	**-0.32**
Well 49S	*	*	*	*	*	*	*	*	*	*
Well 50S	*	*	*	*	*	*	*	*	*	*
Well 51S	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	04/12/02	04/22/02	05/06/02	05/20/02	06/03/02	07/01/02	08/05/02	09/09/02	10/15/02	11/14/02
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	**0.11**	0.64	0.64	**-0.39**	0.60	dry	dry	dry	dry	dry
Well 12S	0.46	dry	dry	**-0.12**	dry	dry	dry	dry	dry	dry
Well 13S	dry	dry	dry	0.51	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	0.46	dry	dry	dry	dry	dry	dry
Well 15S	0.45	dry	dry	0.31	dry	dry	dry	dry	dry	dry
Well 16S	0.31	0.45	0.46	**-0.23**	0.33	0.63	dry	dry	dry	dry
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	**-0.09**	0.53	0.58	**-0.11**	0.63	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	0.32	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	**-0.19**	**0.18**	**0.17**	**-0.18**	0.43	dry	dry	dry	dry	dry
Well 22S	0.39	dry	dry	0.41	dry	dry	dry	dry	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	0.45	dry	dry	0.48	dry	dry	dry	dry	dry	dry
Well 24S	dry	dry	dry	0.66	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	0.72	dry	dry	**0.00**	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	0.58	dry	dry	0.69	dry	**	dry	dry	dry	dry
Well 31S	0.62	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	**0.19**	dry	dry	0.30	dry	dry	dry	dry	dry	dry
Well 33S	0.34	dry	dry	0.45	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 35S	**-0.23**	dry	dry	**-0.25**	dry	**	dry	dry	dry	dry
Well 36S	**0.11**	dry	dry	**0.22**	dry	**	dry	dry	dry	dry
Well 37S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 38S	**0.29**	dry	dry	**0.13**	dry	dry	dry	dry	**	dry
Well 39S	dry	dry	dry	dry	*****	*****	*****	dry	**	dry
Well 40S	**0.07**	dry	0.49	**0.20**	dry	**	dry	dry	dry	dry
Well 41S	dry	dry	dry	dry	dry	**	dry	dry	dry	dry
Well 42S	**-0.33**	0.35	**0.06**	**-0.31**	0.59	dry	dry	dry	dry	dry
Well 43S	**-0.36**	0.60	0.56	**-0.34**	dry	dry	dry	dry	dry	dry
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	**-0.29**	**0.13**	**0.15**	**-0.22**	0.37	dry	*****	dry	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	**0.10**	dry	dry	**-0.01**	dry	dry	dry	dry	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	**-0.26**	0.59	0.52	flooded	0.60	dry	dry	dry	dry	dry
Well 49S	*	*	*	*	*	*	*	dry	dry	dry
Well 50S	*	*	*	*	*	*	*	dry	dry	dry
Well 51S	*	*	*	*	*	*	*	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	12/16/02	01/15/03	02/11/03	03/12/03	04/17/03	05/01/03	05/15/03	05/30/03	06/11/03	07/09/03
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	dry	dry	dry	dry	dry	0.59	0.47	dry	dry	**-0.15**
Well 12S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 13S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 16S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 22S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	dry	dry	dry	frozen	dry	dry	dry	dry	dry	dry
Well 24S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 33S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	dry	dry	dry	dry	dry	0.35	dry	dry	dry
Well 36S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 37S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	dry	dry	dry	dry	dry	dry	0.42	dry	dry	dry
Well 39S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	dry	dry	dry	dry	dry	dry	*****	*****	dry
Well 41S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 43S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	dry	dry	dry	dry	dry	dry	**0.17**	dry	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	dry	dry	dry	dry	dry	dry	**0.08**	dry	dry	dry
Well 49S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	07/25/03	08/11/03	09/08/03	10/08/03	11/13/03	12/16/03	01/23/04	03/08/04	04/16/04	04/29/04
Well 1S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	**-0.26**	0.72	dry	dry	dry	0.64	dry	**-0.01**	dry	dry
Well 12S	**-0.02**	dry	dry	dry	dry	dry	dry	0.42	dry	dry
Well 13S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 15S	0.64	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 16S	dry	dry	dry	dry	dry	dry	dry	dry	0.64	0.67
Well 17S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	**0.01**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	**-0.11**	0.37	0.66	dry	dry	dry	dry	**	0.52	dry
Well 22S	0.51	dry	dry	dry	dry	dry	dry	**	dry	dry
Well 22VS	*	*	*	*	*	*	*	*	*	*
Well 23S	0.57	dry	dry	dry	dry	dry	dry	**	dry	dry
Well 24S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	0.71	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	0.46	dry	dry	dry	dry	dry	dry	0.45	dry	dry
Well 33S	0.56	dry	dry	dry	dry	dry	dry	0.59	dry	dry
Well 34S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	**-0.17**	dry	dry	dry	dry	dry	dry	**0.18**	dry	dry
Well 36S	0.61	dry	dry	dry	dry	dry	dry	0.46	dry	dry
Well 37S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	0.37	dry	dry	dry	dry	dry	dry	**0.27**	dry	dry
Well 39S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	0.31	dry	dry	dry	dry	dry	dry	0.56	dry	dry
Well 41S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	**-0.32**	**0.13**	dry	dry	dry	dry	dry	**	0.63	dry
Well 43S	**-0.32**	**-0.14**	dry	dry	dry	0.65	dry	**	0.39	0.53
Well 43VS	*	*	*	*	*	*	*	*	*	*
Well 44S	**-0.16**	0.48	dry	dry	dry	dry	dry	**	dry	dry
Well 44VS	*	*	*	*	*	*	*	*	*	*
Well 45S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	*	*	*	*	*	*	*
Well 46S	**0.16**	dry	dry	dry	dry	dry	dry	**0.12**	dry	dry
Well 46VS	*	*	*	*	*	*	*	*	*	*
Well 47S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	*	*	*	*	*	*	*
Well 48S	flooded	dry	dry	dry	dry	dry	dry	**0.00**	dry	dry
Well 49S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	**-0.03**	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table D4 Depths to Water in Soil-Zone and Very Shallow Wells *(continued)*

	Depths to Water (in m referenced to land surface)									
Date	05/12/04	05/13/04	05/26/04	06/08/04	06/21/04	07/02/04	08/05/04	09/16/04	10/19/04	11/22/04
Well 1S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 10S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 11S	**	dry	0.66	**-0.05**	**-0.21**	dry	dry	0.67	dry	dry
Well 12S	**	dry	dry	0.32	**0.01**	dry	dry	dry	dry	dry
Well 13S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 14S	**	dry	dry	dry	0.66	dry	dry	dry	dry	dry
Well 15S	**	dry	dry	dry	0.59	dry	dry	dry	dry	dry
Well 16S	**	0.65	0.58	0.40	**-0.06**	0.44	dry	0.58	dry	0.67
Well 17S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 18S	**	dry	dry	0.30	**-0.03**	dry	dry	dry	dry	dry
Well 19S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 20S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 21S	**	0.61	0.48	**-0.09**	**-0.09**	0.36	dry	dry	dry	dry
Well 22S	**	dry	dry	0.53	0.51	dry	dry	dry	dry	dry
Well 22VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 23S	**	dry	dry	0.61	0.64	dry	dry	dry	dry	dry
Well 24S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 26S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 27S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 28S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 29S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 30S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 31S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 32S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 33S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 34S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 35S	dry	**	dry	0.61	**0.04**	dry	dry	dry	dry	dry
Well 36S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 37S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 38S	**	dry	dry	dry	0.47	dry	dry	dry	dry	dry
Well 39S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 40S	dry	**	dry	0.46	0.58	dry	dry	dry	dry	dry
Well 41S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 42S	**	dry	0.56	**-0.30**	**-0.29**	0.36	dry	dry	dry	dry
Well 43S	**	0.46	**0.30**	**-0.29**	**-0.31**	**-0.18**	dry	**0.14**	dry	dry
Well 43VS	*	*	*	**-0.30**	**-0.30**	**-0.17**	dry	**0.10**	dry	dry
Well 44S	**	dry	0.59	**-0.06**	**-0.02**	0.50	dry	dry	dry	dry
Well 44VS	*	*	*	**-0.09**	**-0.05**	dry	dry	dry	dry	dry
Well 45S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 45VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 46S	**	dry	dry	0.65	**0.13**	dry	dry	dry	dry	dry
Well 46VS	*	*	*	dry	**0.10**	dry	dry	dry	dry	dry
Well 47S	**	dry	dry	dry	dry	dry	dry	dry	dry	dry
Well 47VS	*	*	*	dry	dry	dry	dry	dry	dry	dry
Well 48S	**	dry	dry	**-0.35**	**-0.65**	dry	dry	dry	dry	dry
Well 49S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 50S	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
Well 51S	dry	**	dry	0.63	**-0.07**	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

– indicates water above land surface
S indicates soil-zone monitoring well
VS indicates very shallow monitoring well
bold values less than or equal to 0.304 m

APPENDIX D Water-Level Elevations and Depths to Water

Table A5 Water-Level Elevations on Stage Gauges

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	08/20/99	09/17/99	10/18/99	11/03/99	12/01/99	01/19/00	02/16/00	03/08/00	04/04/00	04/05/00
Gauge SW1f	*	*	*	*	*	*	*	*	*	*
Gauge SW2A	*	*	*	*	*	*	*	*	*	0
Gauge SW3f	*	*	*	*	*	*	*	*	*	*
Gauge SW4f	*	*	*	*	*	*	*	*	*	*
Gauge SW5f	*	*	*	*	*	*	*	*	**	dry
Gauge SW6f	*	*	*	*	*	*	*	*	**	147.74
Gauge SW7f	*	*	*	*	*	*	*	*	*	*
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/19/00	05/02/00	05/03/00	05/15/00	05/30/00	06/14/00	06/15/00	06/20/00	07/05/00	07/18/00
Gauge SW1f	*	*	*	*	147.90	***	***	**	148.37	147.78
Gauge SW2A	*	148.33	**	148.44	148.63	149.65	**	**	148.58	148.38
Gauge SW3f	*	*	*	*	149.02	**	flooded	**	148.93	148.83
Gauge SW4f	*	*	*	*	147.87	***	***	147.74	148.32	147.75
Gauge SW5f	149.71	dry	**	dry	dry	149.71	**	**	**	149.88
Gauge SW6f	147.78	147.65	**	147.75	147.95	flooded	**	**	148.35	**
Gauge SW7f	*	*	*	*	*	*	*	*	*	*
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/19/00	08/21/00	09/18/00	10/25/00	10/26/00	11/21/00	01/02/01	01/03/01	01/31/01	02/01/01
Gauge SW1f	**	147.34	147.46	**	147.36	147.52	**	**	***	**
Gauge SW2A	**	147.89	147.87	**	147.89	148.29	**	**	150.00	**
Gauge SW3f	**	dry	dry	**	dry	148.70	**	**	**	flooded
Gauge SW4f	**	147.34	147.60	**	147.35	147.56	**	**	flooded	**
Gauge SW5f	**	149.77	dry	dry	**	frozen	frozen	**	150.02	**
Gauge SW6f	147.66	147.36	147.47	147.35	**	147.50	**	**	flooded	**
Gauge SW7f	*	*	*	*	*	*	*	*	*	*
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

f indicates staff gauge
Lf indicates lower staff gauge
A indicates spot on bridge

APPENDIX D Water-Level Elevations and Depths to Water

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	02/20/01	03/12/01	03/13/01	04/09/01	04/10/01	04/23/01	04/24/01	05/08/01	05/23/01	06/11/01
Gauge SW1f	148.25	147.87	**	**	147.65	**	147.87	147.47	147.46	***
Gauge SW2A	**	**	148.87	148.69	**	148.85	**	148.40	148.39	149.42
Gauge SW3f	flooded	149.21	**	**	149.14	**	149.33	148.87	148.87	flooded
Gauge SW4f	flooded	*****	*****	*****	*****	*****	*****	*****	*****	*****
Gauge SW5f	**	**	149.95	149.93	**	149.91	**	149.89	149.85	149.91
Gauge SW6f	flooded	**	148.05	147.94	**	148.28	**	147.73	147.71	flooded
Gauge SW7f	150.33	150.21	**	dry	**	**	dry	dry	dry	150.49
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	06/25/01	08/02/01	08/03/01	09/11/01	10/23/01	11/27/01	12/11/01	01/24/02	02/28/02	03/18/02
Gauge SW1f	147.43	147.86	**	147.46	***	147.46	147.44	147.50	147.78	148.02
Gauge SW2A	148.37	147.91	**	147.98	149.77	148.49	148.54	**	148.88	149.07
Gauge SW3f	148.83	dry	**	148.28	flooded	148.55	148.91	frozen	***	149.47
Gauge SW4f	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
Gauge SW5f	149.86	149.79	**	dry	149.95	149.92	149.92	149.89	149.91	149.95
Gauge SW6f	147.72	**	148.18	147.48	flooded	147.56	147.60	147.59	148.10	148.26
Gauge SW7f	dry	dry	**	dry	150.36	dry	dry	dry	dry	150.43
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	04/12/02	04/22/02	05/06/02	05/20/02	06/03/02	07/01/02	08/05/02	09/09/02	10/15/02	11/14/02
Gauge SW1f	flooded	148.07	147.97	flooded	147.71	147.50	147.44	147.33	147.32	147.33
Gauge SW2A	149.71	149.04	149.05	149.53	148.55	148.25	148.25	147.84	147.81	147.86
Gauge SW3f	flooded	149.45	149.49	flooded	148.95	148.66	dry	148.20	148.24	148.30
Gauge SW4f	flooded	****	****	flooded	****	****	****	****	****	****
Gauge SW5f	149.94	149.92	149.92	149.92	149.91	**	149.79	dry	dry	dry
Gauge SW6f	flooded	148.21	148.23	flooded	147.75	147.58	147.65	****	****	****
Gauge SW7f	150.57	dry	150.40	150.52	dry	**	dry	dry	dry	dry
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

f indicates staff gauge
Lf indicates lower staff gauge
A indicates spot on bridge

APPENDIX D Water-Level Elevations and Depths to Water

Table A5 Water-Level Elevations on Stage Gauges

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	12/16/02	01/15/03	02/11/03	03/12/03	04/17/03	05/01/03	05/15/03	05/30/03	06/11/03	07/09/03
Gauge SW1f	**	frozen	frozen	147.32	147.28	147.95	148.34	147.68	147.44	flooded
Gauge SW2A	frozen	frozen	frozen	147.89	147.92	148.10	148.88	148.70	148.14	149.02
Gauge SW3f	frozen	frozen	frozen	148.30	148.27	148.37	149.20	149.11	148.54	149.55
Gauge SW4f	****	****	****	****	****	****	****	****	****	****
Gauge SW5f	dry	dry	dry	dry	dry	dry	150.09	dry	dry	149.74
Gauge SW6f	****	****	****	****	****	****	****	****	****	****
Gauge SW7f	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Gauge SW7Lf	*	*	*	*	*	*	*	*	*	dry

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	07/25/03	08/11/03	09/08/03	10/08/03	11/13/03	12/16/03	01/23/04	03/08/04	04/16/04	04/29/04
Gauge SW1f	flooded	147.40	147.42	147.33	147.37	147.89	dry	flooded	147.51	147.40
Gauge SW2A	149.02	148.06	147.94	147.82	148.08	148.75	frozen	149.56	148.41	148.81
Gauge SW3f	149.29	148.40	148.27	148.23	148.48	149.14	frozen	**	148.83	149.31
Gauge SW4f	****	****	****	****	****	****	****	****	****	****
Gauge SW5f	149.89	149.81	dry	dry	dry	frozen	frozen	149.83	149.81	149.81
Gauge SW6f	****	****	****	****	****	****	****	****	****	****
Gauge SW7f	150.44	dry	dry	dry	dry	dry	dry	dry	dry	dry
Gauge SW7Lf	flooded	149.65	dry	dry	dry	frozen	frozen	flooded	149.48	149.26

Table A5 Water-Level Elevations on Stage Gauges *(continued)*

	Water-Level Elevations (in m referenced to NAVD, 1988)									
Date	05/12/04	05/13/04	05/26/04	06/08/04	06/21/04	07/02/04	08/05/04	09/16/04	10/19/04	11/22/04
Gauge SW1f	147.43	**	148.25	147.92	flooded	147.35	147.64	147.34	147.26	147.51
Gauge SW2A	148.88	**	149.11	148.81	148.68	148.21	148.53	148.07	148.22	148.78
Gauge SW3f	**	149.38	149.63	149.33	149.04	148.56	149.01	148.40	148.64	149.28
Gauge SW4f	****	****	****	****	****	****	****	****	****	****
Gauge SW5f	149.82	**	149.81	149.80	149.80	149.83	dry	149.84	149.76	149.88
Gauge SW6f	****	****	****	****	****	****	****	****	****	****
Gauge SW7f	dry	**	dry	150.36	150.32	dry	dry	dry	dry	dry
Gauge SW7Lf	149.34	**	149.46	flooded	flooded	149.78	dry	149.12	dry	149.24

* not yet installed
** no measurement
*** inaccessible due to high water
**** discontinued
***** damaged

f indicates staff gauge
Lf indicates lower staff gauge
A indicates spot on bridge

APPENDIX E Charts of Water-Level Elevations and Depths to Water

Section E1 2000 Monitoring Period

Chart E1	2000-1A	Water-level elevations in upper and lower wells
	2000-1B	Depths to water in upper and lower wells
Chart E1	2000-2A	Water-level elevations in soil-zone wells 1 through 24
	2000-2B	Depths to water in soil-zone wells 1 through 24
Chart E1	2000-3A	Water-level elevations in soil-zone wells 25 through 39
	2000-3B	Depths to water in soil-zone wells 25 through 39
Chart E1	2000-4	Water-level elevations on stage gauges
Chart E1	2000-5	Water-level elevations on stage gauges and loggers

Section E2 2001 Monitoring Period

Chart E2	2001-1A	Water-level elevations in upper and lower wells
	2001-1B	Depths to water in upper and lower wells
Chart E2	2001-2A	Water-level elevations south of the Mazon River
	2001-2B	Depths to water south of the Mazon River
Chart E2	2001-3A	Water-level elevations north of the Mazon River
	2001-3B	Depths to water north of the Mazon River
Chart E2	2001-4A	Water-level elevations in the east field and near the natural slough
	2001-4B	Depths to water in the east field and near the natural slough
Chart E2	2001-5A	Water-level elevations near the Illinois River floodplain forest
	2001-5B	Depths to water near the Illinois River floodplain forest
Chart E2	2001-6	Water-level elevations on stage gauges

Section E3 2002 Monitoring Period

Chart E3	2002-1A	Water-level elevations in upper and lower wells
	2002-1B	Depths to water in upper and lower wells
Chart E3	2002-2A	Water-level elevations south of the Mazon River
	2002-2B	Depths to water south of the Mazon River
Chart E3	2002-3A	Water-level elevations north of the Mazon River
	2002-3B	Depths to water north of the Mazon River
Chart E3	2002-4A	Water-level elevations in the east field and near the natural slough
	2002-4B	Depths to water in the east field and near the natural slough
Chart E3	2002-5A	Water-level elevations near the Illinois River floodplain forest
	2002-5B	Depths to water near the Illinois River floodplain forest
Chart E3	2002-6	Water-level elevations on stage gauges

Section E4 2003 Monitoring Period

Chart E4	2003-1A	Water-level elevations in upper and lower wells
	2003-1B	Depths to water in upper and lower wells
Chart E4	2003-2A	Water-level elevations south of the Mazon River
	2003-2B	Depths to water south of the Mazon River
Chart E4	2003-3A	Water-level elevations north of the Mazon River
	2003-3B	Depths to water north of the Mazon River
Chart E4	2003-4A	Water-level elevations in the east field and near the natural slough
	2003-4B	Depths to water in the east field and near the natural slough

Section E4 2003 Monitoring Period *(continued)*

Chart E4	2003-5A	Water-level elevations near the Illinois River floodplain forest
	2003-5B	Depths to water near the Illinois River floodplain forest
Chart E4	2003-6	Water-level elevations on stage gauges
Chart E4	2003-7	Water-level elevations near the natural slough

Section E5 2004 Monitoring Period

Chart E5	2004-1A	Water-level elevations in upper and lower wells
	2004-1B	Depths to water in upper and lower wells
Chart E5	2004-2A	Water-level elevations south of the Mazon River
	2004-2B	Depths to water south of the Mazon River
Chart E5	2004-3A	Water-level elevations north of the Mazon River
	2004-3B	Depths to water north of the Mazon River
Chart E5	2004-4A	Water-level elevations in the east field and near the natural slough
	2004-4B	Depths to water in the east field and near the natural slough
Chart E5	2004-5A	Water-level elevations near the Illinois River floodplain forest
	2004-5B	Depths to water near the Illinois River floodplain forest
Chart E5	2004-6	Water-level elevations on stage gauges
Chart E5	2004-7	Water-level elevations near the natural slough

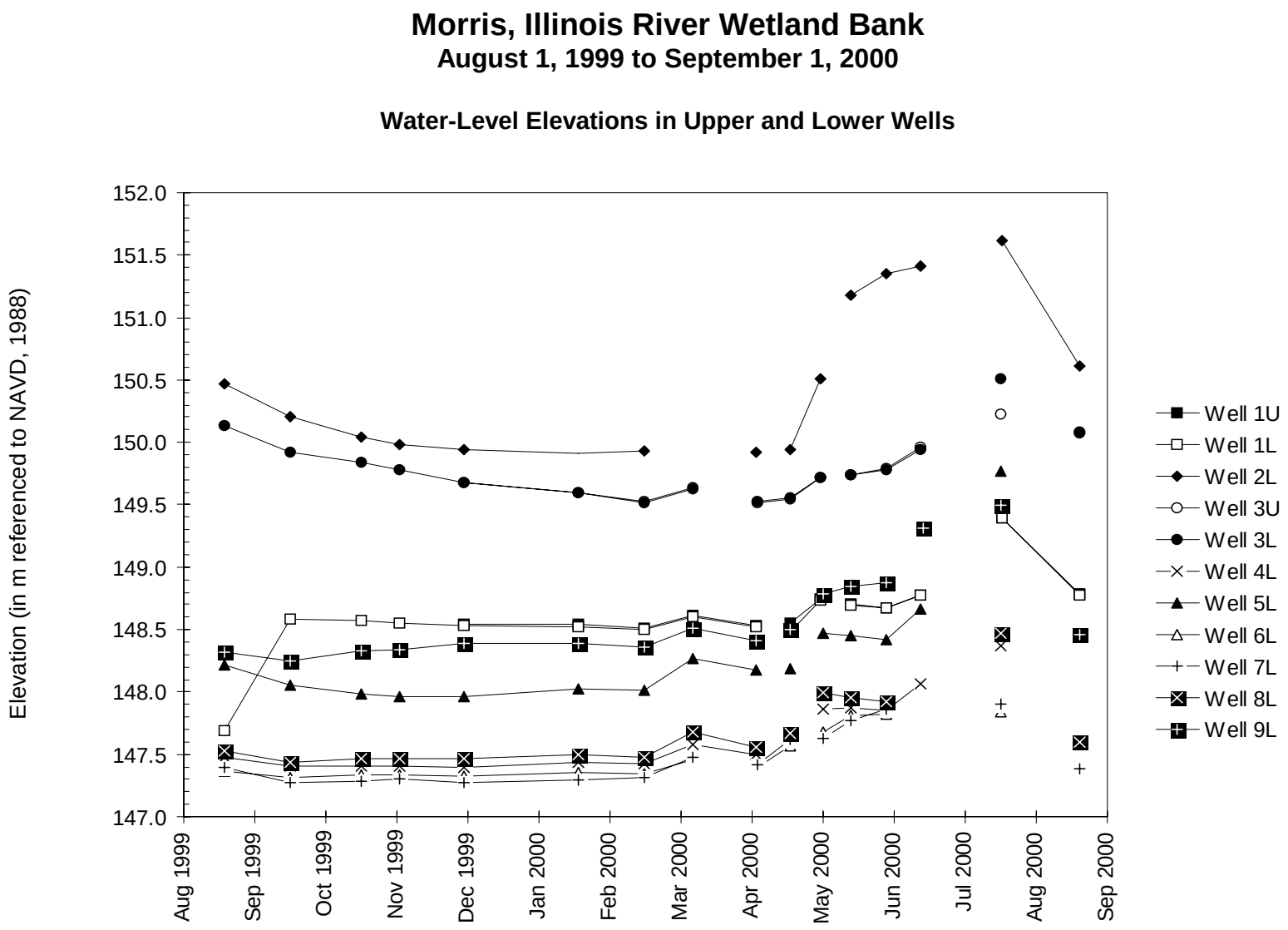


Chart E1 2000-1A Water-level elevations in upper and lower wells

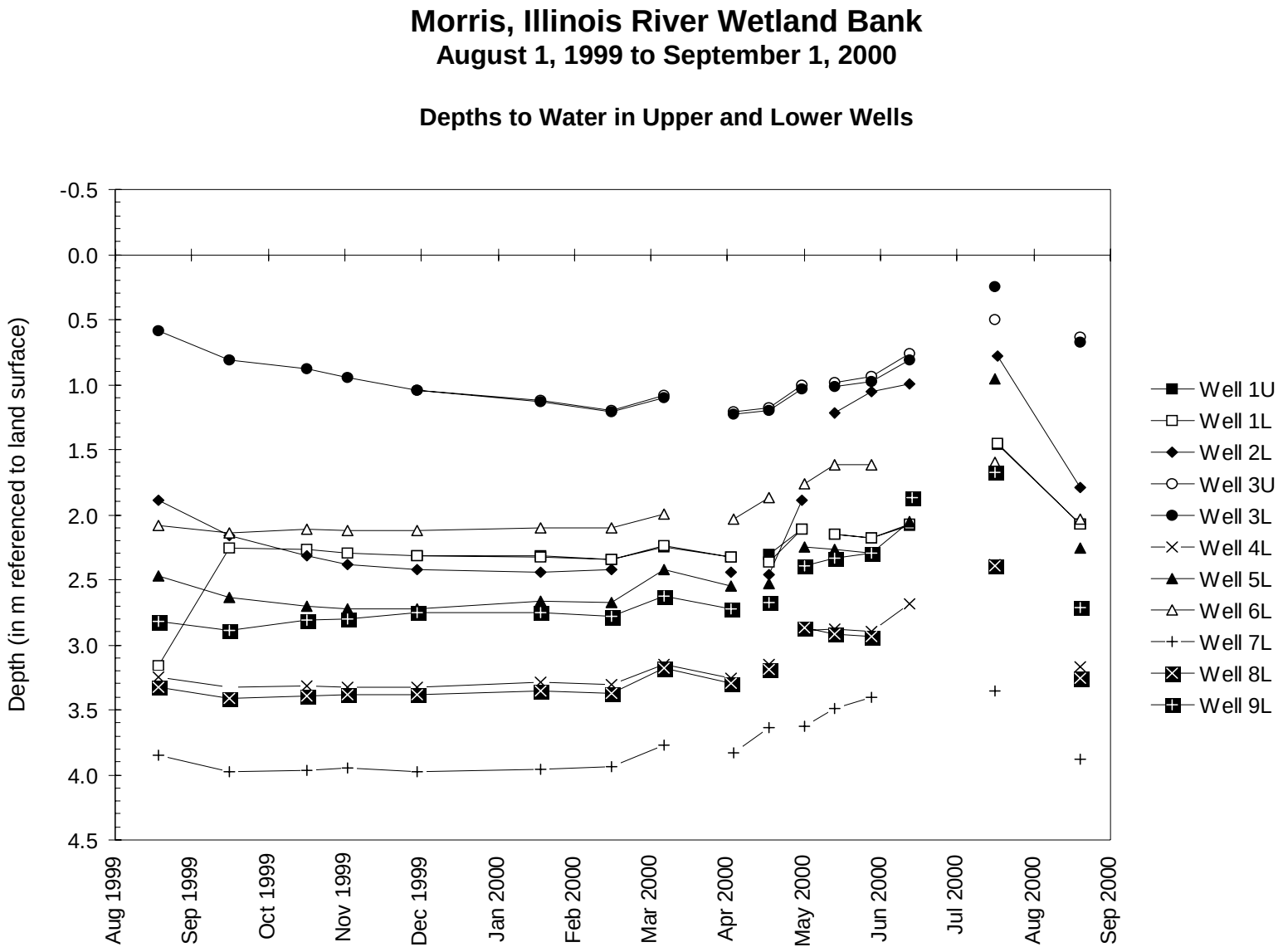


Chart E1 2000-1B Depths to water in upper and lower wells

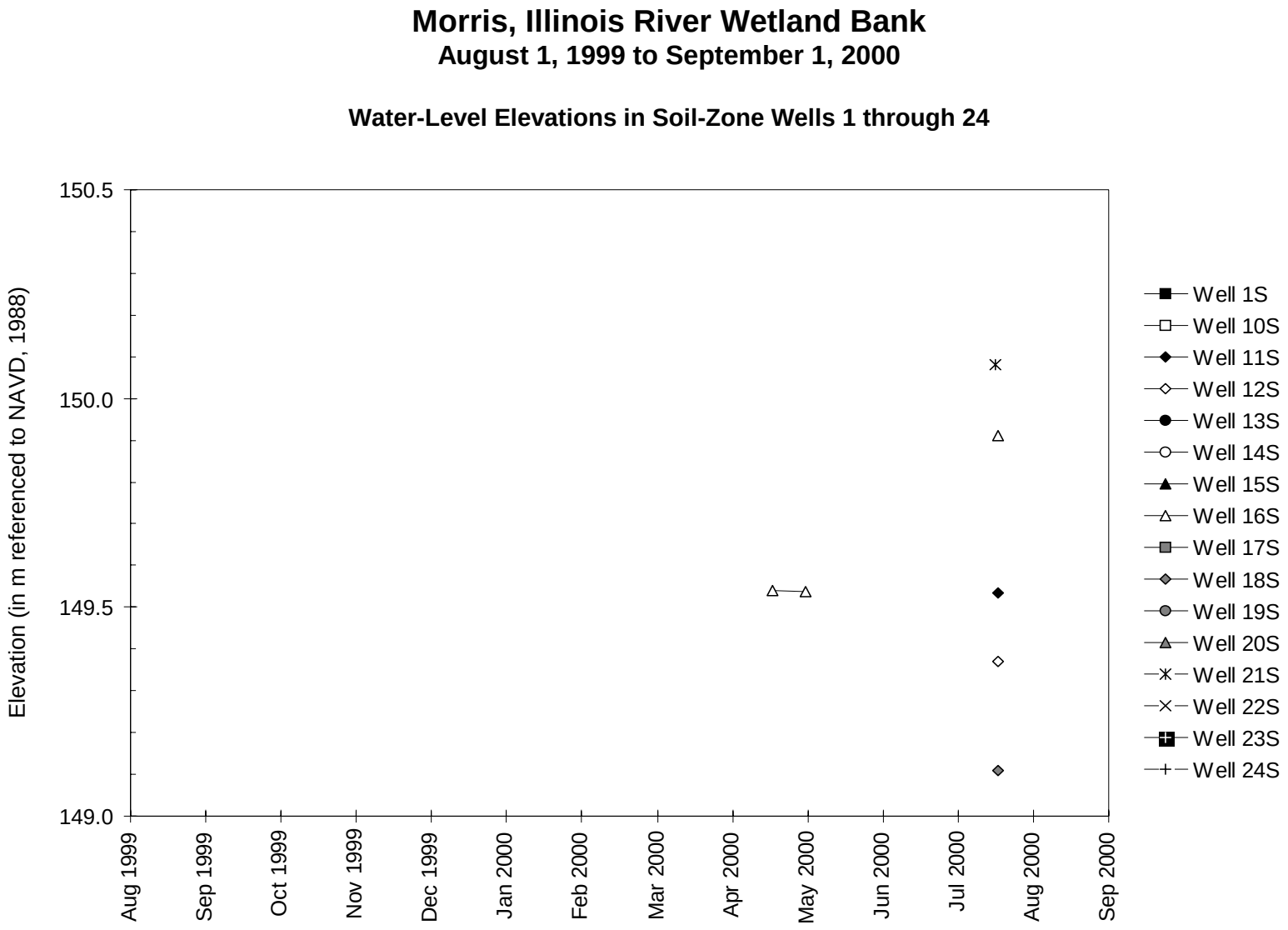


Chart E1 2000-2A Water-level elevations in soil-zone wells 1 through 24

Morris, Illinois River Wetland Bank
August 1, 1999 to September 1, 2000

Depths to Water in Soil-Zone Wells 1 through 24

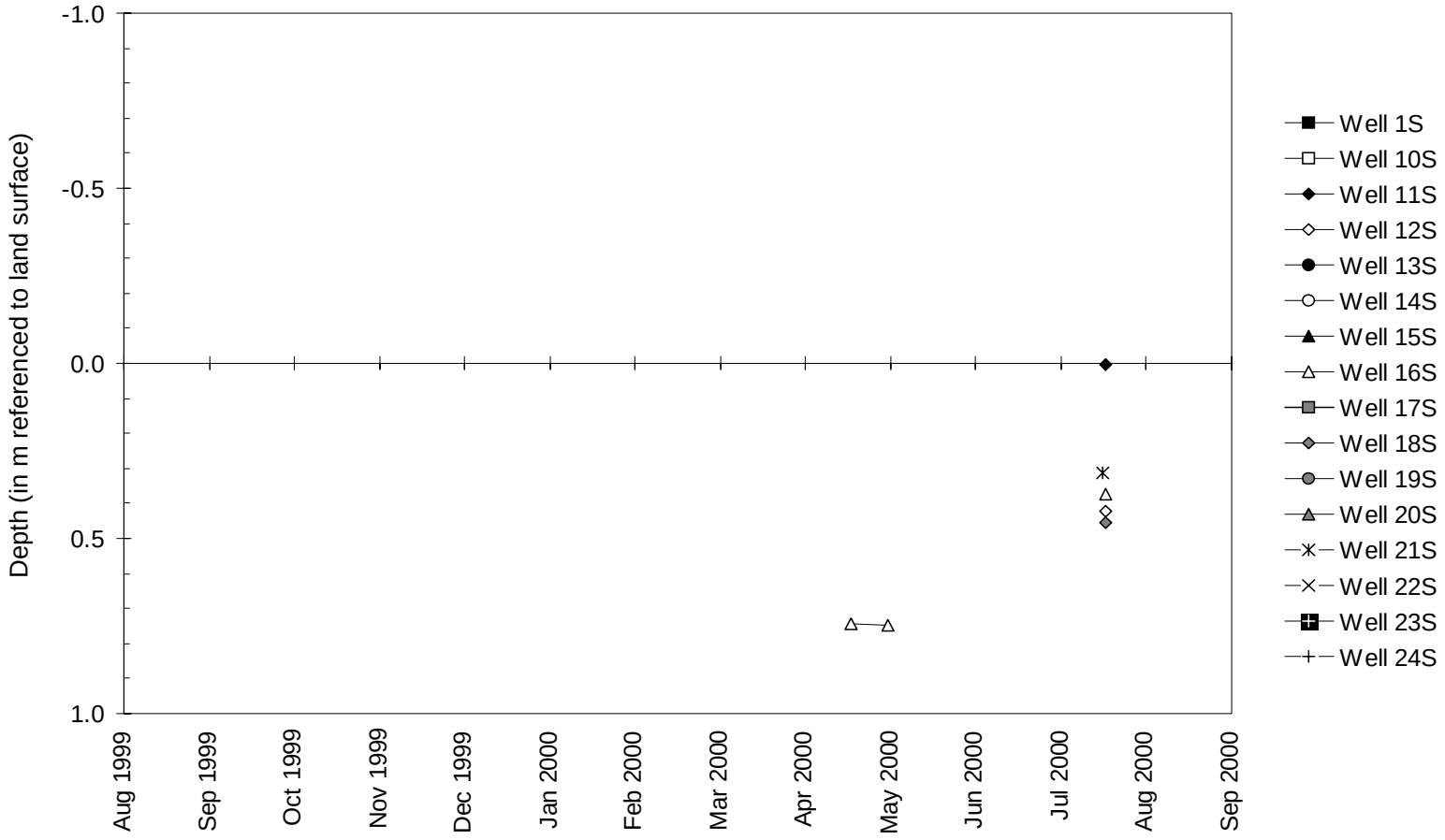


Chart E1 2000-2B Depths to water in soil-zone wells 1 through 24

Morris, Illinois River Wetland Bank
August 1, 1999 to September 1, 2000

Water-Level Elevations in Soil-Zone Wells 25 through 39

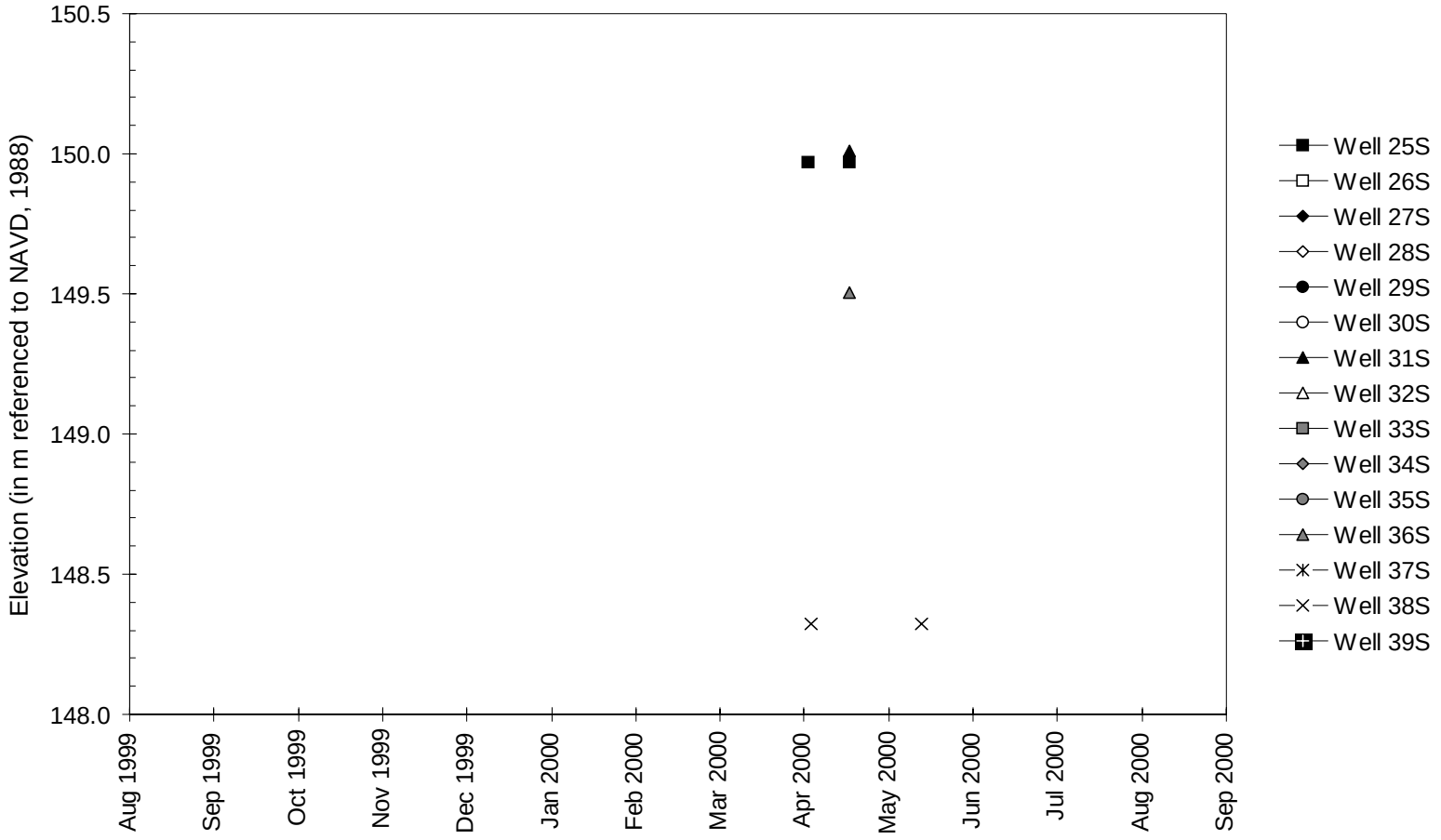


Chart E1 2000-3A Water-level elevations in soil-zone wells 25 through 39

Morris, Illinois River Wetland Bank
August 1, 1999 to September 1, 2000

Depths to Water in Soil-Zone Wells 25 through 39

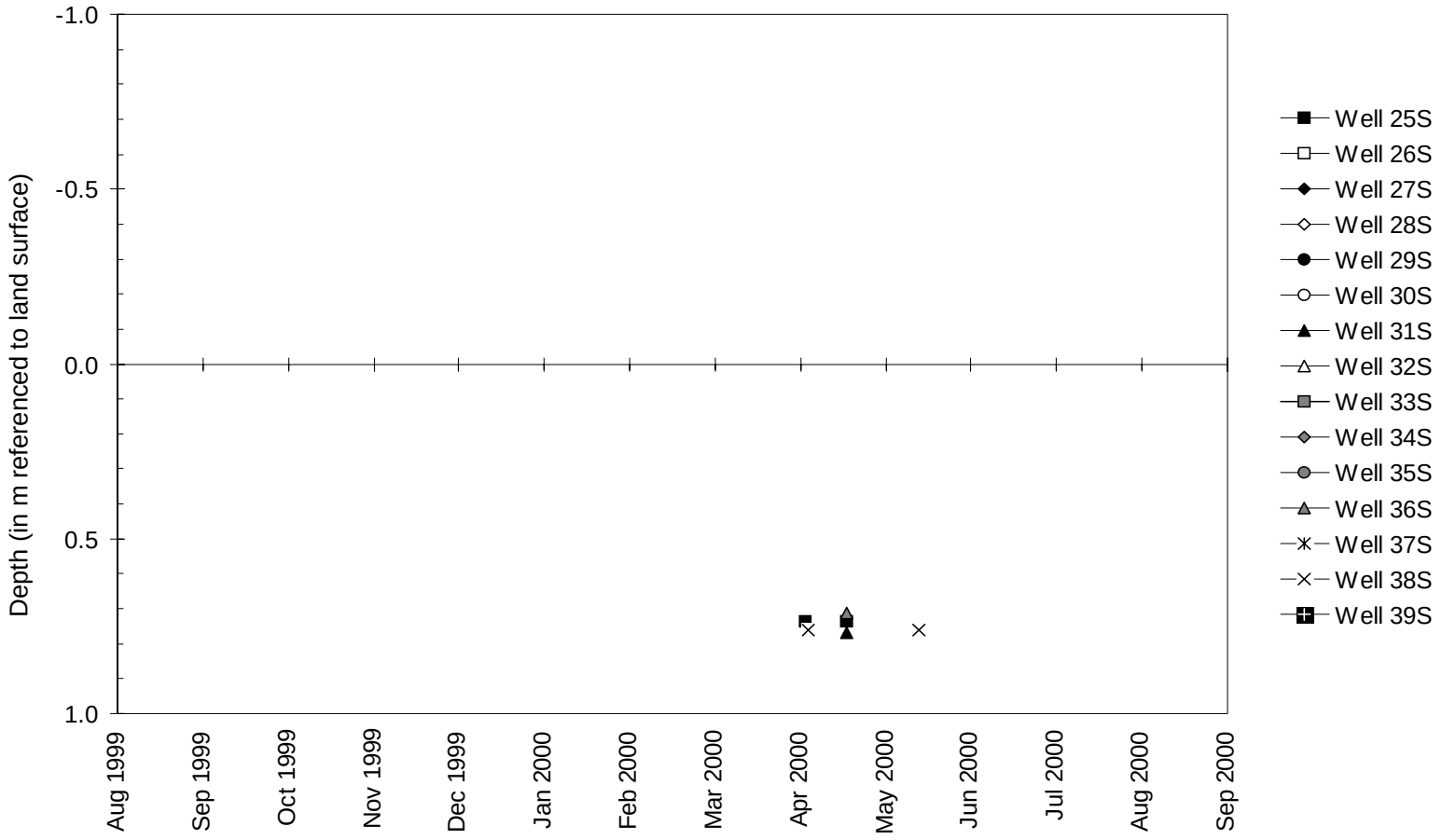


Chart E1 2000-3B Depths to water in soil-zone wells 25 through 39

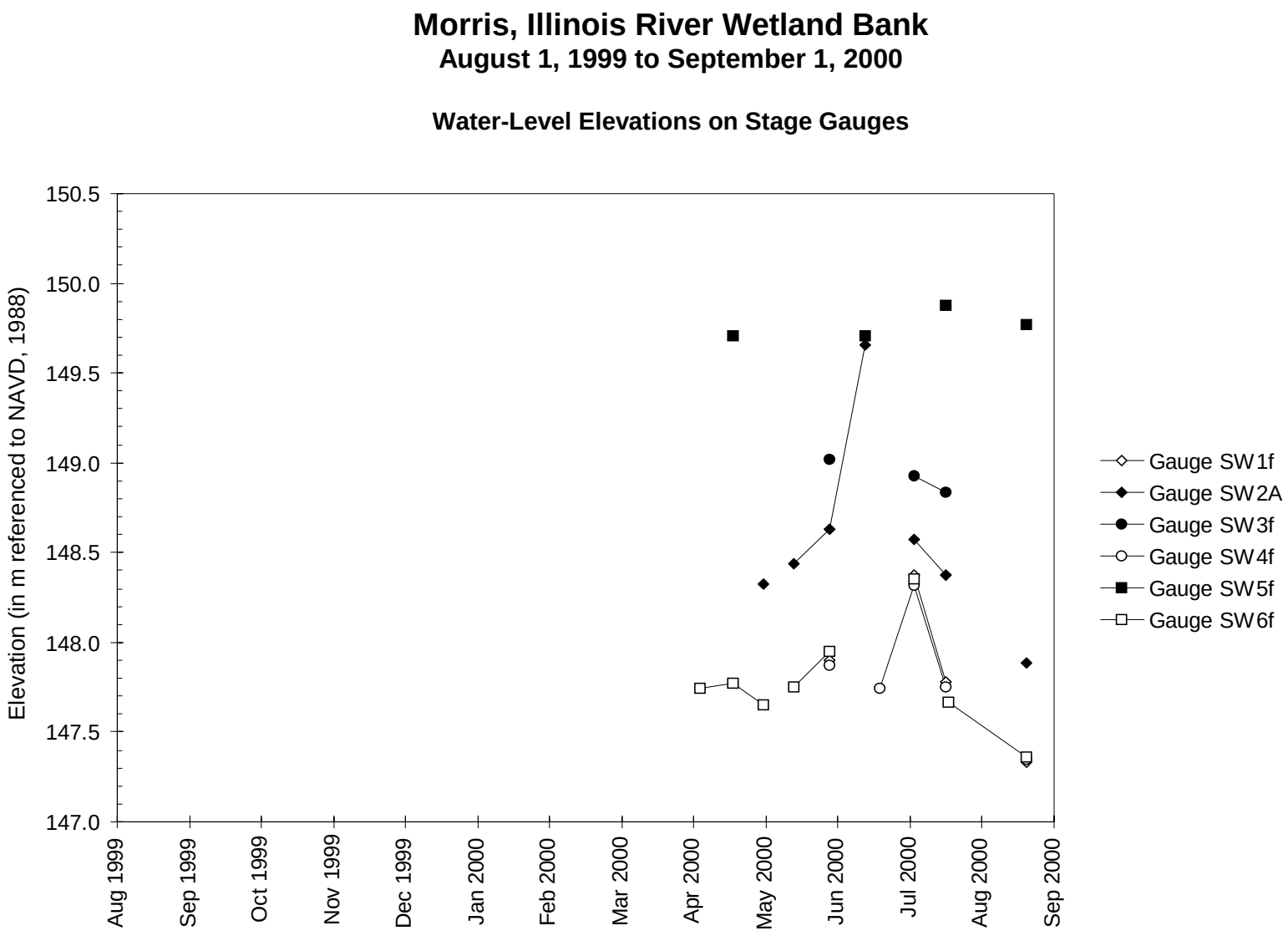


Chart E1 2000-4 Water-level elevations on stage gauges

Morris, Illinois River Wetland Bank
August 1, 1999 to September 1, 2000

Water-Level Elevations on Stage Gauges and Loggers

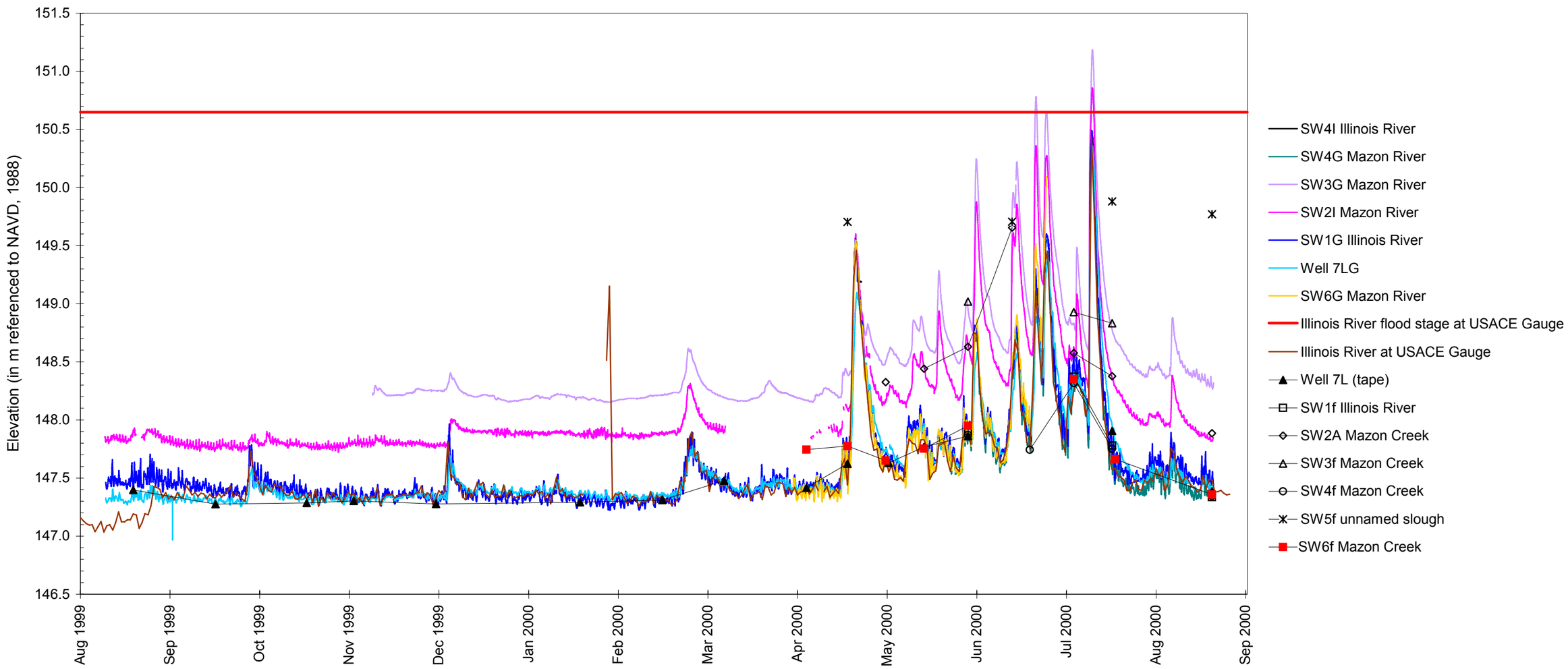


Chart E1 2000-5 Water-level elevations on stage gauges and Infinities (I) and Global (G) loggers

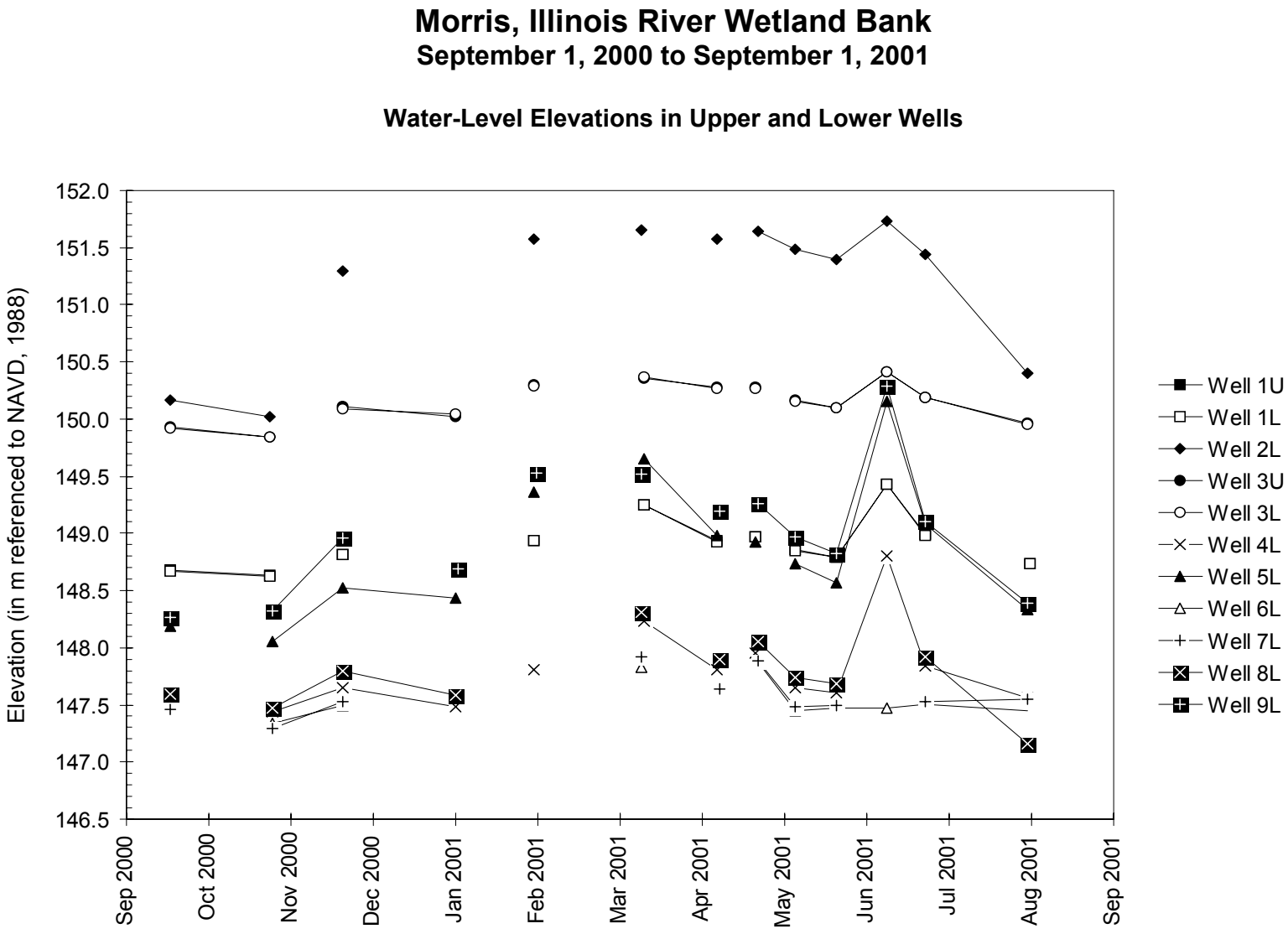


Chart E2 2001-1A Water-level elevations in upper and lower wells

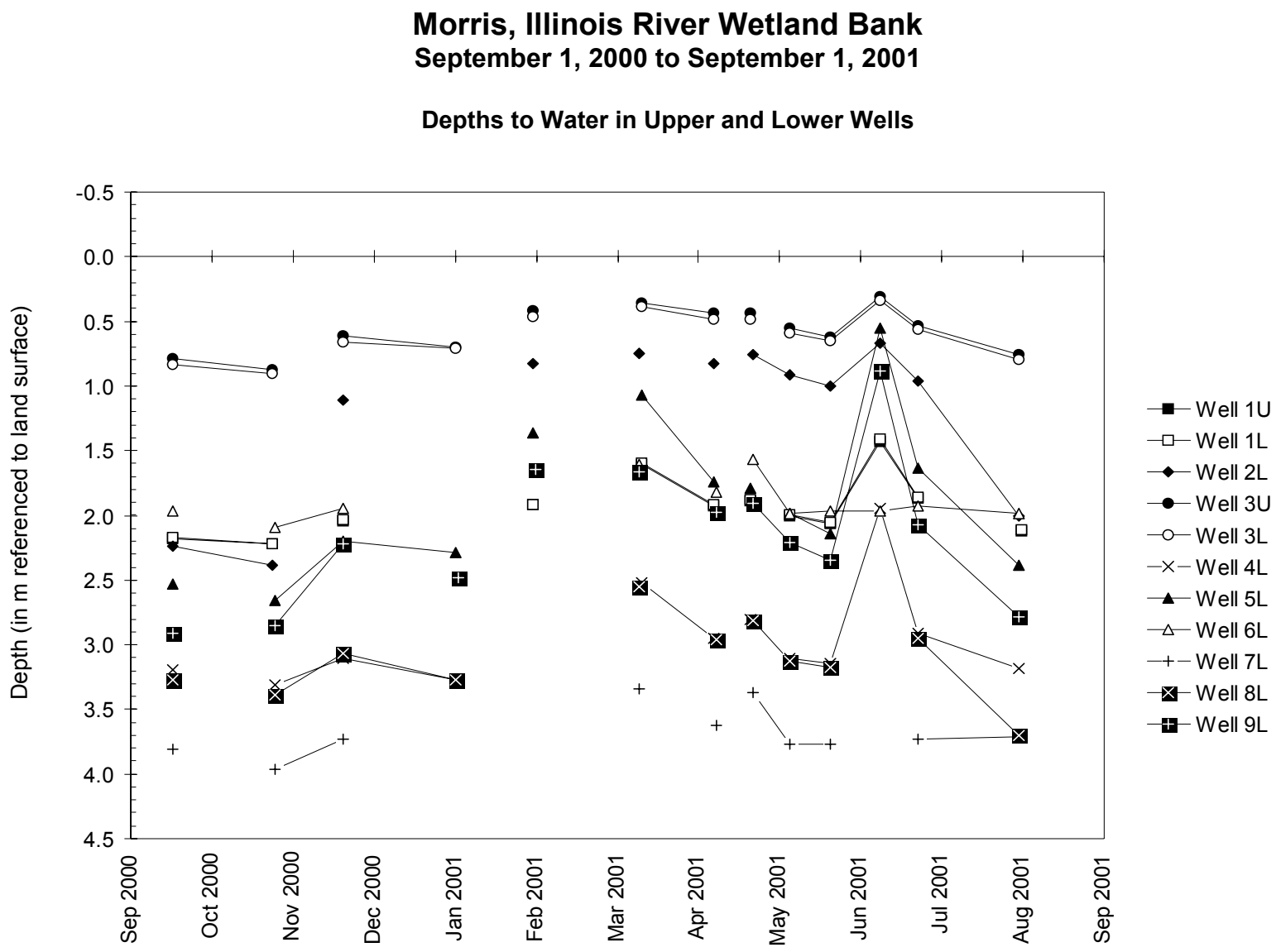


Chart E2 2001-1B Depths to water in upper and lower wells

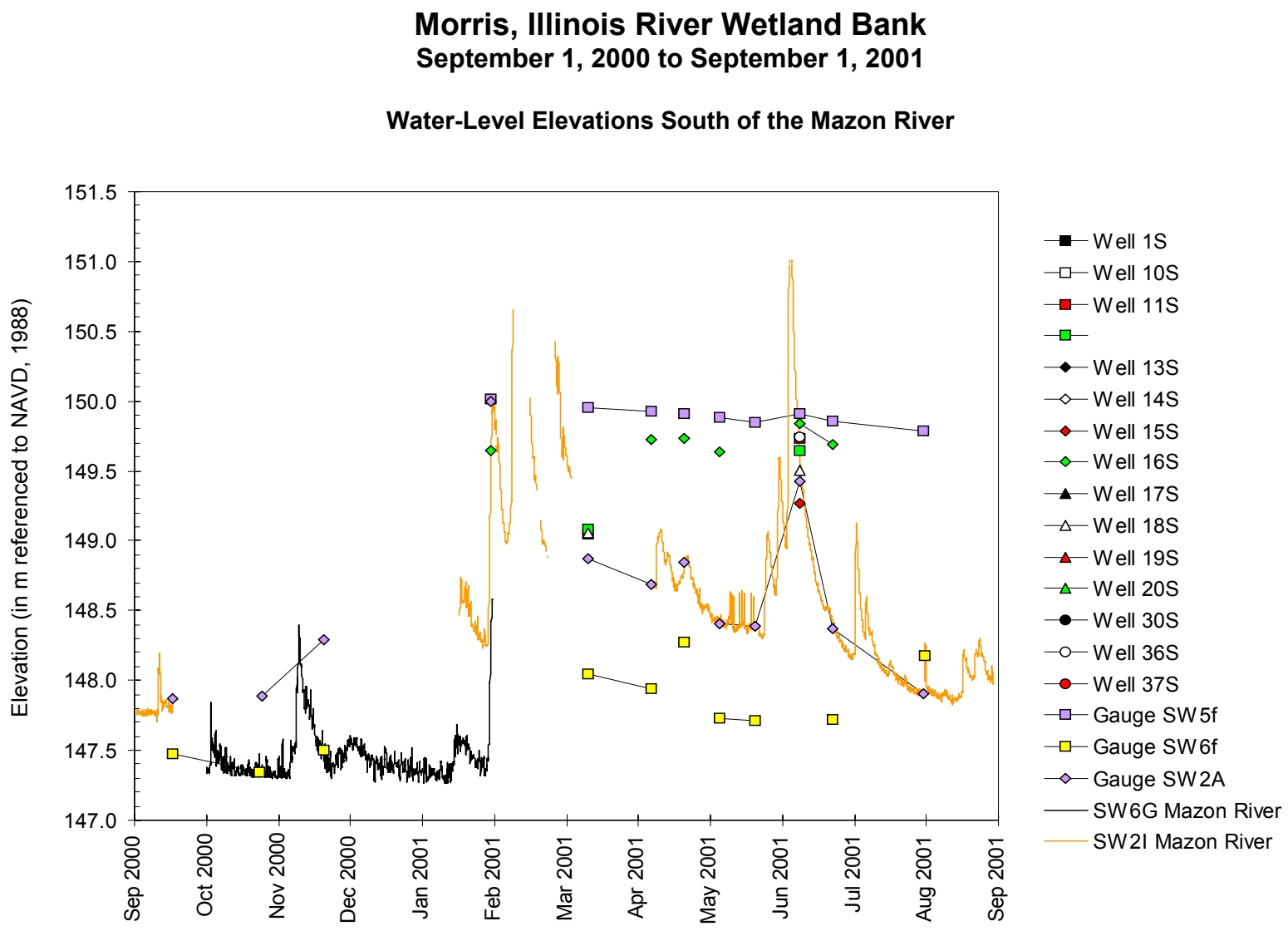


Chart E2 2001-2A Water-level elevations south of the Mazon River in soil-zone wells, on stage gauges, and at the Infinities (I) and Global (G) loggers

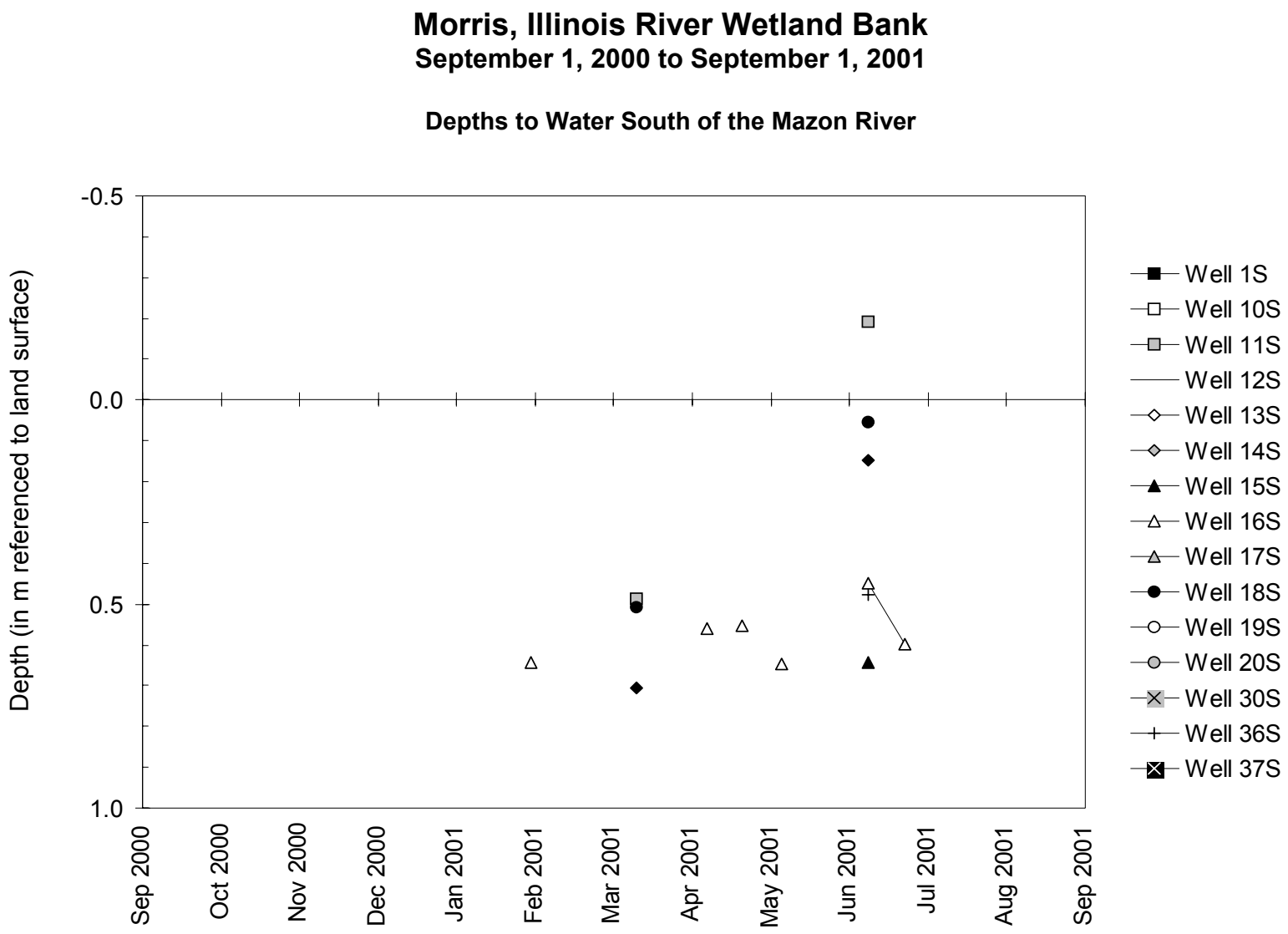


Chart E2 2001-2B Depths to water south of the Mazon River in soil-zone wells

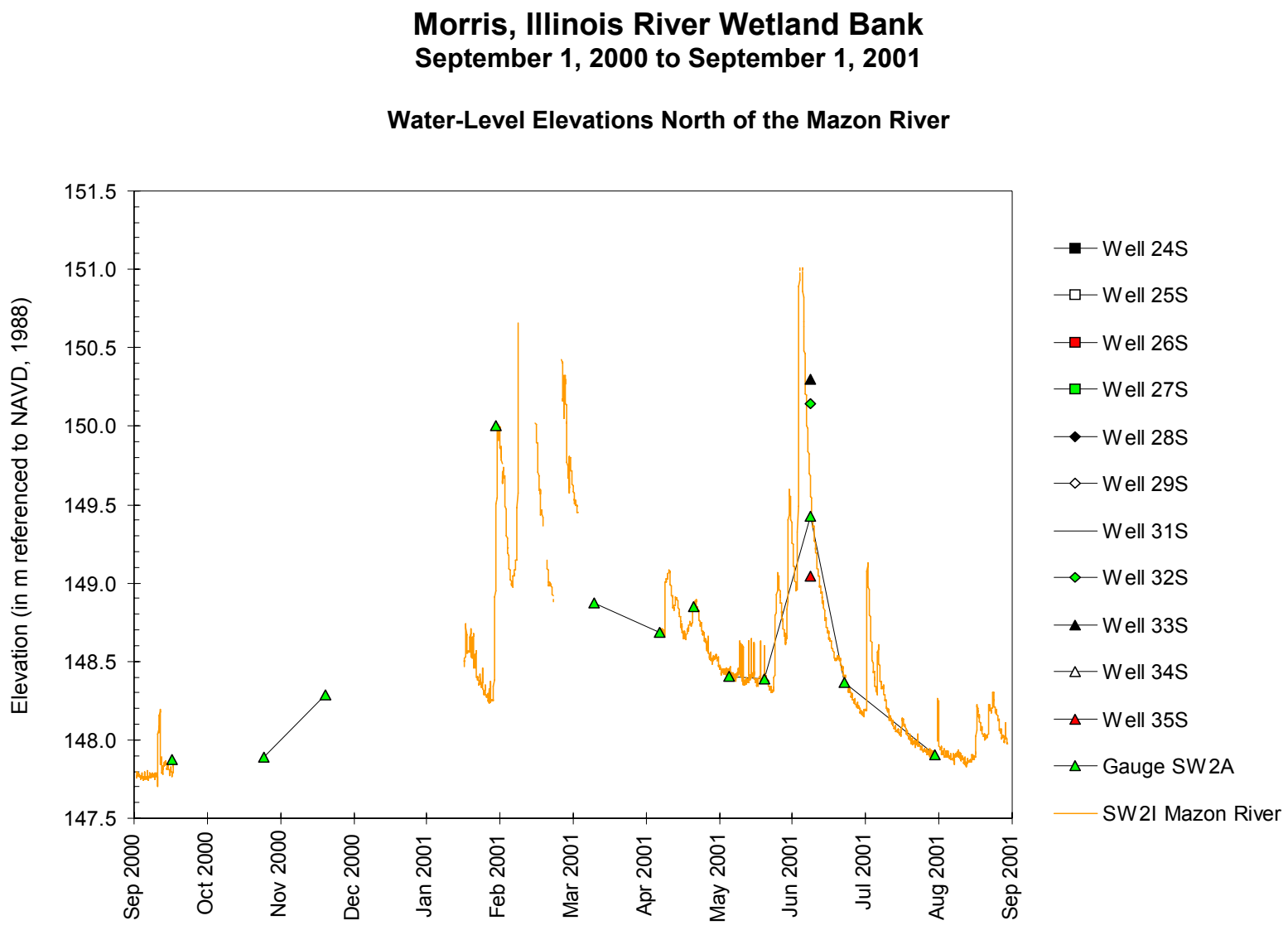


Chart E2 2001-3A Water-level elevations north of the Mazon River in soil-zone wells, on a stage gauge, and at the Infinities (I) sonic logger

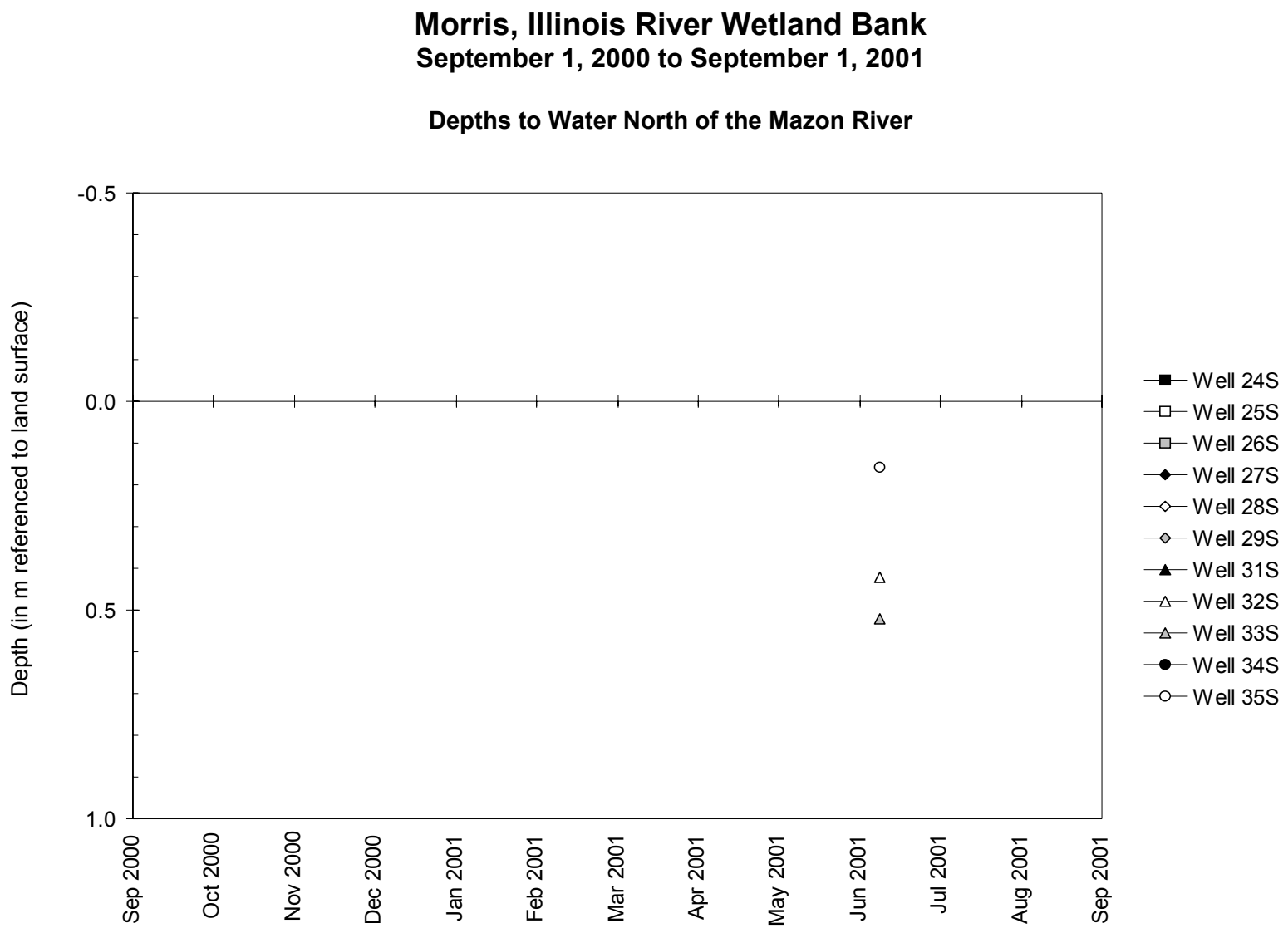


Chart E2 2001-3B Depths to water north of the Mazon River in soil-zone wells

Morris, Illinois River Wetland Bank
September 1, 2000 to September 1, 2001

Water-Level Elevations in the East Field and near the Natural Slough

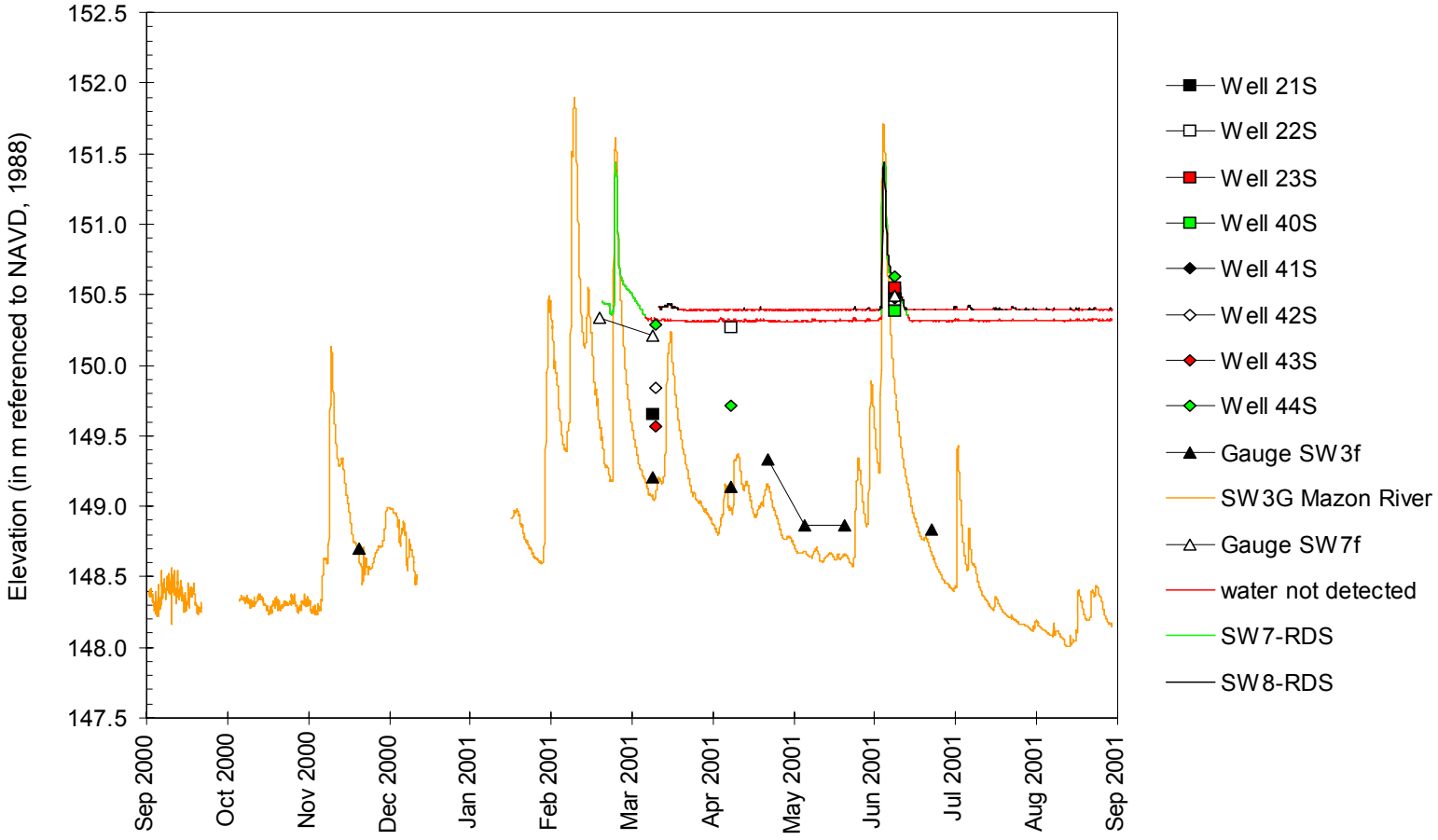


Chart E2 2001-4A Water-level elevations in the east field and near the natural slough in soil-zone wells, on stage gauges, and at the Global (G) and RDS loggers

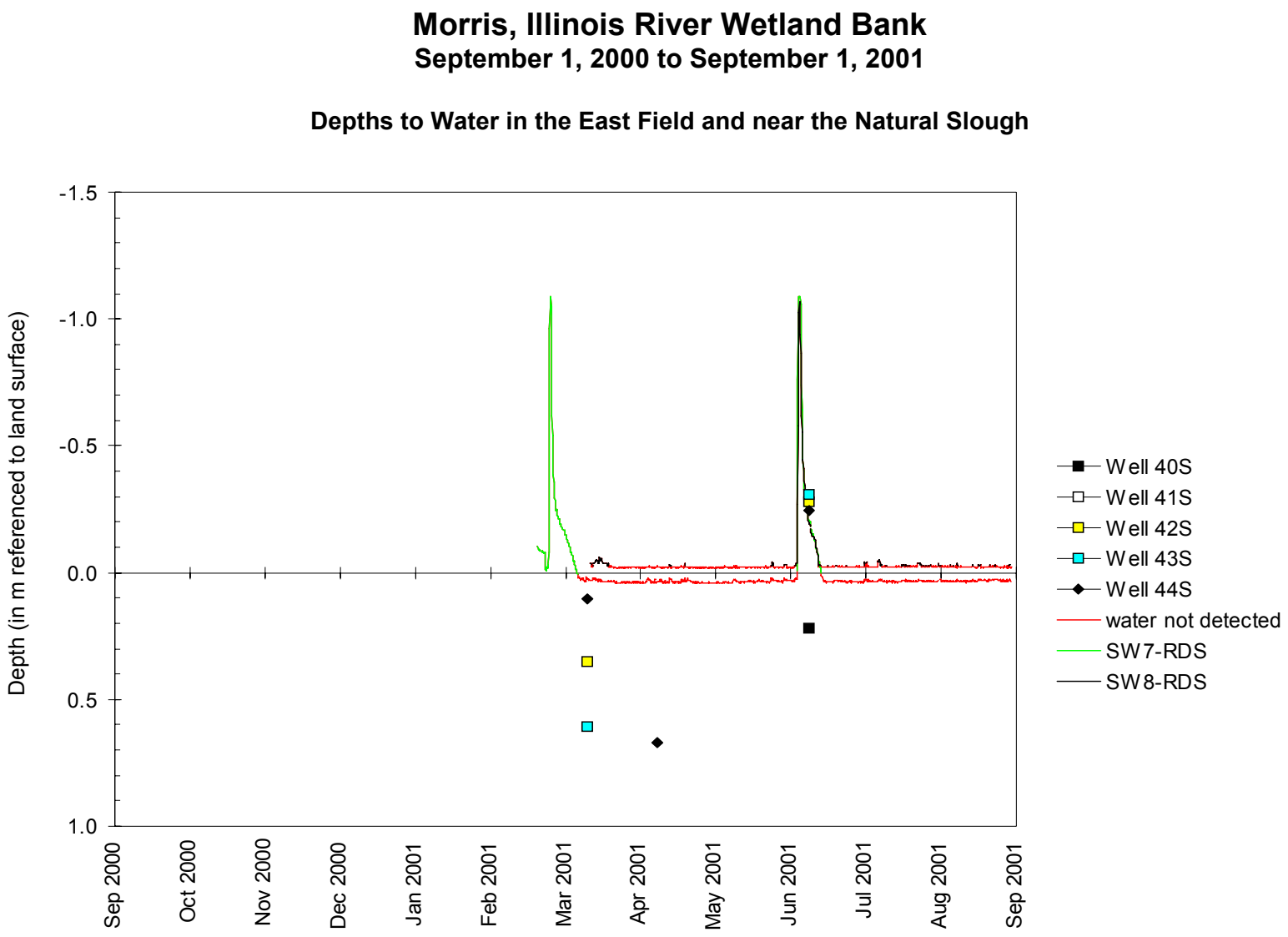


Chart E2 2001-4B Depths to water in the east field and near the natural slough in soil-zone wells and at the RDS loggers

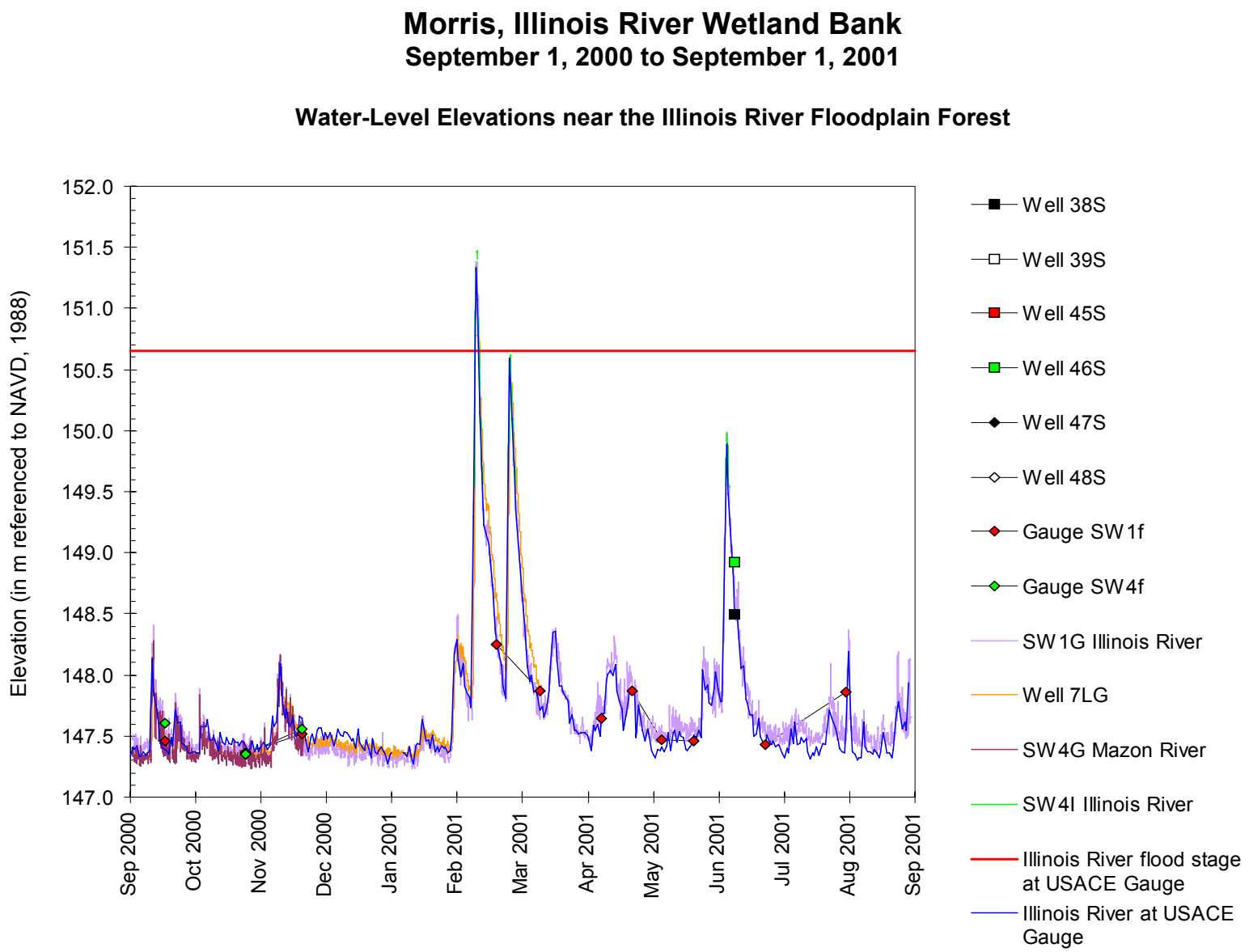


Chart E2 2001-5A Water-level elevations near the Illinois River floodplain forest in soil-zone wells, on stage gauges, and at the Global (G) and Infinities (I) sonic loggers

Morris, Illinois River Wetland Bank
September 1, 2000 to September 1, 2001

Depths to Water near the Illinois River Floodplain Forest

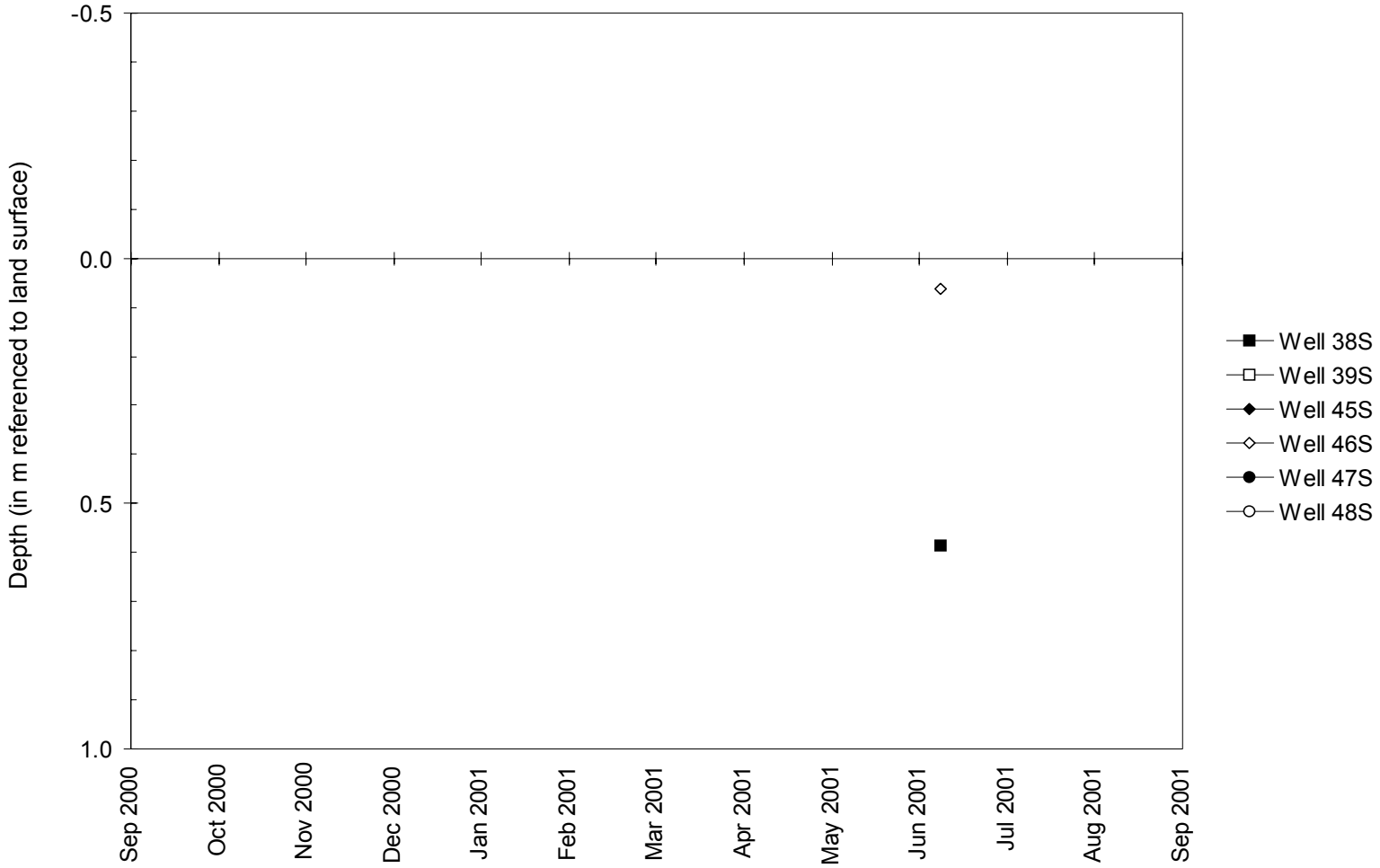


Chart E2 2001-5B Depths to water near the Illinois River floodplain forest in soil-zone wells

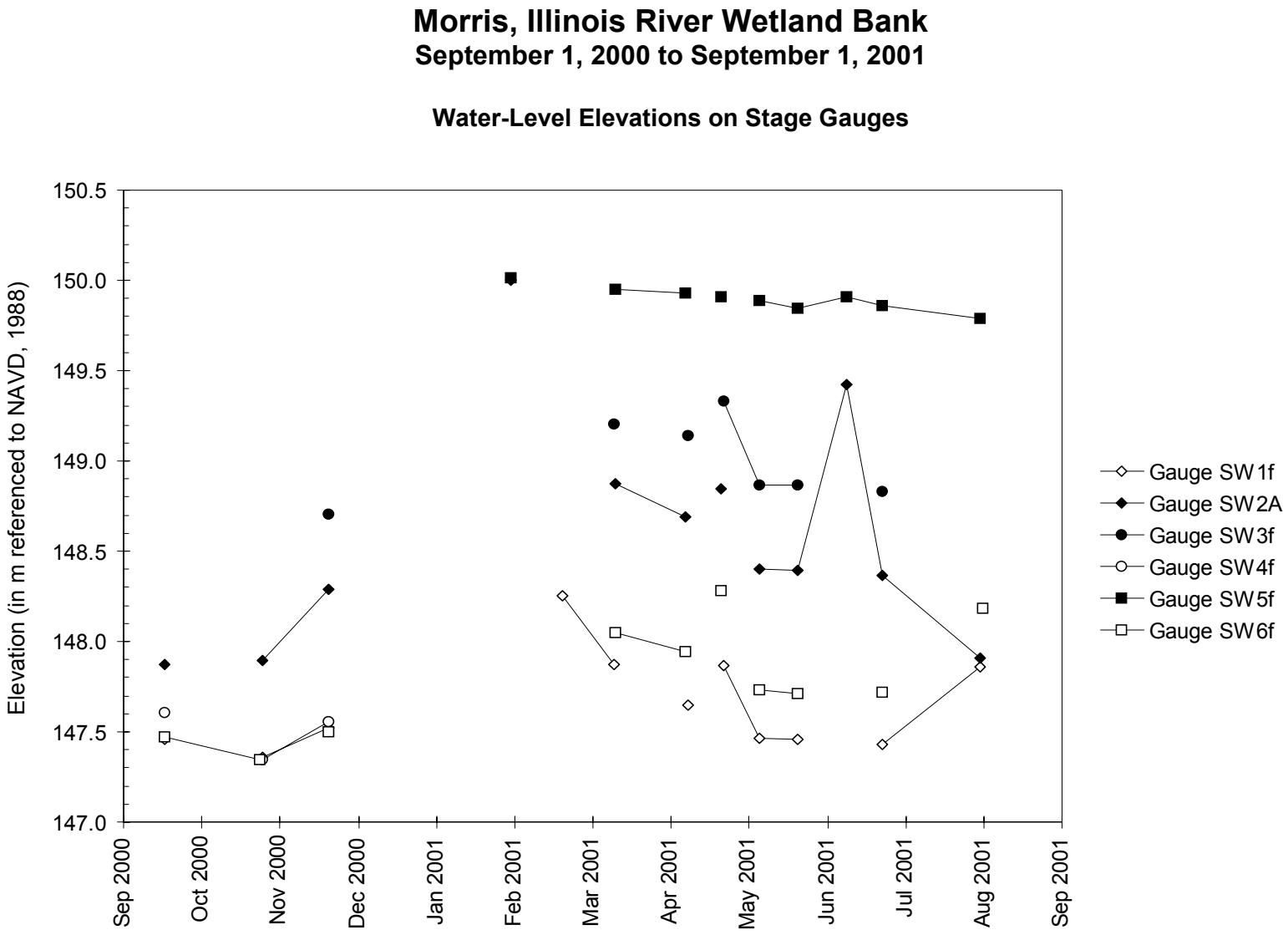


Chart E2 2001-6 Water-level elevations on stage gauges

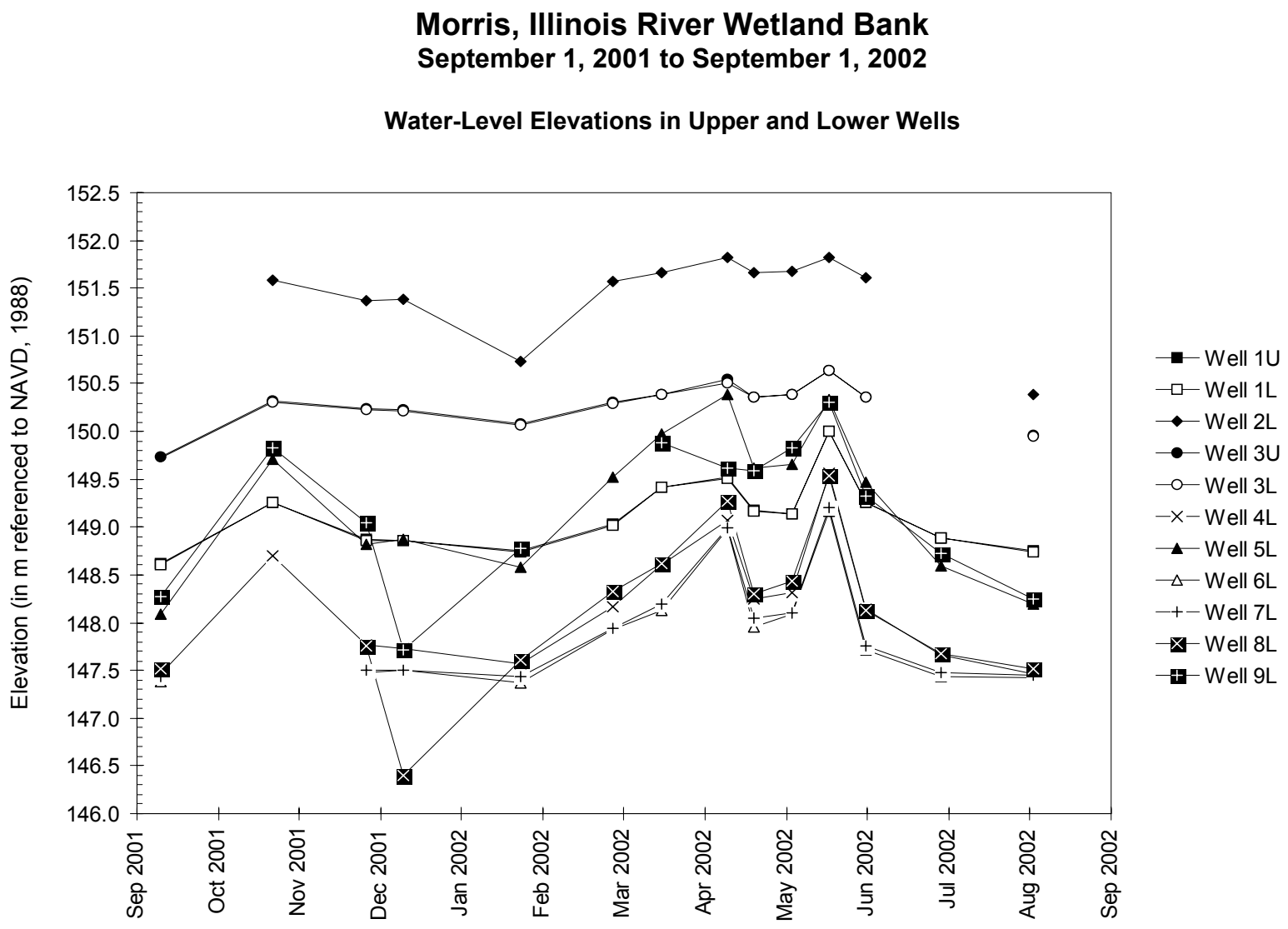


Chart E3 2002-1A Water-level elevations in upper and lower wells

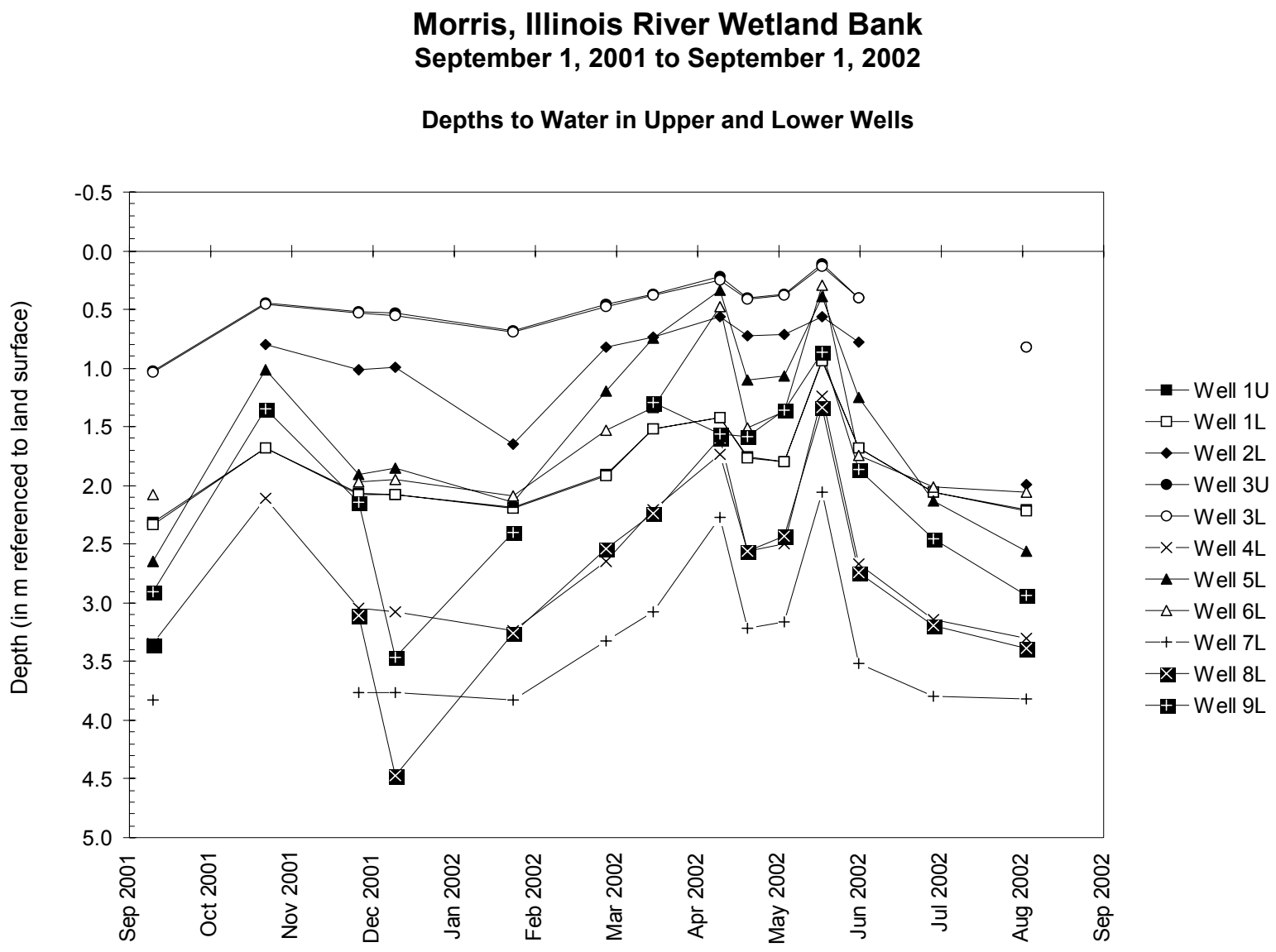


Chart E3 2002-1B Depths to water in upper and lower wells

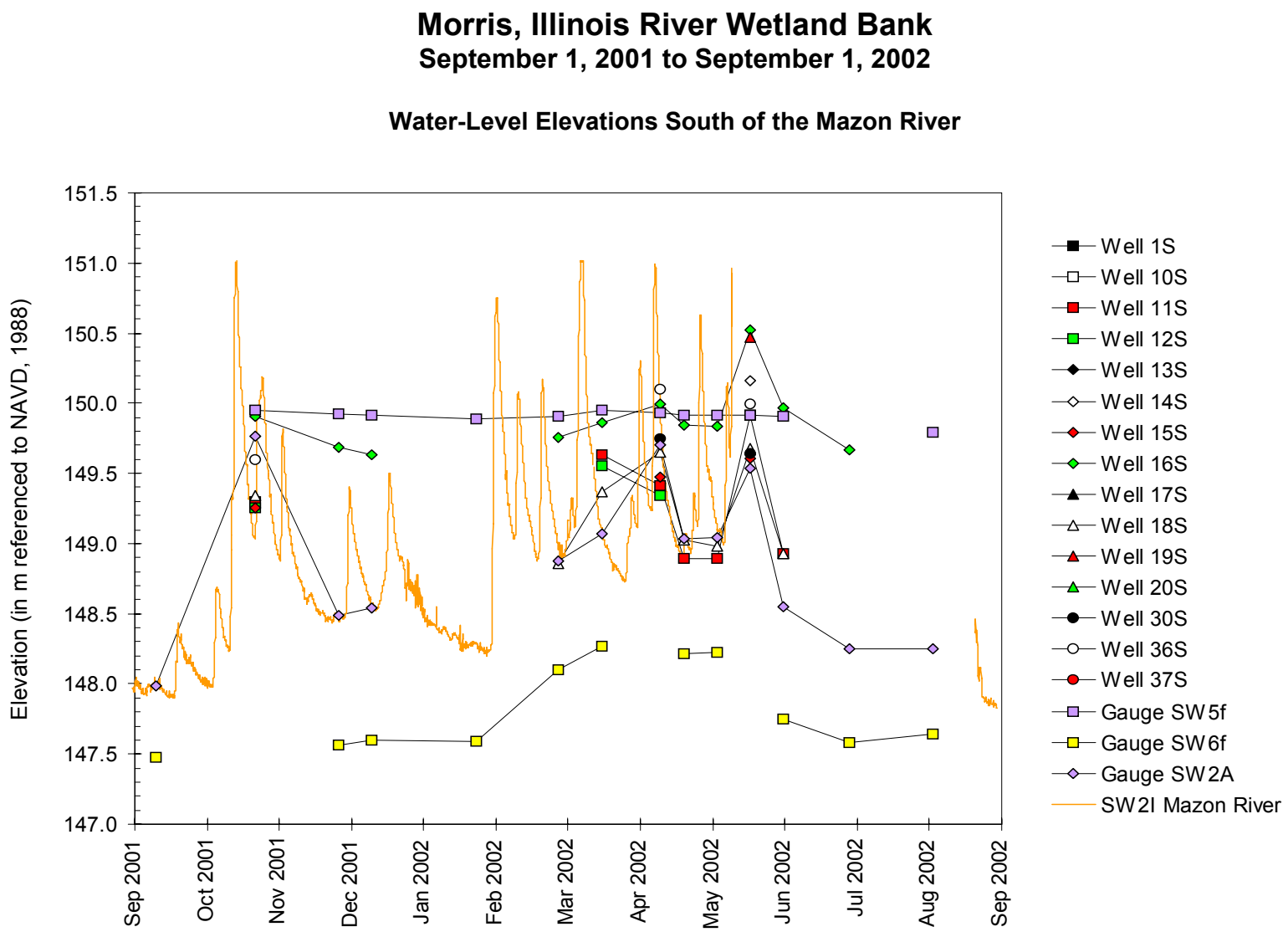


Chart E3 2002-2A Water-level elevations south of the Mazon River in soil-zone wells, on stage gauges, and at the Infinities (I) sonic logger

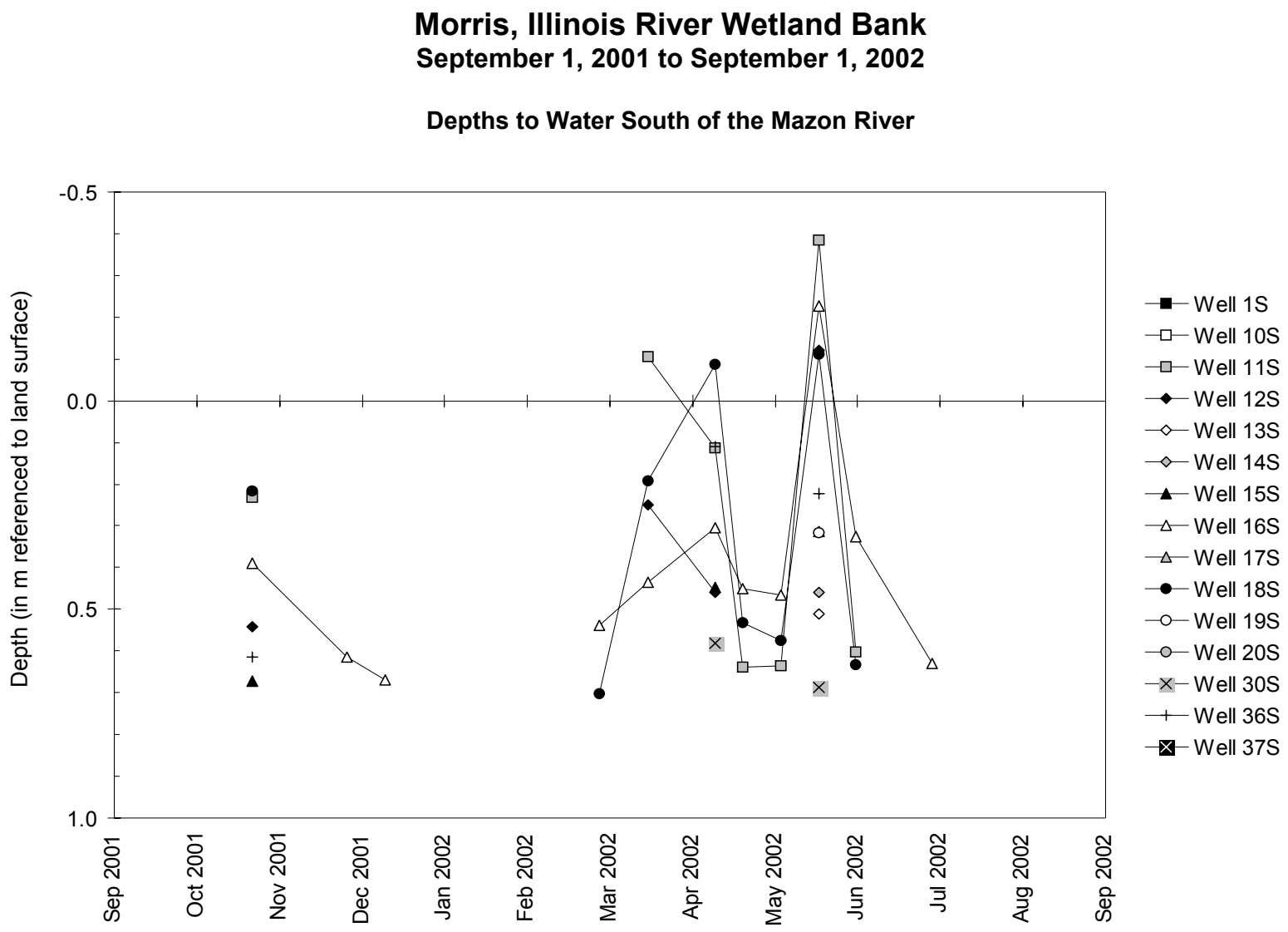


Chart E3 2002-2B Depths to water south of the Mazon River in soil-zone wells

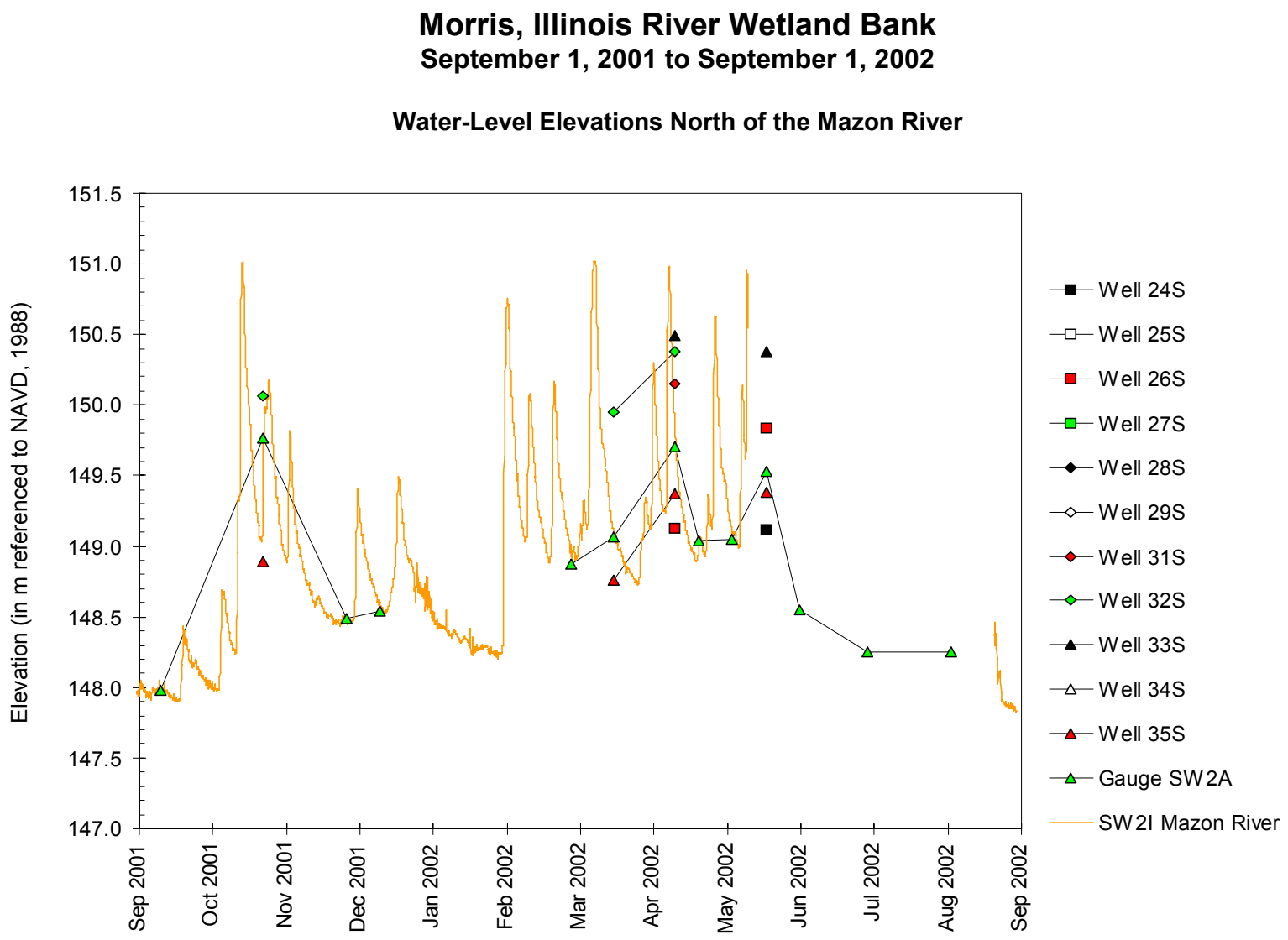


Chart E3 2002-3A Water-level elevations north of the Mazon River in soil-zone wells, on a stage gauge, and at the Infinities (I) sonic logger

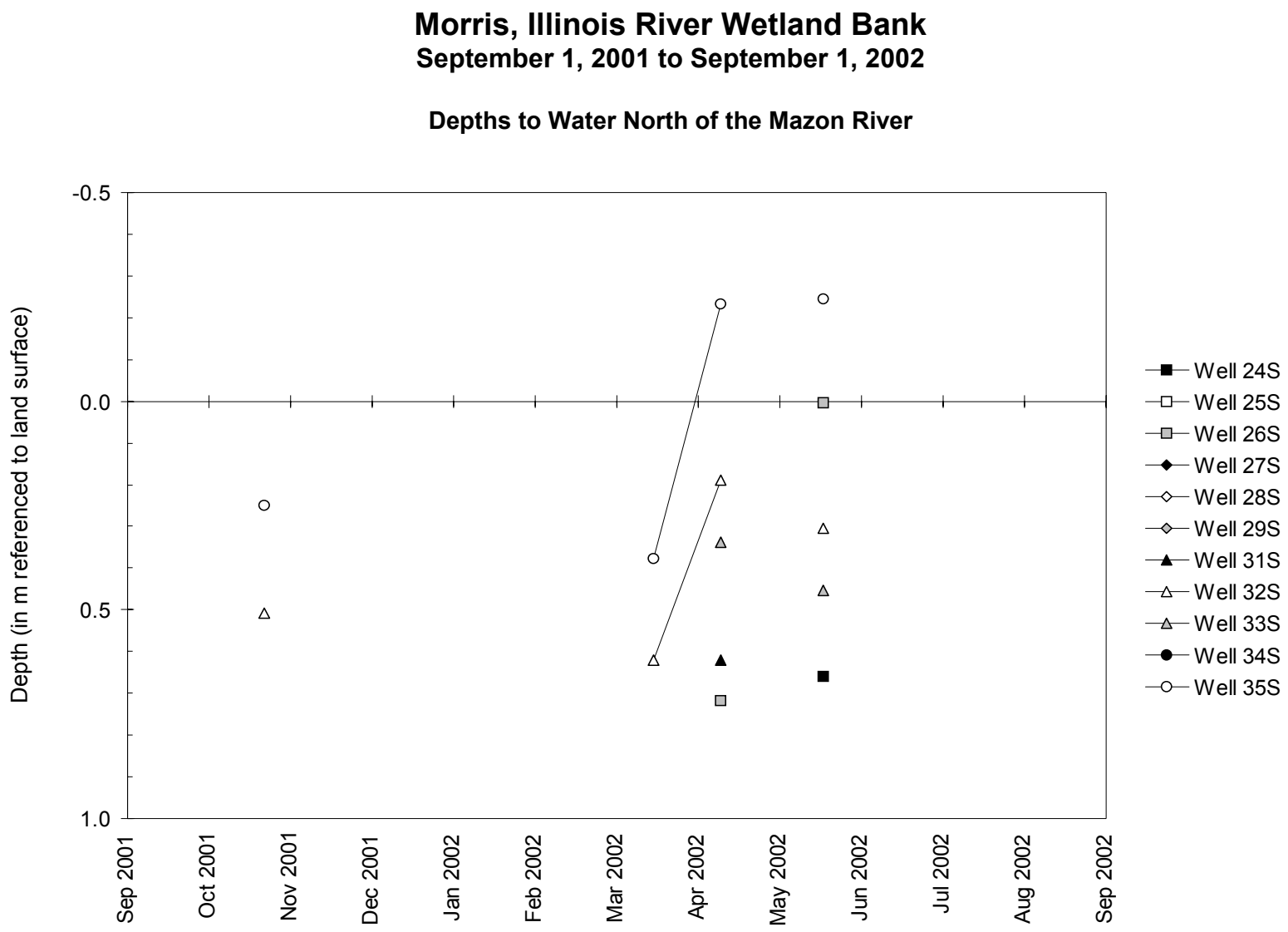


Chart E3 2002-3B Depths to water north of the Mazon River in soil-zone wells

Morris, Illinois River Wetland Bank
September 1, 2001 to September 1, 2002

Water-Level Elevations in the East Field and near the Natural Slough

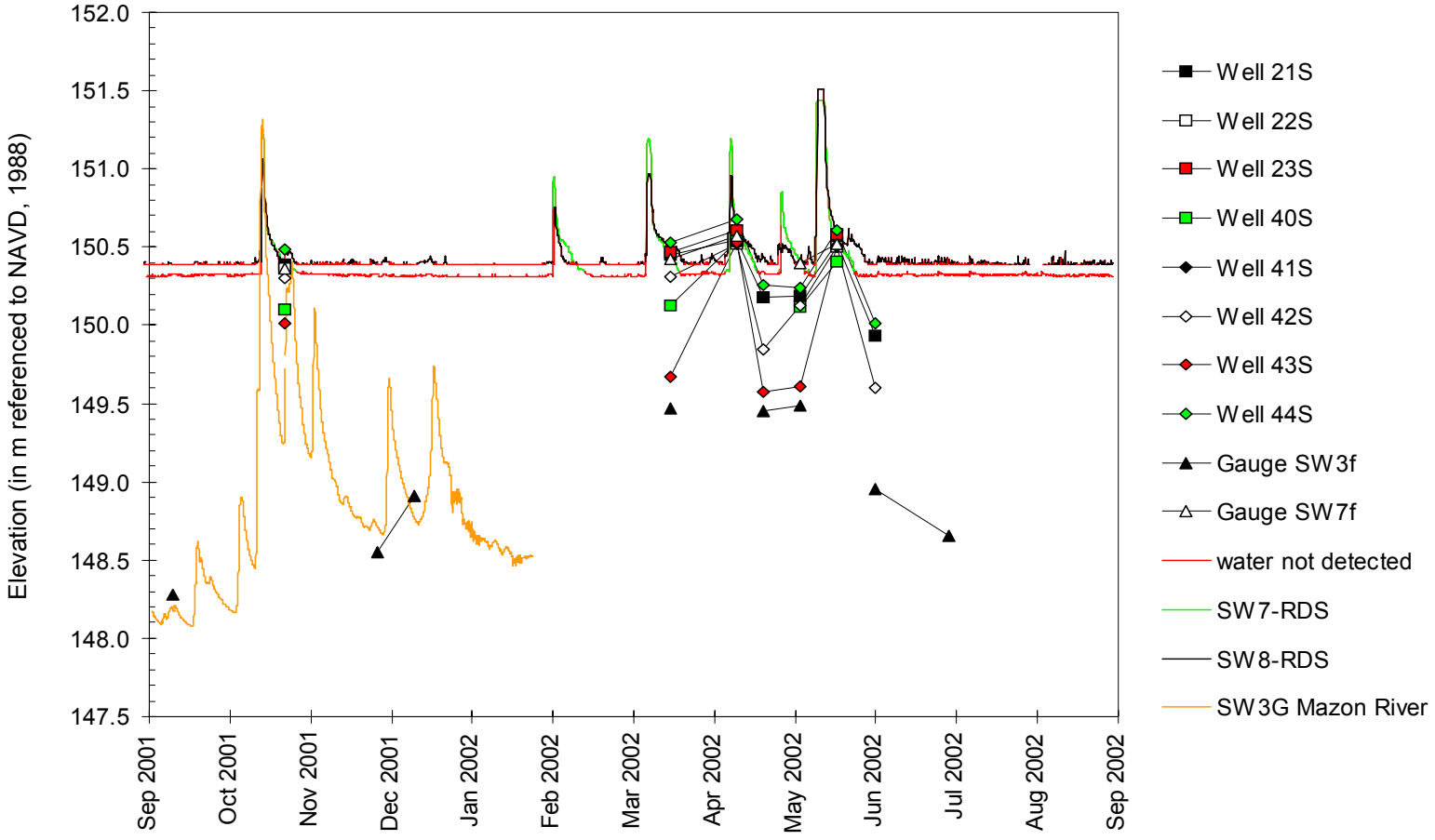


Chart E3 2002-4A Water-level elevations in the east field and near the natural slough in soil-zone wells, on stage gauges, and at the Global (G) and RDS loggers

Morris, Illinois River Wetland Bank
September 1, 2001 to September 1, 2002

Depths to Water in the East Field and near the Natural Slough

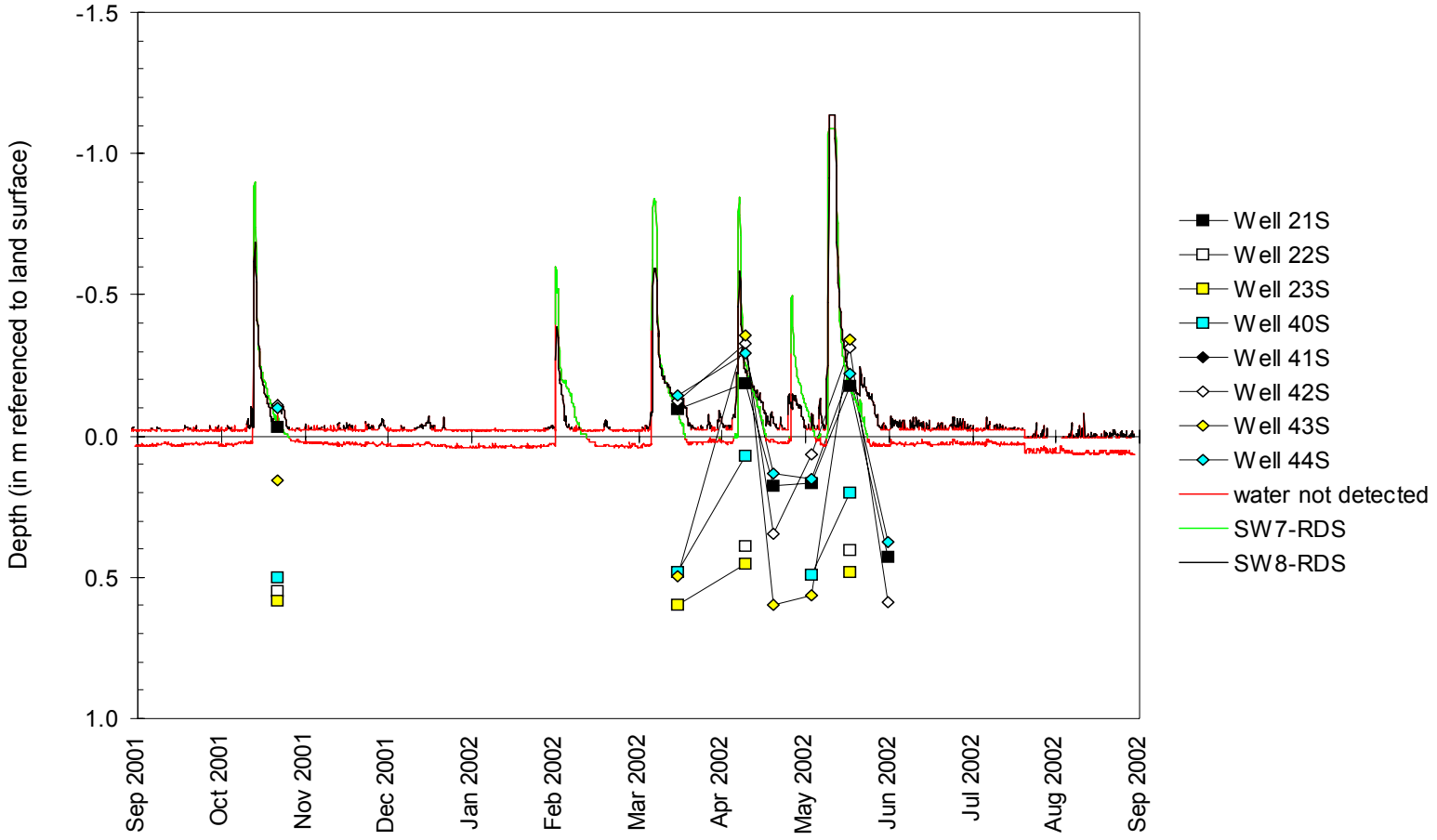


Chart E3 2002-4B Depths to water in the east field and near the natural slough in soil-zone wells and at the RDS loggers

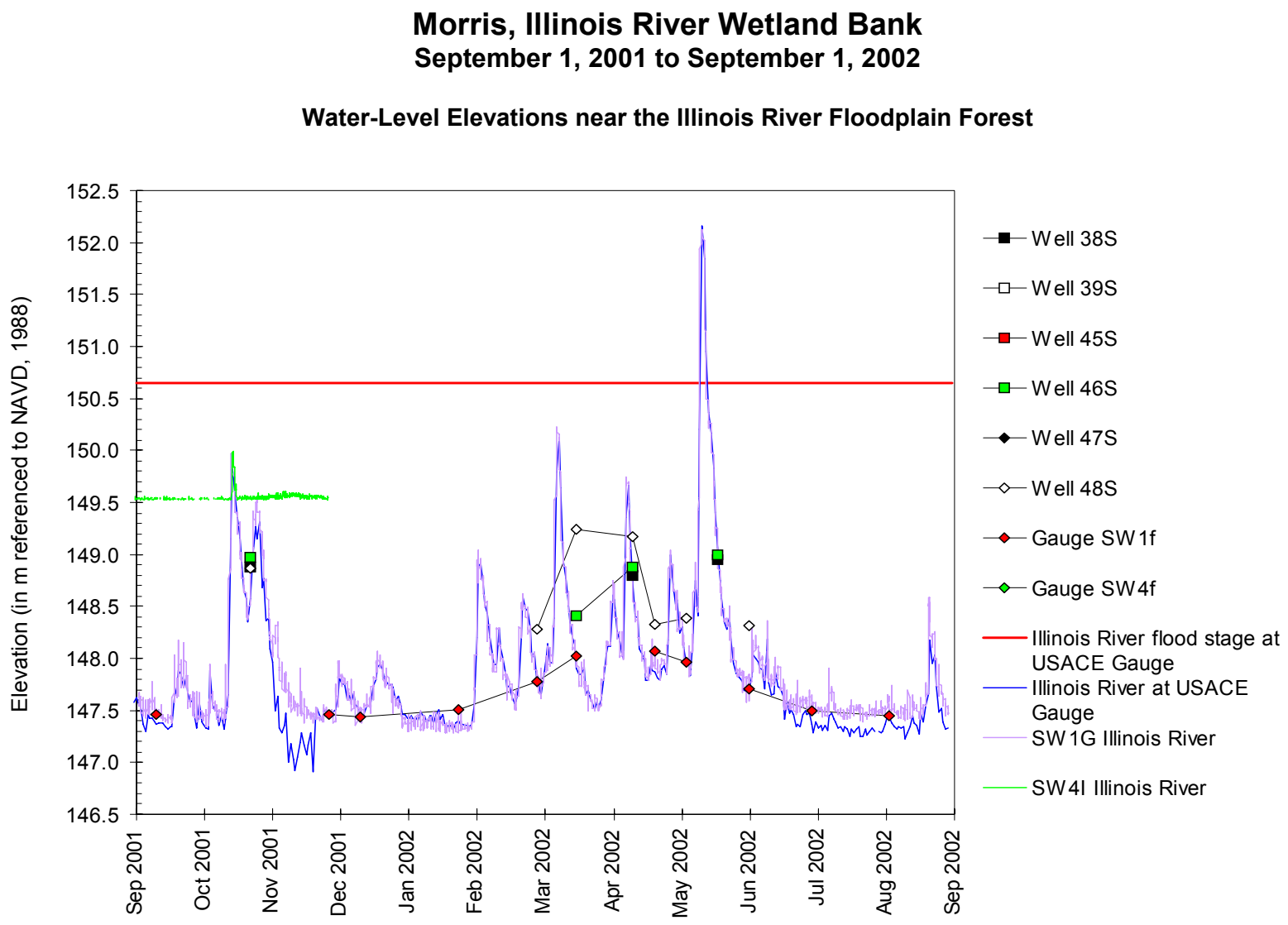


Chart E3 2002-5A Water-level elevations near the Illinois River floodplain forest in soil-zone wells, on stage gauges, and at the Global (G) and Infinities (I) sonic loggers

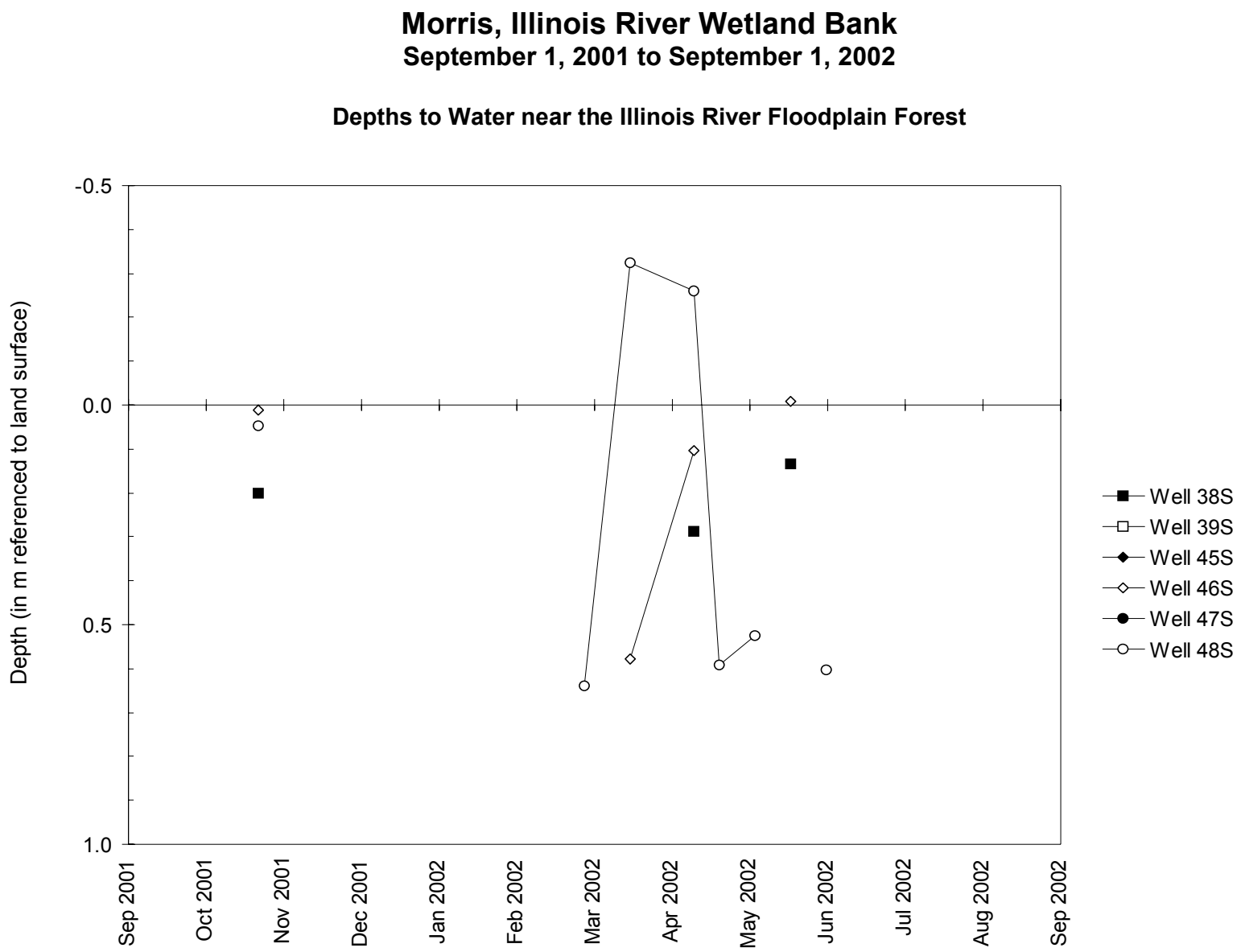


Chart E3 2002-5B Depths to water near the Illinois River floodplain forest in soil-zone wells

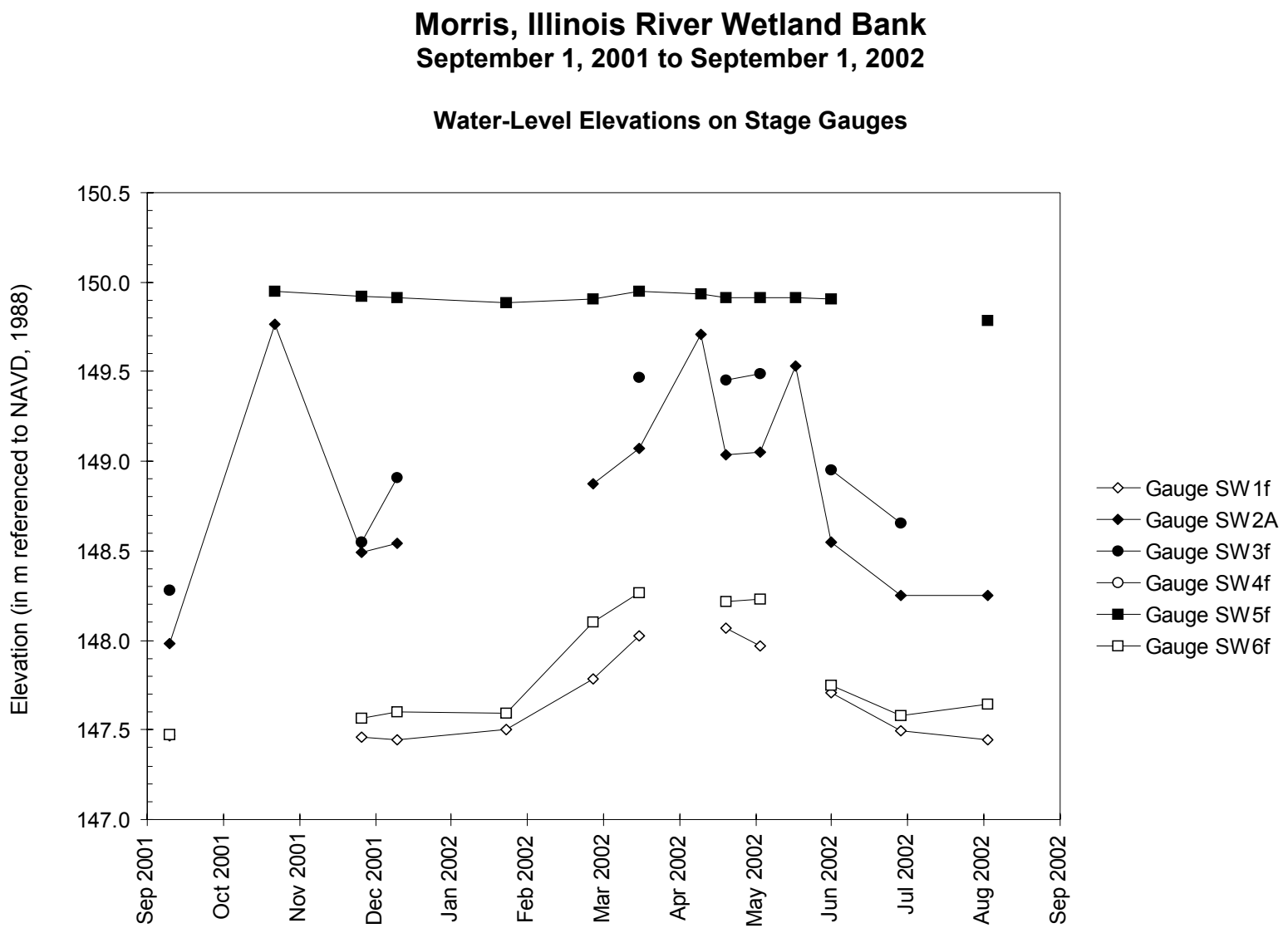


Chart E3 2002-6 Water-level elevations on stage gauges

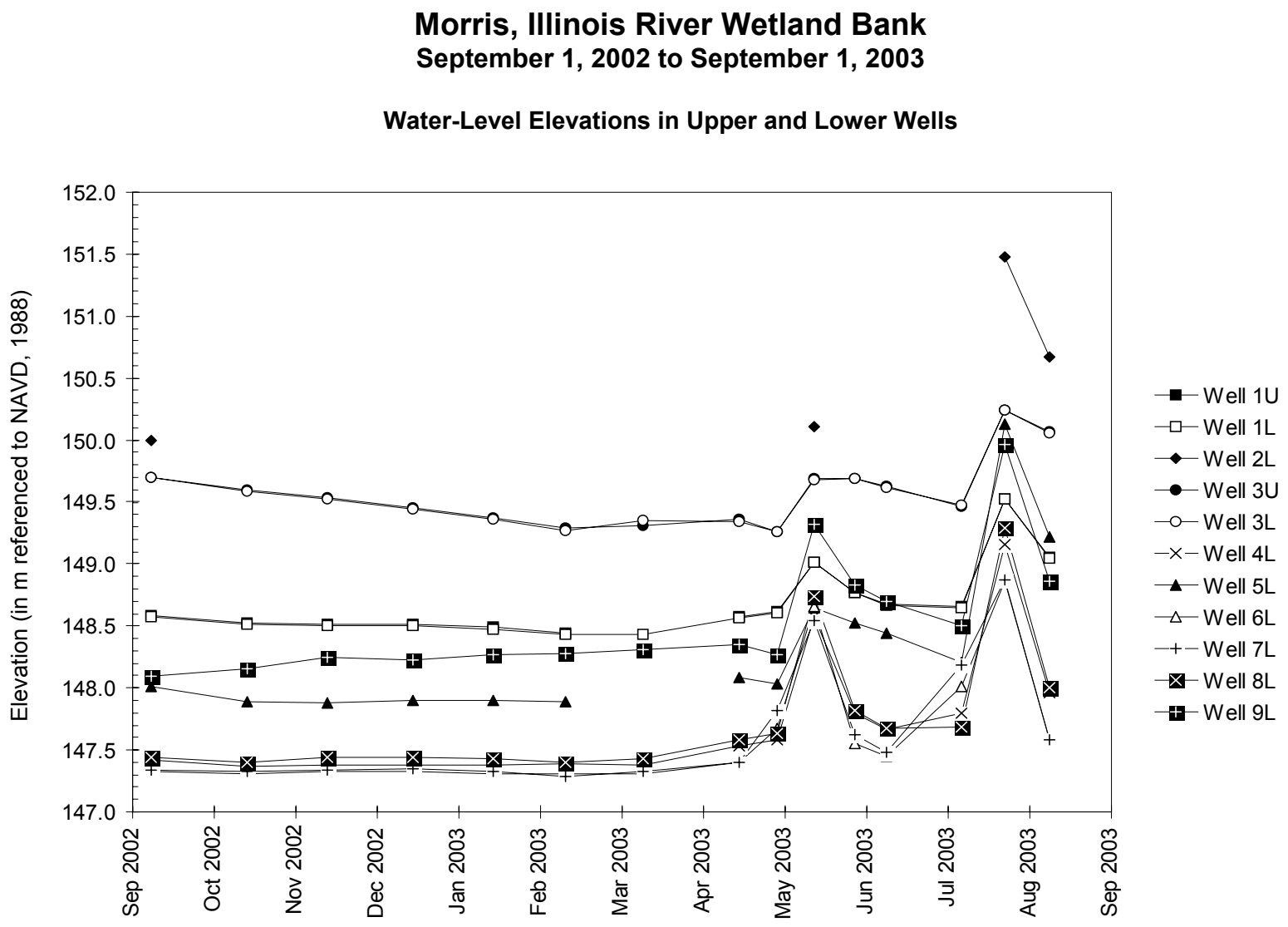


Chart E4 2003-1A Water-level elevations in upper and lower wells

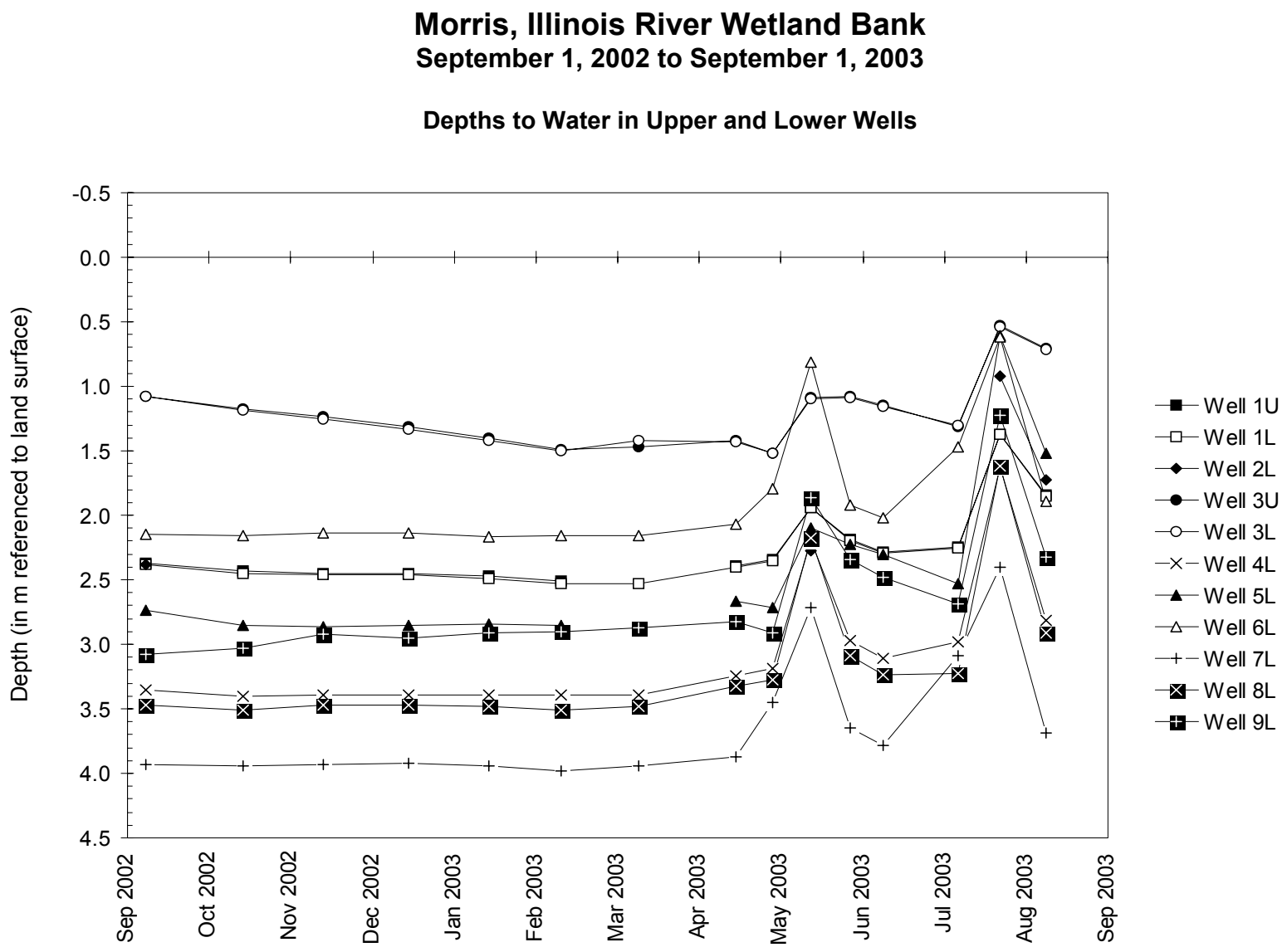


Chart E4 2003-1B Depths to water in upper and lower wells

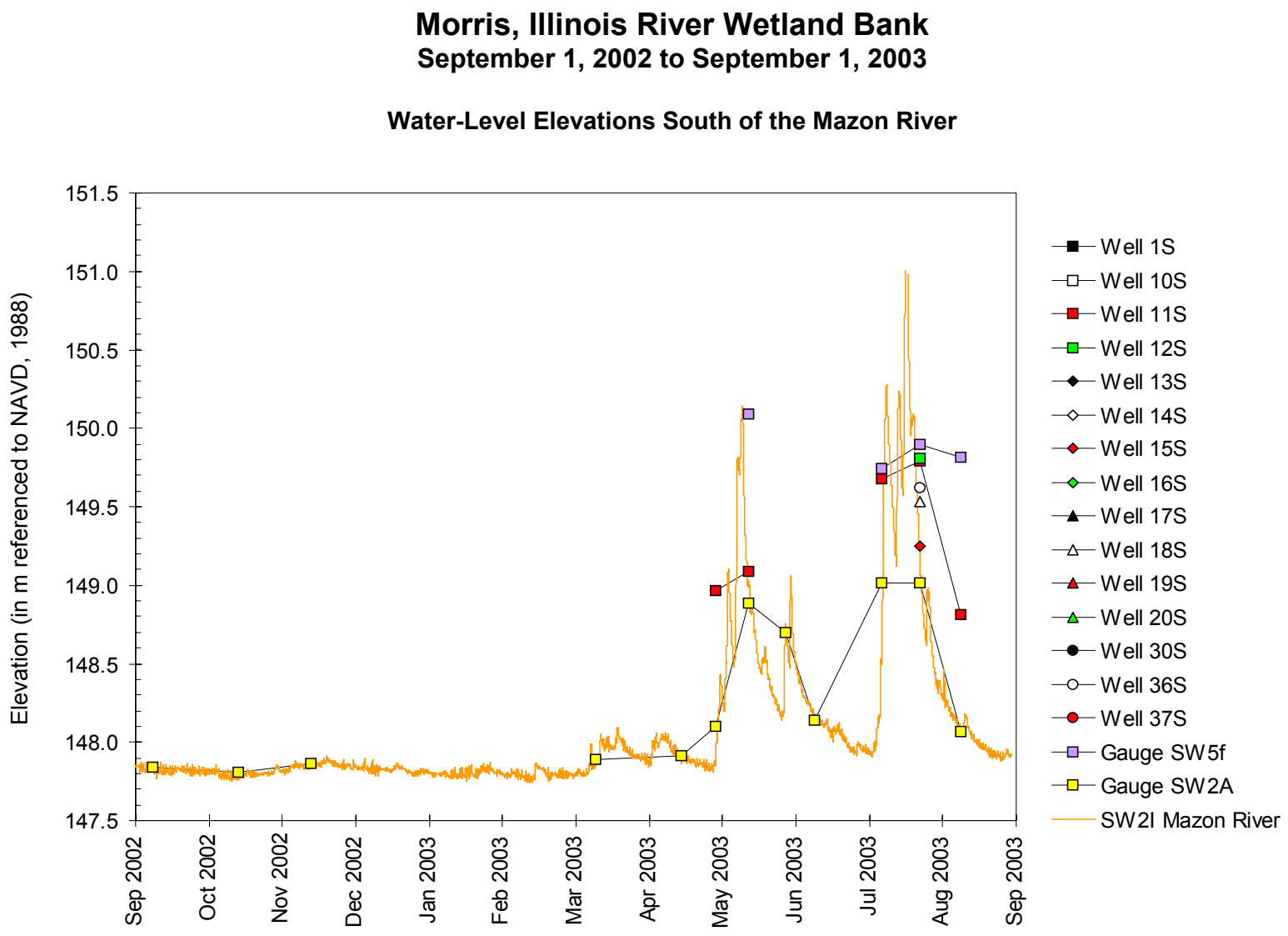


Chart E4 2003-2A Water-level elevations south of the Mazon River in soil-zone wells, on stage gauges, and at the Infinities (I) sonic logger

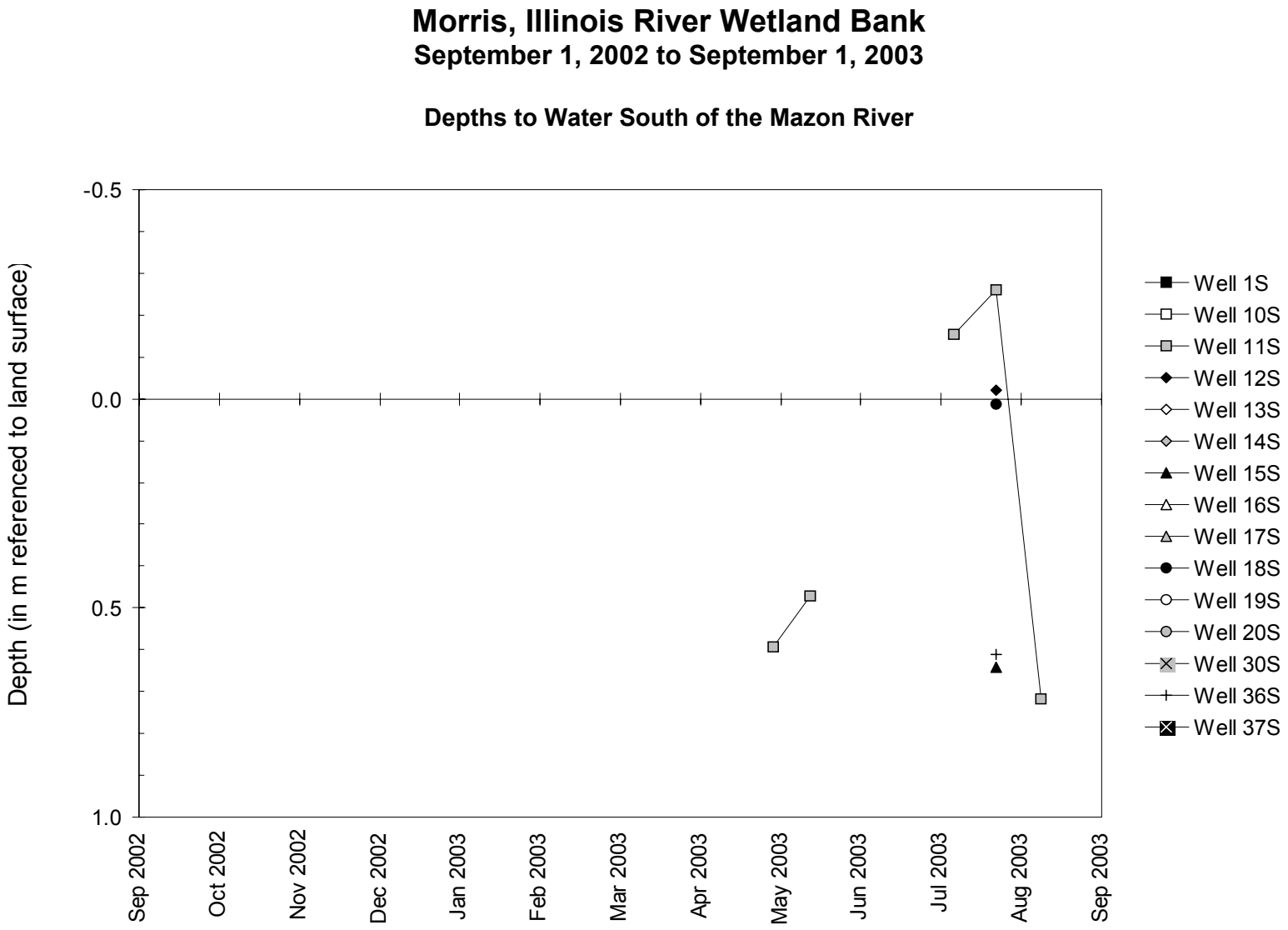


Chart E4 2003-2B Depths to water south of the Mazon River in soil-zone wells

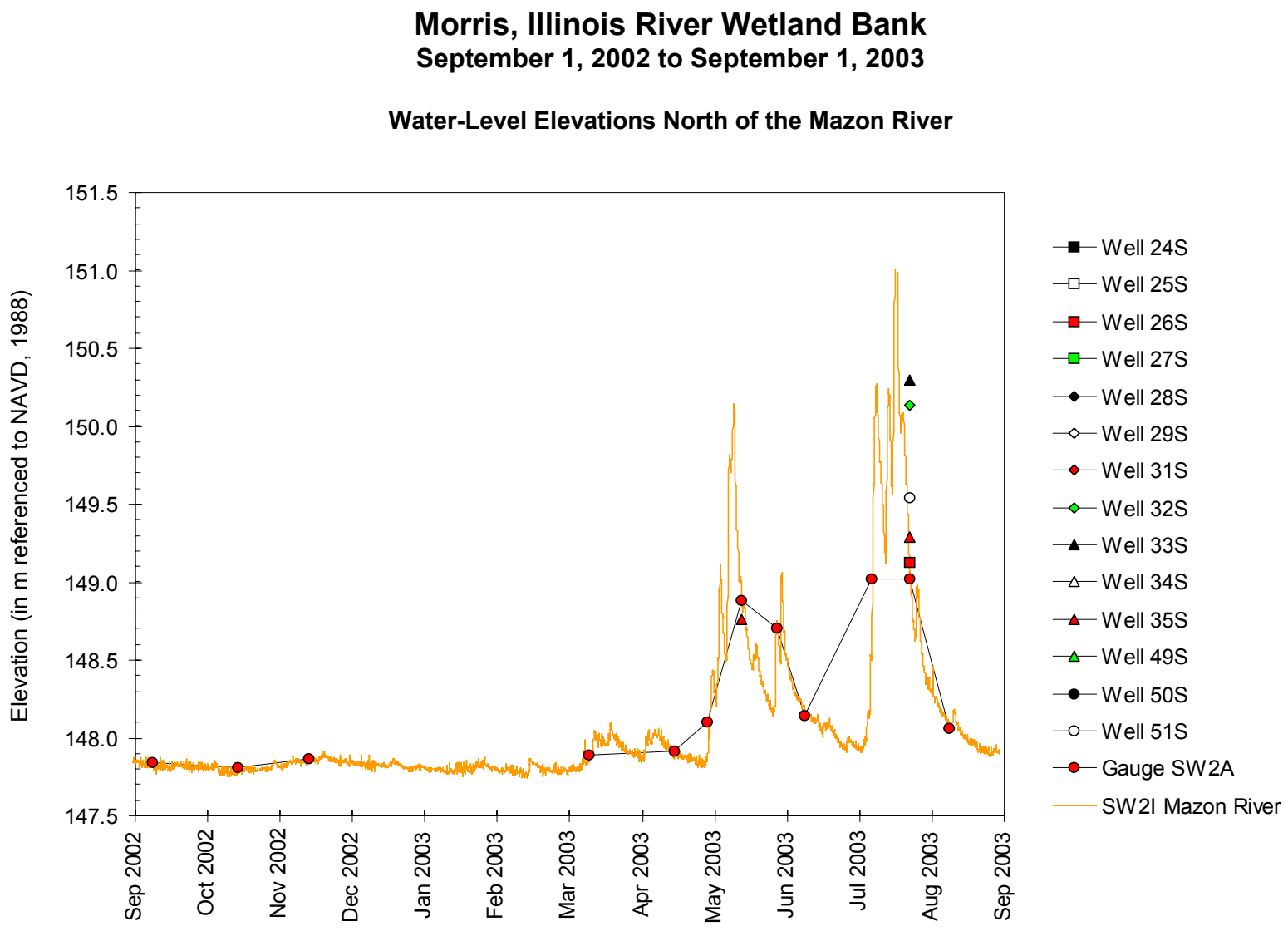


Chart E4 2003-3A Water-level elevations north of the Mazon River in soil-zone wells, on a stage gauge, and at the Infinities (I) sonic logger

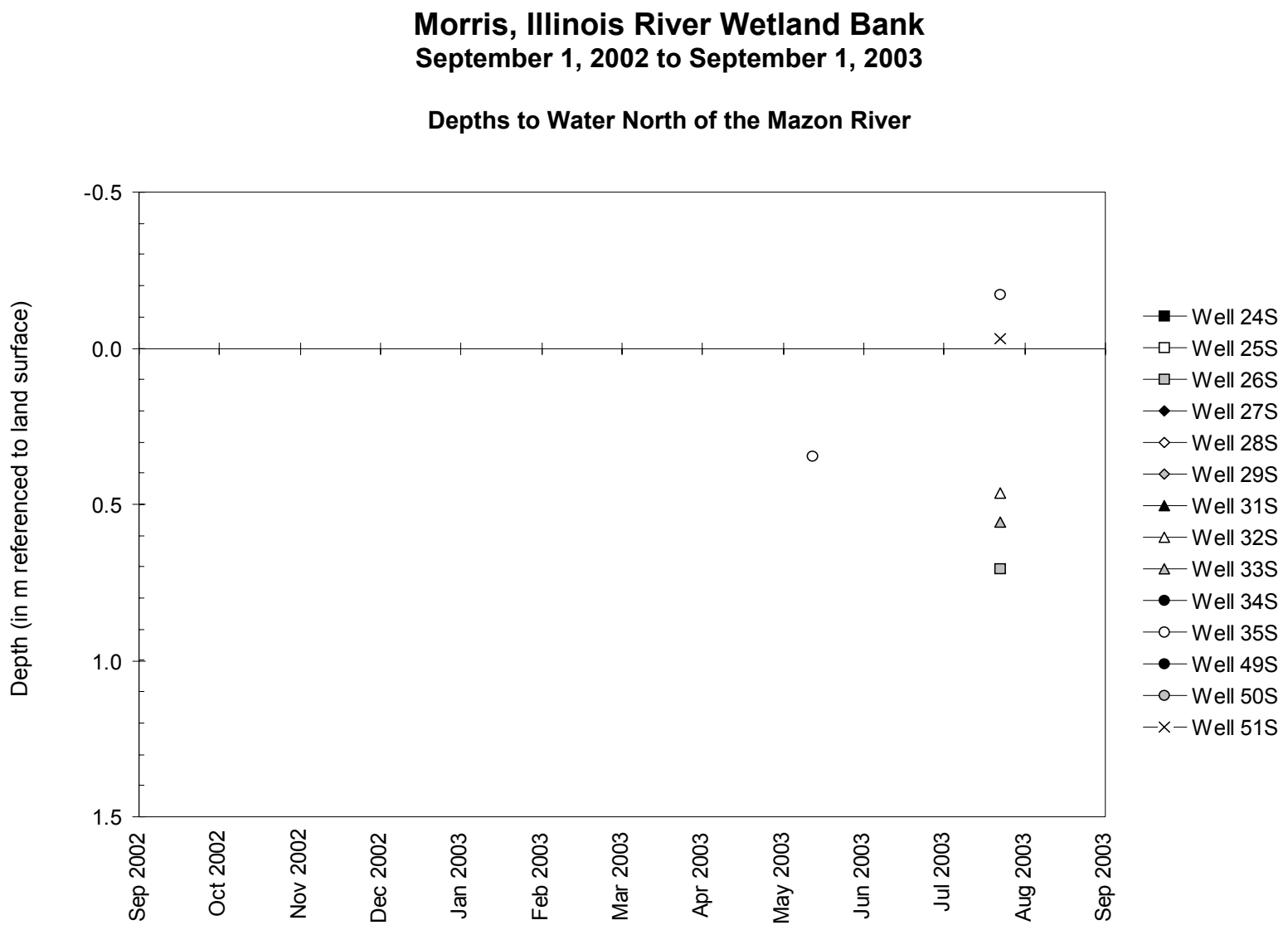


Chart E4 2003-3B Depths to water north of the Mazon River in soil-zone wells

Morris, Illinois River Wetland Bank
September 1, 2002 to September 1, 2003

Water-Level Elevations in the East Field and near the Natural Slough

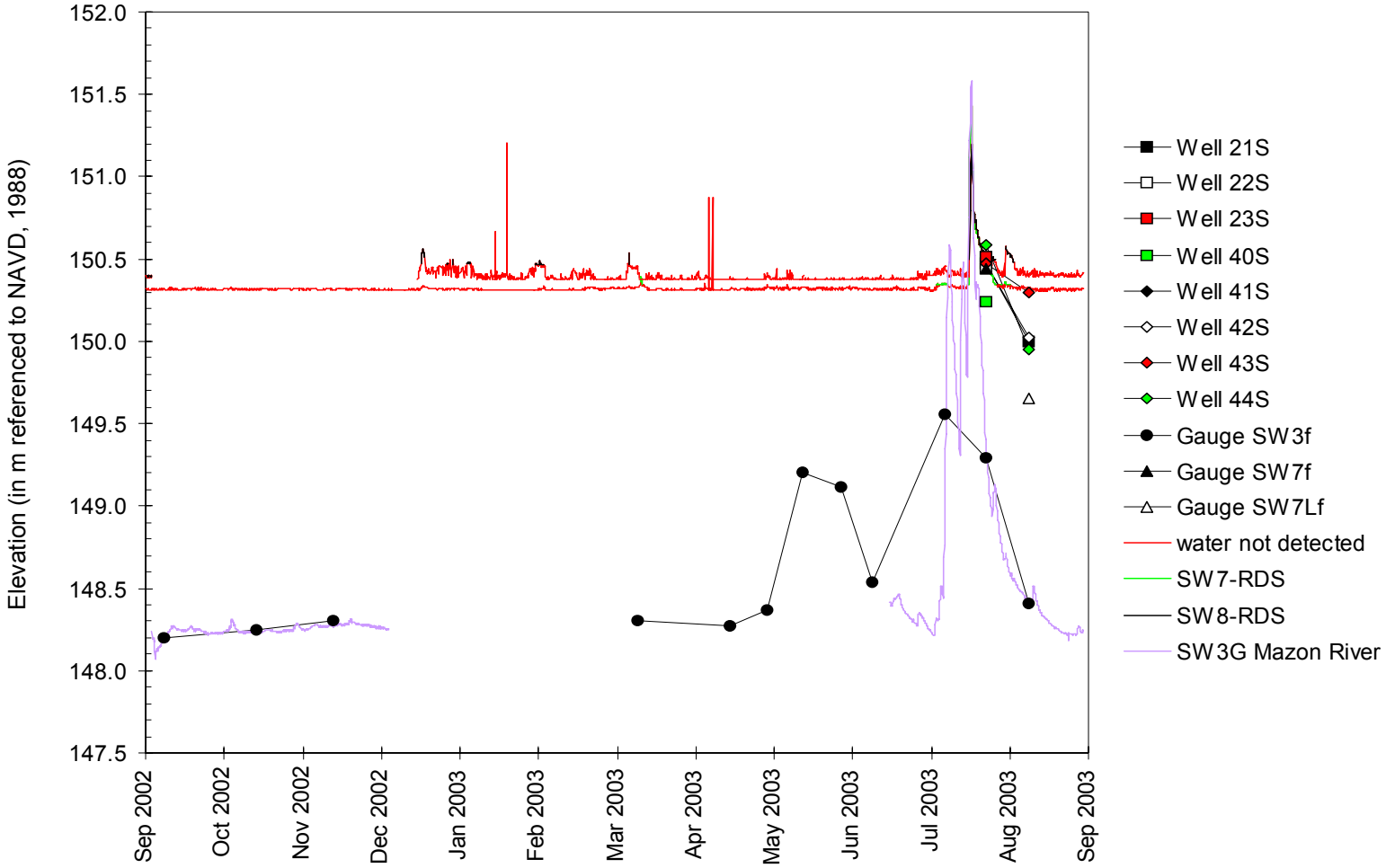


Chart E4 2003-4A Water-level elevations in the east field and near the natural slough in soil-zone wells, on stage gauges, and at the Global (G) and RDS loggers

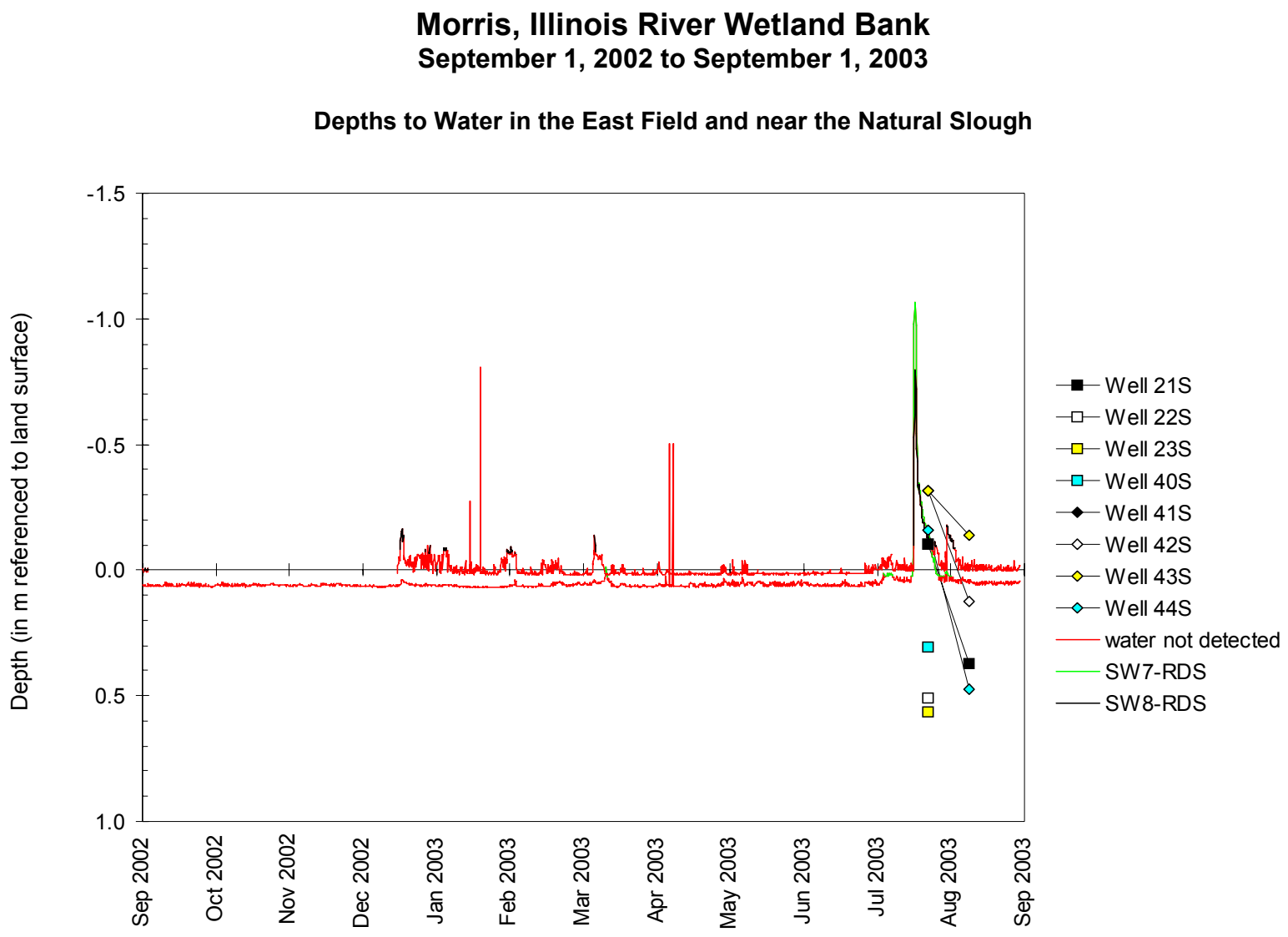


Chart E4 2003-4B Depths to water in the east field and near the natural slough in soil-zone wells and at the RDS loggers

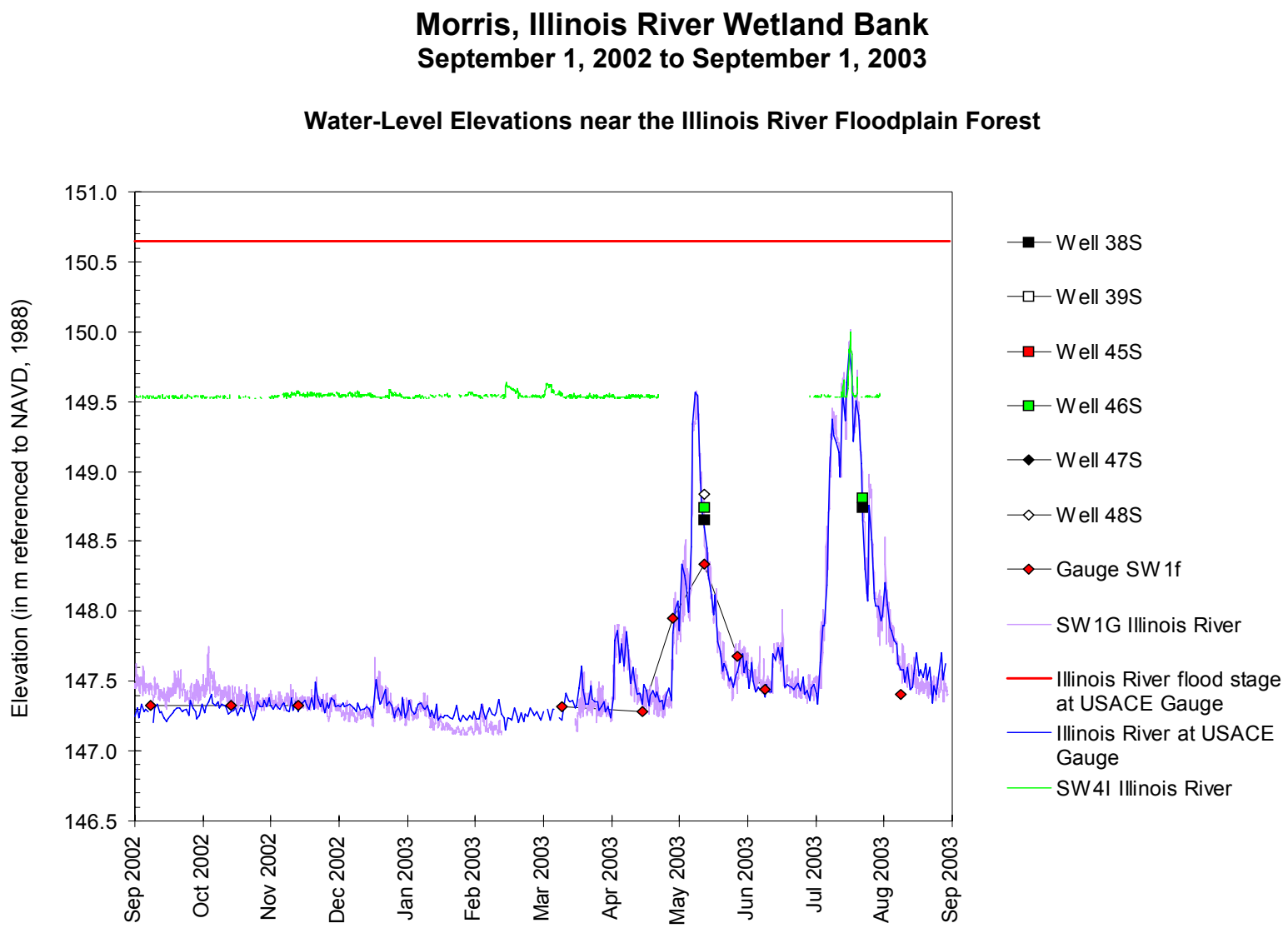


Chart E4 2003-5A Water-level elvations near the Illinois River floodplain forest in soil-zone wells, on stage gauges, and at the Global (G) and Infinities (I) sonic loggers

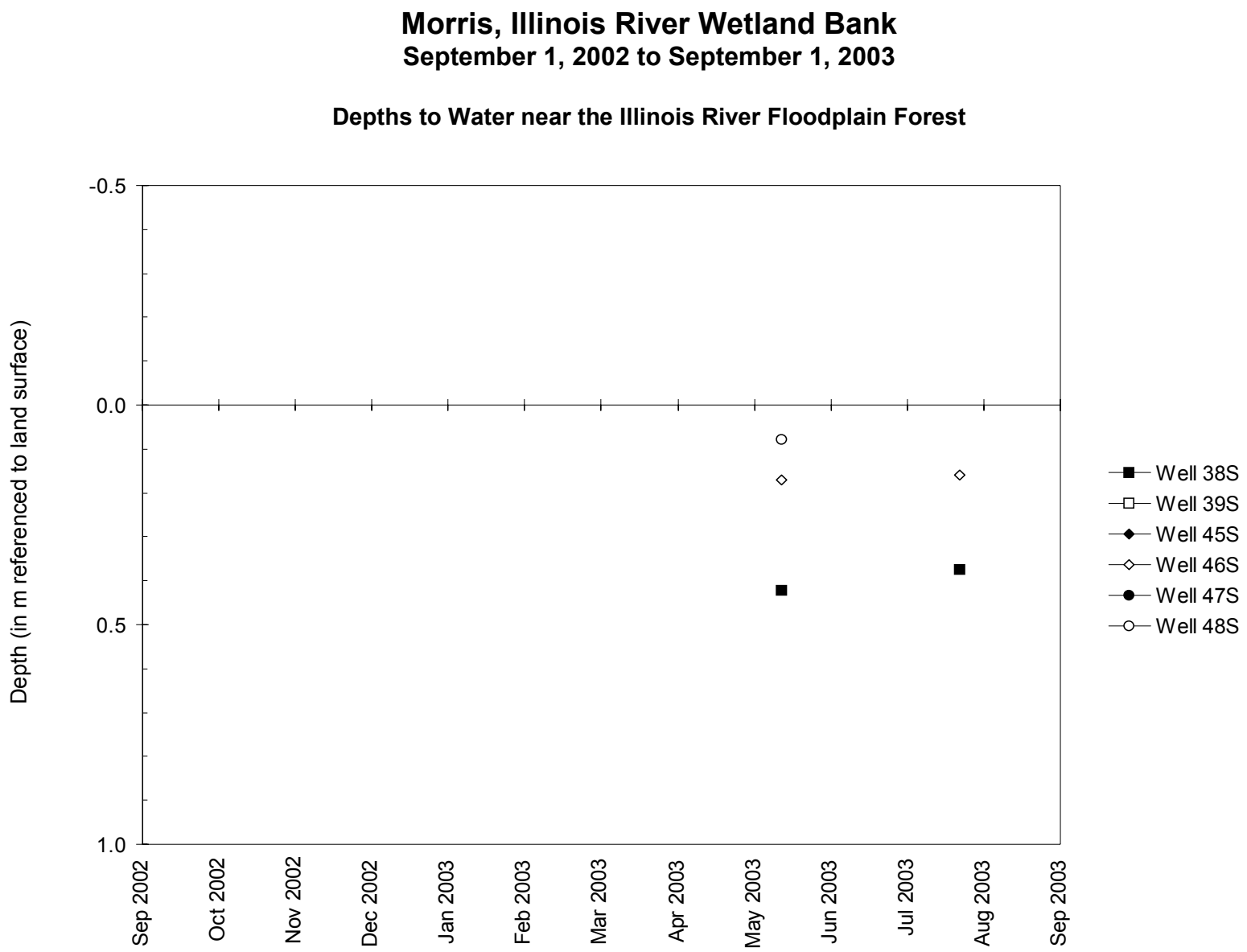


Chart E4 2003-5B Depths to water near the Illinois River floodplain forest in soil-zone wells

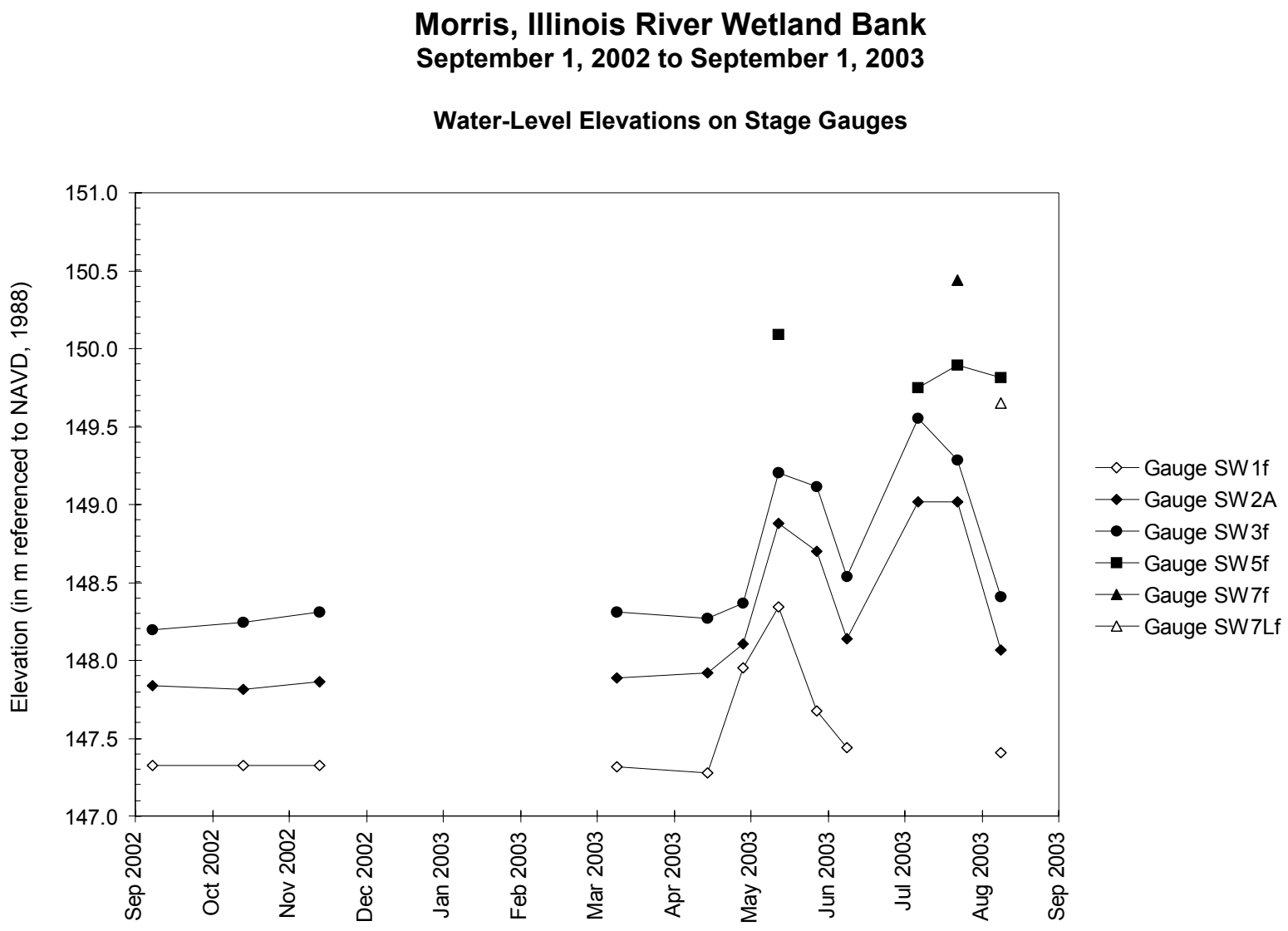


Chart E4 2003-6 Water-level elevations on stage gauges

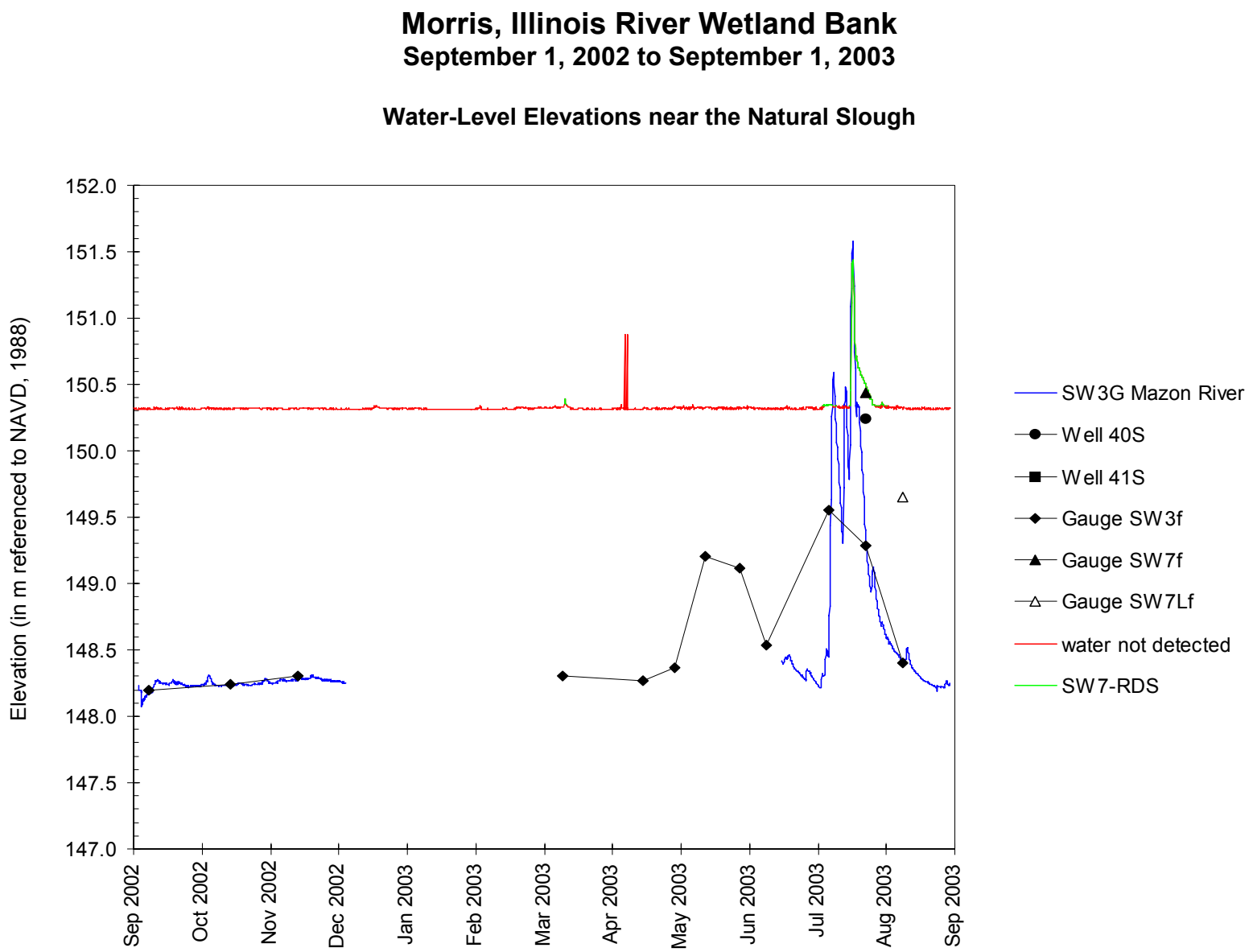


Chart E4 2003-7 Water-level elevations near the natural slough in soil-zone monitoring wells, on stage gauges, and at the Global (G) and RDS loggers

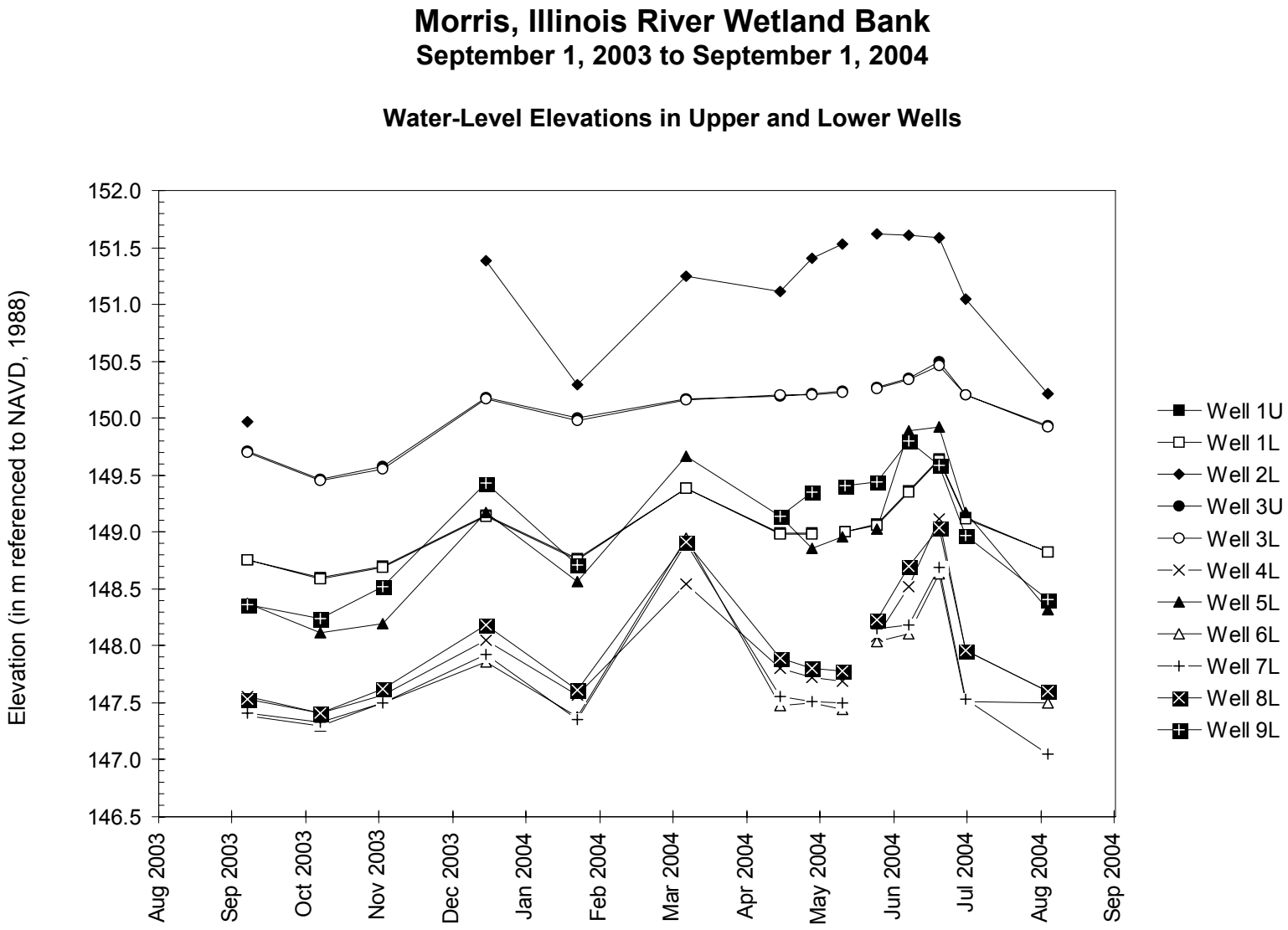


Chart E5 2004-1A Water-level elevations in upper and lower wells

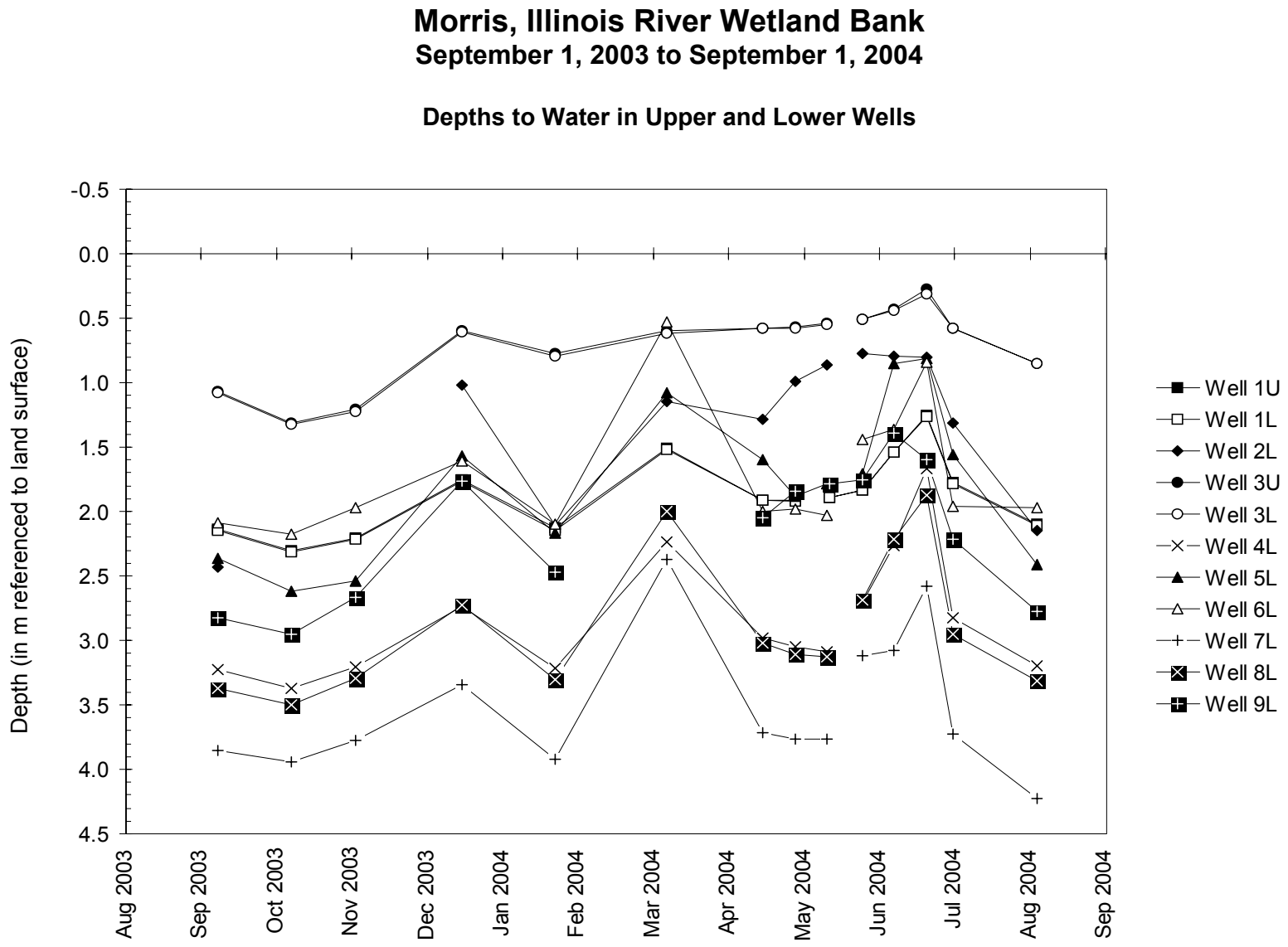


Chart E5 2004-1B Depths to water in upper and lower wells

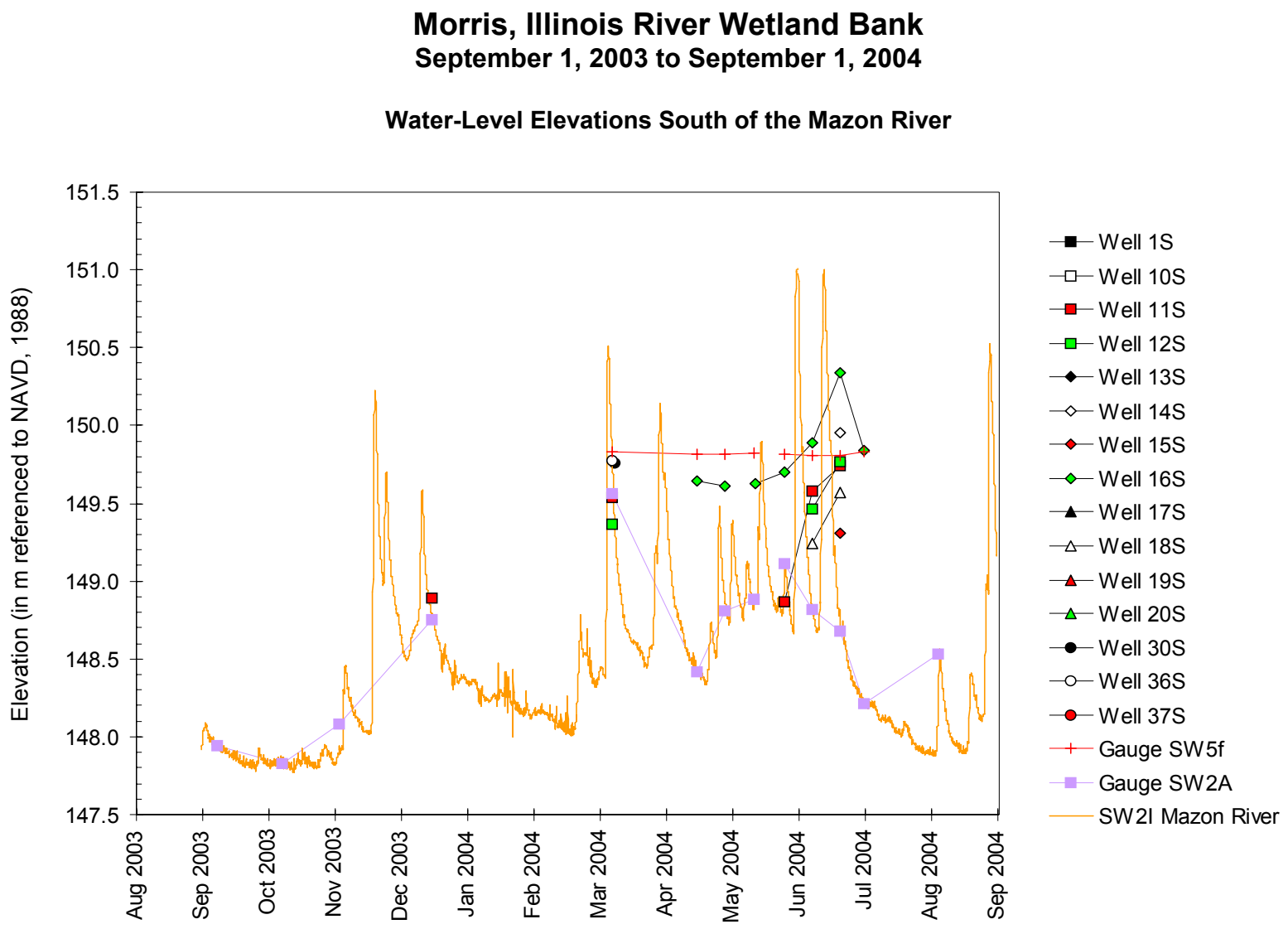


Chart E5 2004-2A Water-level elevations south of the Mazon River in soil-zone wells, on stage gauges, and at the Infinities (I) sonic logger

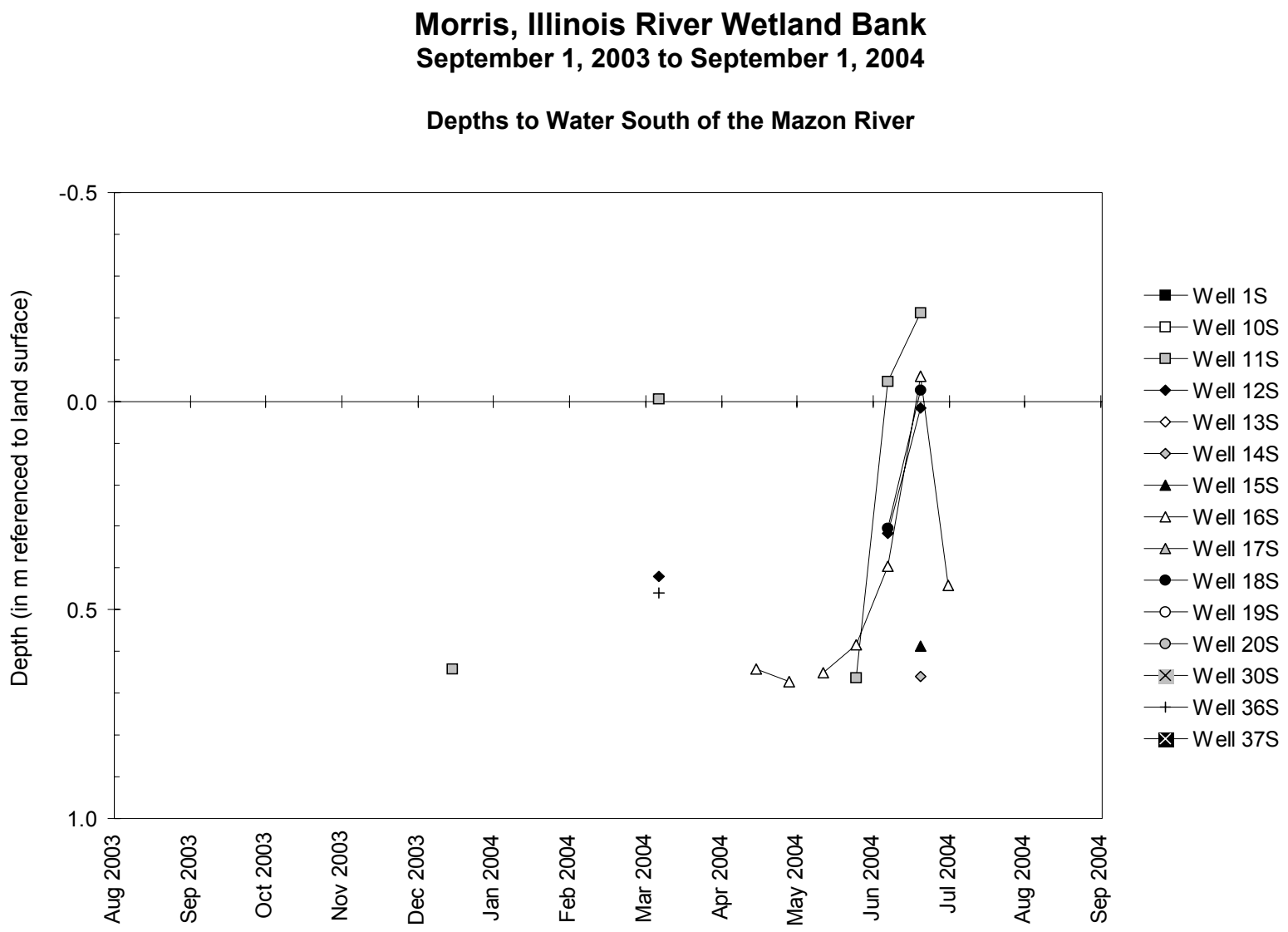


Chart E5 2004-2B Depths to water south of the Mazon River in soil-zone wells

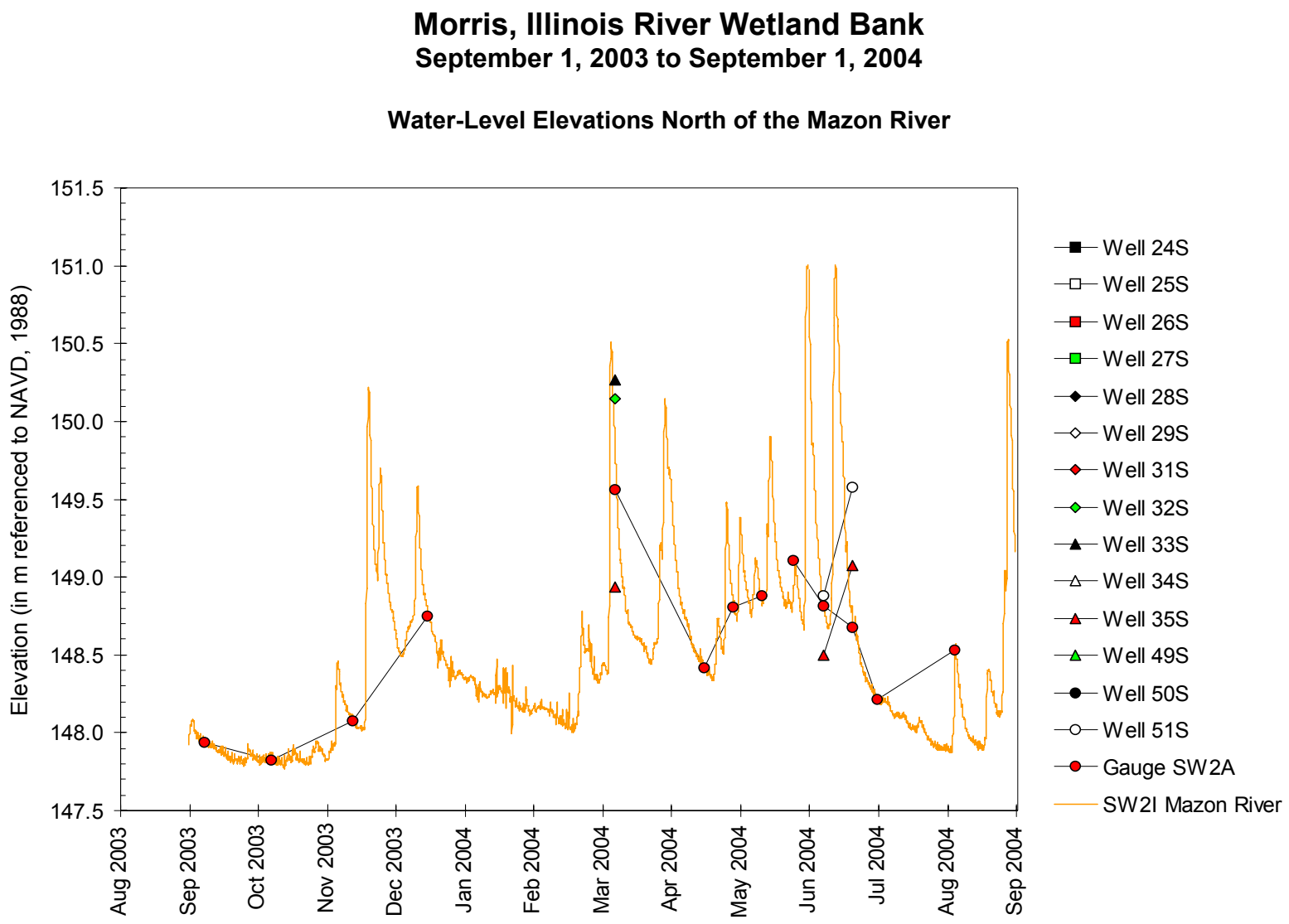


Chart E5 2004-3A Water-level elevations north of the Mazon River in soil-zone wells, on a stage gauge, and at the Infinities (I) sonic logger

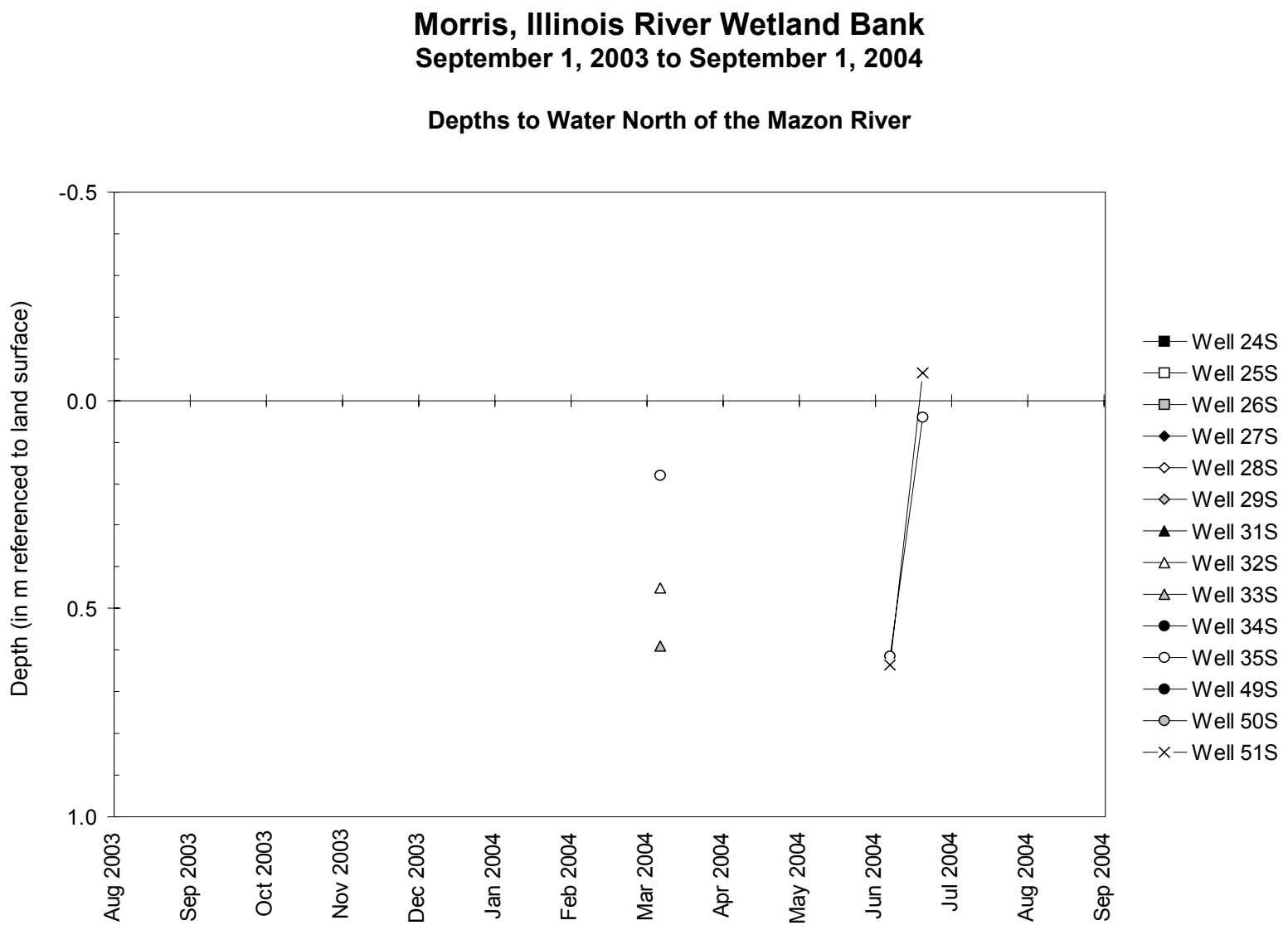


Chart E5 2004-3B Depths to water north of the Mazon River in soil-zone wells

Morris, Illinois River Wetland Bank
September 1, 2003 to September 1, 2004

Water-Level Elevations in the East Field and near the Natural Slough

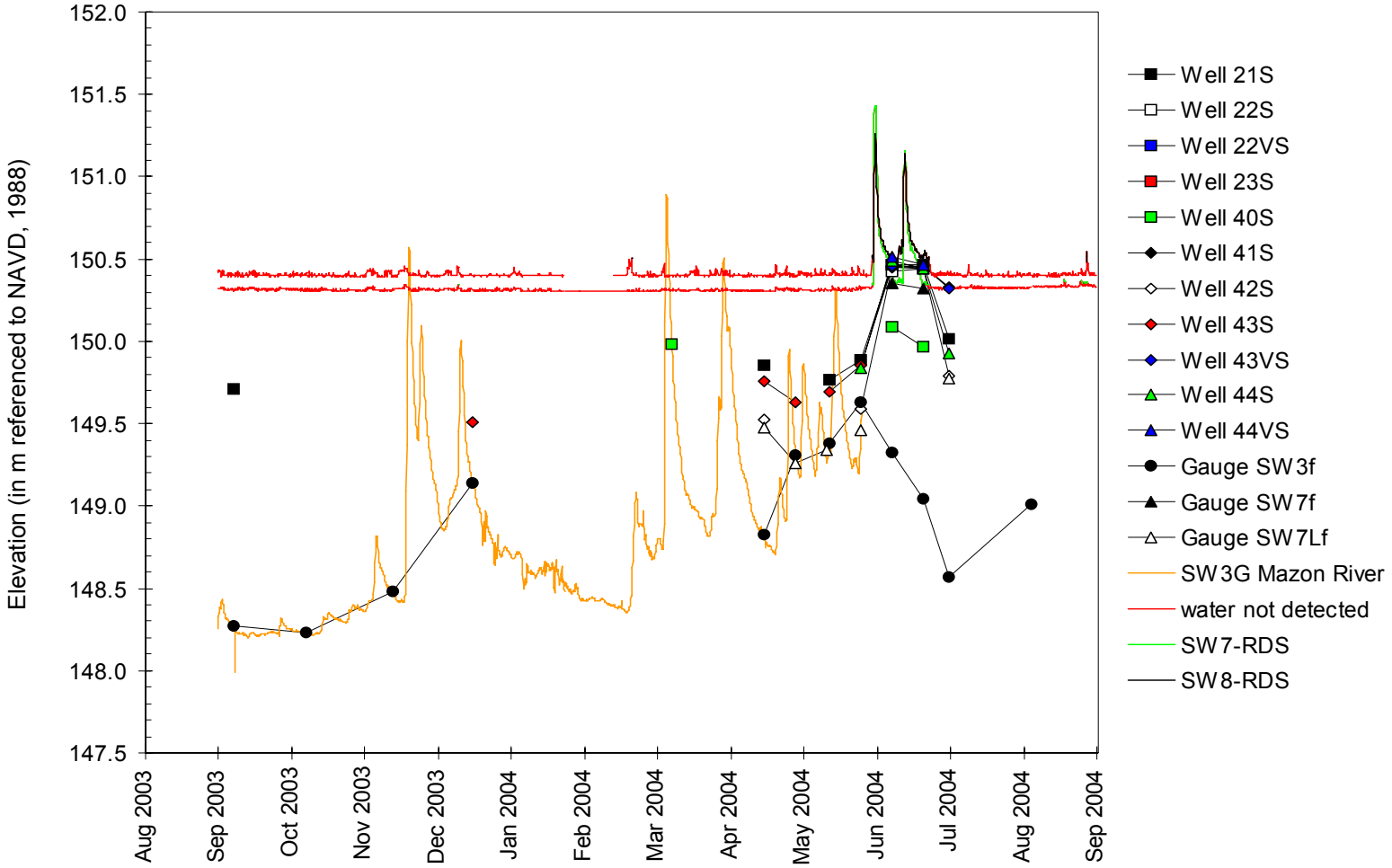


Chart E5 2004-4A Water-level elevations in the east field and near the natural slough in soil-zone and very shallow wells, on stage gauges, and at the Global (G) and RDS loggers

Morris, Illinois River Wetland Bank
September 1, 2003 to September 1, 2004

Depths to Water in the East Field and near the Natural Slough

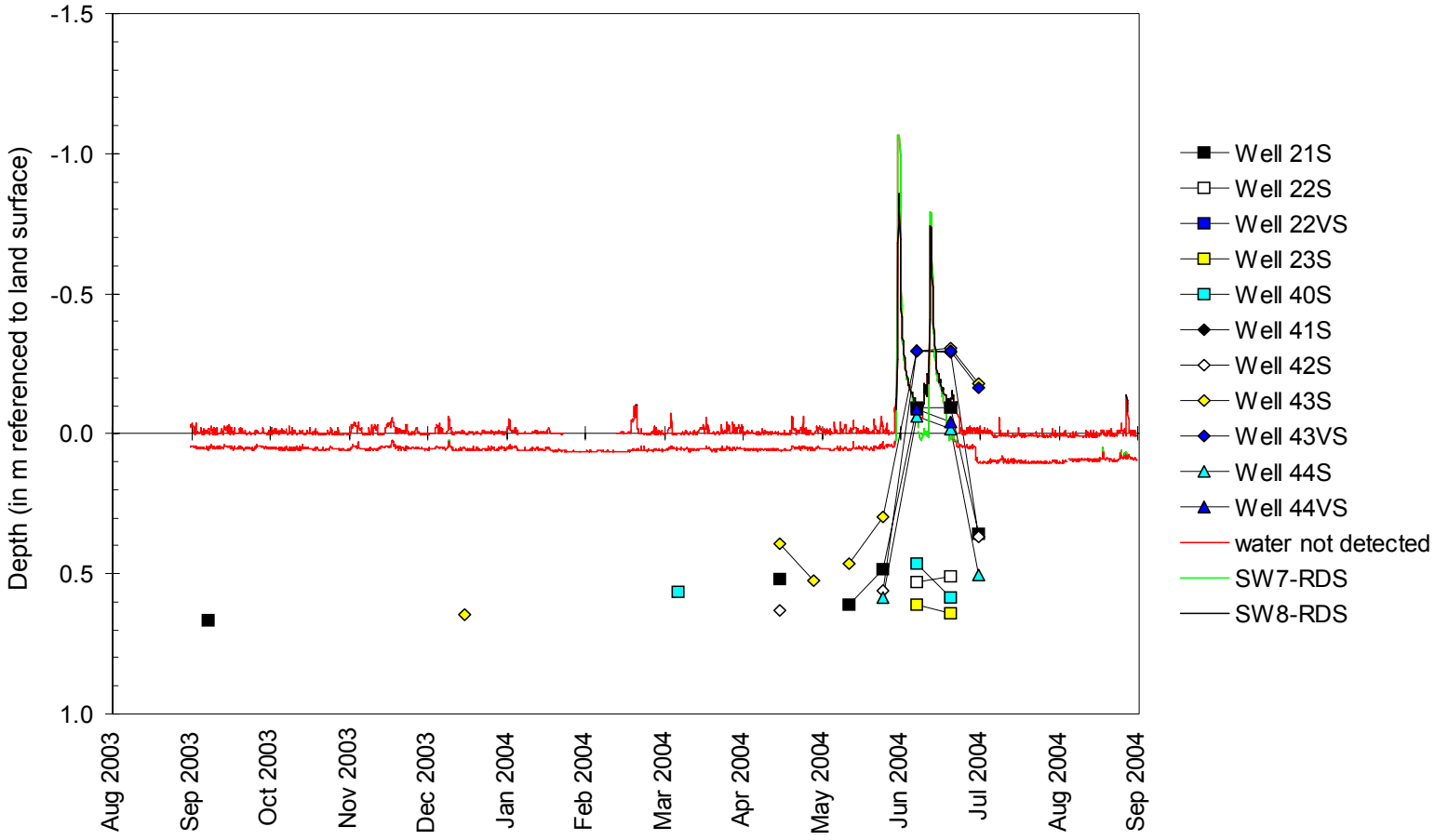


Chart E5 2004-4B Depths to water in the east field and near the natural slough in soil-zone and very shallow wells, and at the RDS loggers

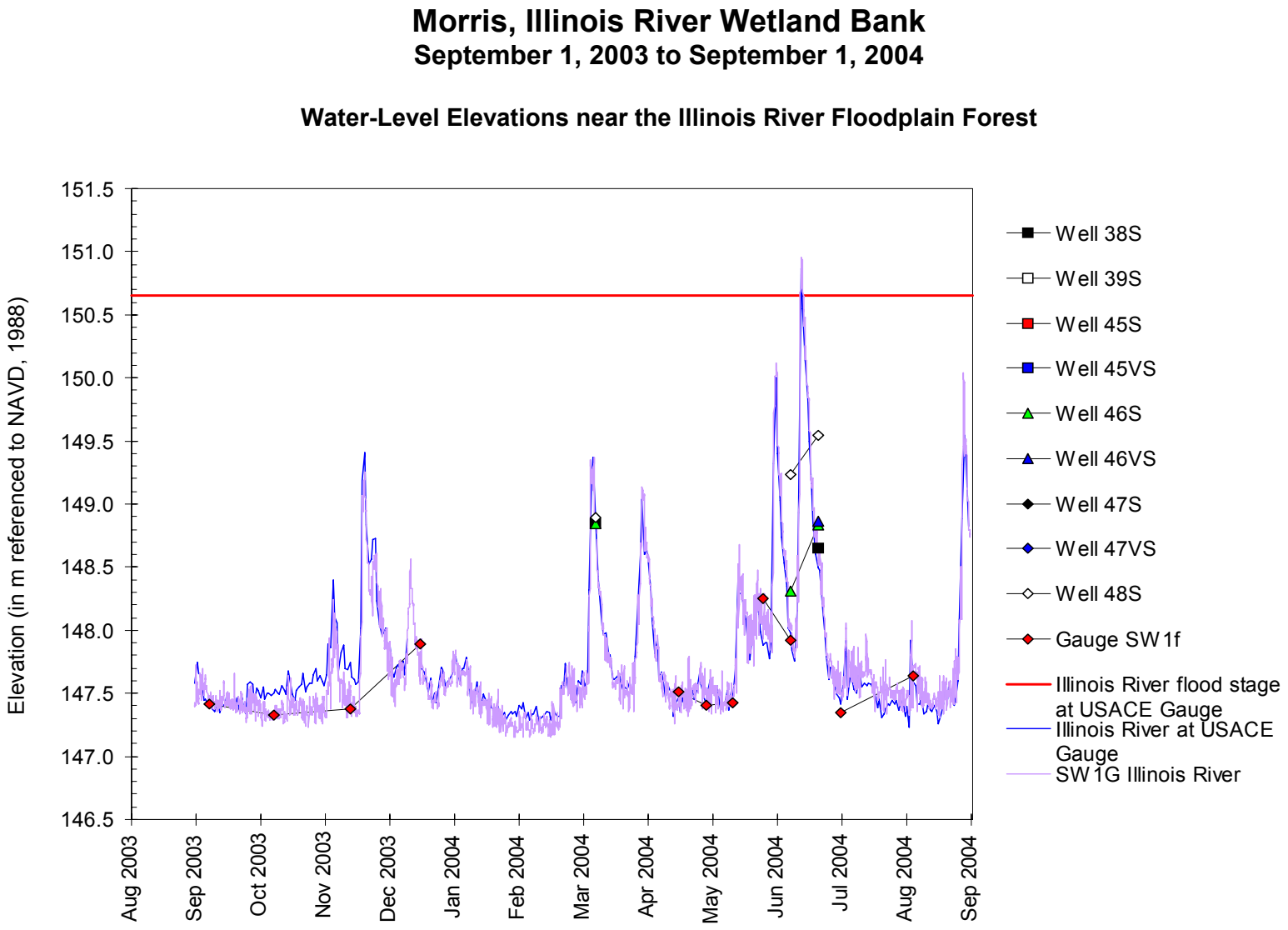


Chart E5 2004-5A Water-level elevations near the Illinois River floodplain forest in soil-zone and very shallow wells, on stage gauges, and at the Global (G) logger

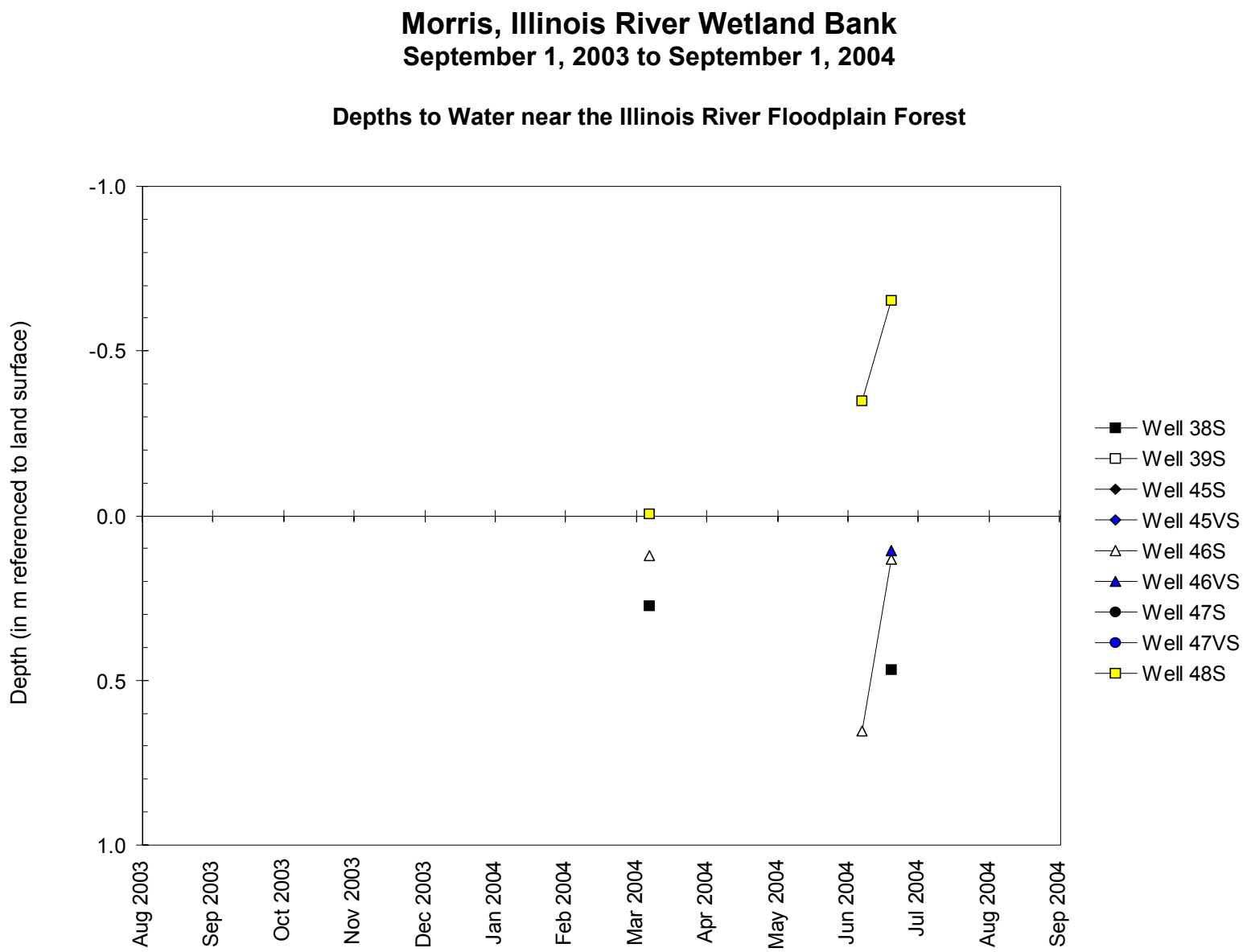


Chart E5 2004-5B Depths to water near the Illinois River floodplain forest in soil-zone and very shallow wells

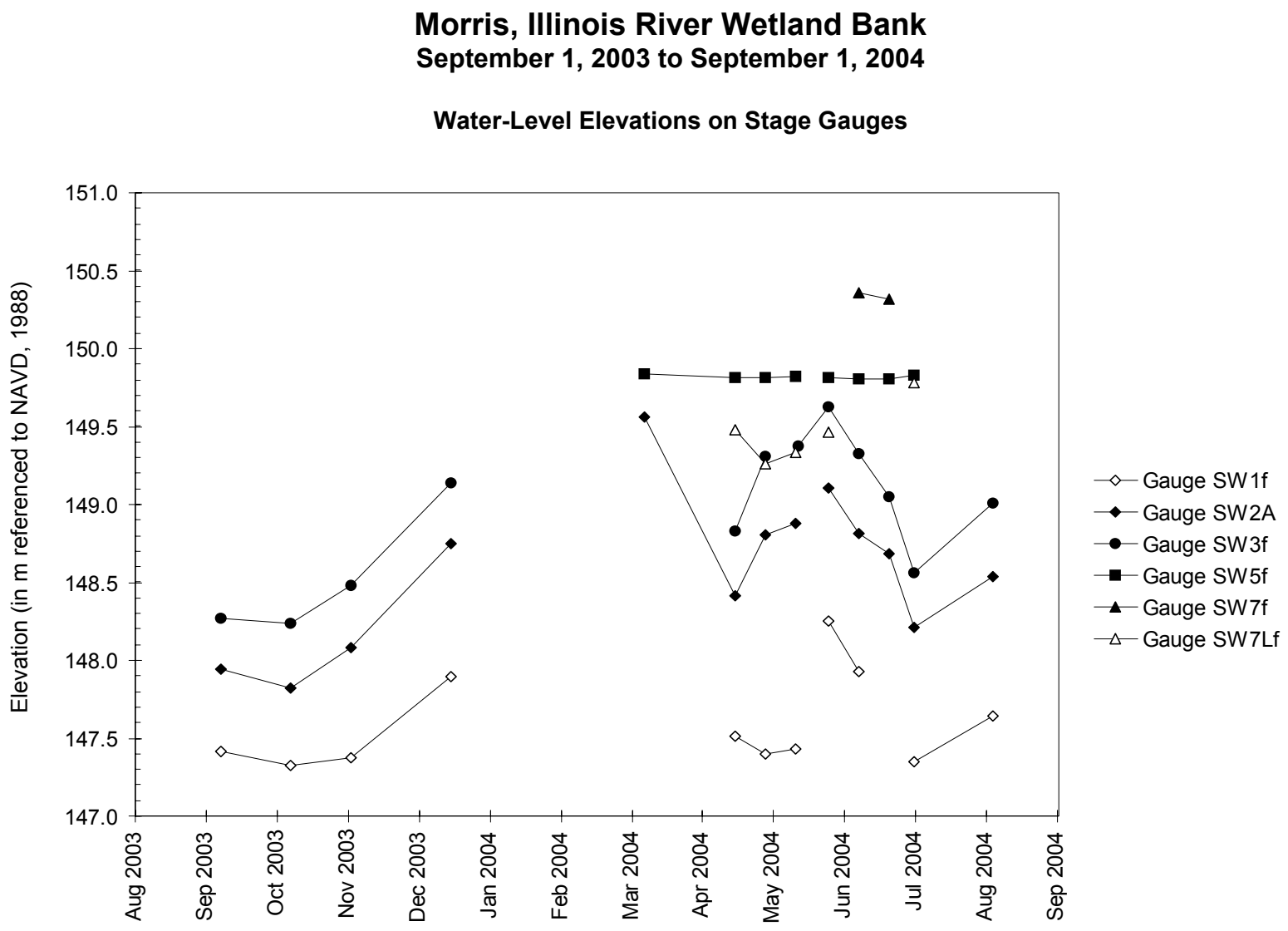


Chart E5 2004-6 Water-level elevations on stage gauges

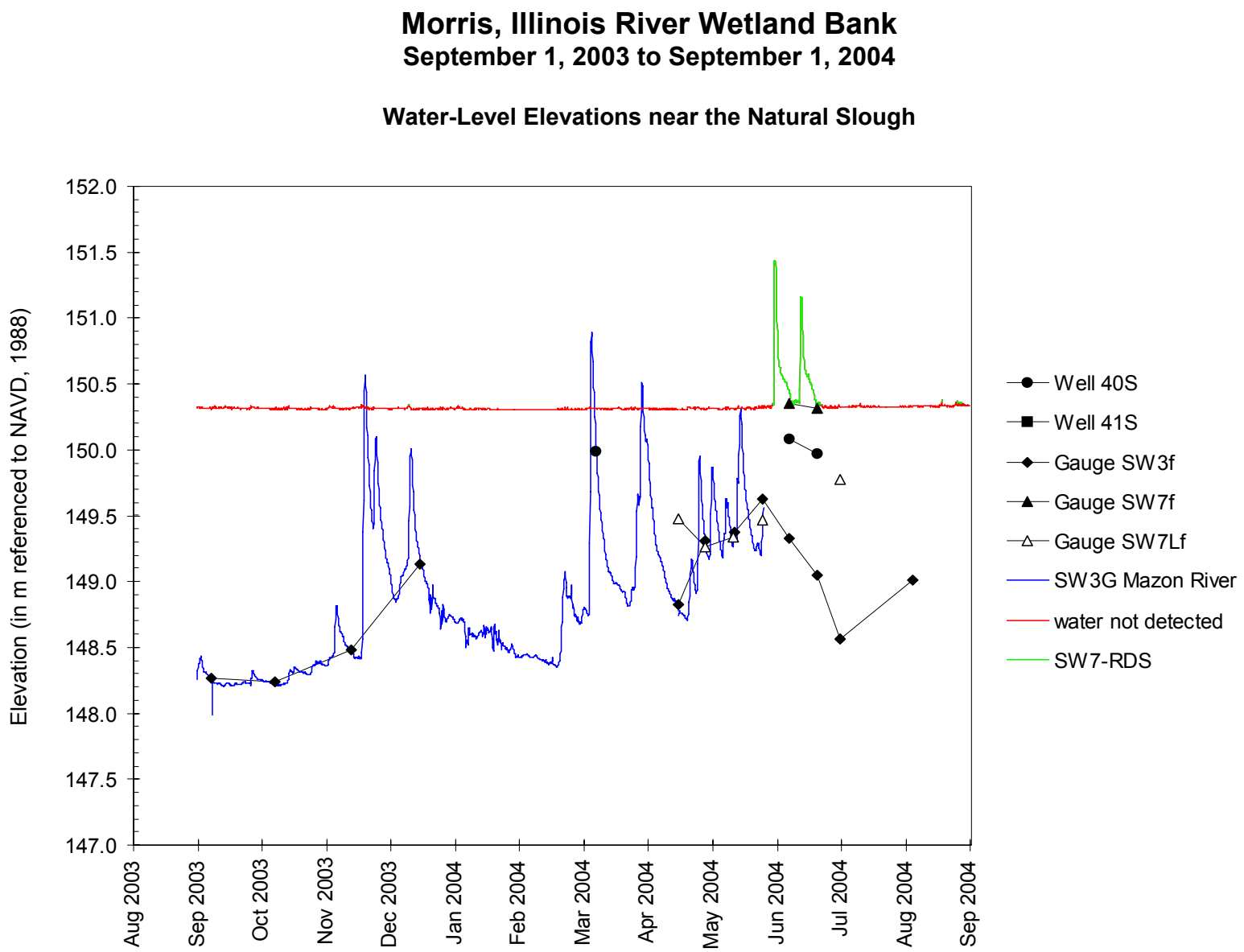


Chart E5 2004-7 Water-level elevations near the natural slough in soil-zone monitoring wells, on stage gauges, and at the Global (G) and RDS loggers