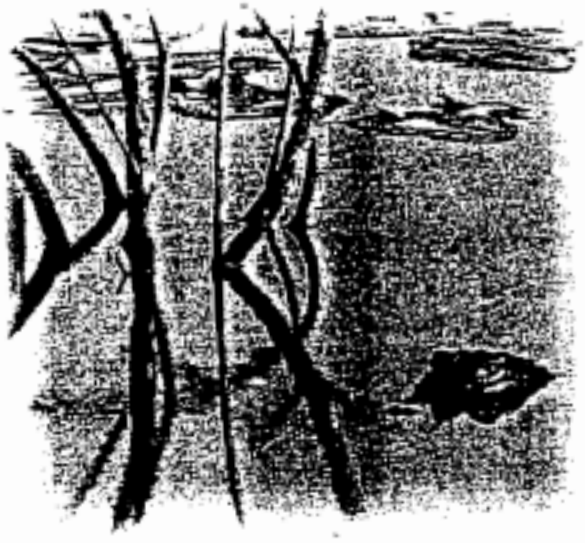
Southwest Florida Water Management District

Northern Tampa Bay
Minimum Flows & Levels White Papers



White Papers Supporting The Establishment of Minimum Flows and Levels For:

- Isolated Cypress Wetlands
- Category 1 and 2 Lakes
- Seawater Intrusion
- Environmental Aquifer Levels, and
- Tampa Bypass Canal

PEER REVIEW FINAL DRAFT
March 19, 1999

Northern Tampa Bay
Minimum Flows and Levels
Overview

The Northern Tampa Bay area is comprised of the counties of Pinellas, Pasco and the northern portion of Hillsborough. These counties are located in southwest Florida and surround the northern half of Tampa Bay. Pinellas County is almost entirely urbanized, as are much of northwest Hillsborough County and southwestern Pasco County. Inland areas of Pasco are rapidly becoming urbanized also. Potable water supplies for these counties and municipalities within these counties are principally from eleven regional wellfields located in Hillsborough and Pasco counties drawing from the Upper Floridan aquifer.

The first of the regional wellfields began operating in the early 1930's. The eleventh wellfield began operating in 1992. In addition to other sources, wellfields continue to be brought on-line in the area to meet the potable water supply needs of the Northern Tampa Bay area.

The surface water environment within the Northern Tampa Bay area is highly interconnected with the ground water system. Because of the karst geology that characterizes the area, a discontinuous and leaky confining layer provides a relatively good hydraulic connection between the surficial aquifer and the underlying Upper Floridan aquifer. Although localized areas of good confinement exist, overall the Upper Floridan aquifer is described as poorly to moderately confined within the Northern Tampa Bay area. As a result, water levels in the aquifers are linked, and fluctuate similarly.

Without ground water withdrawals, recharge from rainfall to the surficial aquifer and discharge by evapotranspiration and flow from the surficial aquifer are the only significant driving forces of these fluctuations. Very little ground water is contributed to the area from lateral inflow. The variable head in the surficial aquifer in turn largely regulates the recharge to the Upper Floridan aquifer through the leaky semi-confining unit. Therefore, the fluctuations in the surficial aquifer affect the fluctuations in the Upper Floridan aquifer.

An additional stress is introduced to this process when ground water withdrawals from the Upper Floridan aquifer are added. Ground water withdrawals lower the potentiometric surface of the Upper Floridan aquifer, which in turn increase leakage from the surficial aquifer to the Upper Floridan aquifer. This additional recharge is referred to as induced recharge. The result is a lowering of the water table. Assessments have shown that in leaky areas of the Northern Tampa Bay area, most of the water withdrawn from the Upper Floridan aquifer by pumping is derived by vertical leakage downward from the surficial aquifer (Liu and Polmann, 1996). Thus, Upper Floridan aquifer water level fluctuations caused by ground water withdrawals affect surficial aquifer water level fluctuations, as well as the water levels of lakes

and wetlands that are connected to the surficial aquifer.

Waters and wetlands account for approximately 23 percent of the land area within the Northern Tampa Bay area.

In the mid 1980's, the District declared the northwest Hillsborough County area and limited portions of Pinellas and Pasco Counties, within which several of the wellfields are located, to be an "area of special concern" regarding the condition of local water resources.

In 1987, the District undertook a water resource assessment project ("WRAP") to examine the water resources within the area of special concern. In 1989, based on preliminary information from the WRAP, the District declared an area as the "Northern Tampa Bay Water Use Caution Area" in recognition of environmental stress identified by the District.

In 1992, the WRAP study area was expanded and became identified as the "Northern Tampa Bay Water Resource Assessment Project" ("NTBWRAP"). The NTBWRAP is the District's most recent attempt at determining the condition of the water resources in the area of the regional wellfields. (The NTBWRAP is among the materials provided with the White Papers).

Due to environmental stress to the water resources in the Northern Tampa Bay area, Section 373.02 Florida Statutes (F.S.), as amended by the Florida Legislature in 1996, directed the District to establish minimum flows and levels for the region before October 1, 1997.

Section 373.042, F.S. defines the minimum flow to a surface water course to be the flow below which additional withdrawals would cause significant harm to the water resources or ecology of the area. Section 373.042, F.S. defines the minimum level of an aquifer or surface water body to be the level below which additional withdrawals would cause significant harm to the water resources of the area. The 1996 amendments to the statute required the District to adopt minimum flows and levels in Hillsborough, Pasco, and Pinellas County for priority waters that are experiencing or may be expected to experience adverse impacts. In response to this legislative direction, the District established 41 minimum wetland levels, minimum levels for 15 lakes, sea water intrusion aquifer levels, narrative aquifer levels and a minimum flow for the Tampa Bypass Canal. Work is ongoing to establish minimum flows and levels in the future for additional water bodies.

Section 373.042, F.S. requires the District to use the best data available to set minimum flows and levels. The legislative requirement to set the levels by October 1, 1997 was absolute, that is, there was a limited time to collect additional information. Because of the time deadline, and the associated requirement to use the best information available, the District was constrained to use existing data complete with any associated limitations of that data.

The process to develop the methods for determination of minimum flows and levels was an open

public process with all interested parties invited to participate in the development of methodologies for determining the limit at which significant harm occurs to the lakes, wetlands, surface water courses and aquifers for which levels must be established. Many lay and technical representatives of the interested local governments, environmental groups and individuals did participate in the rule development process through months of meetings, public workshops, and public hearings.

Following this public process the District staff finalized methodologies and minimum levels and flows for approval by the Governing Board. However, effective July 1, 1997, subparagraph 373.042(1)(a), F.S. was added. That paragraph directs the District to consider changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes and alterations have had when establishing minimum flows and levels. Therefore, at the Board's direction, staff reviewed the previous work, additional data as appropriate, continued meetings and workshops with affected parties and held public workshops with the Governing Board to ensure that the changes to the statute had been assimilated into the methodologies.

On October 28, 1998, the Governing Board approved the subject minimum flows and levels.

As permitted under subsection 373.042(4), F.S., five parties requested Scientific Peer Review of the scientific and technical data and methodologies used to determine the flows and levels. The purpose of this series of reports is to document for the Scientific Peer Review Panel scientific and technical data and methodologies used to determine the flows and levels for priority waters in the Northern Tampa Bay area.

The reports are organized in the following sections. This first section provides a general explanation of the area, hydrogeology, the Legislature's direction to the District and the processes and constraints for the District's establishment of minimum flows and levels. The next four sections describe the specific methods developed for determination of minimum levels in certain wetlands, certain lakes, and in the Upper Floridan aquifer, respectively. The last section describes the methods used to develop the minimum flow for the Tampa Bypass Canal.

FINAL DRAFT

Environmental Minimum Aquifer Levels
As Used in Rule 40D-8, F.A.C.

March 19, 1999

Environmental Minimum Aquifer Levels White Paper - DRAFT

Introduction

In the area of Pasco, Hillsborough, and Pinellas counties within which Minimum Levels have recently been established for certain Lakes and Wetlands, the hydrogeology is characterized by a surficial aquifer (sand, silt, clay, and shell, average thickness approximately 35 feet) which is in hydrologic connection with numerous wetlands, lakes, streams and conveyance ditches. Beneath this aquifer lies a leaky confining layer (phosphatic clay, clayey-sand, and limestone averaging approximately 20 feet in thickness, with an average vertical hydraulic conductivity of 1.22×10^{-3} ft/day) that is present throughout most of the area. Below this confining layer lies the upper portion of the Floridan aquifer, which is moderately to highly productive (limestone, with a transmissivity range of 18,700 ft^2/day to 130,000 ft^2/day) and a source of fresh water supply for various purposes[1].

Water-well withdrawals from the Upper Floridan aquifer create drawdown of the Upper Floridan aquifer potentiometric surface. This drawdown induces leakage of water (through any confining layers present) from the surficial aquifer to the Upper Floridan aquifer, resulting in a lowering of the water table of the surficial aquifer. The lowering of the surficial aquifer water table consequently results in a lowering of water levels in contiguous lakes and wetlands. Knowing that this relationship of Floridan potentiometric levels to surficial water-table levels exists, Floridan levels can be utilized to monitor the effect of Floridan aquifer withdrawals on the water table.

For the purpose of preventing significant harm to those water bodies for which Minimum Wetland and Lake Levels have been established, the Minimum Aquifer Level for the Upper Floridan aquifer ("Environmental Minimum Aquifer Level", or "EMAL") shall be the Long-term potentiometric level which achieves the Minimum Levels established for wetlands and lakes in Rule 40D-8, F.A.C.

Methodology

The Environmental Minimum Aquifer Level for the Upper Floridan aquifer system can be calculated based on the relationship between the potentiometric level of the Upper Floridan aquifer and water levels in the surficial aquifer system and associated wetlands and lakes for which minimum levels have been established. The Environmental Minimum Aquifer Level is determined by estimating the amount of Upper Floridan aquifer potentiometric level drawdown that will not cause the Long-term average water level in lakes or wetlands to fall below a Minimum Wetland Level or Minimum Lake Level, according to the following guidelines (as used within this paper, "Long-term" means an evaluation period that represents an interval which spans the range of hydrologic conditions which can be expected to occur based upon historical records, ranging from high water levels to low water levels. In the context of a predictive model simulation, a Long-term simulation will be insensitive to temporal fluctuations in withdrawal rates and hydrologic conditions, so as to simulate steady-state average conditions. In the context of an average water level, the average will be based upon the expected range and frequency of levels):

1. Determine the Historic (as used within this paper, "Historic" means a period during which there were no significant impacts due to withdrawals) average Upper Floridan aquifer potentiometric level in the vicinity to the wetland or lake for which a Minimum Wetland Level or Minimum Lake Level has been set forth in this Chapter 40D-8, F.A.C. (Referred to hereafter as MFL wetland or MFL lake, as applicable). The Historic average potentiometric level is estimated for each site as follows:

i. If an Upper Floridan aquifer monitor well is located in the vicinity, and if the available pre-withdrawal potentiometric data are sufficient to capture the expected Long-term range of Pre-withdrawal potentiometric levels, then the Historic average potentiometric level is calculated by taking the average of the pre-withdrawal potentiometric level data.

ii. If an Upper Floridan aquifer monitor well is located in the vicinity, and if the available pre-withdrawal potentiometric level data are not sufficient to capture the expected Long-term range of pre-withdrawal potentiometric levels, then the Historic average potentiometric level will be estimated using best available data and methods. Methods may include correlation of the available pre-withdrawal potentiometric level data to Historic potentiometric data in other areas of the region, and estimating the Historic potentiometric level at the site in question using statistical analysis.

iii. If no pre-withdrawal potentiometric level data for an existing Upper Floridan aquifer monitor well in the vicinity are available, then the Historic average potentiometric level is determined by adding the absolute value of the estimated current average cumulative drawdown at the well to the Current average potentiometric level of the well. As used within this paper, "Current" means a recent period during which the physical setting of the lake has been observed and hydrologic stresses affecting the lake were stable.

iv. If no Upper Floridan aquifer monitor well exists in the vicinity of each MFL lake or MFL wetland, the Historic average potentiometric level can be determined based on an evaluation of regional aquifer potentiometric level data, including potentiometric surface maps.

2. Estimate the allowable Upper Floridan aquifer potentiometric level drawdown at the location of the wetland or lake utilizing acceptable ground-water flow models or analytical techniques.

3. The allowable Upper Floridan aquifer drawdown is subtracted from the Historic average potentiometric level to determine the Environmental Minimum Aquifer Level.

For each location where it is necessary to determine the Environmental Minimum Aquifer Level associated with each MFL wetland, the allowable drawdown in the Upper Floridan Aquifer System is the drawdown in the Floridan aquifer that allows the Minimum Level to be achieved in MFL wetlands and MFL lakes based solely on

withdrawal management. Since an EMAL may need to be calculated in the same location for multiple MFL lakes and wetlands with varying sensitivity to Floridan aquifer drawdown (due to variability in natural wetland water-level fluctuations, local confinement, and existing structural impacts), the higher of the calculated EMALs shall control to protect the most sensitive MFL wetland or lake. Allowable drawdown will be determined using industry-standard ground-water flow models or analytical techniques, based on best available aquifer-characteristic information, simulating Long-term average water use and hydrologic conditions.

[1]Source: Northern Tampa Bay Water Resources Assessment Project, SWFWMD, 1998.

Geological interpretations and analysis relative to this report were prepared or reviewed by a Professional Geologist certified by the State of Florida.

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