Wetland monitoring of the Olentangy River Wetland bottomland hardwood forest (Year 4 - 2004)

William J. Mitsch and Li Zhang

Olentangy River Wetland Research Park, School of Natural Resources, The Ohio State University

Introduction

This report represents the fourth-year mitigation report for the project "*Wetland Monitoring and Management Plan for Off-Site Wetland Mitigation for Spring-Sandusky Interchange*" contracted between The Ohio State University and the Ohio Department of Transportation (ODOT). The restoration is being carried out as part of the mitigation for the Spring-Sandusky interchange project in downtown Columbus. The bottomland hardwood forest is part of the 30-acre Olentangy River Wetland Research Park (ORWRP) at The Ohio State University (Figure 1). This report covers the period October 1, 2003 - September 30, 2004.

Site Restoration

Restoration/enhancement of this 13-acre bottomland forest involves two major management approaches:

Hydrologic Restoration

Four 20-ft wide breeches were made in an artificial levee that runs most of the northern half length of the 13-acre bottomland forest along the Olentangy River at the ORWRP. The levee had been constructed to prevent floodwater from reaching the floodplain perhaps as long as 100 years ago. In June 2000 and again in April 2001, the levee was breached in 4 locations to allow floodwater to enter the site. Locations of levee cuts and general elevations of the bottomland forest are shown in Figure 2. Restored hydrology is expected to increase long-term productivity of canopy trees in the forest and may result in some species shifts to more flood-tolerant species. The increased flooding is also expected to bring in nutrients with sediment input and plant propagules with flowing water, both of which will lead to enhanced forest productivity and biodiversity. It is also expected that the shifting sediments caused by more frequent surface flooding will change the understory and eventually the sub-canopy vegetation to a more natural condition typical of bottomland hardwood forests.

Removal of Alien Honeysuckle

In addition to the hydrologic modification, a program of invasive plant removal has been initiated, designed so that researach can be done to monitor its effectiveness. The major invasive plant species that has been removed from the forest in several locations on several occasions is Amur honeysuckle (*Lonicera maackii* Maxim.). Table 1 provides a summary of all honeysuckle removal episodes that have occurred at the bottomland in the past 4 years. No organized honeysuckle removal projects were conducted in 2004 because of lack of volunteer groups. In the previous 3 years, honeysuckle removal projects were regularly conducted using volunteer groups, in collaboration with the ORWRP, ODOT, FLOW (Friends of Lower Olentangy Watershed) and the City of Columbus. The removal of honeysuckle is expected to allow the bottomland subcanopy to become more diverse as its dense biomass is removed. After skipping honeysuckle removal for just one year, we have observed that honeysuckle is making a significant recovery in areas that were harvested on several occasions from 2001-03, suggesting that an annual honeysuckle removal program is required for it to be successful. The program that we established is based on volunteering of time and material by individuals and many organizations.

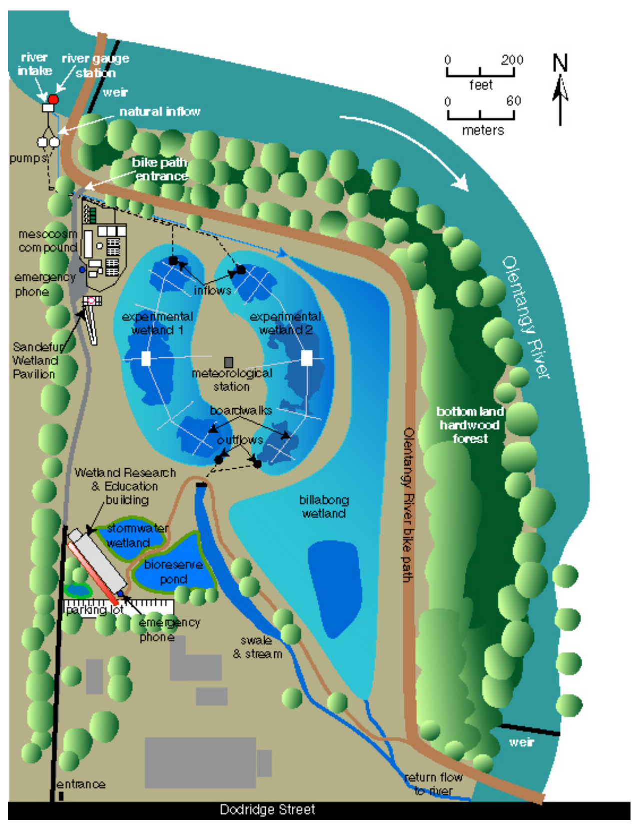

Figure 1. Master map for the Olentangy River Wetland Research Park at The Ohio State University. The bottomland hardwood forest is shown along the northern and eastern edges of the research park.

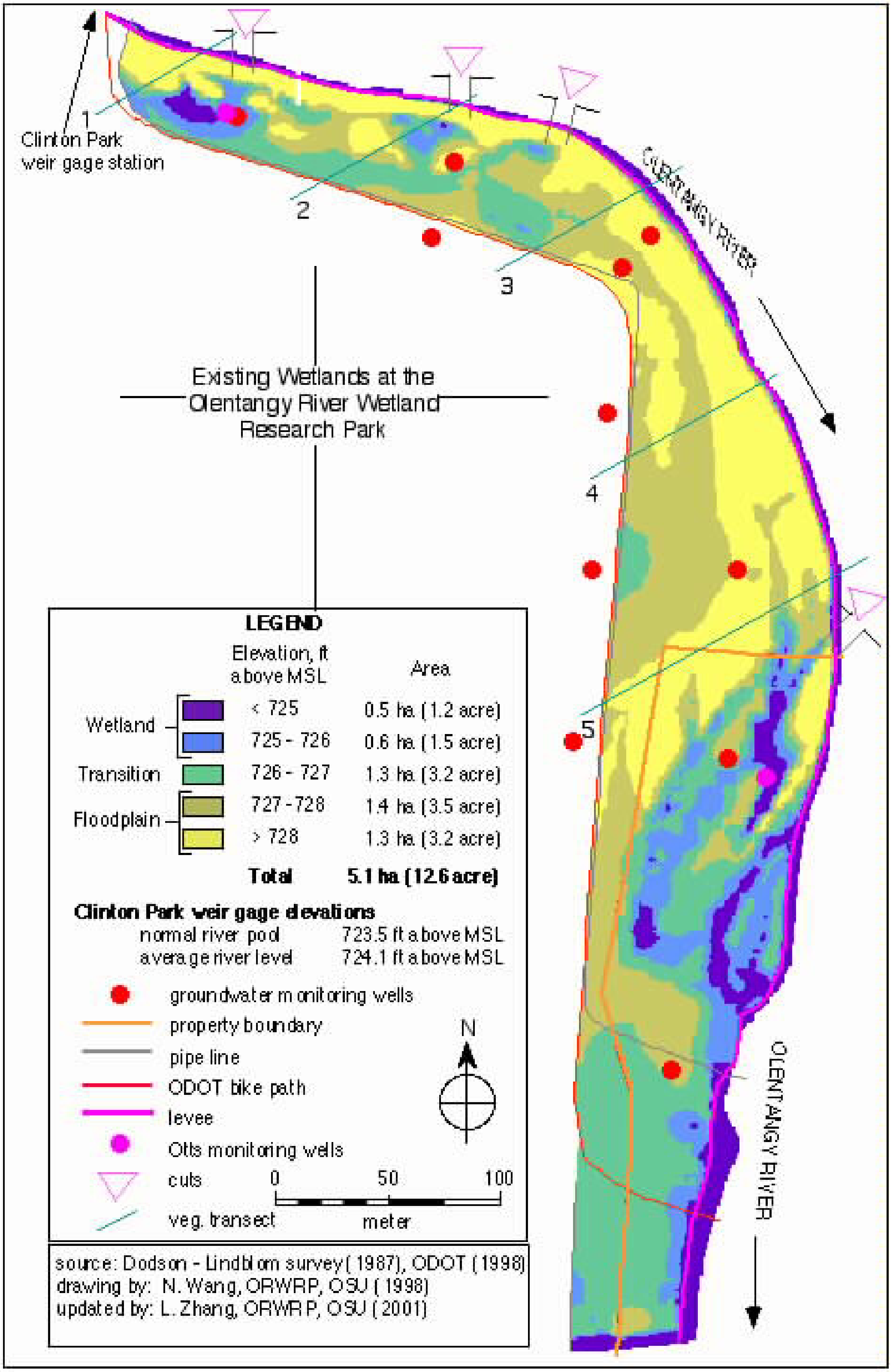

Figure 2. The 13-acre bottomland forest monitoring area, indicating land elevations, monitoring wells, and 4 locations ("cuts") where artificial levee was breached to allow bottomland flooding.

Figure 3. Aerial photo in June, 2004, for bottomland forest and Olentangy River Wetland Research Park. Vegetation shows no permanent scars in forest canopy from the cuts.

Table 1. Dates of honeysuckle removal in the bottomland hardwood forest at the Olentangy River Wetland Research Park sicne 2001

Date	Location of activity	Herbicide?	Group Est. man-hrs	
September 18, 2001	FLOW/OSU volunteer group	northern one-fifth	yes	100
October 18, 2001	Franklin Heights/FLOW volunteers	northern one-third	no	30
May 3, 2002	OSU/ORWRP Wetland Day	northern one-third	yes	60
April 12, 2003	OSU/ORWRP Planting Day	northern one-fifth	yes	100
September 23, 2003	FLOW/OSU volunteer group	northern one-third	yes	60
October 11, 2003	FLOW volunteer group	northern one-third	yes	60

Figure 4. Photos taken on May 6, 2004 of bottomland hardwood forest during flooding event

Table 2. Floods of bottomland hardwood forest since beginning of the mitigation monitoring of this bottomland hardwood forest in January 2001.

Date	Peak river stage, ft
WATER YEAR 2001	
April 11, 2001	16.15
WATER YEAR 2002	
December 2, 2001	16.74
December 18, 2001	17.87
February 3, 2002	16.91
April 5, 2002	16.88
April 14-18, 2002	17.88
May 17, 2002	
WATER YEAR 2003	16.99
March 5-14, 2003	16.85
April 8, 2003	16.61
May 12-16,2003	18.22
June 14, 2003	17.77
July 13, 2003	16.23
August 30,2003	16.93
September 30, 2003	17.08
WATER YEAR 2004	
Decemebr 1, 2003	16.89
January 4, 2004	19.21
March 22, 2004	16.99
April 2, 2004	16.88
May 4, 2004	17.17
May 21, 2004	18.21
June 2, 2004	17.90
June 14, 2004	20.22
June 20, 2004	17.79

Aerial Photographs for 2004

Aerial photography of the bottomland forest is obtained annually from ODOT low altitude remote sensing. The aerial photo for June, 2004 is shown in Figure 3. No winter photography was obtained in 2004. Summer 2004 photography shows a fully developed canopy with no indications of any permanent gaps in the canopy caused by the breeches.

Hydrology

A stream gauging station with an Ott Thalimedes water level recoreder and data logger and water quality probe was installed on the Olentangy River in June 2001 and a 30-min interval reading was established for downloading data (see "Clinton Park weir gage station in Figure 2). Two water level stations with Ott Thalimedes data loggers were installed at upstream and downstream sites in the bottomland forest in December 2000 (see "Ott monitoring wells" in Figure 2) with 30-min interval readings. Recording started February 2001. One Ott recorder is located near the 1st cut in the levee and is referred to as "upstream" site. The 2nd Ott is located downstream of the 4th and last cut and is referred to as the "downstream" site.

Nine major independent flooding events occured in the 2004 water year (Oct 1, 2003 - Sept 30, 2004) with sufficient stage to flood the bottomland forest through the levee breeches (Table 2; Figures 4 and 5). In the four years of monitoring the river since the cuts were made in the levee, 23 flooding events have occurred. This is a rate of approximately six flood events per year, the rate that was predicted when the mitigation was designed in 1998-99. Water level records for periods of available data in the 2004 water year from the upstream groundwater recorder in the bottomland forest (Figure 6) show that substantial and sustained flooding occurred in the bottomland hardwood forest by the Olentangy River in the period January to July 2004. There were even small pulses in what is usually the low-water period of August and September, in 2004. The downstream water level data logger was harmed by a particularly high river flood in 2003 and was not operating in 2004. Both water level recorders were reinstalled in fall 2003 to elevations well above any expected flood stage to avoid future damage to instrumentation.

Water Quality

Figures 7 and 8 show river stage and water quality in the Olentangy River during flooding events in May and June 2004. Flooding generally caused decreases in dissolved materials (see conductivity) and dampened diurnal patterns of temperature, dissolved oxygen, and pH, indicating the effects of floods on changing in-stream productivity. Although turbidity data are not shown here, there are often significant increases in turbidity (suspended sediments) immediately before and during bottomland flooding, maximizing sediment transport into the bottomland forest. This increased sediment input yields incresased nutrient input, which will likely contribute in the long term to enhanced forest productivity.

Soils

In October, 2003 a detailed study was undertaken to examine soil development in the bottomland following the restoration (Hossler and Mitsch, 2004). Soil colors were compared with pre-restoration data, and the percent of cores taken at the 0 to 5 cm depth with a soil chroma value of less than or equal to 2 increased from 46% of samples in 1998 to 70% of samples in 2003. This study also found that groundwater concentrations of nitrate-nitrogen and soluble reactive phosphorus were higher than those before the restoration. Both the increase in hydric soil indicators and the increase in groundwater nutrients could be the result of more frequent river flooding caused by the levee breeching in 2000-01.

Sedimentation

A sedimentation study was conducted in 2003 in the bottomland hardwood forest and data were analyzed in 2004 (Zhang and Mitsch, 2004). Sediment samples were captured

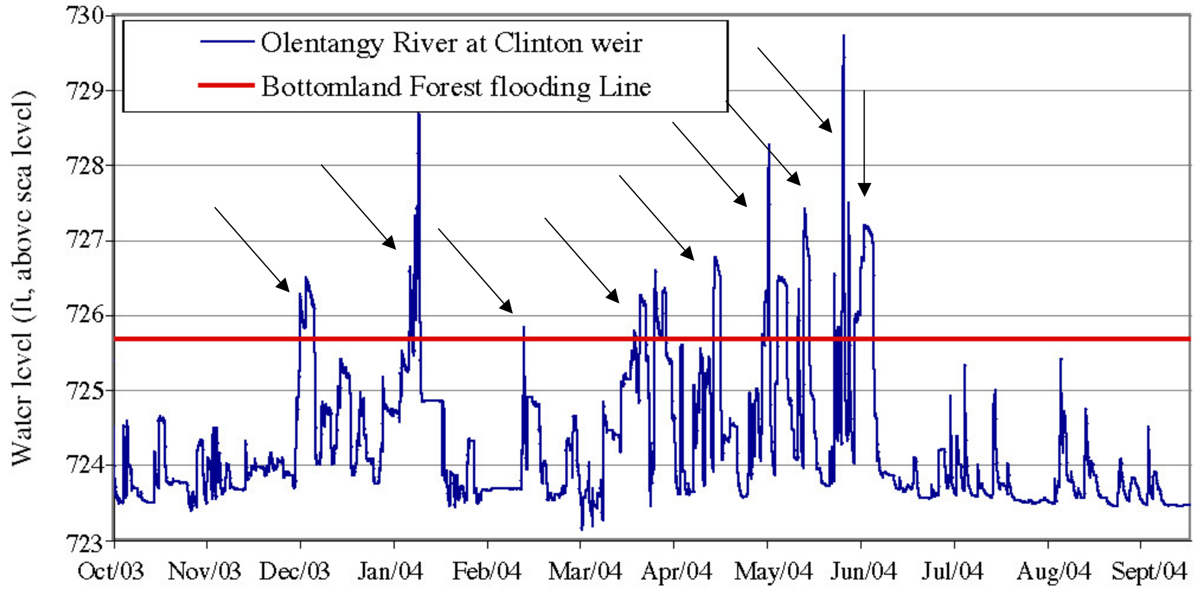

Figure 5. Hydroperiod for Olentangy River at ORWRP for 2004. Arrows indicate flood peaks that occurred in 2004 water year in the bottomland hardwood forest. Flooding line indicates approximate elevation of floodplain at which the river floods the bottomland.

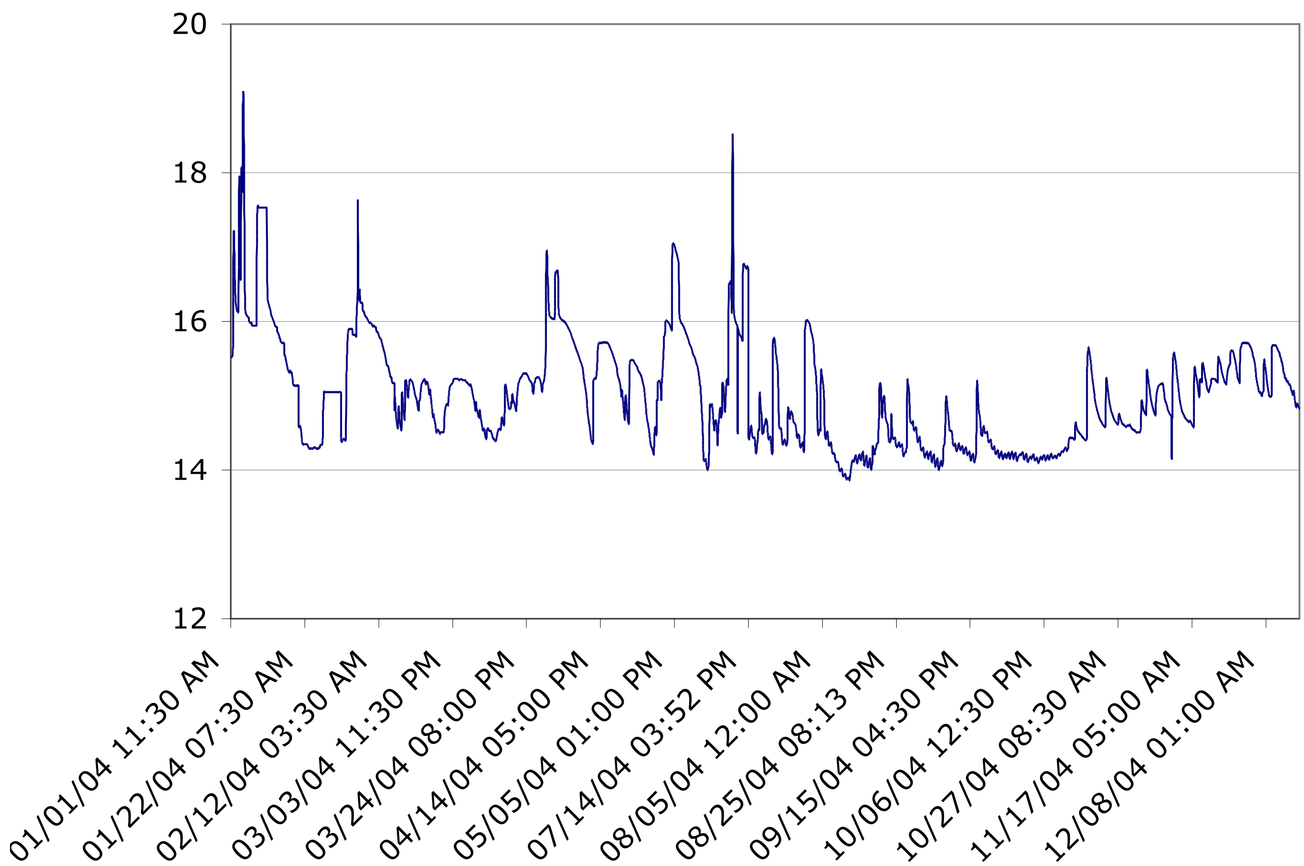

Figure 6. Upstream groundwater monitoring well in bottomland hardwood forest, January to November, 2004. Water level peaks correspond to river flooding.

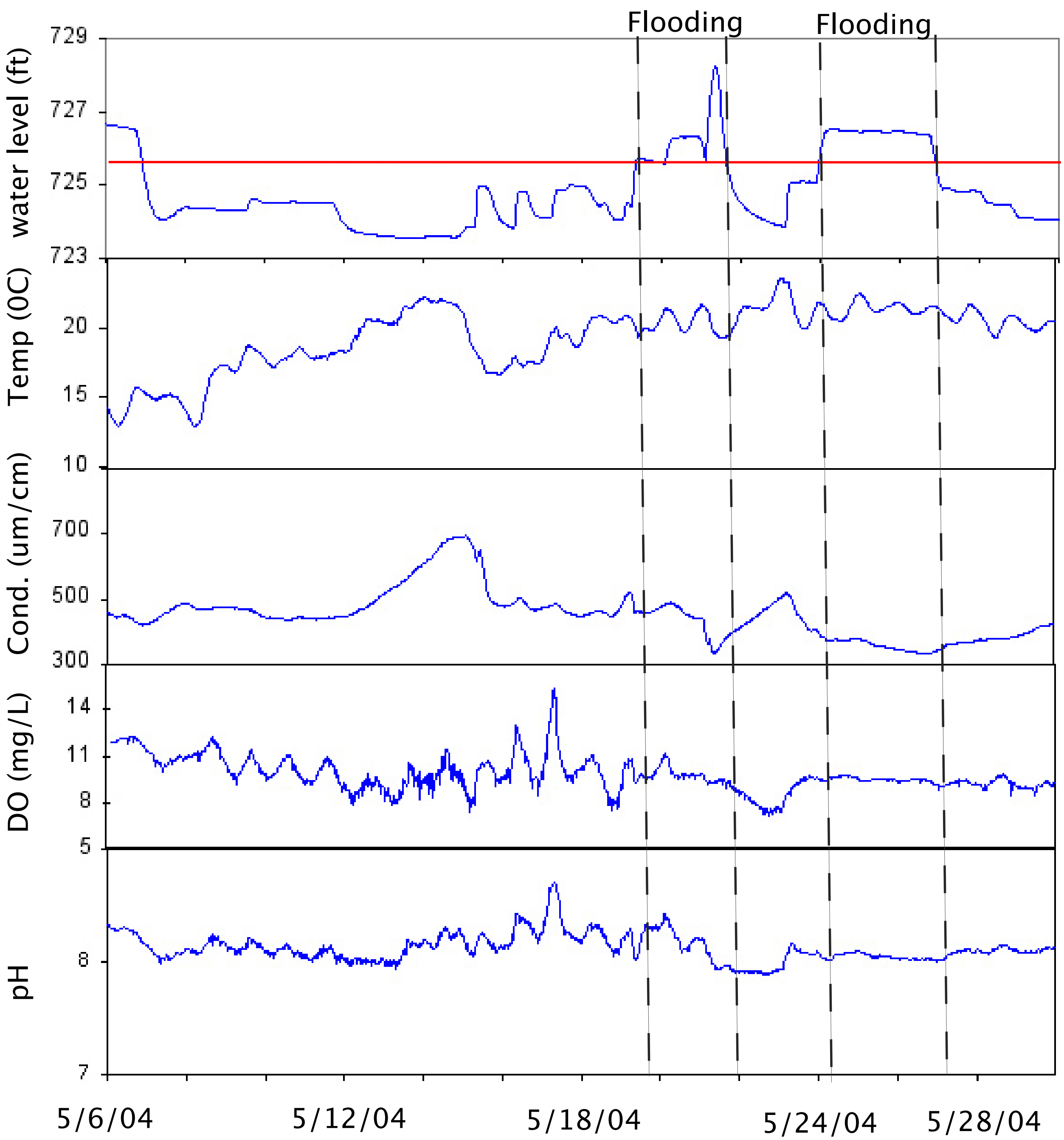

Figure 7. River stage and water quality of the Olentangy River at the Clinton Park weir for May 2004. Two major flood events occured during this period and are highlighted.

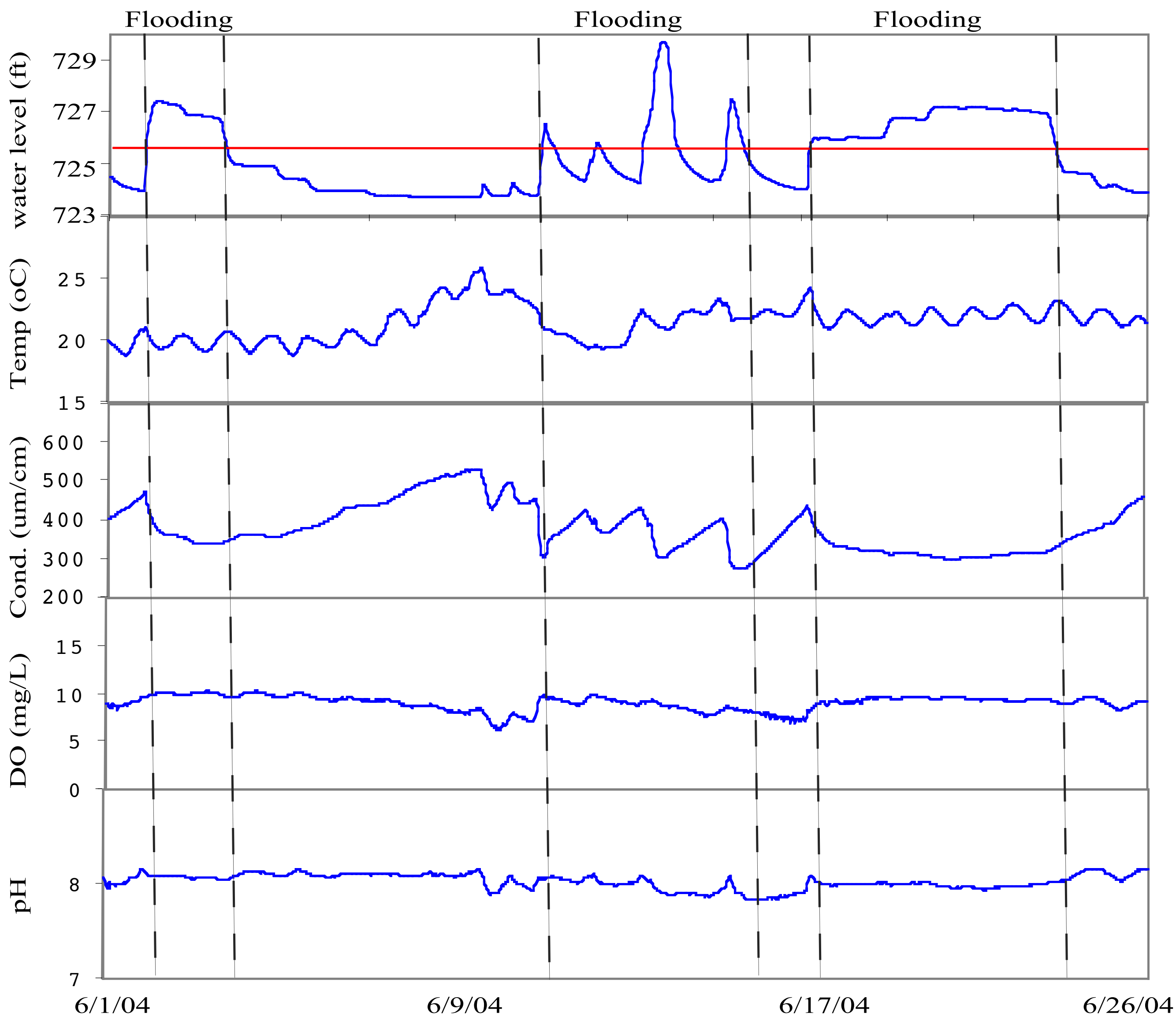

Figure 8. River stage and water quality of the Olentangy River at the Clinton Park weir for June 2004. Three major flood events occured during this period and are highlighted.

for nine flooding events that occurred in 2003, which lasted from 7 to 110 hours. Sedimentation in the wettest areas averaged 134 g-dry wt m^{-2}. These data were used to estimate the sedimentation contribution of carbon and nitrogen to the bottomland hardwood forest by the river.

Forest Canopy

Ten 20 x 25 m (500 m^2) plots were established in the bottomland forest in April 2003 for vegetation productivity estimations (Anderson and Mitsch, 2004). Four of the plots were in the northern half of the bottomland forest where the levee was breeched. Six plots were in the southern half of the bottomland where flooding has normally occurred. All trees greater than 5 cm dbh within these plots were identified in April 2004. Mean tree density was 40 ± 7 trees per plot. Tree density was higher in the northern section of the forest (62.8 ± 7.2 trees per plot) than in the southern section (24.8 ± 3.7 trees per plot). Tree species with the highest relative densities were box elder (*Acer negundo*), Ohio buckeye (*Aesculus glabra*) and pawpaw (*Asimina triloba*). All three species occurred in the subcanopy. Canopy trees were dominated by American sycamore (*Platanus occidentalis*), Eastern cottonwood (*Populus deltoides*), hackberry (*Celtis occidentalis*) and osage-orange (*Maclura pomifera*). While most of the tree species are facultative (FAC) and adapted to drier conditions, we continue to believe that in the long run (>50 years) the composition of the canopy will change to reflect wetter conditions as a result of the hydrologic restoration. Aerial photography from June 2004 (Figure 3) shows a healthy canopy with no obvious gaps that would be caused by dying trees. One development that has affected the forest canopy in the past year is increased deterioation of the existing levee along the north section of the bottomland. This has been caused by scouring along the levee-river interface, particularly during high water events. As a result, a few of the sizeable trees growing on the levee fell into the river in 2004. The fallen trees were uprooted, which led to further deterioation of the berm. We expect this trend to continue, and consider it a positive development as it will increase exposure of the bottomland to periodic flooding.

Net aboveground primary productivity (NAPP) in the bottomland forest for the months June through October 2004 was 450 ± 6 g-dry wt m^{-2} for the north section that was restored and 467 ± 30 g-dry wt m^{-2} for the south section that had continuous flooding and was not as significantly impacted by the restoration. Rates of NAPP were not significantly different between the two sections. Productivity data are preliminary, with more complete results expected in 2005.

Understory vegetation

Understory vegetation studies in 2004 continued to emphasize the effects of honeysuckle removal on other understory vegetation. While no results are available from student studies in 2004, a report that was compiled in 2004 but based on 2003 data is included (Swab and Mitsch, 2004). That study shows that after one season of surveys, there is very little difference in species richness for cleared or uncleared portions of the bottomland hardwood forest. Species richness was 4.3 ± 0.2 for cleared sections and 4.4 ± 0.2 for uncleared sections. The lack of any significant differences between areas where honeysuckle was removed and where it was left in place could be due to the lack of time for recovery of plant diversity. It was also observed that other invasive plants, e.g. *Allaria petiola*, invade when honeysuckle is removed.

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