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A Message from Ward Freeman

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U.S. Geological Survey, New York Water Science Center Newsletter

Superstorm Sandy | 2011 Year of The Flood | Streamgage Flood Hardening | NYC Groundwater Flooding | Hydrologic Conditions

Current Efforts by the USGS NY WSC in response to Hurricane Sandy

Hurricane Sandy was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season, as well as, the second costliest hurricane in United States history. Department of the Interior (DOI) agencies are working to restore and rebuild national parks, national wildlife refuges, and other Federal public assets; and to increase the resiliency and capacity of coastal habitat and infrastructure to withstand storms and reduce the amount of damage caused by such storms. The USGS New York Water Science Center has been tasked, in part, with the following:

Fire Island —The USGS, in cooperation with the National Park Service and the U.S. Army Corps of Engineers, are conducting surveys of tide elevation, bathymetry, and current velocities to evaluate the open breach of the barrier island at the Federal Wilderness Area, Fire Island National Seashore, N.Y. The open breach is a concern to local communities on Long Island, like Bayshore, N.Y., because it is speculated that the break in the barrier island could increase the likelihood of Long Island coastal flooding from future storms. Others have also speculated that the water quality in the back bay may improve due to increased mixing with ocean waters. Monitoring the breach, and predicting and managing the dynamics of coastal barriers are essential for understanding the threats and vulnerabilities that adjacent communities, ecosystems, and waters may incur.

The USACE LARC and NYWSC personnel with the remote controlled Q boat surveying the breach at the Federal Wilderness near the Old Inlet area of Fire Island National Seashore, N.Y.

USGS activities on coastal storm impacts, vulnerability, and resilience support objectives of federal, state, and local agencies that plan and manage coastal zone infrastructure, and who are responsible for coastal protection, emergency management, hazard reduction, and post-Sandy response and recovery.

For more information contact Chris Schubert

Assessing the Dispersion of Contaminants Associated with Hurricane Sandy —Environmental assessment projects in New York from New York Harbor to Peconic Bay have begun, with special emphasis on areas of the Western Bays, Great South Bay, and the Peconic estuary. Analyses will allow USGS to assess the range in concentrations of contaminants near important representative sources. Some examples include: (1) wastewater treatment facilities (WWTFs), several large WWTFs were compromised and released millions of gallons of untreated or poorly treated sewage into sensitive coastal areas; (2) discharges from dewatering tunnels, dewatering activities likely introduced large amounts of contaminants such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl (PCBs), flame retardants, metals, and others; and, (3) spillage from home heating oil, fuel storage, and fuel transfer facilities, which contributed contaminants such as PAHs. Contaminants introduced on the eastern portion of Long Island reflect a more diffuse non-point source of contaminants and were dispersed from structures that may have stored small amounts of pesticides, fertilizers, paint thinners and other contaminants (such as those stored in garages).

For more information contact Pat Phillips.

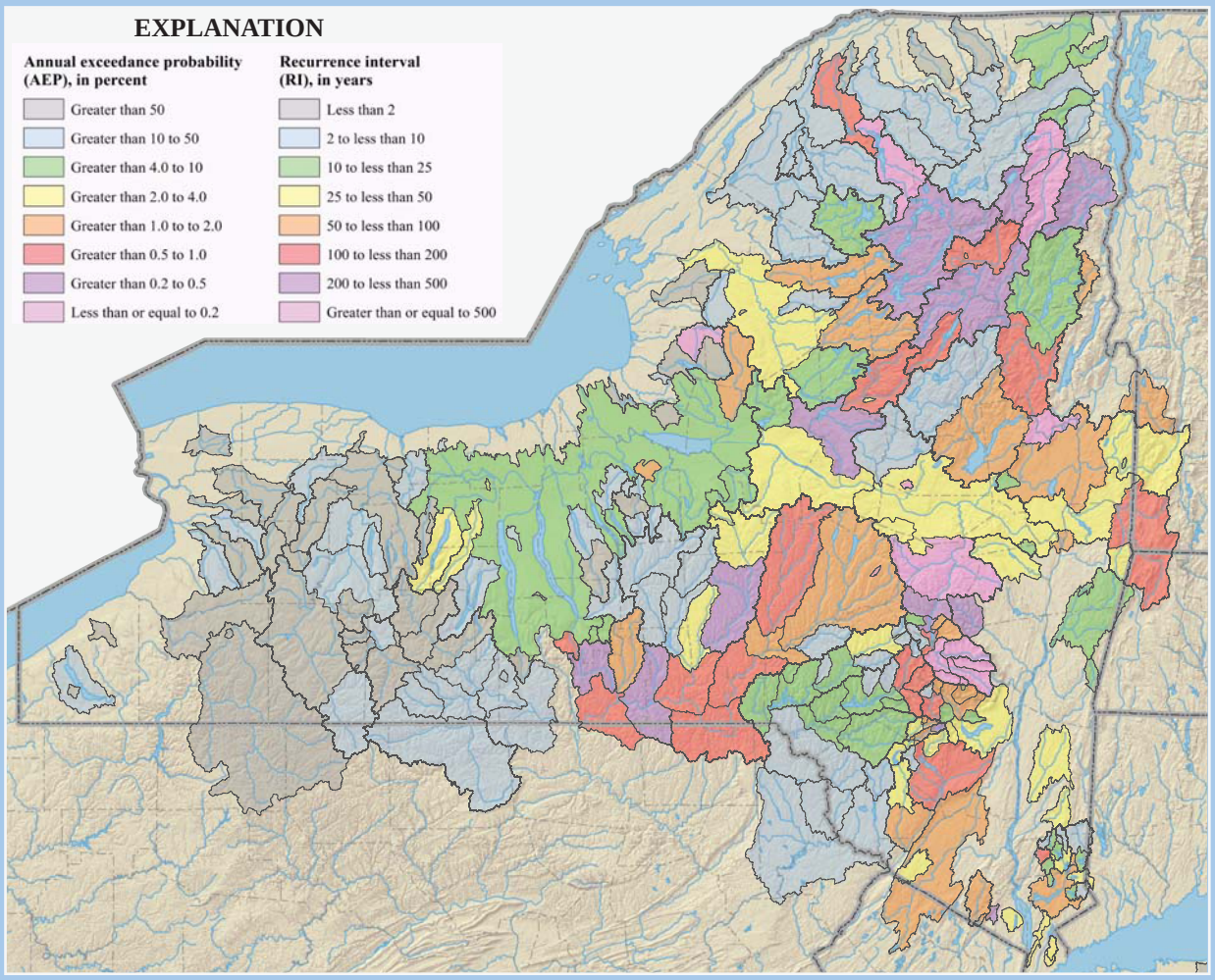
Network Design for coastal and inland flood documentation —This project, with stakeholder input, will: (1) analyze the flood documentation network density and model uncertainty; (2) establish fixed-place and define rapidly deployable storm tide networks along the Atlantic and other vulnerable coastal areas which fill data gaps, meet local response data needs, and systematically reduce forecast model uncertainty; (3) enhance the capability to deploy a network of sensors to meet water-level, flow, and quality data needs during emergency situations; (4) provide detailed observations of water and wind impacts on built structures and natural features; and (5) collect water velocity and directional data during storms in selected areas along the coast to improve the definition of bay, estuary, and(or) river channel flows for improved storm surge modeling and prediction. This work will be performed in Southeastern New York State and coordinated with other federal, State and local stakeholders.

Photo showing Bay Park Wastewater Treatment Plan Discharge to Western Bay following Hurricane Sandy.

For more information contact Ron Busciolano.

2011 Year of the Flood

Record rainfall combined with above average temperatures and significant spring snowmelt, resulted in record flooding throughout New York during 2011. Rainfall totals in eastern New York were the greatest since 1895 by as much as 60 percent above the long-term average within the Catskill Mountains area and the Susquehanna River Basin. This figure (see below) summarizes the effects of the three largest storms and resultant flooding during the year: (1) Spring storm during April and May, (2) Tropical Storm Irene during August, and (3) Remnants of Tropical Storm Lee during September. According to the Federal Emergency Management Agency (FEMA), the cost of these three storms exceeded $1.5 billion in federal disaster assistance. The 2011 water year (October 2010 through September 2011) was atypical in that major floods occurred at different times and at different places within the same year. A composite of the most severe flooding during the 2011 water year shows the drainage basin for active USGS streamgages, color coded to reflect the annual exceedance probability (AEP) for the maximum discharge at each streamgage during 2011. The AEP values used in this figure are given in percent chance (for example, the 0.01 AEP is shown as a 1-percent chance AEP). The inverse of the AEP flood was commonly referred to in the past as the flood recurrence interval. For example, a 1-percent chance AEP flood (a flood having a 1-percent chance of being equaled or exceeded in any given year) is also referred to as a flood with a 100-year recurrence interval. As indicated in this figure much of the State experienced major flooding at some time during the 2011 water year. The basin color represents the most extreme of the three events. Extreme western New York was one of the few upstate areas spared significant flooding.



Maximum AEP and recurrence interval values for three floods in 2011 at selected U.S. Geological Survey gaging-station basins in New York.

Streamgage Flood Hardening in Central, NY

On August 28-29 2011, Hurricane Irene struck eastern New York State and New England causing record breaking flooding and damages. While Irene spared much of central and western New York from extensive flooding, it did saturate the ground. Two weeks later on September 7-8, record precipitation fell within the Susquehanna River Basin (10-12 inches in Binghamton, NY), as a result of Tropical Storm Lee. Lee caused historic flooding from Binghamton, New York downstream to Waverly, Pennsylvania. Several streamgages along the Susquehanna River and its tributaries were inundated by floodwaters. The Susquehanna River at Owego gage was completely submerged and all equipment was lost. Because of the extent of the flooding in the Village of Owego, New York, USGS personnel had to wait until the following day to reach the gage to repair it, using a kayak to paddle down city streets with replacement equipment. The Susquehanna River at Waverly gage was also flooded with close to 3 ft of water inside the gagehouse at the peak. Other USGS streamgages in the Susquehanna Basin were inundated, but to a lesser extent —Susquehanna River at Vestal, Unadilla River at Rockdale, and Owego Creek near Owego, each with several inches of water inside their respective gagehouses.

Also hit hard by Tropical Storm Lee was Oneida Creek at Oneida, in the Oswego River Basin. Water levels at this streamgage peaked at about 3 ft above the floor inside the gage. The gage was out of service for less than 24 hrs. Of the six gages inundated by flood waters in 2011, only three lost any record due to submergence of equipment and (or) from water sensor floats becoming fouled in the gagehouse.

Since the storm, personnel from the USGS New York Water Science Center, Ithaca office have flood hardened five of these six gages by reconstructing the gagehouses: Susquehanna River at Owego was moved to a new location near the previous site and raised by about 8 ft. Susquehanna River near Waverly was completely rebuilt approximately 6 ft higher than the previous gage. Unadilla River at Rockdale, Oneida Creek at Oneida, and Owego Creek near Owego all were completely rebuilt and raised to an elevation above the newly-computed 0.5 percent flood levels (or 200 year flood).

Many of these gages have long-term records and have survived flooding during the 1930s, Hurricane Agnes in 1972, and record flooding in 2006 —several Susquehanna River gages were raised following one of these previous events. This recent reconstruction to even greater heights is testimony to the increased extremes in both precipitation and flooding experienced along the East Coast (For example, Hurricane Sandy in 2012), and elsewhere in the United States. The need for continued operation and funding of long-term streamgages across the United States can be clearly seen through our recent flood-hardening experiences in New York.

A similar streamgage flood-hardening effort is ongoing in Eastern NY.

PROPOSAL -Simulation of Climate Factors and Management Alternatives Affecting Groundwater Flooding on Long Island, New York

The U.S. Geological Survey has documented rising water tables and groundwater flooding problems within the following communities on Long Island, N.Y.: (1) South Jamaica, Queens County; (2) Elmont, Nassau County; and (3) Ronkonkoma, Suffolk County. These rises are attributed partly to changes in well pumping, stormwater control, and sewering and partly to a changing climate. Some global climate models have forecast a wetter and more intense precipitation regime on Long Island that could cause groundwater levels to rise. Projected long-term increases in relative mean-sea level could also cause coastal groundwater levels to rise.

Low-lying and subterranean infrastructure including subway tunnels, bridge underpasses, roadways, and buried electrical lines can also be subject to groundwater flooding. Typically, gravity drainage to alleviate this flooding is not feasible and other approaches such as well pumping and waterproofing are necessary. It is critical to have a good understanding of the potential for groundwater flooding. For example, when designing waterproofing for transportation infrastructure, it is important to plan for changing groundwater conditions because it is much more effective to implement the preferred methods during initial construction, not later when a problem may arise unexpectedly. There have also been failures to apply basic principles of dynamic groundwater hydrology in planning for water table recovery in the aftermath of construction-related dewatering activities.

The indirect regional effects of groundwater flooding may even be a greater cause for concern than direct effects. As a water table rises, the capacity of roadside subsurface unsaturated zones to store or convey stormwater may decrease, along with decreased capacity of stormwater recharge basins. The result can be stormwater runoff over roads, which creates numerous hazards. Beyond effects of transportation safety, there may be other consequences such as groundwater flooding of basements, wastewater system failures, degradation of drinking water supplies, or increased vector-borne diseases such as West Nile Virus caused by increased mosquito breeding areas.

In order to solve Long Island's groundwater flooding problems, an understanding of the mechanisms —including the role of climate change— that generate this flooding is essential. Unfortunately, there can only be an incomplete understanding because of uncertainty in future climate scenarios, and uncertainty in hydrogeologic framework characterization. Thus, development of a computer model is valuable because it provides a way to test a range of scenarios. There also is uncertainty in what management alternatives to mitigate flooding problems may be implementable and effective. Hypothetical scenarios that test how groundwater flooding may be mitigated by management alternatives could be developed and model results could be evaluated for the various management alternatives. This proposed project would build off of existing USGS regional and local groundwater models for Long Island.

For more details, contact Paul Misut.

Groundwater Monitoring on Long Island

Ground water is the sole source of water supply for more than 3 million people on Long Island, New York. Large-scale ground-water pumpage, installation of sanitary-and storm-sewer systems, and frequent variations in precipitation all have significant effects on regional groundwater levels and streamflow. The U.S. Geological Survey (USGS) has operated and maintained a hydrologic-data-collection program on Long Island and in the five boroughs of New York City[1] since the early 1900's. This program is needed so that a consistent, long-term, islandwide hydrologic data set is available for scientists to properly manage the region's water resources.

Groundwater data are the primary focus of the USGS data-collection program on Long Island and in the five boroughs of New York City; however, because most streams, ponds, and lakes in the region are hydraulically connected with the shallow groundwater system, the USGS monitors stream discharge and lake levels as part of its hydrologic-surveillance network. Groundwater-level, lake-level, and stream-discharge data are all needed to accurately assess seasonal fluctuations and long-term trends in groundwater storage and climate change.

The goals of the USGS data-collection program on Long Island include:

- *Collect long-term hydrologic data using nationally consistent standards and techniques to provide the information needed to evaluate water availability, salt-water intrusion, drought and flooding susceptibility, wetlands health, and other hydrologic concerns.*
- *Supply prompt dissemination of collected data by the USGS online on NWISWeb and in the USGS Annual Data Report.*
- *Allow for the production of USGS regional water-table, potentiometric-surface, and depth-to-water maps, used extensively by local agencies, water managers, engineers and consultants, and the public to assess groundwater flooding, contaminant movement, over-pumping, and saltwater intrusion issues across the region.*
- *Provide the data needed for other regional and National hydrologic studies.*

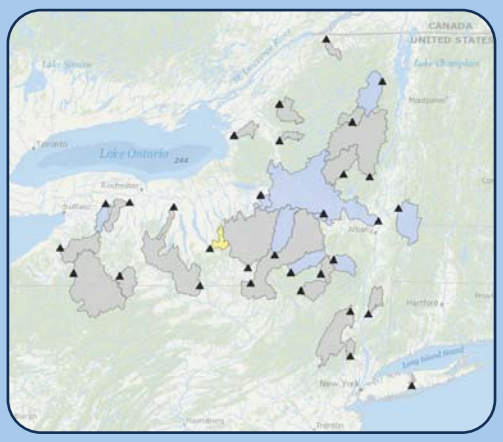
Allow for continuing long-standing ties and exchange of scientific data between the USGS and other Federal, State, and local agencies.

[1] To date (2014), the USGS data-collection program in the five boroughs of New York has been discontinued.

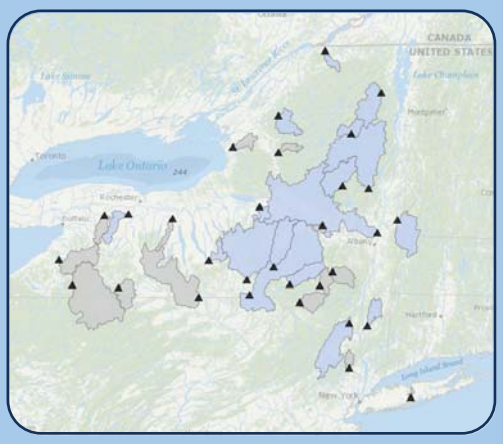
Surface Water and Groundwater Conditions in New York

Monthly and seasonally (shown below), hydrologists at the New York Water Science Center synthesize and summarize streamflows and groundwater levels for New York. Visual representation of the streamflow and groundwater conditions are shown on the NY WSC's Hydrologic Conditions Mapper. Streamflows and groundwater levels have been about the same from April 2012 - September 2013. That is, streamflow was in the wet or normal ranges at all of the index stations with the majority of sites in the wet range since June. Groundwater levels at the observation wells varied around the State from wet to very dry with the majority of the wells in the wet range since April.

A. Streamflow

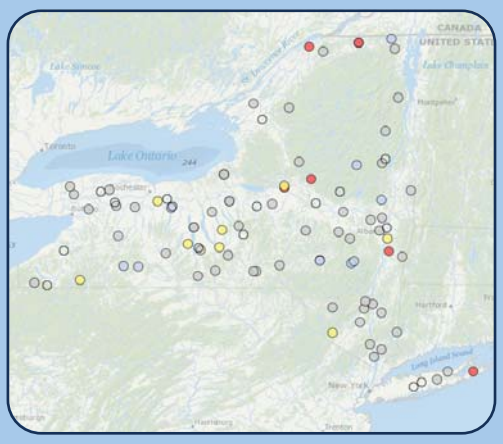


Spring 2013 (April, May, June)

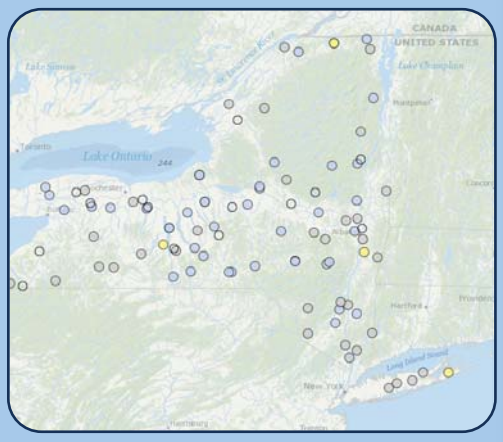


Sumer 2013 (July, August, September)

B. Groundwater



Spring 2013 (April, May, June)



Sumer 2013 (July, August, September)

EXPLANATION

Basin boundry — Drought Region — Streamgage — Groundwater well

Percentages of Monthly Means (Period of Record)

WET — NORMAL — DRY — VERY DRY

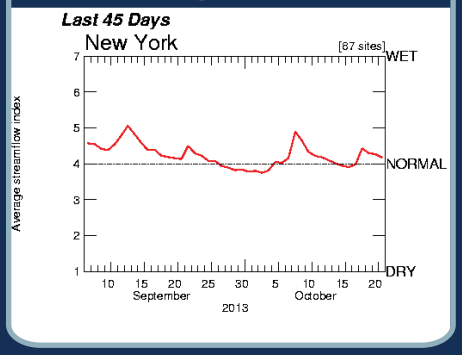
Seasonal conditions at selected (A) streamgages and (B) groundwater wells in New York. USGS maintains and operates most streamgages and groundwater wells in cooperation with various federal, state, and local agencies. Winter (January, February, March), Spring (April, May, June), Summer (July, August, September), Autumn (October, November, December).

USGS Water Watch & Groundwater Watch

WaterWatch is a USGS World Wide Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the Nation. Real-time streamflow information (stage and flow) generally is updated on an hourly basis. WaterWatch provides maps that show the location of more than 3,000 long-term (30 years or more) USGS streamgages.

Groundwater Watch is a USGS World Wide Web site that displays maps, graphs, and tables describing groundwater level data from wells currently in a regular measurement program. Three types of water-level data are displayed, including periodic, continuous data that are periodically retrieved, and real-time data generally updated on an hourly basis. Groundwater Watch contains water levels and well information from more than 20,000 wells that have been measured by the USGS or USGS cooperators at least once within the past 365 days.

45 Day Index Plot



Among other things, WaterWatch summarizes streamflow conditions in a region (state or hydrologic unit) in terms of the long-term typical condition at streamgages in the region. For example, this plot shows that streamflow over the last 45 days was at or above normal conditions for New York.

New Reports from the New York Water Science Center

Chu, Anthony, Stumm, Frederick, Joesten, P.K., and Noll, M.L., 2013, Geophysical and hydrologic analysis of an earthen dam site in southern Westchester County, New York: U.S. Geological Survey Scientific Investigations Report 2012–5247, 64 p. (http://pubs.usgs.gov/sir/2012/5247/)

Coon, W.F., 2013, Flood-inundation maps for the Flatrock River at Columbus, Indiana, 2012: U.S. Geological Survey Scientific Investigations Map 3241, 12 p., 12 sheets, at http://pubs.usgs.gov/sim/3241.

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McCallum, B.E., Wicklein, S.M., Reiser, R.G., Busciolano, Ronald, Morrison, Jonathan, Verdi, R.J., Painter, J.A., Frantz, E.R., and Gotvald, A.J., 2013, Monitoring storm tide and flooding from Hurricane Sandy along the Atlantic coast of the United States, October 2012: U.S. Geological Survey Open-File Report 2013–1043, 42 p., at http://pubs.usgs.gov/of/2013/1043/.

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Nystrom, E.A, 2013, Flood-inundation maps for the White River at Spencer, Indiana: U.S. Geological Survey Scientific Investigations Map 3251, 20 sheets, 8-p. pamphlet, at http://pubs.usgs.gov/sim/3251.

Nystrom, E.A., and Scott, T., 2013, Groundwater quality in the Mohawk River Basin, New York, 2011: U.S. Geological Survey Open-File Report 2013-1021, 43 p., at http://pubs.usgs.gov/of/2013/1021/.

Reddy, J.E., 2013, Groundwater quality in western New York, 2011: U.S. Geological Survey Open-File Report 2013–1095, 28 p., at http://pubs.usgs.gov/of/2013/1095/.

Reynolds, R.J., 2013, Hydrogeology of the West Branch Delaware River basin, Delaware County, New York: U.S. Geological Survey Scientific Investigations Report 2013–5025, 26 p., at http://pubs.usgs.gov/sir/2013/5025/.

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The USGS Water Mission Area (WMA) has the principal responsibility within the Federal Government to provide the hydrologic information and interpretation needed by others to achieve the best use and management of the Nation's water resources. WMA actively promotes the use of its information products by decision makers to:

- Minimize loss of life and property as a result of water-related natural hazards, such as floods, droughts, and land movement.
- Effectively manage groundwater and surface-water resources for domestic, agricultural, commercial, industrial, recreational, and ecological uses.
- Protect and enhance water resources for human health, aquatic health, and environmental quality.
- Contribute to wise physical and economic development of the Nation's resources for the benefit of present and future generations.

If you have an environmental or resource-management issue in which you would like to partner with the USGS to investigate, please contact any of our senior management staff (listed below). Projects are supported primarily through the Cooperative Water Program. This is a program through which any State, County, or local agency may work with the USGS to fund and conduct a monitoring or investigation project.

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