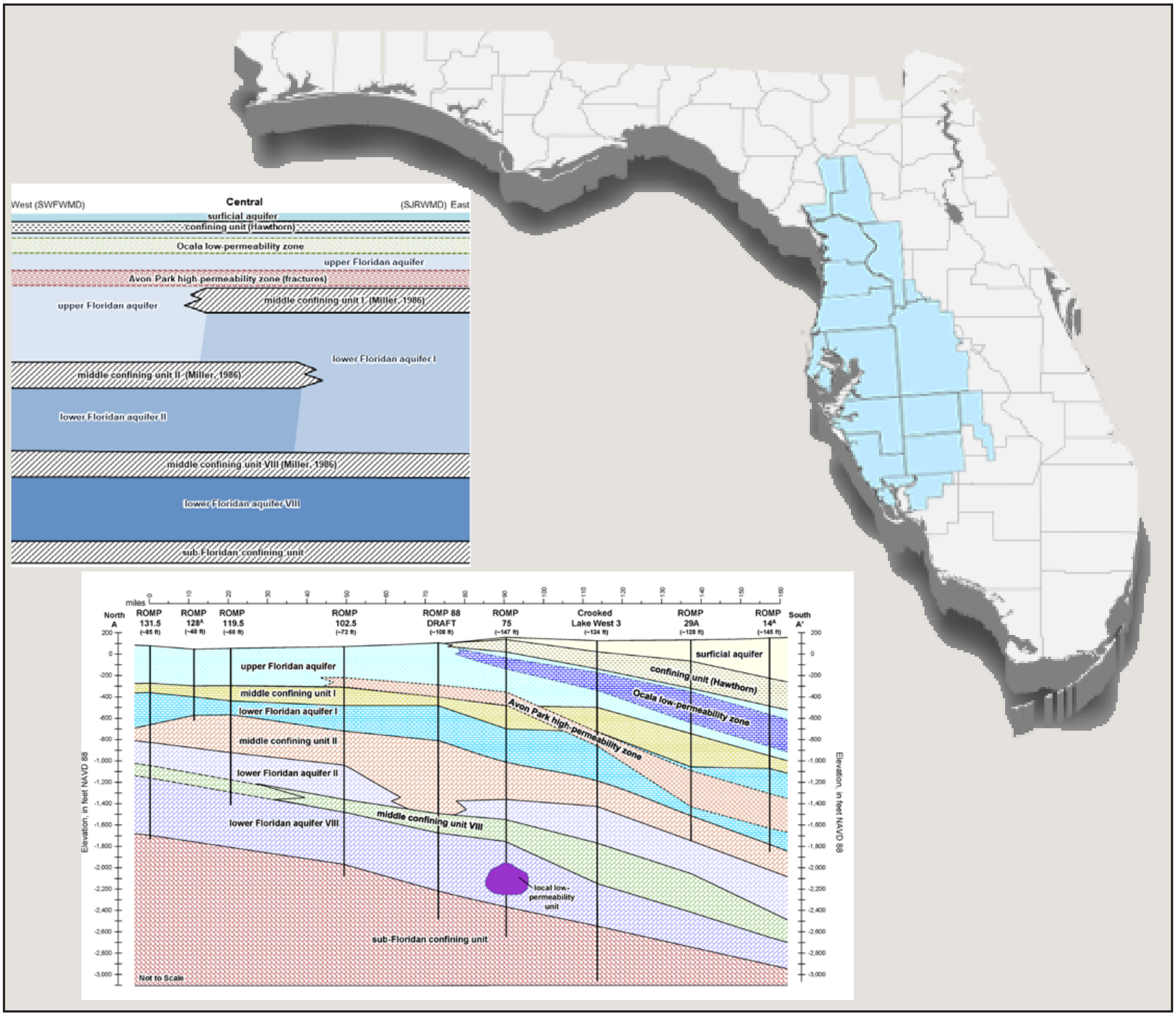
Southwest Florida
Water Management District

Hydrostratigraphic Framework of the Southwest Florida Water Management District: Technical Report of the Regional Observation and Monitor-well Program



Southwest Florida Water Management District
Geohydrologic Data Section

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Southwest Florida Water Management District

Operations, Lands and Resource Monitoring Division
Brian Starford, P.G., Director

Data Collection Bureau
Sandie Will, P.G., Chief

Geohydrologic Data Section
M. Ted Gates, P.G., Manager

Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34604-6899

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The hydrogeologic evaluations and interpretations contained in *Hydrostratigraphic Framework of the Southwest Florida Water Management District: Technical Report of the Regional Observation and Monitor-well Program* have been prepared by or approved by a licensed Professional Geologist in the State of Florida, in accordance with Chapter 492, Florida Statutes.

Tiffany Horstman

TIFFANY M HORSTMAN LICENSE No. 2661 STATE OF FLORIDA PROFESSIONAL GEOLOGIST

Tiffany M. Horstman
Professional Geologist
State of Florida License No. PG 2661

Date: 10-30-2023

Jason LaRoche

JASON J. LAROCHE LICENSE No. 2525 STATE OF FLORIDA PROFESSIONAL GEOLOGIST

Jason J. LaRoche
Professional Geologist
State of Florida License No. PG 2525

Date: 10-30-2023

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Lastly, the authors thank all the geologists and core drillers who have been a part of the Geohydrologic Data section and the Regional Observation and Monitor-well Program over the last four decades for their tremendous contributions to hydrogeologic data collection and exploration innovations that made development of this document possible.

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Hydrostratigraphic Framework of the Southwest Florida Water Management District: Technical Report of the Regional Observation and Monitor-well Program

By Jason LaRoche and Tiffany Horstman

Introduction

The purpose of this report is to define the current hydrostratigraphic conceptualization of the Southwest Florida Water Management District (District) based on site investigations and comprehensive mapping research of the Geohydrologic Data Section's Regional Observation and Monitor-well Program (ROMP) using consistent terminology and nomenclature guidelines. The ROMP was started in 1974 in response to the need for hydrogeologic information by the District. The focus of the ROMP is to characterize the hydrogeology and water quality of the groundwater systems within southwestern Florida by performing exploratory core drilling, aquifer testing, and well construction. Data from 109 ROMP sites have helped develop the hydrostratigraphic conceptualization of the District and refine the Regional Aquifer-System Analysis of Miller (1986) that form the basis of the District's hydrostratigraphic conceptualization (fig. 1). This report will be updated annually as new data is collected from ROMP sites that will further refine the hydrostratigraphy of the District.

There has been a lot of variation in nomenclature conventions used to describe the aquifers and confining units underlying Florida. Although uniform guidelines for hydrostratigraphic nomenclature have not been formally adopted nationwide, the United States Geological Survey (Laney and Davidson, 1986) recognized the importance of consistent hydrostratigraphic terminology and their definitions for effective scientific communication and developed uniform nomenclature guidelines for designating and naming aquifers that is consistent with the stratigraphic nomenclature recommendations of the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 2021). The District's hydrostratigraphic nomenclature convention (based on Miller [1986]) is consistent with the aquifer nomenclature guidelines of Laney and Davidson (1986) to appropriately rank and name the hydrogeologic units underlying the District. The following recognized definitions for stratigraphic terms are used for this report.

Stratigraphy (International Commission on Stratigraphy, 1994) – the description of all rock bodies forming the Earth's crust and their organization into distinctive, useful, mappable units based on their inherent properties or attributes in order to establish their distribution and relationship in space and their succession in time, and to interpret geologic history.

Stratigraphic unit (North American Commission on Stratigraphic Nomenclature, 2021) – a naturally occurring body of rock or rock material distinguished from adjoining bodies of rock on the basis of some stated property or properties.

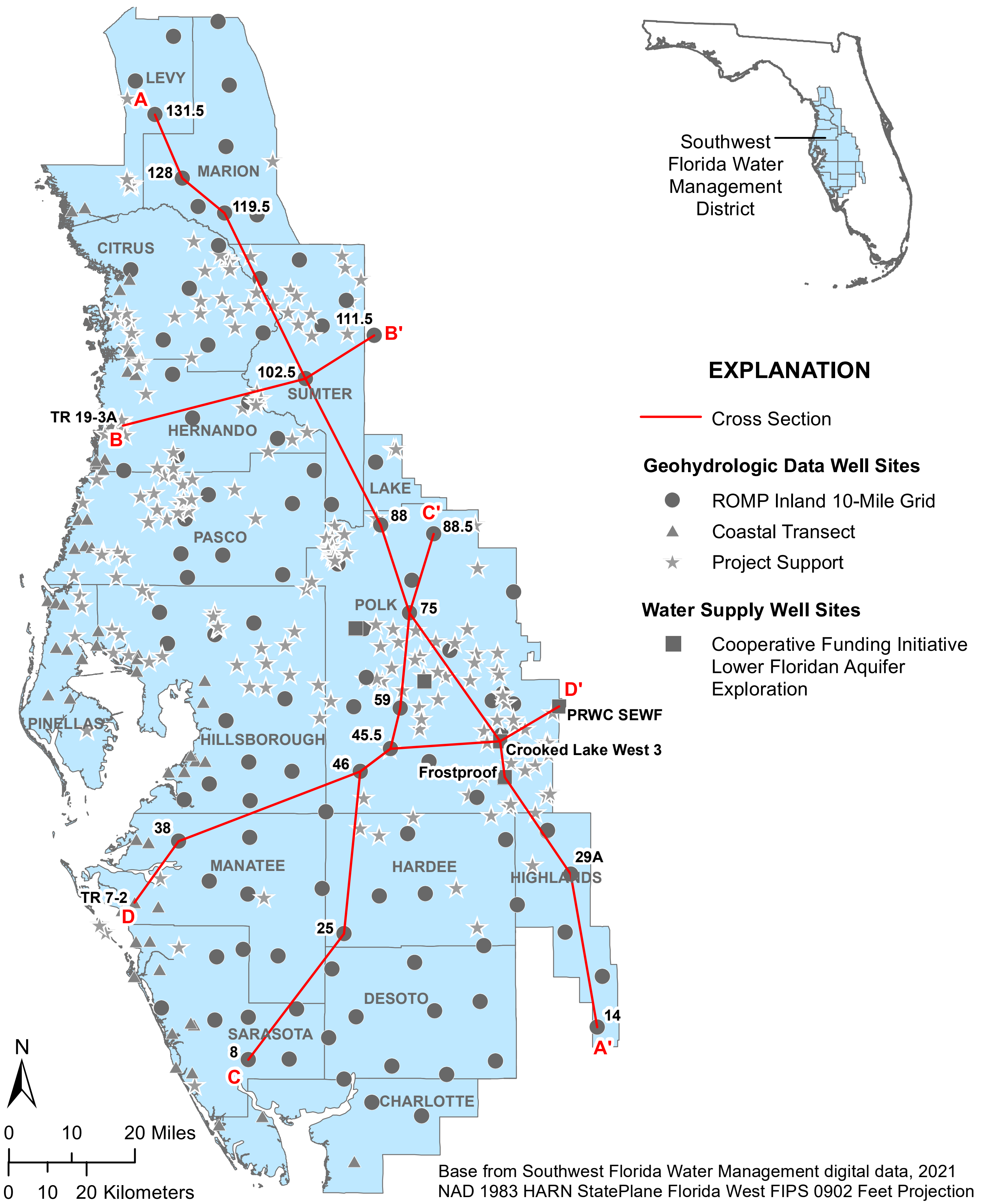
Hydrostratigraphic unit (Seaber, 1988) – a body of rock distinguished and characterized by its porosity and permeability. A hydrostratigraphic unit may occur in one or more lithostratigraphic, allostratigraphic, pedostratigraphic, or lithodemic units and is unified and delimited on the basis of its observable hydrologic characteristics that relate to its interstices.

Chronostratigraphic Unit (North American Commission on Stratigraphic Nomenclature, 2021) – A body of rock established to serve as the material reference for all rocks formed during the same span of time. Each boundary of a chronostratigraphic unit is synchronous.Chronostratigraphy provides a means of organizing strata into units based on their age relations.A chronostratigraphic body also serves as the basis for defining the specific interval of geologic time, or geochronologic unit, represented by the referent.

Lithostratigraphic Unit (North American Commission on Stratigraphic Nomenclature, 2021) – A stratum or body of strata, generally but not invariably layered, generally but not invariably tabular, that conforms to the Law of Superposition and is distinguished and delimited on the basis of lithic characteristics and stratigraphic position.

Aquifer system (Poland and others, 1972) – A heterogeneous body of intercalated permeable and poorly permeable material that functions regionally as a water-yielding hydraulic unit; it comprises two or more aquifers separated at least locally by confining units that impede ground-water movement but do not greatly affect the regional hydraulic continuity of the system.

Aquifer (Meinzer, 1923) – "A rock formation or stratum that will yield water in sufficient quantity to be of consequence as a source of supply…". "It is water-bearing not in the sense of holding water but in the sense of carrying or conveying water."



[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; PRWC, Polk Regional Water Cooperative; ROMP, Regional Observation and Monitor-well Program; SEWF, Southeast Wellfield; TR, transect]

Figure 1. Well sites of the Southwest Florida Water Management District and hydrostratigraphic framework cross-section locations.

Zone (Laney and Davidson, 1986) – used to subdivide an aquifer for the purpose of delineating a particular hydrologic characteristic that is not typical of the entire aquifer.

Confining unit (Lohman and others, 1972; Laney and Davidson, 1986) – "a body of "impermeable" material stratigraphically adjacent to one or more aquifers. In nature, however, its hydraulic conductivity may range from nearly zero to some value distinctly lower than that of the aquifer…". "Many confining units are leaky and in some areas may, under natural conditions, contribute significant amounts of water to the aquifers they confine…".

Each category of stratigraphy (for example, chronostratigraphic, lithostratigraphic, hydrostratigraphic, and others) has a hierarchy of rank terms, each with distinct meaning (North American Commission on Stratigraphic Nomenclature, 2021). Within any hierarchy, the fundamental unit is the required basic building block without which no other units can exist. For hydrostratigraphy, the recognized hierarchy of rank terms from largest to smallest is the aquifer system, aquifer, and zone (Laney and Davidson, 1986). The fundamental hydrostratigraphic unit used in describing and interpreting the hydrogeology of a region is the aquifer, bounded immediately by adjacent confining units (Mallams and Dewitt, 2007). Therefore, an aquifer system (next higher rank) or zone (next lower rank) cannot exist without aquifers. A comparison of the stratigraphic framework and nomenclature convention used by the District with other published conventions is in figure 2.

Hydrostratigraphic Framework

The District is underlain by several aquifers of varying productivity, water quality, and regional extent. Generally, these aquifers include, in descending order: the undifferentiated surficial aquifer, the Peace River aquifer, the upper Arcadia aquifer, the lower Arcadia aquifer, the upper Floridan aquifer, the lower Floridan aquifer below middle confining unit I, the lower Floridan aquifer below middle confining unit II, the lower Floridan aquifer below middle confining unit VIII, and rarely the lower Floridan aquifer below middle confining unit VI (fig. 3). The undifferentiated surficial aquifer is present throughout most of the central and southern District but is not a major source of water (appendices A and B). The Peace River, upper Arcadia, and lower Arcadia aquifers compose the Hawthorn (formerly intermediate) aquifer system and are present throughout much of the southern portion of the District (fig. 4, appendix A). The upper and lower Floridan aquifers compose the Floridan aquifer system and underlie all of Florida and parts of Georgia, Alabama, and South Carolina (Miller, 1986) (appendix A). The upper Floridan aquifer contains most of the fresh water underlying the District and is the primary water source in the District. The lower Floridan aquifer below middle confining unit I contains fresh water in some areas and is withdrawn in parts of northeastern Sumter County at this time. The lower Floridan aquifers below middle confining unit II and VIII commonly contain non-potable water and are not major water sources historically but are being investigated as alternative water sources in Polk County.

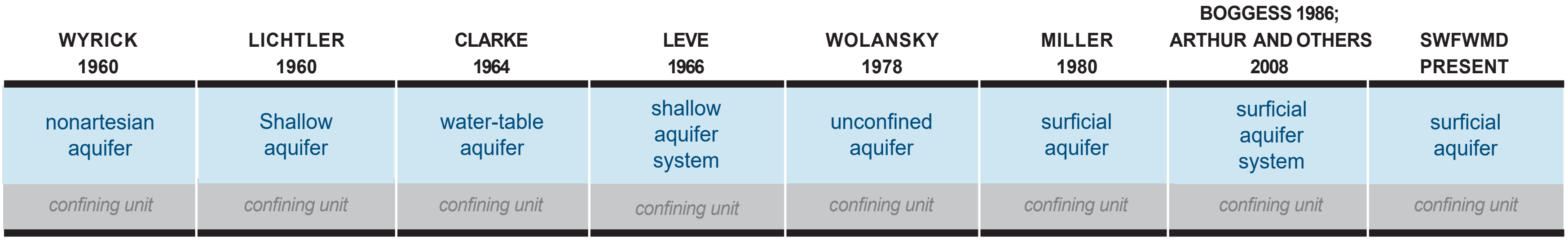
Surficial aquifer

The undifferentiated surficial aquifer (where present) is the uppermost aquifer within the District and mostly consists of undifferentiated sand, but may also contain shell, gravel, and clay. It contains water under unconfined (water table) conditions and is delineated where basal confinement is present. The undifferentiated surficial aquifer is absent in all or parts of Hillsborough, Pasco, Hernando, Sumter, Citrus, Marion, and Levy counties where basal clay is absent or very thin and breached by sinkholes or fractures that precludes characterization as a laterally extensive and functional surficial aquifer because of a lack of hydraulic continuity (Arthur and others, 2008). The undifferentiated surficial aquifer can be greater than 250 feet thick along the Lake Wales Ridge and Intraridge Valley in parts of Polk and Highlands counties (fig. 4 and appendix A). In two areas of Florida where surficial deposits are thick, highly permeable, and extensively used as a water source, they have been given aquifer names such as the sand-and-gravel aquifer in the westernmost panhandle and the Biscayne aquifer in southeastern Florida (Miller, 1986). These aquifers grade laterally into thin sands that are called the undifferentiated surficial aquifer (Miller, 1986). Although these three uppermost aquifers are often collectively referred to as the surficial aquifer system, they do not conform to the definition of an aquifer system because they are not separated at least locally by confining units that impede groundwater movement (Poland and others, 1972). Therefore, the District identifies them as aquifers.

Hawthorn aquifer system

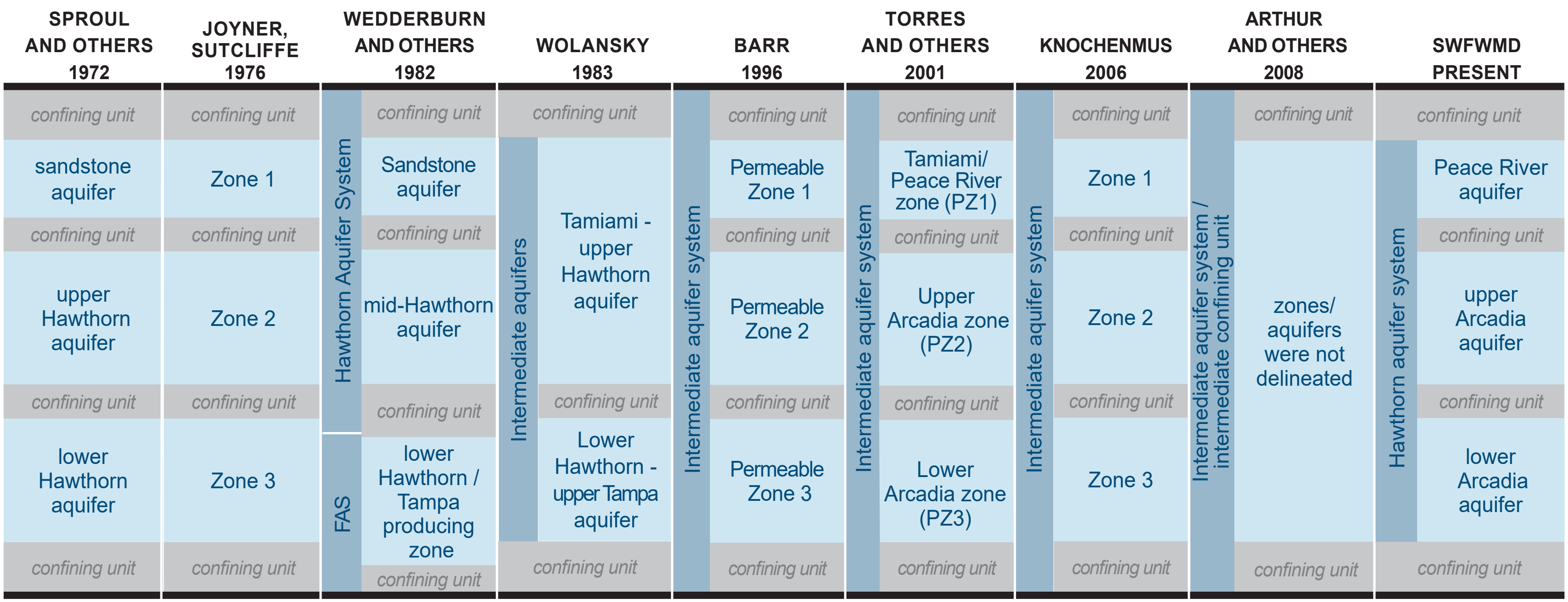
The Hawthorn aquifer system is present only in the southern part of the District and pinches out north of central Hillsborough County (fig. 4 and appendix A). The Hawthorn aquifer system within the District contains up to three aquifers: the Peace River aquifer, the upper Arcadia aquifer, and the lower Arcadia aquifer (fig. 3). The Hawthorn aquifer system thickness generally ranges from about 50 feet in the northern portion to about 300 feet in the southern portion of where it is present in the District (appendix A, figs. A3 and A4). At any location, the top of the Hawthorn aquifer system coincides with the top of the uppermost aquifer present, and the bottom coincides with the base of the lowermost aquifer present. Where no aquifers are present, the Hawthorn sediments are confining and pinch out north of central Pasco County. This aquifer system has inappropriately been referred to as the intermediate aquifer system and the aquifers within it have inaccurately been ranked as zones 1, 2, and 3. However, the District has made considerable progress in correcting the preceding naming, ranking, and vertical boundary errors based

A



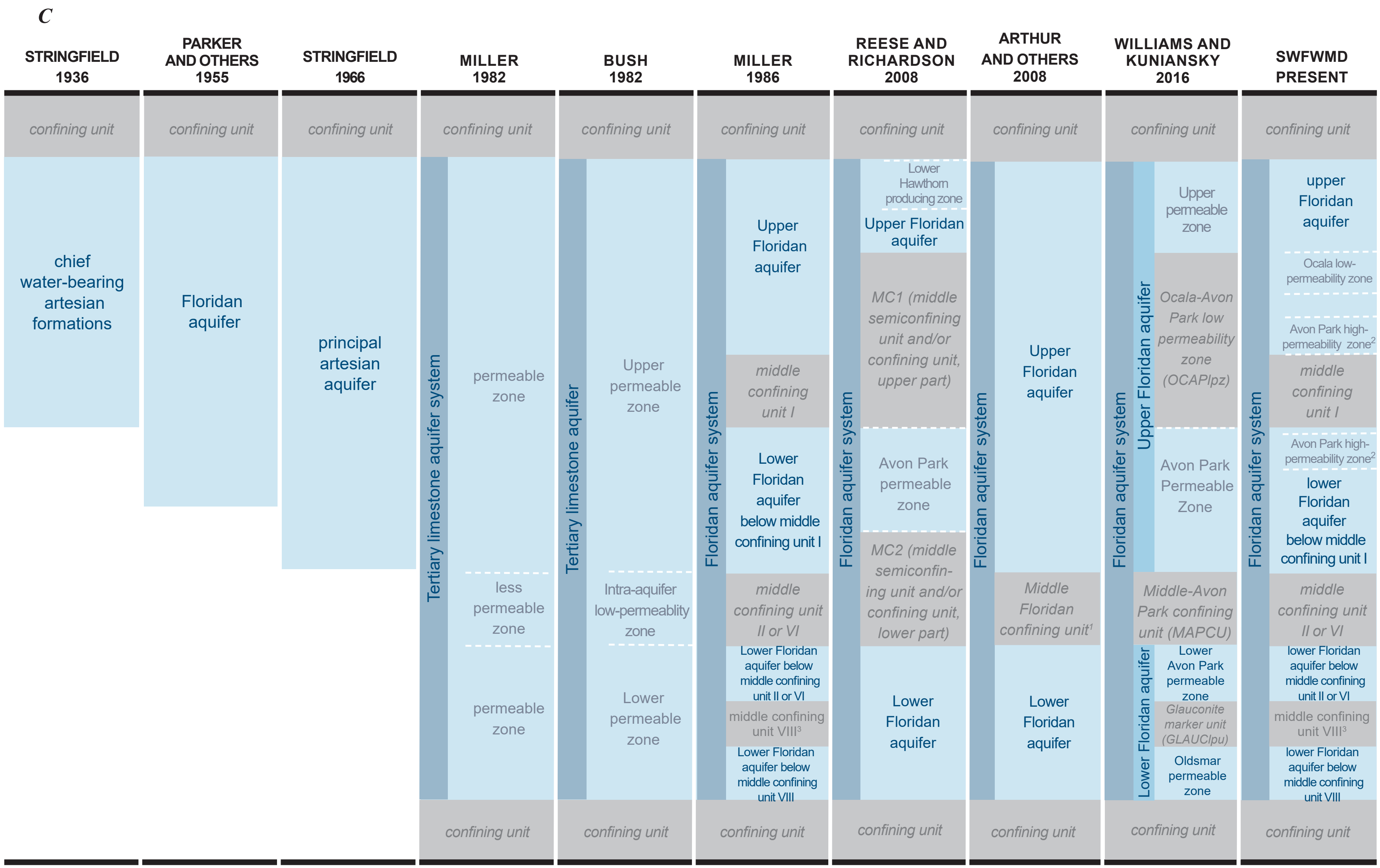
[SWFWMD, Southwest Florida Water Management District]

B



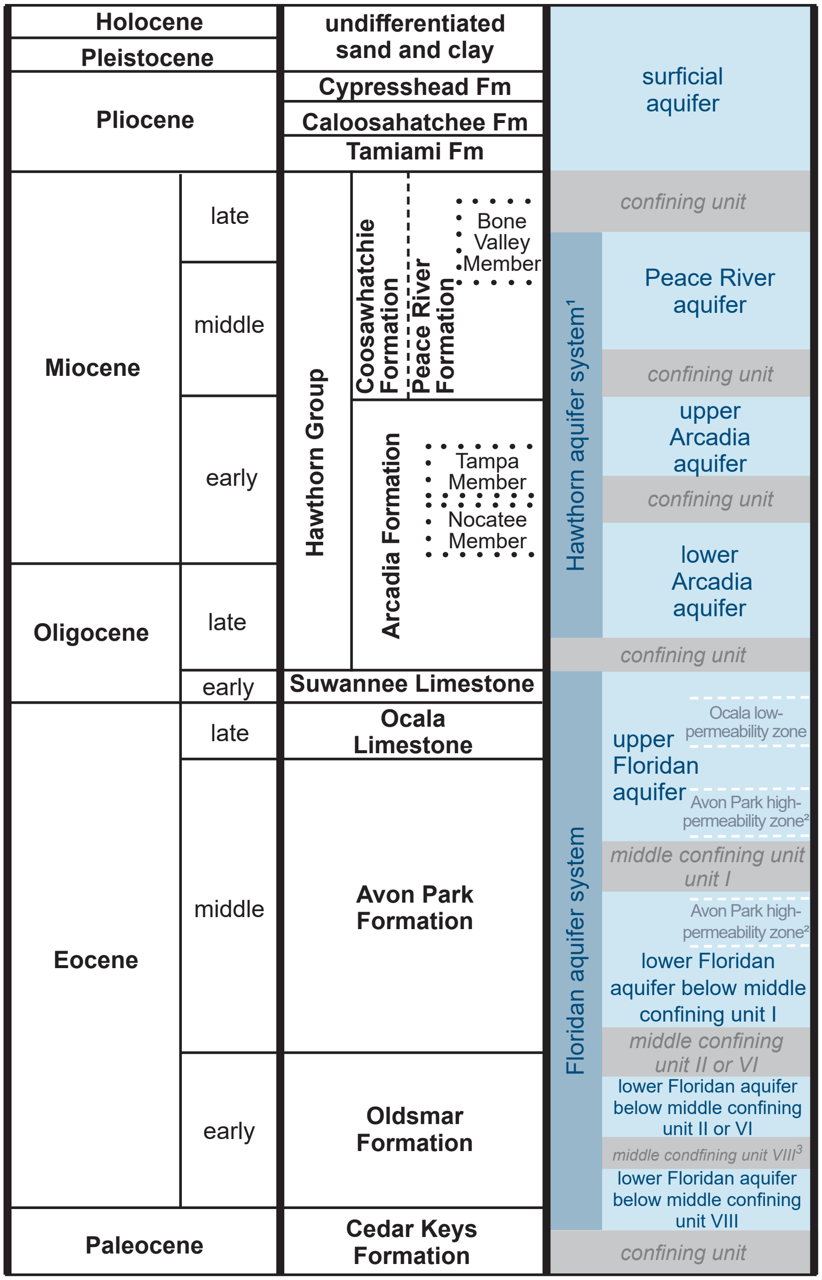
[FAS, Floridan aquifer system; PZ, permeable zone; SWFWMD, Southwest Florida Water Management District]

Figure 2. Nomenclature of (*A*), the surficial aquifer, (*B*), the Hawthorn aquifer system, and (*C*), the Floridan aquifer system used by the Southwest Florida Water Management District compared to nomenclature in previously published reports.



[Terms shown are for hydrogeologic units present within the Southwest Florida Water Management District (SWFWMD); [1]Arthur and others acknowledge existence of the middle confining unit I within the Southwest Florida Water Management but do not map it for Special Publication 68; [2]The Avon Park high-permeability zone (SWFWMD fracture zone) crosses middle confining unit I in central Polk County; therefore, it occurs above the middle confining unit I in northern Polk and below the middle confining unit I in southern Polk; [3]The middle confining unit VIII of Miller (1986) in south Florida was extended across the entire peninsula as the Glauconite marker unit based on new data in Williams and Kuniansky (2016)]

Figure 2. (Continued) Nomenclature of (*A*), the surficial aquifer, (*B*), the Hawthorn aquifer system, and (*C*), the Floridan aquifer system used by the Southwest Florida Water Management District compared to nomenclature in previously published reports.



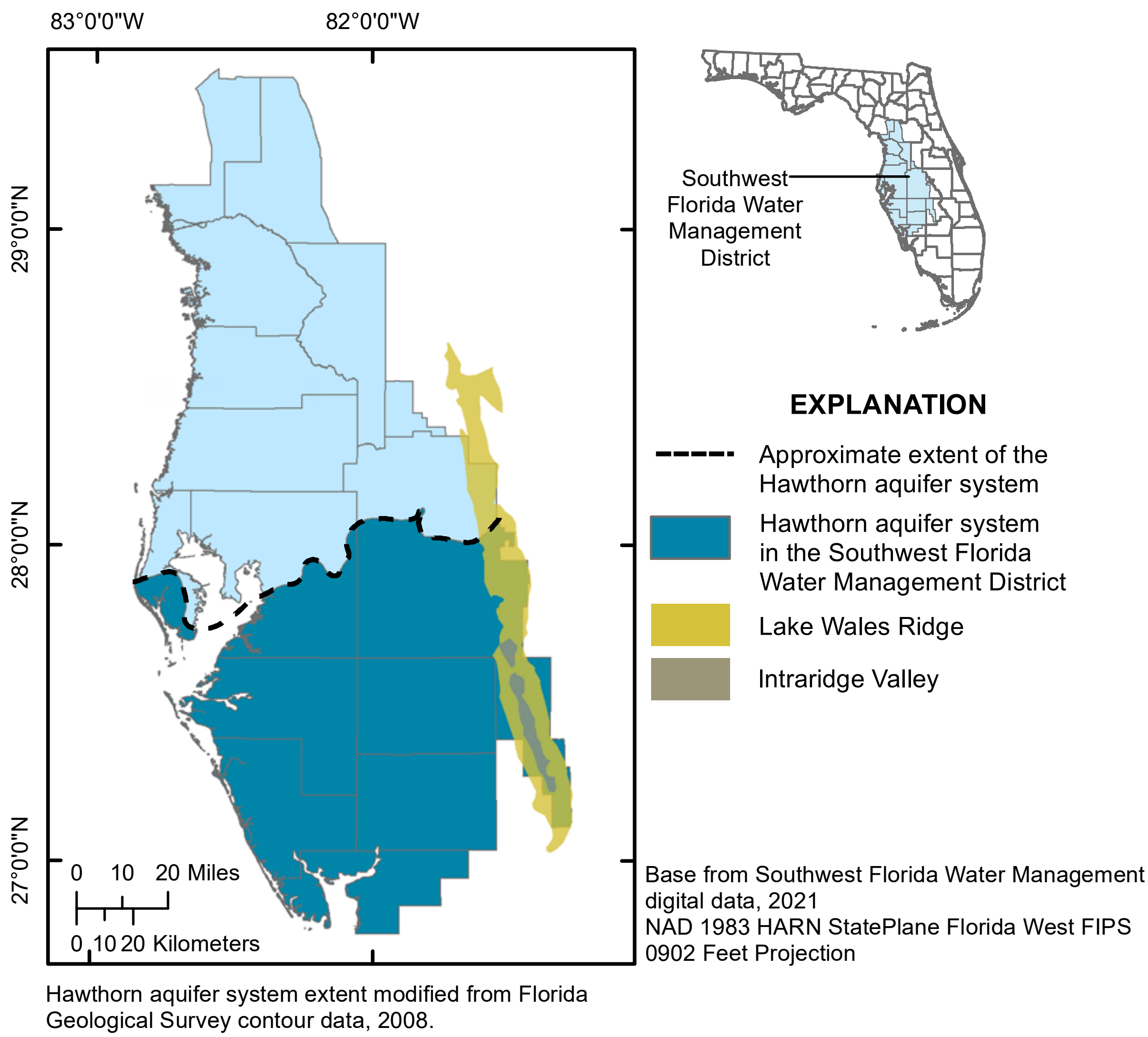
[Fm, Formation; [1]The Hawthorn aquifer system was previously referred to as the intermediate aquifer system; [2]The Avon Park high-permeability zone (SWFWMD fracture zone) crosses middle confining unit I in central Polk County; therefore, it occurs above the middle confining unit I in northern Polk and below the middle confining unit I in southern Polk; [3]The middle confining unit VIII of Miller (1986) was extended beyond the original extent in south Florida based on new data]

Figure 3. Chart correlating chronostratigraphic and lithostratigraphic units to the current hydrogeologic framework of the Southwest Florida Water Management District.

on aquifer nomenclature guidelines proposed by Laney and Davidson (1986) and the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 2021). DeWitt and Mallams (2007) proposed the revised name of Hawthorn aquifer system and its aquifers as the Peace River aquifer, the upper Arcadia aquifer, and the lower Arcadia aquifer. The Hawthorn aquifer system is entirely within the Hawthorn Group, which contains highly variable deposits of siliciclastics, phosphates, various clays, and carbonates (fig. 3). The groundwater within the Hawthorn aquifer system is under confined conditions. A chart correlating past and present nomenclature used for the Hawthorn aquifer system and its aquifers is in figure 2.

Floridan aquifer system

The Floridan aquifer system underlies all of Florida and parts of Georgia, Alabama, and South Carolina (Miller, 1986). The Floridan aquifer system thickness ranges from about 1,800 feet in the northern portion of the District to more than 2,500 feet in the southern portion of the District (appendix A, figs. A1 and A3). Within the District, generally four of the eight subregional middle confining units delineated by Miller (1986) are encountered. Where present, these units divide the Floridan aquifer system into the upper Floridan aquifer and separate lower Floridan aquifers (figs. 2 and 3). The four subregional middle confining units include middle confining



[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; W, west]

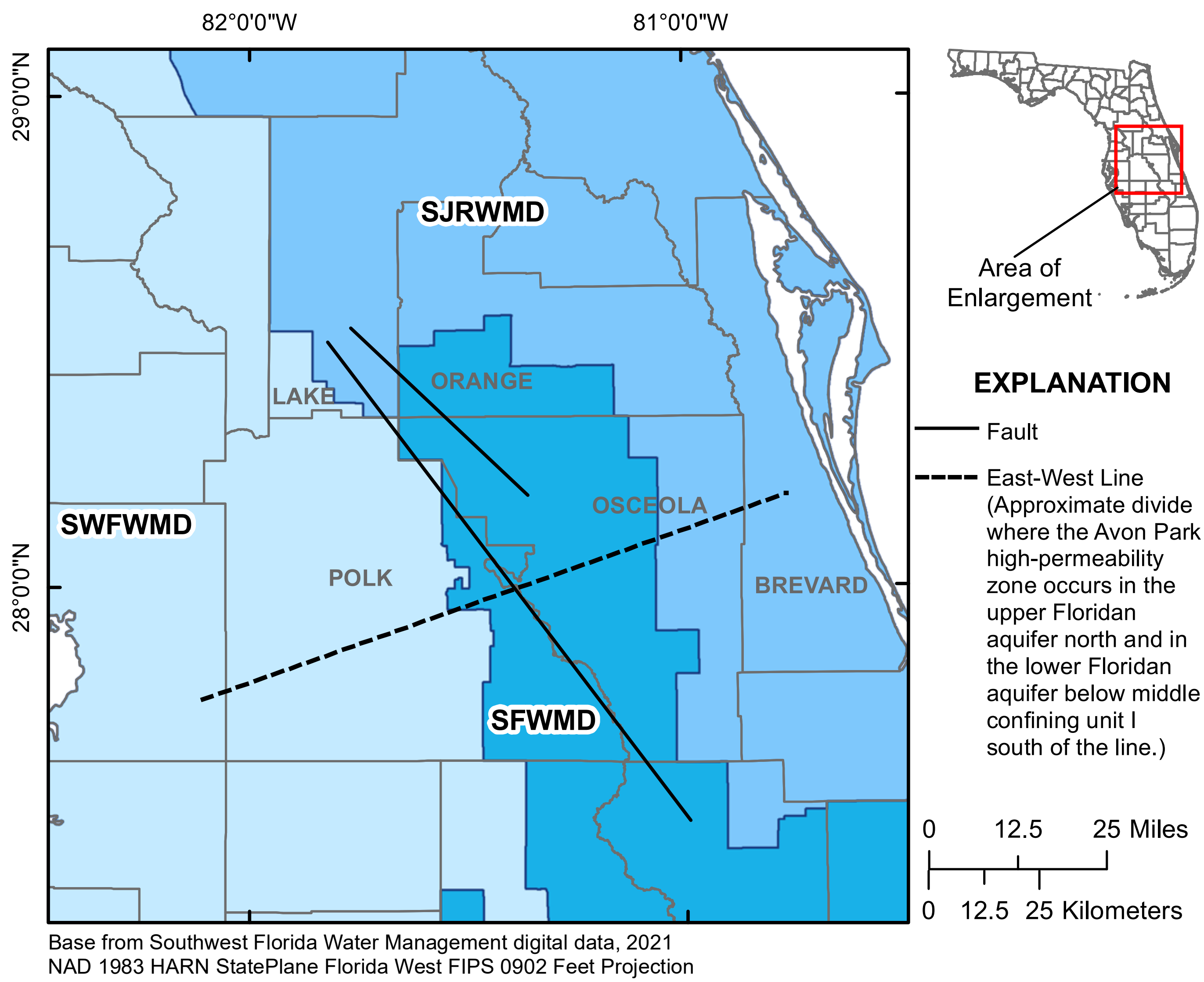
Figure 4. The extent of the Hawthorn aquifer system and the location of the Lake Wales Ridge within the Southwest Florida Water Management District.

unit I, middle confining unit II, middle confining unit VI, and middle confining unit VIII.

Upper Floridan aquifer

The upper Floridan aquifer is the most important source of groundwater in the District. The upper Floridan aquifer contains groundwater under confined conditions except in large parts of the northern District where the confining unit is absent. This is because the clays that compose the confining unit in this region are absent or discontinuous because of erosion, or are substantially breached by karst features. As a result, the upper Floridan aquifer becomes regionally unconfined and the uppermost aquifer in the northern part of the District (appendices A and B).

Laney and Davidson (1986) referred to regionally mappable units within aquifers that have permeability that is not characteristic of the entire aquifer, whether higher or lower, as zones. The District identifies two zones that are present regionally within the District: the Ocala low-permeability zone and the Avon Park high-permeability zone. These zones are present throughout the southern part of the District but are mostly absent north of Pasco County where active and relict karst processes increase the permeability of the carbonates in the Ocala Limestone or where the carbonates are not dense and brittle for fractures to form in the Avon Park Formation (appendices A and B). The Ocala low-permeability zone occurs exclusively within the upper Floridan aquifer and generally coincides with the Ocala Limestone (fig. 3). The lower permeability is attributed to the finer grained texture of the Ocala Limestone relative to adjacent formations. Many aquifer performance tests across this zone and a statistical investigation of long-term water level data that assessed 26 monitor-well sites confirms the Ocala low-permeability zone is not a confining unit anywhere it exists (Ron Basso and Cortney Cameron, written commun., 2018). The higher permeability of the Avon Park high-permeability zone is attributed to secondary porosity from fractured and vugular dolostone. Comprehensive regional mapping using data collected from ROMP sites shows the Avon Park high-permeability zone crosses middle confining unit I of Miller (1986) along a general east-west line through central Polk County and likely Osceola and Brevard counties (fig. 5 and appendix B). Therefore, it occurs in the upper Floridan aquifer north of the east-west line and in the lower Floridan aquifer below middle confining unit I south of the east-west line. The high-permeability zone gradually passes through middle confining unit I across approximately 30 miles and hydraulic testing and long-term water level monitoring show that confinement is not disrupted. The fractures that distinguish this high-permeability zone within the aquifers are secondary porosity features that formed after the primary carbonate units were deposited. As a result, the fractures are independent of the carbonate units and may cross aquifer



[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SWFWMD, Southwest Florida Water Management District; W, west]

Figure 5. The approximated line where the Avon Park high-permeability zone crosses the middle confining unit I and is in the upper Floridan aquifer north of the line and in the lower Floridan aquifer below middle confining unit I south of the line. Also, the approximate location of faults (modified from Miller, 1986) presumably causing anomolous stratigraphy of the middle and late Eocene rocks in northeast Polk and southeast Lake counties within the District.

boundaries where conditions are favorable for rock fracture.

An area of anomalous stratigraphy generally occurs in northeast Polk (east of Highway 27) and southeast Lake counties within the District; and in northwest Osceola and southwest Orange counties beyond the District's boundary that is presumably caused by paleokarst and faulting of middle and late Eocene rocks (Miller, 1986). The lithology in the graben formed between two generally parallel and northwest trending faults is highly unusual (fig. 5). For example, at the ROMP 74X – Davenport well site near the western edge of this area within the District, numerous voids filled with quartz sand are observed in the Ocala Formation and upper portion of the Avon Park Formation (approximately 240 to 540 feet below land surface) that suggest paleokarst (Gates, 2006). Also, alternating beds (up to 100 feet thick) of uncharacteristic carbonate clay and dolosilt are observed to approximately 1,000 feet below land surface that is indicative of faulting. This area is known in the well drilling community for potentially hazardous drilling conditions because large sand-filled voids are commonly encountered, which can require prolonged dredging that increases the risk of ground surface collapse. Stratigraphic mapping is inconsistent in this area because the disturbed lithology causes hydrostratigraphic unit discontinuity relative to the surrounding region.

Lower Floridan aquifers

The lower Floridan aquifers are present in permeable rock below any of the subregional middle confining units that are encountered. The base of the upper Floridan aquifer is the top of the shallowest subregional middle confining unit and the permeable rock below is considered a distinct lower Floridan aquifer below the subregional middle confining unit encountered. In west-central Florida and most of the District, very low permeability evaporitic dolostones of middle confining unit II (Miller, 1986) separate the upper and lower Floridan aquifers (appendix A). In east-central Florida, at a higher elevation, low permeability micritic limestone and fine-grained dolomitic limestone of middle confining unit I (Miller, 1986) separate the upper and lower Floridan aquifers and is present exclusively within the upper part of the Avon Park Formation (appendix B). In rare parts of the southernmost portion of the District, the evaporitic dolostones of middle confining unit VI can be present. Where no middle confining unit exists, only the upper Floridan aquifer is present.

In a narrow northwest-trending band in central peninsular Florida, the middle confining unit II is overlapped and separated from the middle confining unit I by a few hundred feet of permeable rock (Miller, 1986). This is verified at numerous ROMP sites in the overlap region (appendix A). Where this overlap is encountered, the base of the upper Floridan aquifer is the top of the middle confining unit I and at least two lower Floridan aquifers are present (appendices A and B). The permeable rock between the middle confining unit I and middle confining unit II is the lower Floridan aquifer below middle confining unit I. The permeable rock below middle confining unit II is the lower Floridan aquifer below middle confining unit II.

The middle confining unit VIII of Miller (1986) was originally mapped in south and east-central Florida within early Eocene rocks (Oldsmar Formation) above the Boulder Zone based on available data. Williams and Kuniansky (2016) extended the middle confining unit VIII across the entire peninsula as the 'Glauconite marker unit' based on the thin 'glauconite marker horizon' of Reese and Richardson (2008), which is an extension of the 'glauconite marker bed' described by Duncan and others (1994). Reese and Richardson (2008) extended the 'glauconite marker bed' by correlating gamma-ray curves from wells used by Duncan and others (1994) and wells beyond the original study area. Williams and Kuniansky (2016) further extended the 'glauconite marker horizon' beyond the middle confining unit VIII extent of Miller (1986) by coupling a gamma-ray peak with a low-resistivity response as a result of glauconite that is found in the Oldsmar Formation. The permeable rock below the middle confining unit VIII is the lower Floridan aquifer below middle confining unit VIII. Data collected during exploratory core drilling and testing at ROMP sites within Polk County since 2005 indicate the presence of a low-permeability unit within the lower Floridan Aquifer below middle confining unit VIII that generally trends north to south across central Polk County (appendix A). The full extent and properties of the unit are not fully understood and more testing is needed. But it is not considered a mapped confining unit that divides the lower Floridan aquifer below middle confining unit VIII and is considered a locally occurring unit at this time (appendix A).

Initially, the origin and stratigraphic rank of the 'Glauconite marker unit' being mapped in the District was unclear, and the permeable rock below it was informally referred to as the lower Floridan aquifer below middle confining unit II-B. After further review, the 'Glauconite marker unit' in the District correlates (chronologically, lithologically, and hydraulically) to the middle confining unit VIII of Miller (1986); therefore, the name was adopted to be consistent with the established Floridan aquifer system framework of Miller (1986) that the District's hydrostratigraphic conceptualization is based (appendix B).

In parts of the District where the middle confining unit I, middle confining unit II, and middle confining unit VIII overlap, three distinct lower Floridan aquifers are present if separated by permeable rock. At present, an area in north-central Polk County and an area in southwestern Polk County, no permeable rock is encountered between the middle confining units II and VIII; therefore, no lower Floridan aquifer below middle confining unit II is present (appendices A and B).

Summary

There has been a lot of variation in nomenclature conventions used to describe the aquifers and confining units underlying Florida. Guidelines for hydrostratigraphic nomenclature and defined terminology are important for effective and consistent scientific communication. The District's nomenclature for hydrostratigraphic units is consistent with aquifer nomenclature guidelines proposed by the United States Geological Survey (Laney and Davidson, 1986) and the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 2021).

This report defines the current hydrostratigraphic conceptualization of the District. Data from 109 Regional Observation and Monitor-well Program sites have helped develop the hydrostratigraphic conceptualization of the District and refine the Regional Aquifer-System Analysis of Miller (1986) that form the basis of the District's hydrostratigraphic conceptualization.

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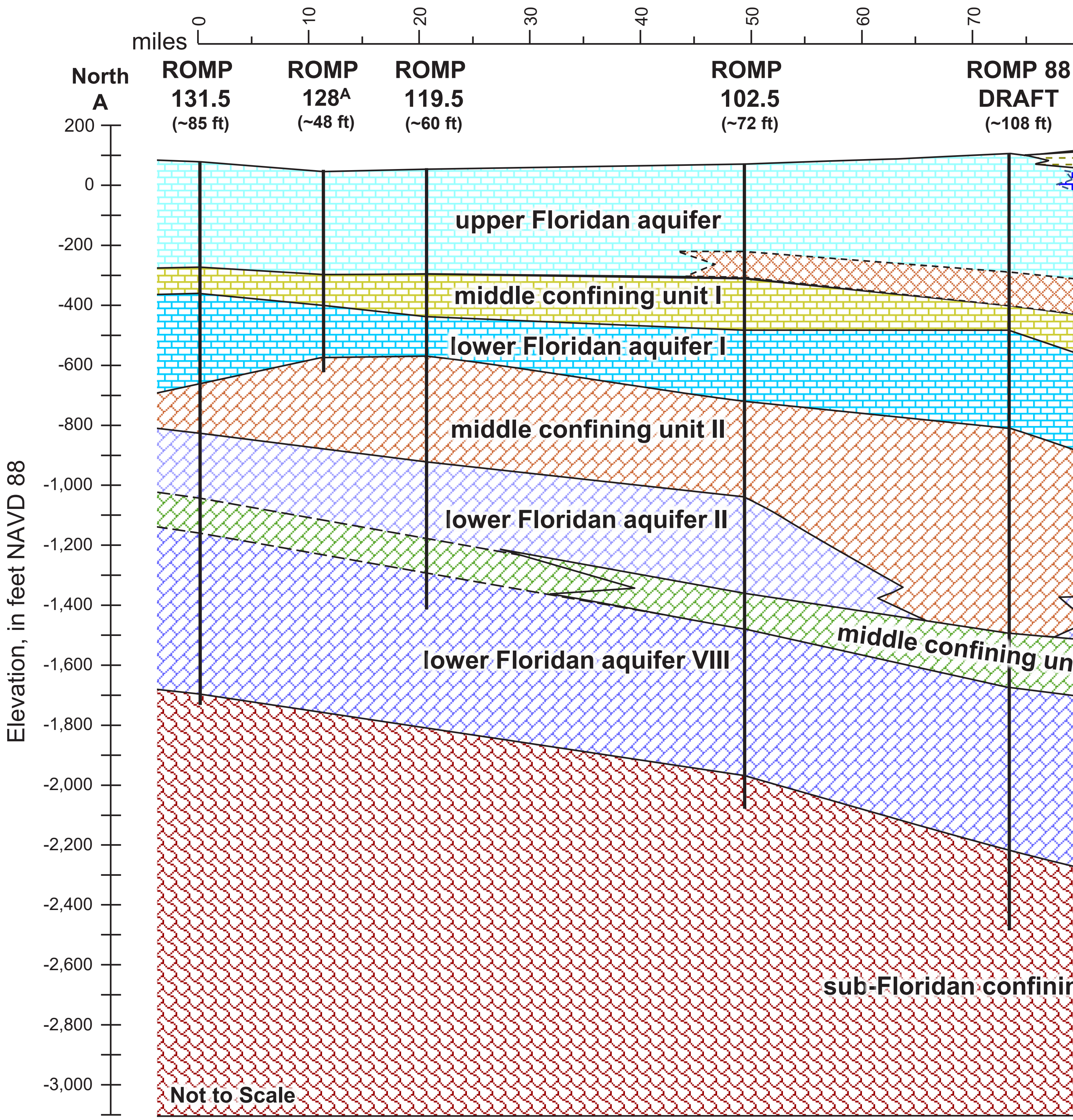
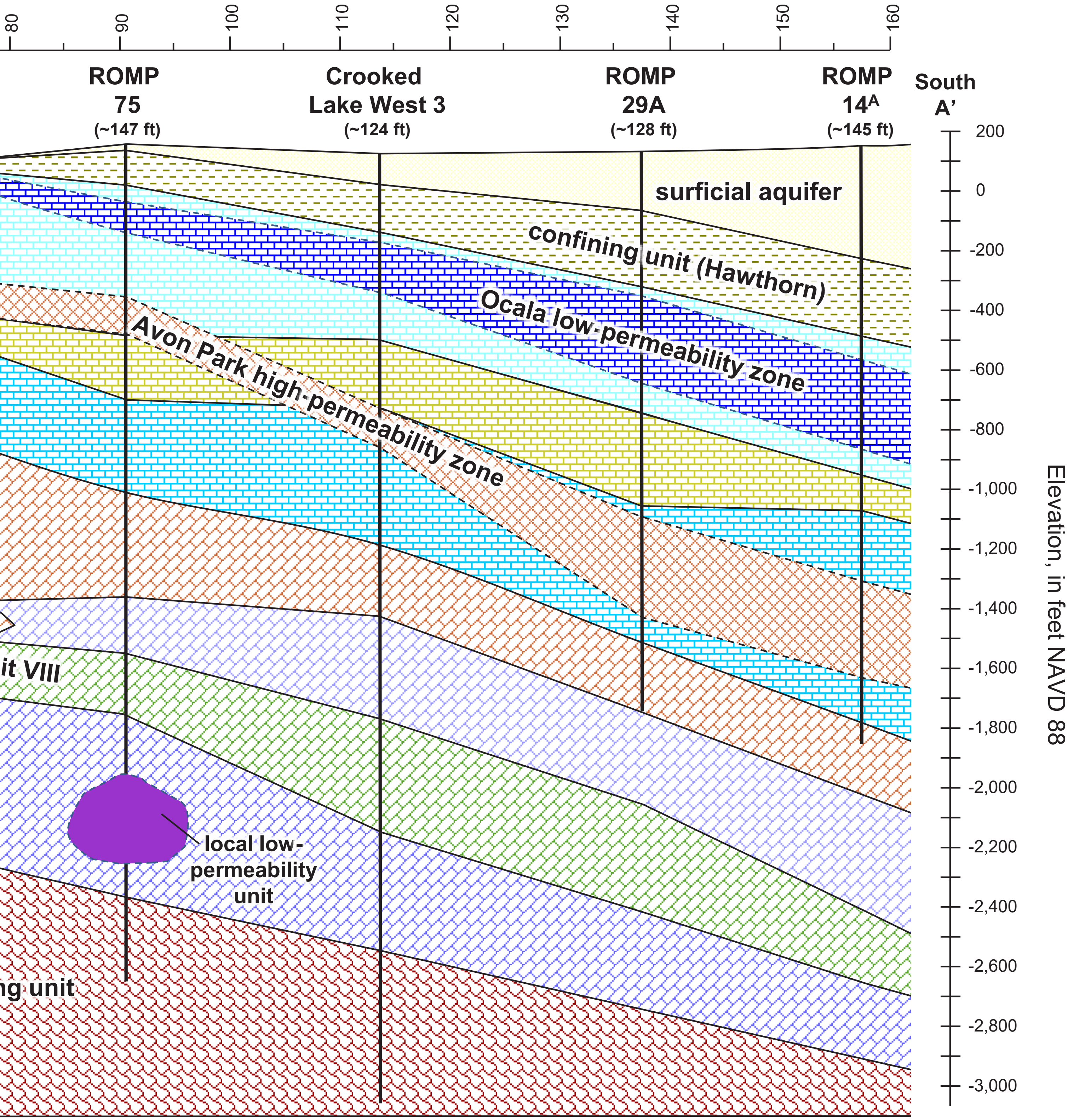
Appendix A. Hydrostratigraphic Framework Cross Sections of the Southwest Florida Water Management District

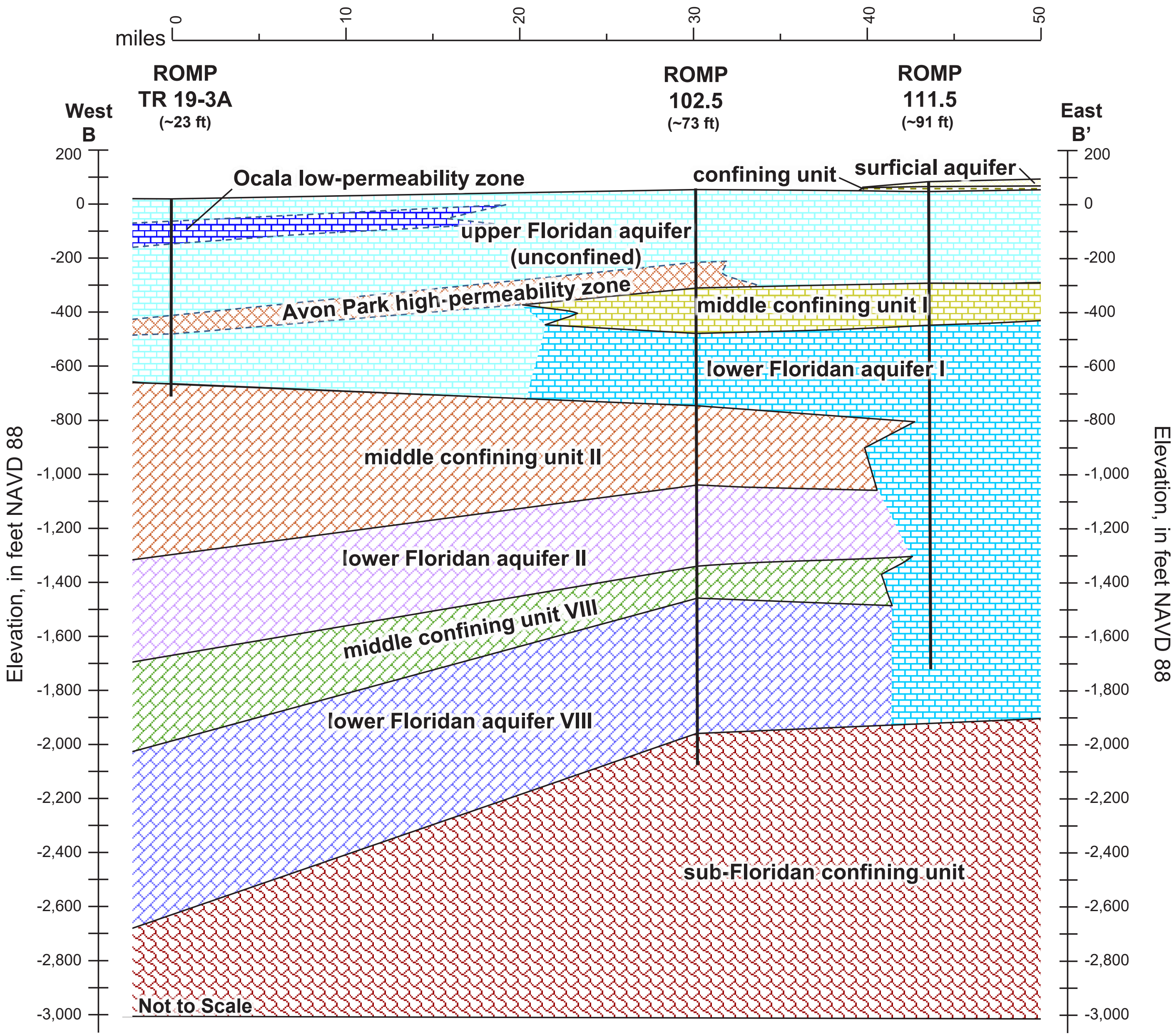


[[A]middle confining unit I is suspected but not confirmed; ~, approximate; NAVD 88, North American Vertical Datum of 1988; ROMP, Regional Observation and Monitor-well Pr
confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; Estimated depths for the middle confining unit II and the sub-Florida
confining unit VIII below the total depth of exploration are based on the mapped glauconite marker unit of Williams and Kuniansky (2016); DRAFT denotes sites that are not fina

Figure A1. Hydrostratigraphic cross section A-A' of the Southwest Florida Water Management District.

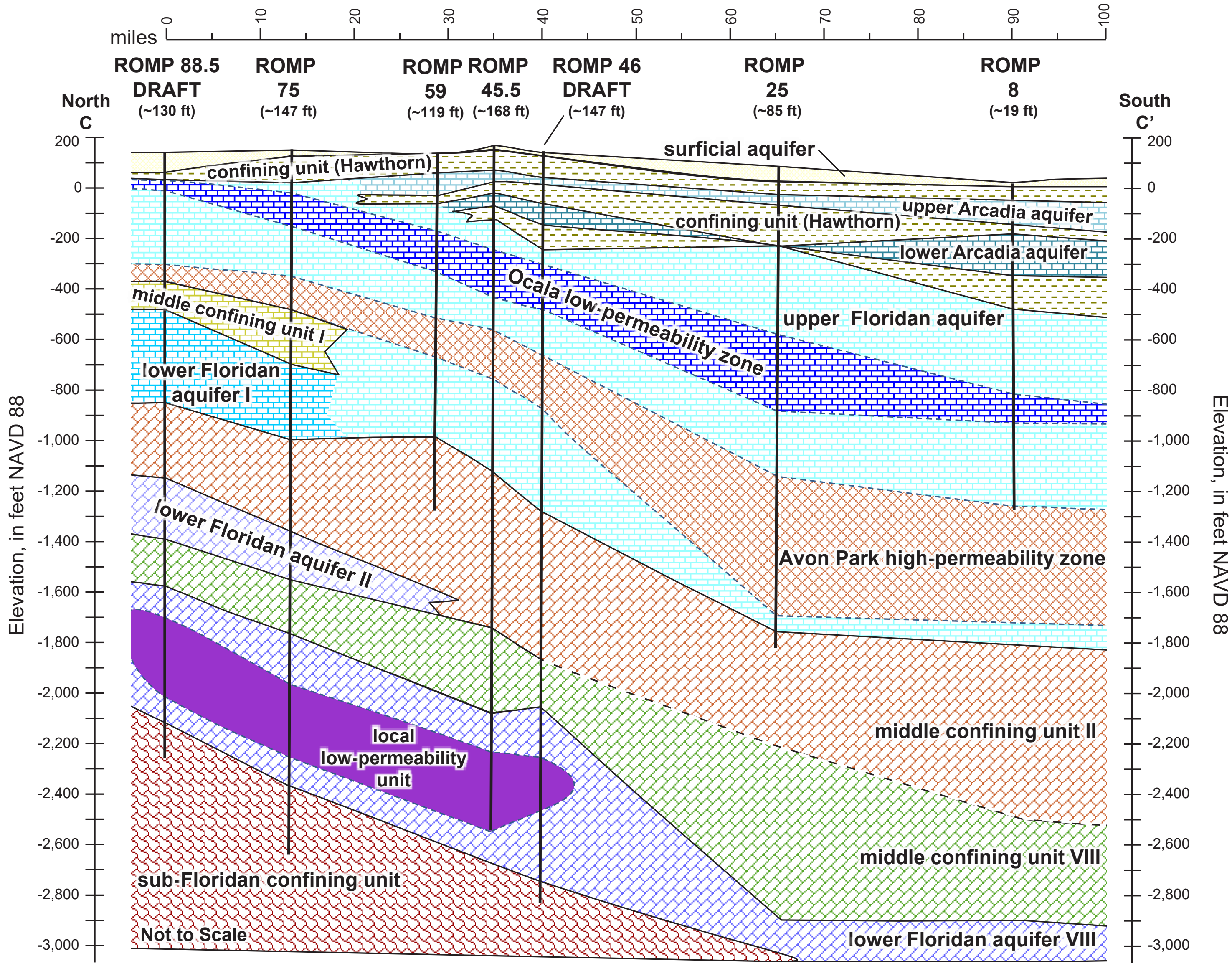


ogram; Numbers in parentheses are land surface elevation at the well site; See map figure 1 for cross-section locations; Aquifer and n confining unit below the total depth of exploration are based on mapped surfaces of Miller (1986); Estimated depths for middle alized]



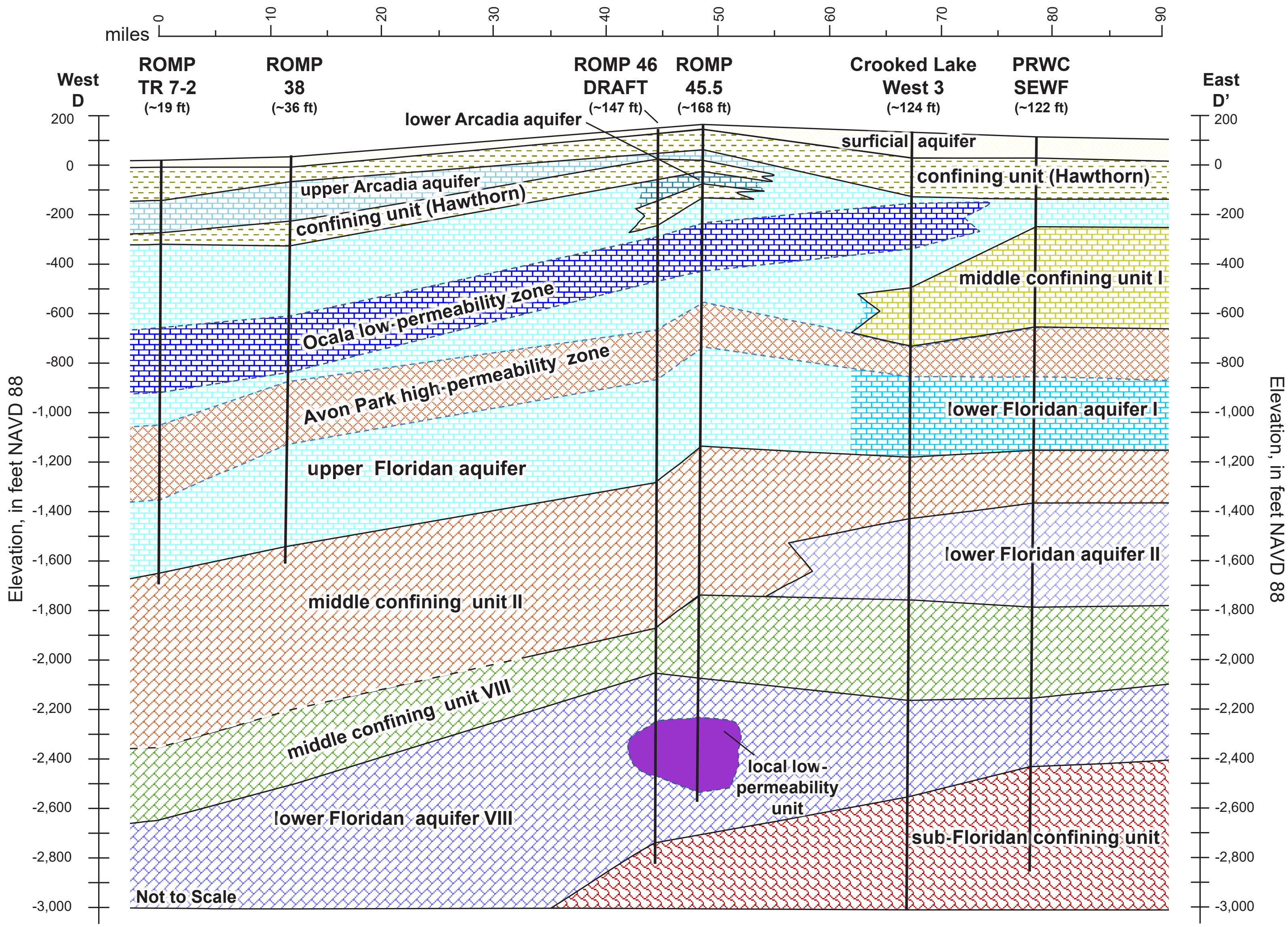
[~, approximate; NAVD 88, North American Vertical Datum of 1988; ROMP, Regional Observation and Monitor-well Program; TR, Transect; Numbers in parentheses are land surface elevation at the well site; See map figure 1 for cross-section locations; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; Estimated depths for the middle confining unit II and the sub-Floridan confining unit below the total depth of exploration are based on mapped surfaces of Miller (1986); Estimated depths for middle confining unit VIII below the total depth of exploration are based on the mapped glauconite marker unit of Williams and Kuniansky (2016)]

Figure A2. Hydrostratigraphic cross section B-B' of the Southwest Florida Water Management District.



[~, approximate; NAVD 88, North American Vertical Datum of 1988; ROMP, Regional Observation and Monitor-well Program; Numbers in parentheses are land surface elevation at the well site; See map figure 1 for cross-section locations; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; Estimated depths for the middle confining unit II and the sub-Floridan confining unit below the total depth of exploration are based on mapped surfaces of Miller (1986); Estimated depths for middle confining unit VIII below the total depth of exploration are based on the mapped glauconite marker unit of Williams and Kuniansky (2016); Dashed line indicates areas where data do not exist and unit extents are estimated; DRAFT denotes sites that are not finalized]

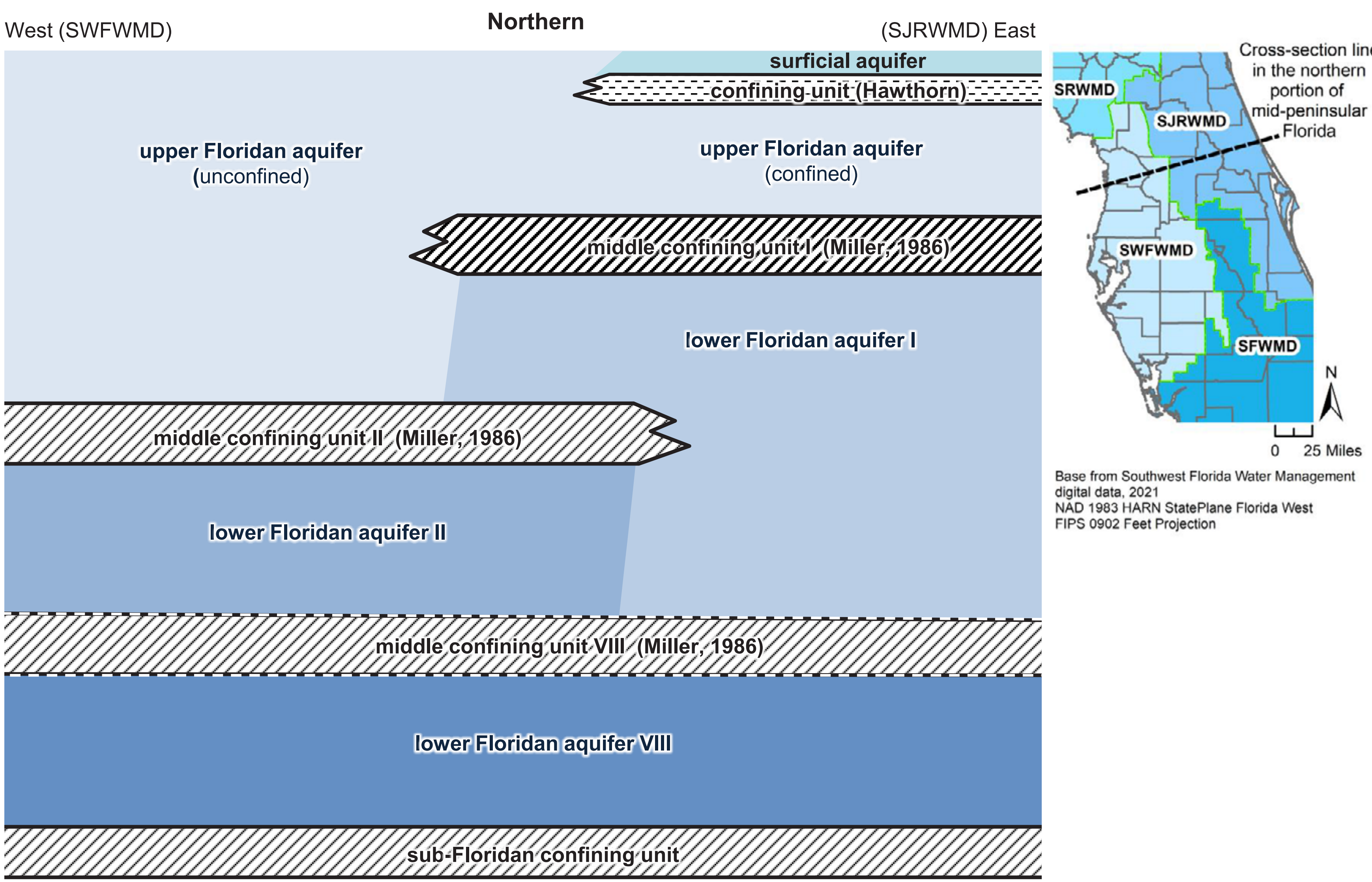
Figure A3. Hydrostratigraphic cross section C-C' of the Southwest Florida Water Management District.



[~, approximate; NAVD 88, North American Vertical Datum of 1988; PRWC SEWF, Polk Regional Water Cooperative Southeast Wellfield; ROMP, Regional Observation and Monitor-well Program; TR, Transect; Numbers in parentheses are land surface elevation at the well site; See map figure 1 for cross-section locations; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; Estimated depths for the middle confining unit II and the sub-Floridan confining unit below the total depth of exploration are based on mapped surfaces of Miller (1986); Estimated depths for middle confining unit VIII below the total depth of exploration are based on the mapped glauconite marker unit of Williams and Kuniansky (2016); Dashed line indicates areas where data do not exist and unit extents are estimated; DRAFT denotes sites that are not finalized]

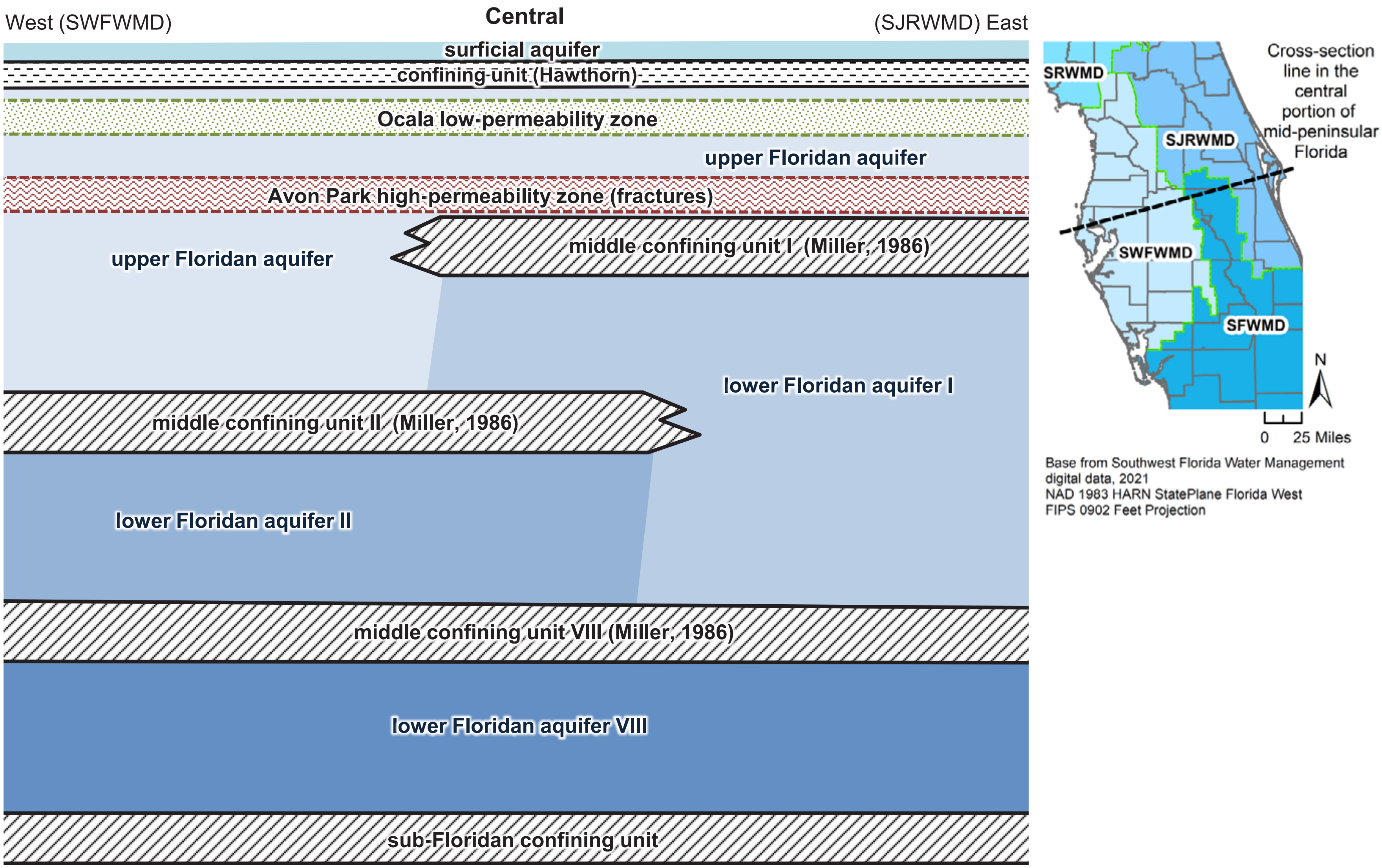
Figure A4. Hydrostratigraphic cross section D-D' of the Southwest Florida Water Management District.

Appendix B. Conceptual Hydrostratigraphic Framework of the Southwest Florida Water Management District



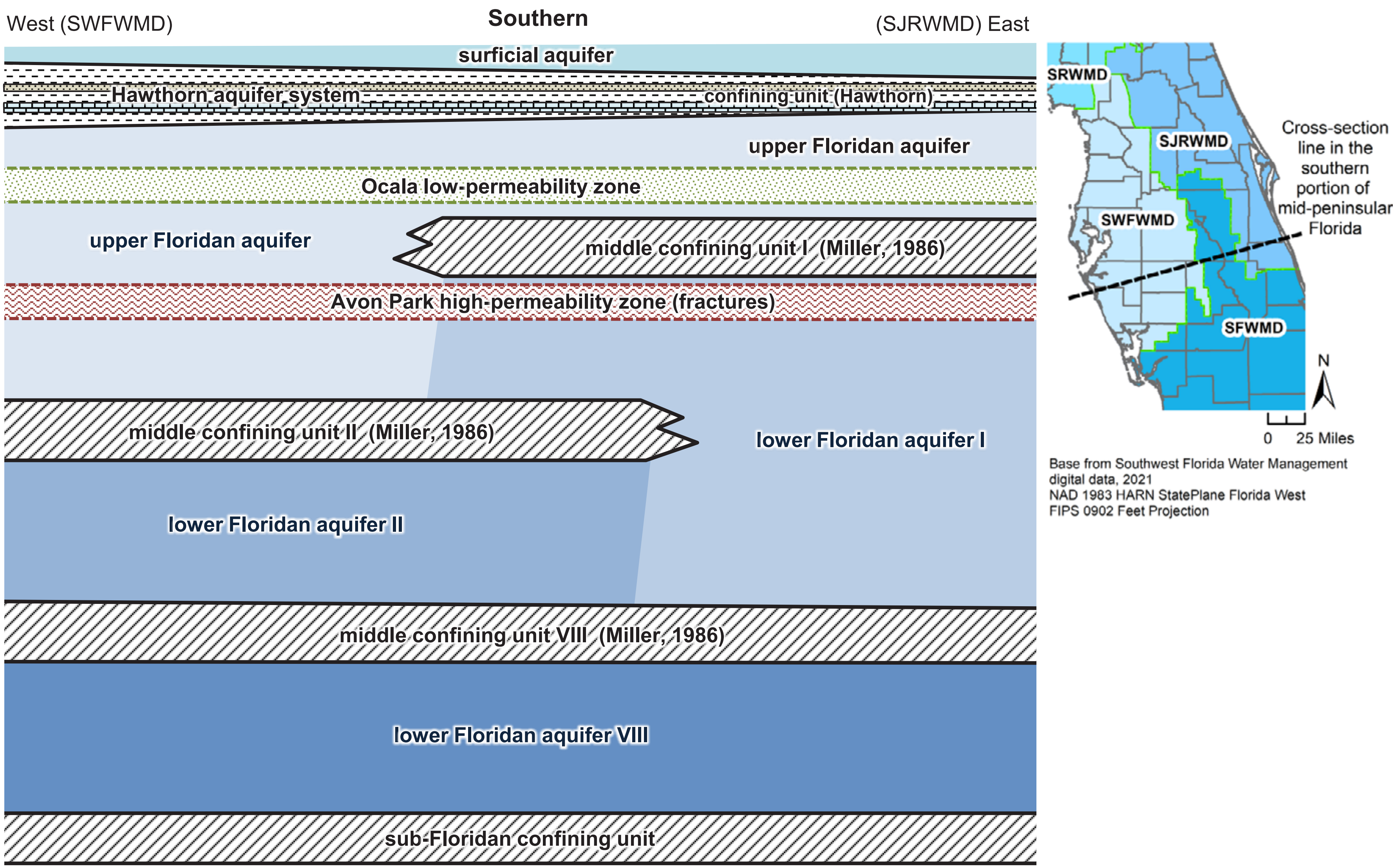
[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SRWMD, Suwannee River Water Management District; SWFWMD, Southwest Florida Water Management District; modified from Miller (1986)]

Figure B1. Conceptual hydrostratigraphic framework of the northern portion of the Southwest Florida Water Management District. The cross-section line is a general east-west trending line.



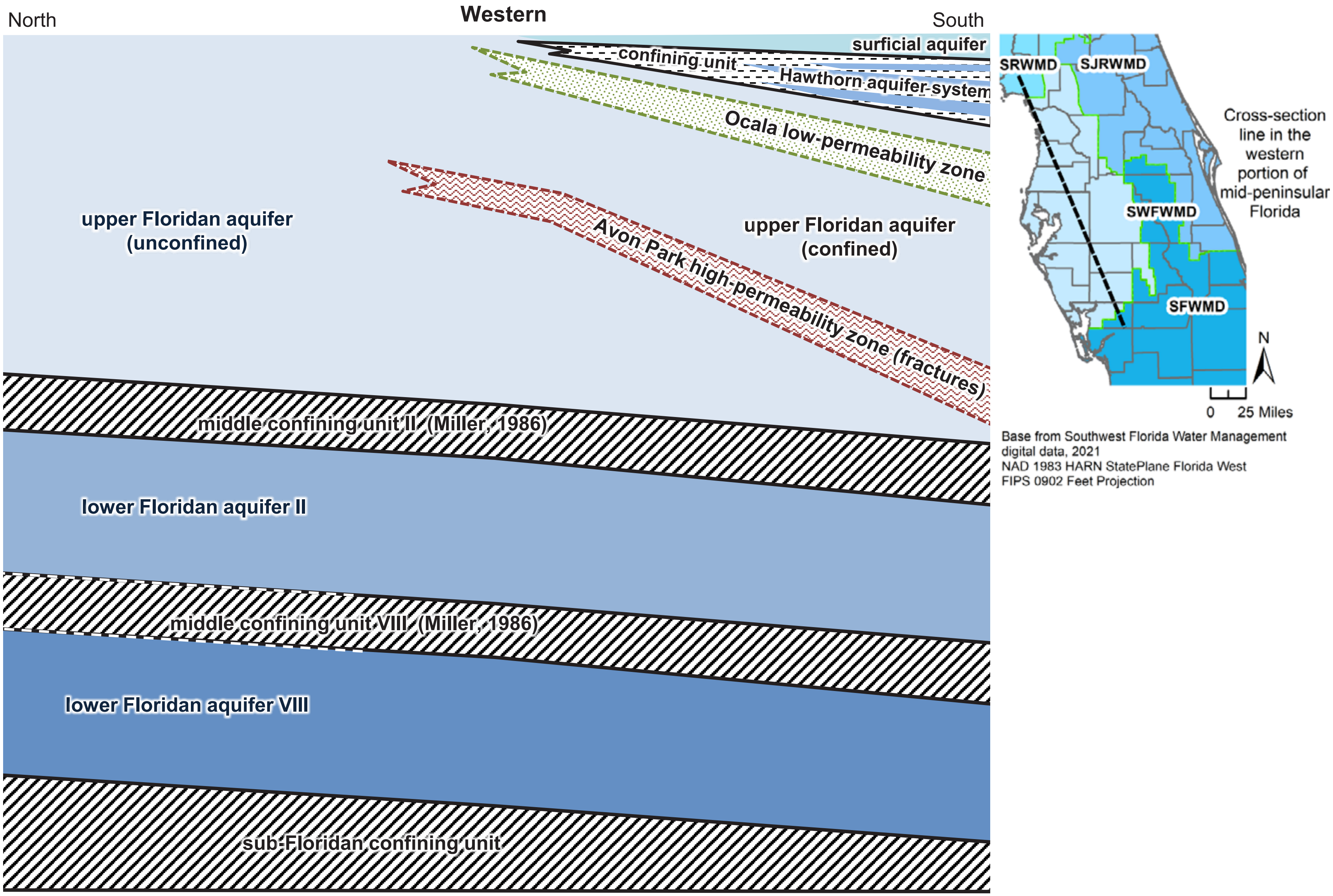
[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SRWMD, Suwannee River Water Management District; SWFWMD, Southwest Florida Water Management District; modified from Miller (1986)]

Figure B2. Conceptual hydrostratigraphic framework of the central portion of the Southwest Florida Water Management District. The cross-section line is a general east-west trending line.



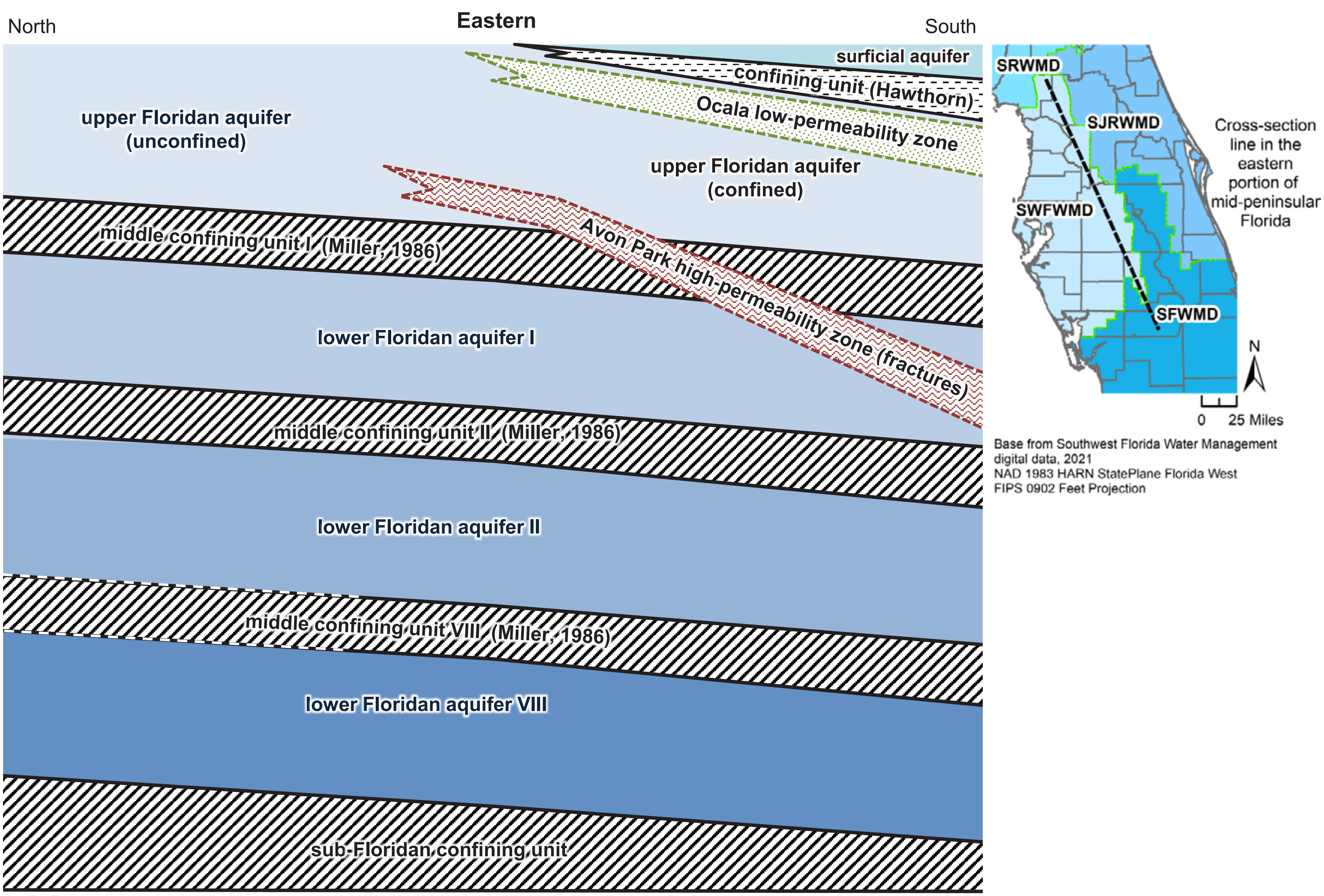
[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SRWMD, Suwannee River Water Management District; SWFWMD, Southwest Florida Water Management District; modified from Miller (1986)]

Figure B3. Conceptual hydrostratigraphic framework of the southern portion of the Southwest Florida Water Management District. The cross-section line is a general east-west trending line.



[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SRWMD, Suwannee River Water Management District; SWFWMD, Southwest Florida Water Management District; modified from Miller (1986)]

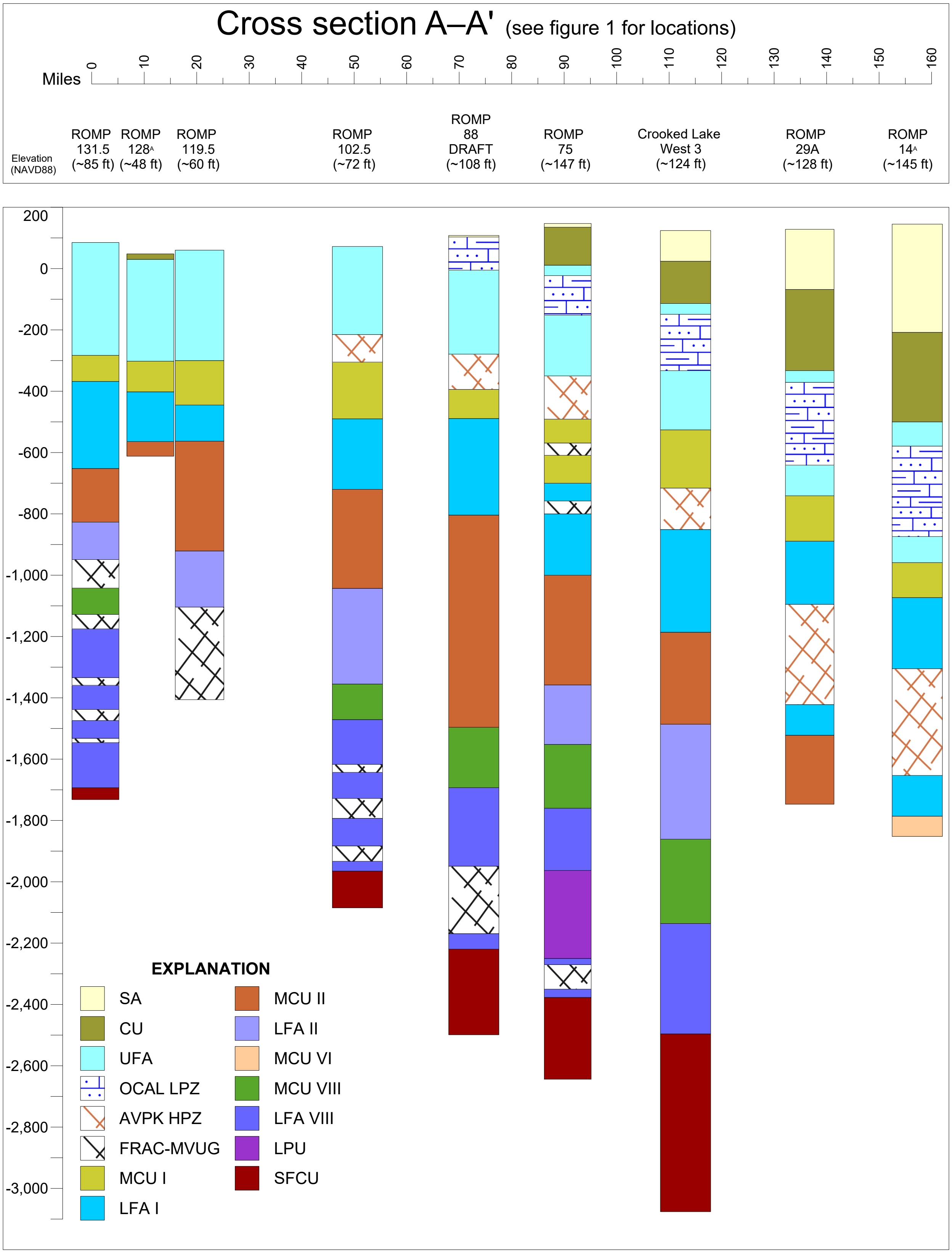
Figure B4. Conceptual hydrostratigraphic framework of the western portion of the Southwest Florida Water Management District. The cross-section line is a general north-south trending line.



[FIPS, Federal Information Processing System; HARN, High Accuracy Reference Network; N, north; NAD, North American Datum; SFWMD, South Florida Water Management District; SJRWMD, St. Johns River Water Management District, SRWMD, Suwannee River Water Management District; SWFWMD, Southwest Florida Water Management District; modified from Miller (1986); The Avon Park high-permeability zone gradually passes through middle confining unit I across approximately 30 miles and hydraulic testing and long-term water level monitoring show that confinement is not disrupted.]

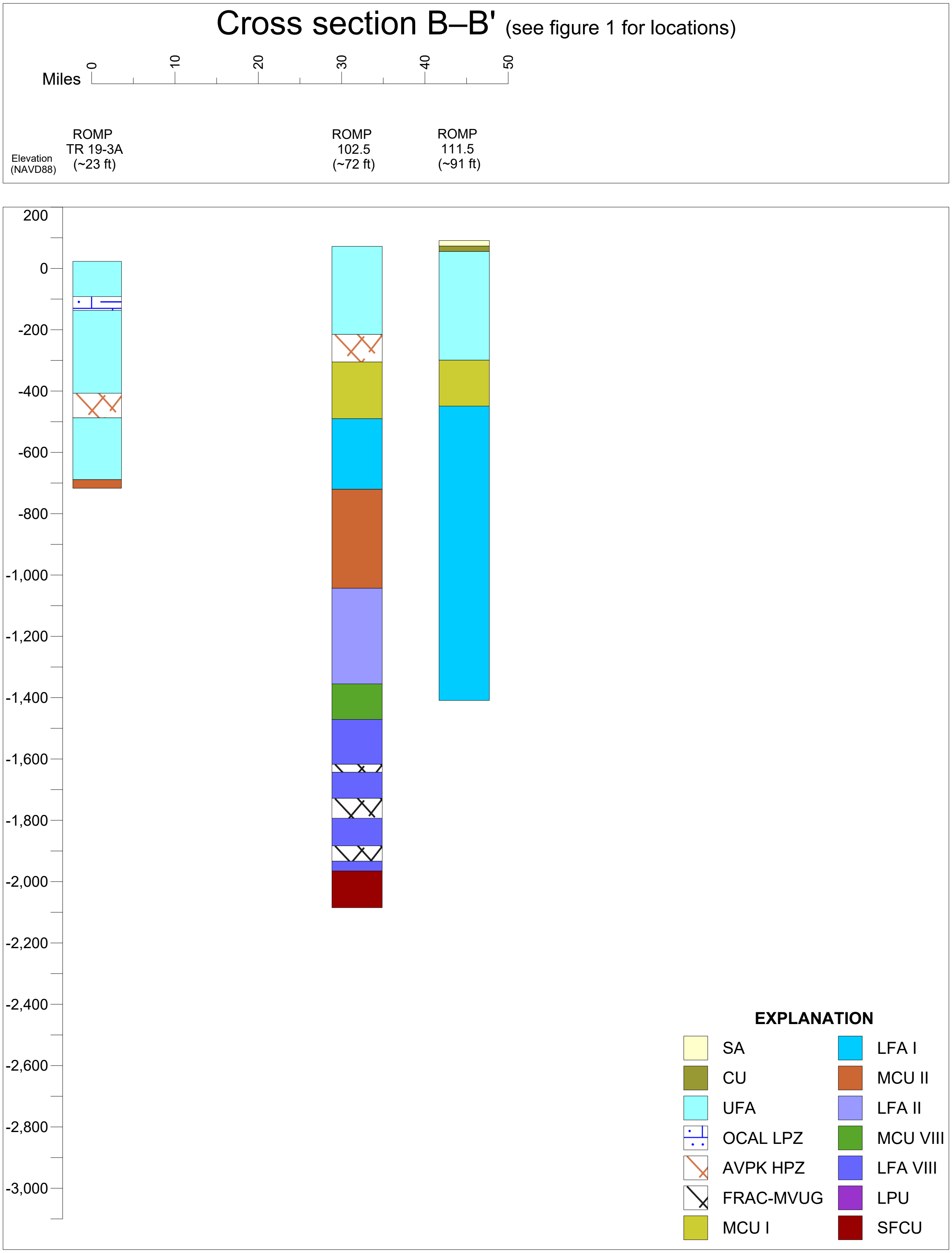
Figure B5. Conceptual hydrostratigraphic framework of the eastern portion of the Southwest Florida Water Management District. The cross-section line is a general north-south trending line.

Appendix C. Hydrostratigraphic Columns of Select Exploratory Core Drilling Well Sites Within the Southwest Florida Water Management District



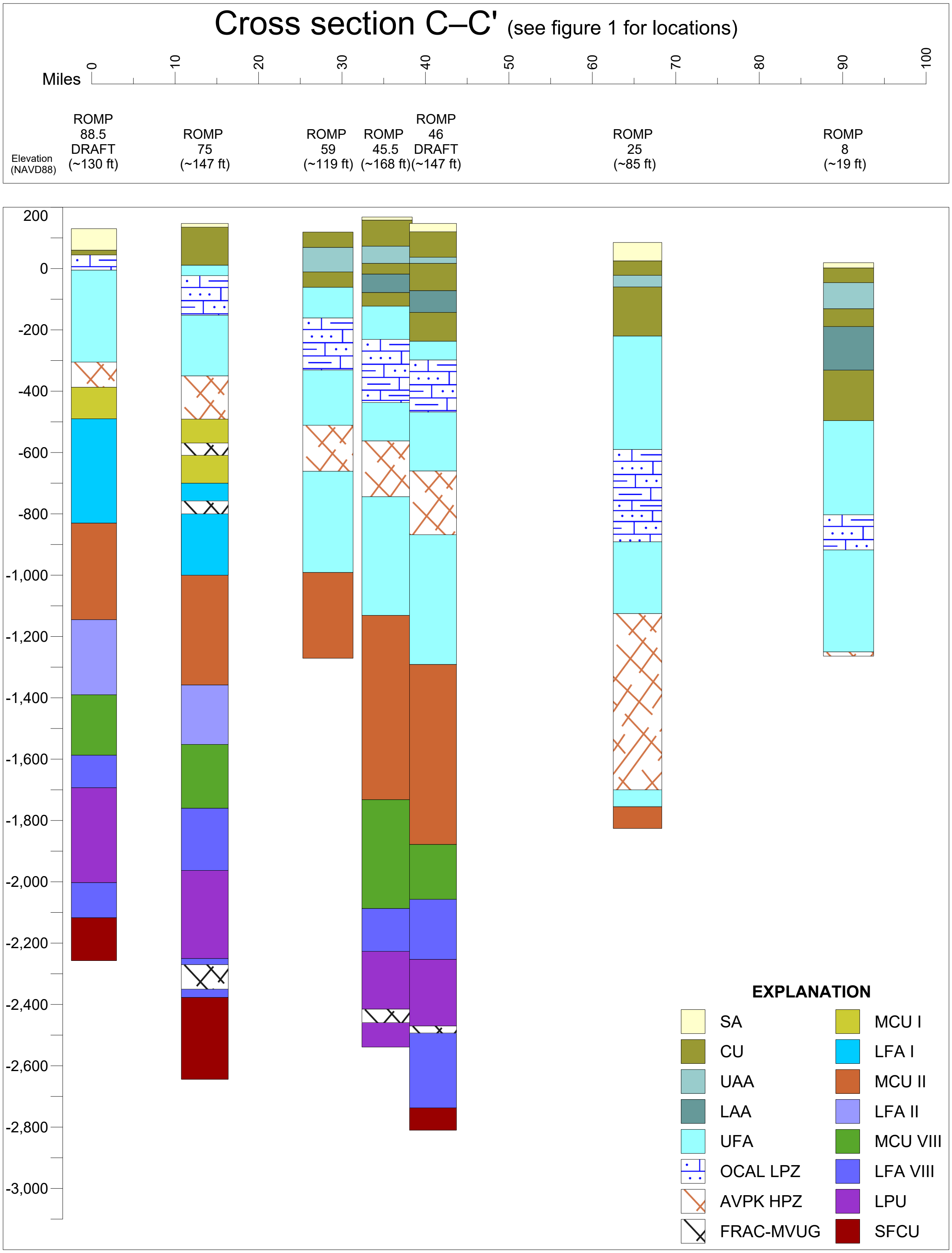
[^Amiddle confining unit I is suspected but not confirmed; ~, approximate; AVPK HPZ, Avon Park high-permeability zone; CU, confining unit; FRAC-MVUG, fractures and/or mega vugs; LFA, lower Floridan aquifer; LPU, low permeability unit; MCU, middle confining unit; NAVD 88, North American Vertical Datum of 1988; OCAL LPZ, Ocala Limestone low-permeability zone; ROMP, Regional Observation and Monitor-well Program; SA; surficial aquifer; SFCU, sub-Floridan confining unit; UFA, upper Floridan aquifer; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; DRAFT denotes sites that are not finalized]

Figure C1. Hydrostratigraphic columns for wells used in cross section A-A'.



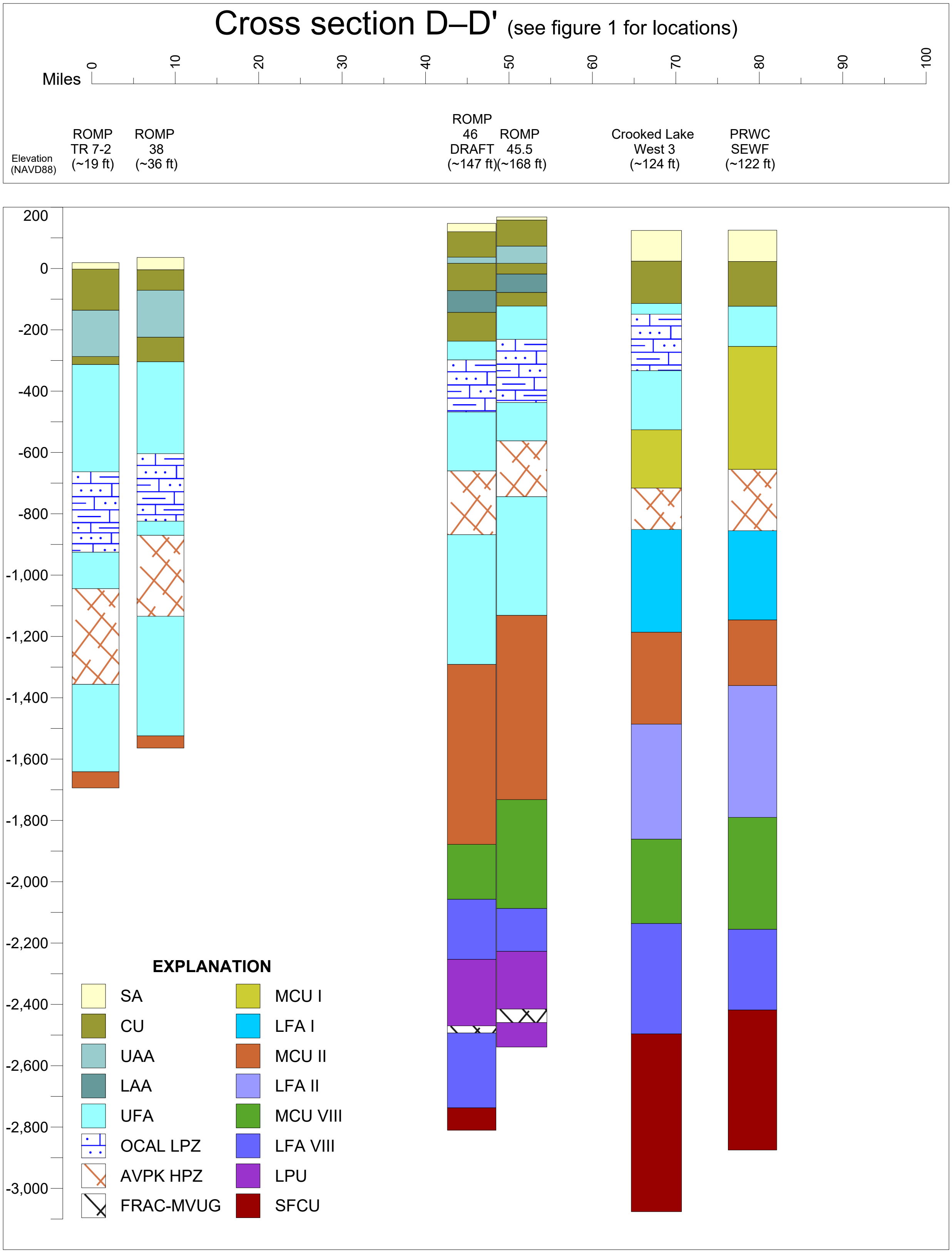
[~, approximate; AVPK HPZ, Avon Park high-permeability zone; CU, confining unit; FRAC-MVUG, fractures and/or mega vugs; LFA, lower Floridan aquifer; LPU, low permeability unit; MCU, middle confining unit; NAVD 88, North American Vertical Datum of 1988; OCAL LPZ, Ocala Limestone low-permeability zone; ROMP, Regional Observation and Monitor-well Program; SA; surficial aquifer; SFCU, sub-Floridan confining unit; UFA, upper Floridan aquifer; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing]

Figure C2. Hydrostratigraphic columns for wells used in cross section B-B'.



[~, approximate; AVPK HPZ, Avon Park high-permeability zone; CU, confining unit; FRAC-MVUG, fractures and/or mega vugs; LAA, lower Arcadia aquifer; LFA, lower Floridan aquifer; LPU, low permeability unit; MCU, middle confining unit; NAVD 88, North American Vertical Datum of 1988; OCAL LPZ, Ocala Limestone low-permeability zone; ROMP, Regional Observation and Monitor-well Program; SA; surficial aquifer; SFCU, sub-Floridan confining unit; UAA, upper Arcadia aquifer; UFA, upper Floridan aquifer; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; DRAFT denotes sites that are not finalized]

Figure C3. Hydrostratigraphic columns for wells used in cross section C-C’.



[~, approximate; AVPK HPZ, Avon Park high-permeability zone; CU, confining unit; FRAC-MVUG, fractures and/or mega vugs; LAA, lower Arcadia aquifer; LFA, lower Floridan aquifer; LPU, low permeability unit; MCU, middle confining unit; NAVD 88, North American Vertical Datum of 1988; OCAL LPZ, Ocala Limestone low-permeability zone; ROMP, Regional Observation and Monitor-well Program; SA; surficial aquifer; SFCU, sub-Floridan confining unit; UAA, upper Arcadia aquifer; UFA, upper Floridan aquifer; Aquifer and confining unit depths are based on hydrogeologic data collected during exploratory core drilling and testing; DRAFT denotes sites that are not finalized]

Figure C4. Hydrostratigraphic columns for wells used in cross section D-D’.

Southwest Florida
Water Management District