Progressive Water Resources
Integrated Water Resource Consultants

5589 Marquesas Circle • Suite 202 • Sarasota, FL 34233 • (941) 552-5657

August 17, 2012

Ms. Inga Williams, AICP
Principal Planner
Charlotte County Community Development Department
18500 Murdock Circle
Port Charlotte, FL 33948-1094

Subject: Response to Charlotte County's Request for Additional Information
Calusa Green Solid Waste Disposal Facility Site Plan

Dear Ms. Williams:

On behalf of the Calusa Green Solid Waste Disposal Facility Permitting Team, we respectfully submit the following response to the August 10, 2012 Cardno Entrix (Cardno) technical memorandum regarding their review of the geologic and hydrogeologic elements of the proposed site plan. After review of the Cardno Report and some of the issues presented, it appears that additional clarification is warranted to assist County staff in developing a more advanced understanding of "Prime Recharge Areas", particularly in respect to the applicable requirements under Charlotte County's Comprehensive Plan and Chapter 1-12, Article V, Solid Waste Management Siting. In addition, Cardno presented a bulleted list of nine items in which additional information was requested as part of the summary and recommendations section of their report. The first three sections of this response include discussions regarding the history of the prime recharge designation, followed by qualitative discussions about recharge to the Upper Floridan Aquifer (UFA) and the Intermediate Aquifer System (IAS). The remaining sections of this response contain specific responses to the list of nine additional actions, studies and information requested by the Cardno Report.

1.0 History of Prime Recharge Designation and Related Legislative Direction

In 1982, the Florida legislature, under Chapter 373.0395 Florida Statutes, directed the state's Water Management Districts to conduct Groundwater Basin Resource Availability Inventories covering areas deemed appropriate by the applicable District's Governing Board. The concept of "Prime Groundwater Recharge Areas" appeared in Florida's water policy framework at this same time. "Prime Groundwater Recharge Areas" were specifically mandated for inclusion in the Groundwater Basin Resource Availability Inventories and upon completion, a copy of the inventory was to be submitted to each affected municipality, county, and regional planning agency and reviewed for consistency with the local government's comprehensive plans, and to be considered in future revisions of such plans.

Since groundwater basins can be of a scale much larger than local and/or county government jurisdictions, it was the intent of the legislature to provide each of these local governments, contained within these groundwater basins, with information at a county-level scale to assist in future governmental planning efforts. The current Florida Statute 373.0397 shown below further refines the concept of Prime Recharge and specifically identifies two aquifers to which this designation was intended to apply, namely the Floridan and Biscayne. The Biscayne Aquifer is located in south Florida and is not present in Charlotte County. However, as reflected in the County's Comprehensive Plan, adverse effects upon any existing areas of Prime Recharge to the Floridan Aquifer are a pertinent issue.

> *Section 373.0397* ***Floridan and Biscayne aquifers****; designation of prime groundwater recharge areas.—Upon preparation of an inventory of* ***prime groundwater recharge areas for the Floridan or Biscayne aquifers****, but prior to adoption by the governing board, the water management district shall publish a legal notice of public hearing on the designated areas for the* ***Floridan and Biscayne aquifers****, with a map delineating the boundaries of the areas, in newspapers defined in chapter 50 as having general circulation within the area to be affected.*

2.0 Recharge to the UFA System (FLU Policy 2.3.6 and FLUM Map No. 6)

The concept of "Prime Recharge" to the upper Floridan Aquifer (UFA) is mirrored in Charlotte County's FLU Policy 2.3.6 Groundwater Protection and presented in FLUM Map No. 6 entitled "Prime Aquifer Recharge Areas". Map No. 6 indentifies geographic areas characterized as either Recharge or Discharge Areas and clearly states that these areas are specific to the UFA, thereby clarifying the policy's intent. No other aquifer systems are identified or noted as being applicable with respect to Prime Recharge under FLU Policy 2.3.6.

Closer inspection of Map No. 6 indicates that it is very similar to, and possibly based on, a map published in 1988 by W.R. Aucott, entitled "Areal Variation in Recharge to and Discharge from the Floridan Aquifer System in Florida". Both the FLUM Map No. 6 and the 1988 Aucott Map agree that at best recharge to the UFA in the northeastern corner of Charlotte County is very low, i.e., between 0 and 1 inches per year.

It is also notable that, although the County's map is labeled as a "Prime Aquifer Recharge Map", a closer informed examination of Map No. 6 reveals that the areas identified as having 0 to 1 inches per year of recharge are also described as areas with "no recharge to very low recharge". Areas described as having no recharge to very low recharge rates, i.e. de minimis, are not considered "Prime Recharge" areas.

The potential for aquifer recharge is critical to understanding the subsurface hydraulics of the site and the protection of groundwater quality in respect to the UFA. The Cardno Report's conclusions regarding recharge to the UFA are consistent with the findings provided by Progressive Water Resources (PWR) in support of the Calusa Green application. The Cardno Report states that "***the Floridan Aquifer System (FAS) in the project area appears to be well confined and the project area would not likely be considered a recharge area for the UFA***". Therefore, the site is not located within an area of "Prime

Recharge" and the County's own consultant has indicated that the site should not be considered as a recharge area to the UFA.

Further evidence of a lack of recharge to the UFA is provided by documented water level elevations in the region. The elevation of the uppermost confining unit shown in **Figure 1,** provided previously by PWR, ranges between 29.5 and 37.5 feet above the North American Vertical Datum of 1988 (NAVD 88). The 12-month (August 2011 to July 2012) median UFA potentiometric elevation, based on a nearby monitor well MW-4; (location shown on **Figure 2**) is approximately 46.58 feet NAVD. This value compares well to the median UFA potentiometric elevations at nearby Southwest Florida Water Management District (SWFWMD) Regional Observation Monitoring Program (ROMP) Sites 12 and 13 of 45.23 feet and 44.92 feet NAVD 88, respectively.

Therefore, water level elevations obtained from MW-4 located immediately east of the project site as well as the nearby ROMP sites indicate that the median annual potentiometric surface elevation for the UFA is approximately 9 feet above the top elevation of the uppermost confining unit as illustrated in **Figure 3**. Consequently, the upward gradient imposed by the UFA potentiometric elevation on the Surficial Aquifer System (SAS) prohibits water from infiltrating downward to recharge the UFA in this area and may be indicative of a hydrodynamic relationship, whereby the SAS is possibly recharged by the UFA.

3.0 Recharge to the Intermediate Aquifer System

The County's consultant states that insufficient site-specific information exists to conclude that no recharge occurs from the SAS to the low yielding producing zones, PZ-1 and PZ-2, of the upper Intermediate Aquifer System (IAS). However, the County's consultant recognizes a hydrogeologic report authored by the United States Geological Survey (USGS), Torres, et al, 2001, which indicates "**that generally there is little hydrogeologic connection between SAS and PZ-1 and PZ-2 of the IAS because of the presence of confining units**." To better illustrate the nature of the confining units at the site, generalized shallow and deep hydrogeologic cross-sections were produced using data taken from on-site soil borings and drilling contractor's Well Completion Reports from three nearby UFA irrigation and water level monitoring sites located immediately east of the project site.

As shown on **Figures 3 and 4,** there exists considerable thickness of confining units between the SAS and the underlying producing zones of the IAS. Examination of the completion reports does not indicate the presence of PZ-1. More detailed information taken from SWFWMD monitoring sites indicates that the IAS in the vicinity of the project site is characterized as a complex, interbedded sequence of dense clay, sandy clay and clayey sand, separating dolostone and limestone units. A water level monitoring well (MW-3) from the adjacent property is open exclusively to the PZ-3 based on the well completion reports. The median 12-month water level for this well is 47.98 Feet NAVD 88 which is, at minimum, 10 feet above the top of the uppermost confining layer as shown in **Figure 3**. Similar to the UFA, the upward gradient imposed by the PZ-3 potentiometric elevation on the SAS prohibits water from the SAS from recharging the PZ-3 in this area and may be indicative of a hydrodynamic relationship, whereby the SAS is possibly recharged by the PZ-3.

There are no dedicated PZ-2 monitor wells on-site, however the median annual water levels at ROMP 12 and 13 are 45.48 feet and 45.81 feet NAVD 88, respectively. While these measurements are not site-specific, it appears likely the PZ-2 at the site could also exert an upward gradient on the SAS such that recharge to the PZ-2 is inhibited and that PZ-2 could possibly contribute groundwater to the SAS.

It is important to recognize that the County's adopted "Prime Recharge" policy criteria applies only to the UFA, and not the IAS. Nonetheless, Calusa Green has incorporated design parameters that will effectively maintain any existing recharge to the upper unit of the IAS (i.e. PZ-2). Even if some degree of recharge naturally occurs to this unit, there will not be an adverse impact upon such recharge. There is even a possibility that the site could potentially display an increased recharge in the post-development condition due to the proposed stormwater management system design.

As identified in the application submitted to the County, the project is proposed to retain 100% of the stormwater generated in up to a 500-year rainfall event. Therefore, in the post-development condition the project will effectively be a zero discharge stormwater facility. Retention of stormwater, that would otherwise have discharged offsite in the pre-development condition, will serve to store water above the current elevations of the SAS, effectively increasing water level differentials, and thereby potentially increasing recharge potential. Without question, the proposed stormwater management system design is not expected to decrease recharge potential to the upper IAS.

4.0 Additional Actions, Studies and Information Requested

4.1 Assessment of Groundwater and Surface Water Quality

The Cardno Report requested an assessment of groundwater and surface water quality as part of the Preliminary Hydrogeological Investigation Report (PRIR). A full assessment and evaluation of surface water and ground water quality will be completed as part of a complete Solid Waste Facility application to be submitted to the Florida Department of Environmental Protection (FDEP). In accordance with Chapter 62-701, groundwater and surface water samples will be collected and analyzed for common field parameters as well as 76 laboratory parameters that include metals, major ions and volatile organic compounds. Surface and groundwater quality analysis is required as part of the FDEP Solid Waste permitting process. The County can be assured that water quality aspects of this project will be thoroughly reviewed by qualified experts at FDEP prior to permit issuance.

In addition, Chapter 1-12, Article V, Section 107 of Charlotte County's Code of Ordinances, states that, *"All new solid waste management facilities within the specified classifications, and modifications to existing facilities must be rezoned...**The issuance of all applicable regulatory agencies' permits shall be a condition of final approval** (as provided by section 3-9-49(d)(2) of the County Code) for any facility subject to this ordinance"* This section of the ordinance states that final approval of a zoning change is conditional upon the issuance of applicable regulatory agency permits. The ordinance language continues to state, ***"Under no circumstances shall Charlotte County issue a building permit or other authorization to begin work on a facility subject to this ordinance until such time as copies of such agencies' permits are received by the community development department."*** Therefore, the County is prohibited from issuing a building permit prior to the receipt of applicable regulatory agency's permits.

As such, surface and groundwater quality analysis will be part of an FDEP application and therefore is not required prior to the conditional approval of a zoning change for the Calusa Green Solid Waste Facility, since such data will be collected, reviewed and provided to the County prior to construction approval.

4.2 Determination of Aquifer Hydraulic Parameters

The Cardno Report questioned the validity of the methodologies used to obtain surficial aquifer horizontal conductivity and the vertical permeability of the upper intermediate confining unit that underlies the surficial aquifer in the project area. The methodology used to determine the horizontal hydraulic conductivity in the surficial aquifer and the vertical permeability of the confining units were described in detail within the PHIR. As stated in the PHIR, slug tests were performed at each of the three piezometer locations. The tests were performed by purging a portion of the water column (the slug) from the piezometers using a bladder pump and recording the water level recovery in the well using a submersible data logger. A hydraulic conductivity was determined for the SAS adjacent to each piezometer.

The slug test methodology is a standardized and well-accepted practice for determining site-specific horizontal conductivity in unconfined aquifer systems as and the procedure is documented in the American Society for Testing and Materials (ASTM) Standard D-4044-96(2008).

Constant-head permeability tests were used to determine the vertical permeability at seven soil boring locations throughout the project area. The constant-head permeameter method for determining vertical permeability is also a well-accepted methodology and the procedure is documented in the ASTM Standard D-5084-10. Both methodologies were performed and evaluated by a Professional Engineer licensed in the State of Florida. However, Cardno stated that a full-scale aquifer performance test (APT) be performed to determine leakance within the upper confining unit.

In PWR's opinion, only in extreme cases where questionable confinement or no confinement exists would a full-scale aquifer performance test (APT) be warranted to determine vertical leakance. The slug test and permeameter methodologies described above are widely accepted for obtaining site-specific hydraulic parameters. Moreover, the confinement of the IAS and UFA in this region of Southwest Florida is extremely well-documented. The United States Geological Survey (USGS) report that Cardno references concluded that there is little hydrogeologic connection between the SAS and the IAS due to the presence of confining units.

As described in the PHIR, Regional Observation Monitoring Program (ROMP) Sites 12 and 13 are the closest monitoring locations to the project site. Both of the sites indicate substantial confinement between the SAS, IAS and UFA based on lithologic data collected during exploratory drilling as well as significant head-differential between the aquifer systems.

4.3 Additional Data on SAS and IAS On-Site and Near-Site Water Levels

The Cardno Report requested additional onsite and/or near-site water levels as part of the Preliminary Hydrogeological Investigation Report (PHIR). As the title of the document suggests, the PHIR is meant to provide an initial assessment of the geology and hydrostratigraphy of the project site. PWR has collected monthly water level elevation readings from the three on-site SAS piezometers. These measurements have been compiled in the table below. There is an existing on-site IAS Well (Irrigation Well No. 8), however it was determined to be open to both IAS permeable zones PZ-2 and PZ-3 based on South Florida Management District (SWFWMD) well construction records. Therefore, the resulting water level is a composite water level of both IAS permeable zones.

PWR was able to identify Lower IAS and UFA water level monitoring wells on the adjacent property to the east of the subject property as shown in **Figure 2**. The Well Completion Report geologic logs for several of these wells were utilized to create the cross-section illustrated in **Figure 4**, clearly indicating Permeable Zones 2 and 3 of the IAS. One of the closest monitor wells to the subject property is Monitor Well 3 (MW-3) which has an open interval from 285 feet to 550 feet below land surface (bls) which corresponds to PZ-3 of the IAS (Lower IAS) as shown in **Figure 4**. In addition, one of the water level monitor wells (MW-4) was also identified with an open interval from 685 to 800 feet bls which corresponds to the UFA as shown in **Figure 4**. While daily SAS, IAS and UFA water level data are currently unavailable, PWR has compiled monthly water level measurements taken for the last 12 months for MW-3 and MW-4 and the last 4 months (period of record) for all three onsite SAS piezometers as shown in **Table 1** below.

Similarly to the collection of site-specific water quality data, a more comprehensive water level collection program and water level analysis will be completed as part of a comprehensive FDEP Solid Waste Facility application.

Table 1. SAS, IAS and UFA Water Level Elevation

MW-3 (PZ-3)		MW-4 (UFA)	
Record Date	WLE (NAVD 88)	Record Date	WLE (NAVD 88)
8/31/2011	48.025	8/31/2011	47.825
9/30/2011	47.925	9/30/2011	46.825
10/31/2011	48.425	10/31/2011	47.825
11/30/2011	48.125	11/30/2011	46.825
12/31/2011	50.125	12/31/2011	44.825
1/30/2012	45.425	1/30/2012	43.825
2/29/2012	41.625	2/29/2012	47.225
3/31/2012	43.325	3/31/2012	42.825
4/30/2012	48.125	4/30/2012	42.825
5/31/2012	44.625	5/31/2012	43.825
6/30/2012	47.525	6/30/2012	46.325
7/31/2012	48.225	7/31/2012	46.825
Median	**47.98**	**Median**	**46.58**

P-1 (SAS)		P-2 (SAS)		P-3 (SAS)	
Record Date	WLE (NAVD 88)	Record Date	WLE (NAVD 88)	Record Date	WLE (NAVD 88)
4/26/2012	53.88	4/26/2012	53.07	4/26/2012	55.39
5/24/2012	53.92	5/24/2012	53.22	5/24/2012	55.46
7/2/2012	54.38	7/2/2012	54.11	7/2/2012	55.36
8/8/2012	54.23	8/8/2012	52.72	8/8/2012	54.68
Average	**54.10**	**Average**	**53.28**	**Average**	**55.22**

4.4 Assessment of Hydraulic Connection between Aquifers

The Cardno Report requested an assessment of recharge from the SAS to IAS as well as an assessment of the hydraulic connection between aquifer systems. The PHIR provided a detailed assessment and evaluation of the hydraulic connection between the SAS, IAS and UFA at both nearby Regional Observation Monitoring Program (ROMP) Sites 12 and 13, since site-specific water levels were not available. Hydrographs of water levels from SAS, IAS and UFA monitor wells were used to describe the upward and downward hydraulic gradients at both locations. In addition, the magnitude of head-differentials between the aquifer systems was used to provide documentation of substantial confinement between aquifer systems throughout the region. The PHIR described the project area as within a hydraulic gradient transition zone whereby UFA and IAS water level elevations are above land surface to the west of the project site (ROMP 12) and below land surface to the east of the project site (ROMP 13).

Additional discussion concerning the connection between aquifer systems has been provided in Section 2.0 and 3.0 above.

4.5 Quantify Aquifer Recharge between the SAS and the IAS

As presented in Section 3 above and as stated by the County's consultant, a hydrogeologic report authored by the United States Geological Survey (USGS), Torres, et al, 2001, indicates "**that generally there is little hydrogeologic connection between SAS and PZ-1 and PZ-2 of the IAS because of the presence of confining units**." In addition as presented in the information provided to the County, in the post-development condition the project will effectively be a zero discharge stormwater facility, with stormwater areas placed in direct contact with the surficial sediments, and is therefore not expected to decrease recharge potential to the upper IAS. These conditions may even increase recharge potential to the SAS.

4.6 Data on Average and Maximum High Groundwater Levels

As previously stated, long-term collection of daily water levels for the SAS, IAS and UFA have not been collected at the subject property. A complete assessment of average, minimum and maximum groundwater levels will be included in a comprehensive Solid Waste Facility application submitted to FDEP. However, ROMP 12 and ROMP 13 SAS, IAS and UFA water levels can provide substantial insight into the seasonality of groundwater levels on the subject property. Therefore, PWR has compiled the average, minimum and maximum SAS, Upper IAS, Lower IAS and UFA water levels for each year from 2001 to 2011 which is provided in **Table 2** below.

Table 2. ROMP 12 and 13 Water Level Summary (January 2001 to April 2012)

Value	UFA	Lower IAS/ Shallow UFA	Upper IAS	Surficial Aquifer
ROMP 12 - Prairie Creek				
Median (Feet NAVD 88)	45.23	45.46	45.48	33.89
Minimum (Feet NAVD 88)	35.48	37.75	38.24	31.94
Maximum (Feet NAVD 88)	48.21	48.12	48.34	40.06
ROMP 13 - Tippen Bay				
Median (Feet NAVD 88)	45.03	45.77	45.81	55.89
Minimum (Feet NAVD 88)	35.88	32.65	36.45	51.92
Maximum (Feet NAVD 88)	48.74	49.01	49.05	59.63

4.7 Discussion of Site Foundation Suitability

PWR's information previously submitted to the County included Standard Penetration Test (SPT) borings and a detailed description of the very low probability for sinkhole development. As shown in the SPT geologic logs, no sequences of mucky soils or previously filled areas were observed. In addition, a full assessment and evaluation of the engineering properties of the site, including a foundation analysis, that includes a determination of foundation bearing capacity, subgrade settlement and stability is required as part of a comprehensive Solid Waste Facility application to be submitted to the FDEP.

4.8 Address Source of Potable Water

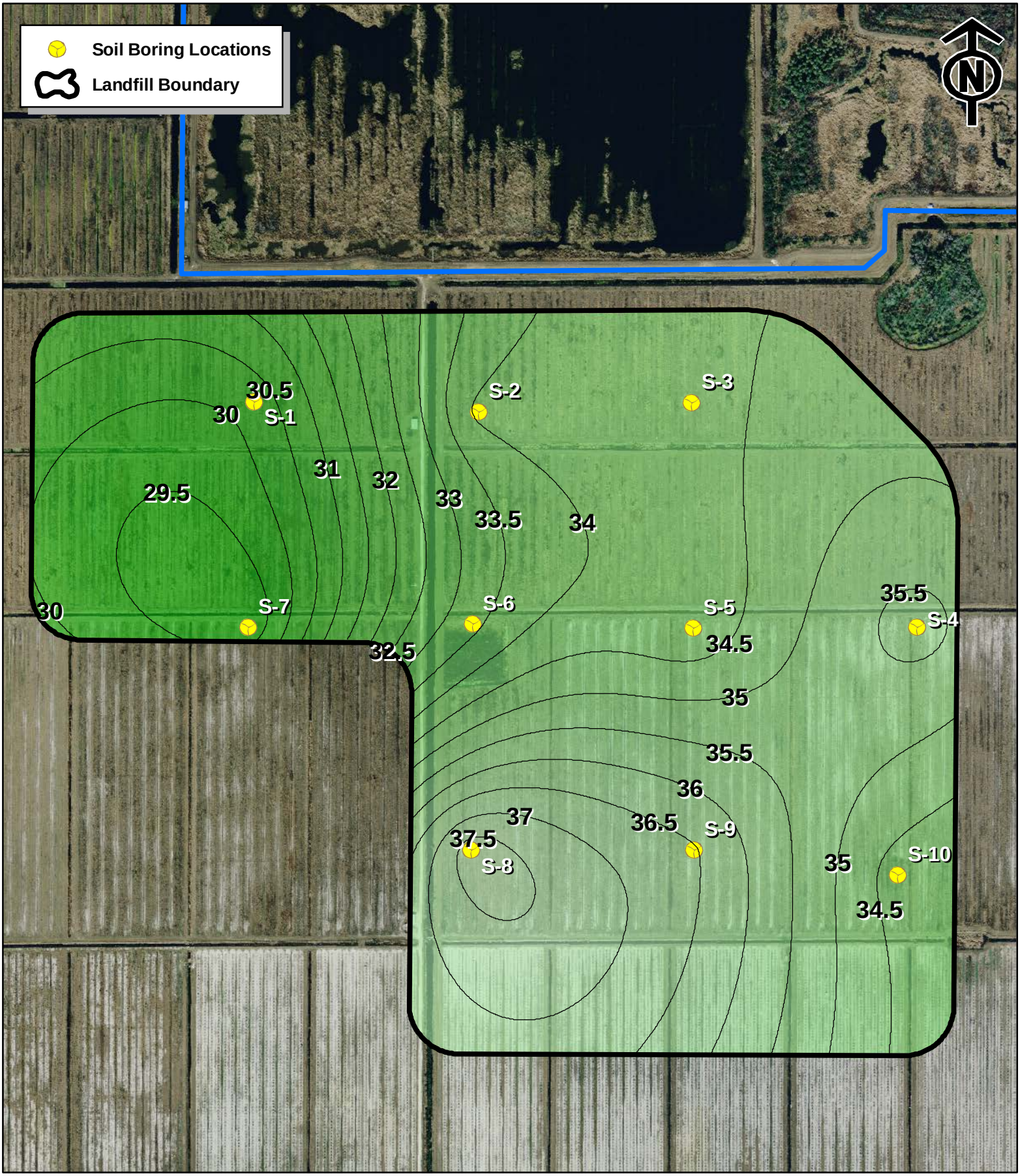
The Cardno Report requested additional information regarding the planned source of potable water for the project. Most likely, a small diameter well will be constructed on-site to supply personal and sanitary water demands. Drinking water may be provided using bottled water, delivered to the site.

4.9 Address Disposition of On-Site Irrigation Wells

The Cardno Report requested additional information on the disposition and potential use of any existing irrigation wells on the subject property. All existing irrigation wells within the project's boundaries will by properly abandoned (plugged top to bottom) by a licensed water well contractor in accordance with South Florida Water Management District (SFWMD) Rule 40E-3.531, Florida Administrative Code.

5.0 Summary

Notwithstanding the favorable subsurface characteristics of the site based on the analysis performed to date, the facility is proposed to be highly-engineered and underlain by a flexible membrane (geomembrane) and be operated and monitored to ensure compliance with all state and federal regulations. Furthermore, water quality will be closely monitored to ensure resource protection. All of these elements, in conjunction with the information provided above, collectively address the analysis required under Section 1-12-109 and the Comprehensive Plan Future Land Use (FLU) polices regarding groundwater protection and recharge, including FLU Policies 2.3.4, 2.3.6, and 2.3.8.



Scale: 1:6,000 08/17/2012 Image: 2011 SWFWMD Aerial

0 250 500 1,000 Feet

Progressive Water Resources has provided the images or data presented in this map for informational purposes only. This data is not intended to be used in lieu of official survey data provided by a Professional Surveyor licensed by the State of Florida

Figure 1
Calusa Green Facility
Elevation of Uppermost Confining Unit (Feet NAVD 88)

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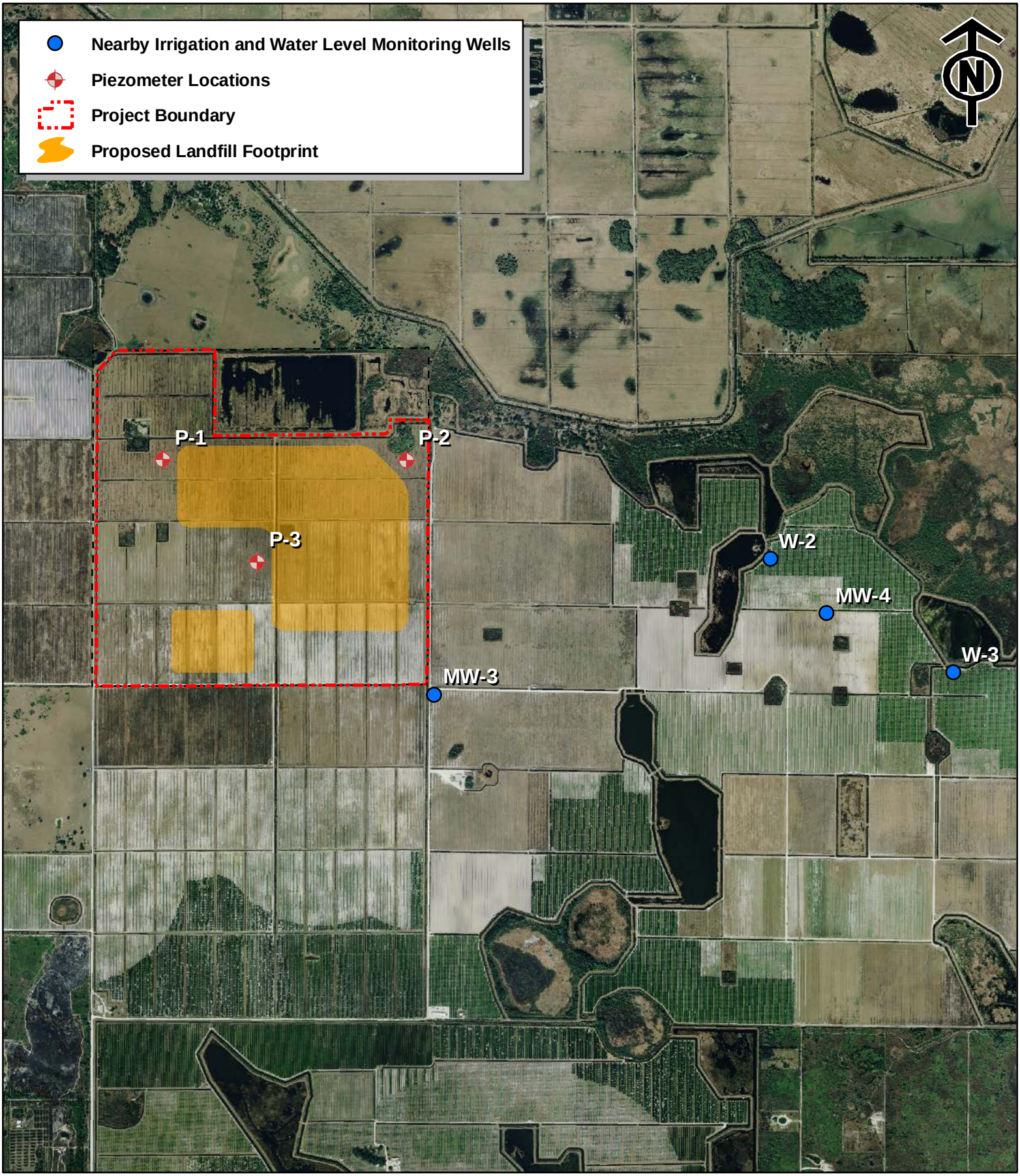

Scale: 1:24,000 08/16/2012 Image: 2011 SWFWMD Aerial

0 500 1,000 2,000 3,000 Feet

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Figure 2
Calusa Green Facility
Additional Hydrogeologic Data Locations

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Figure 3

Shallow Hydrogeologic Cross-Section

Calusa Green Soil Borings S-4, S-5, S-6 and S-7

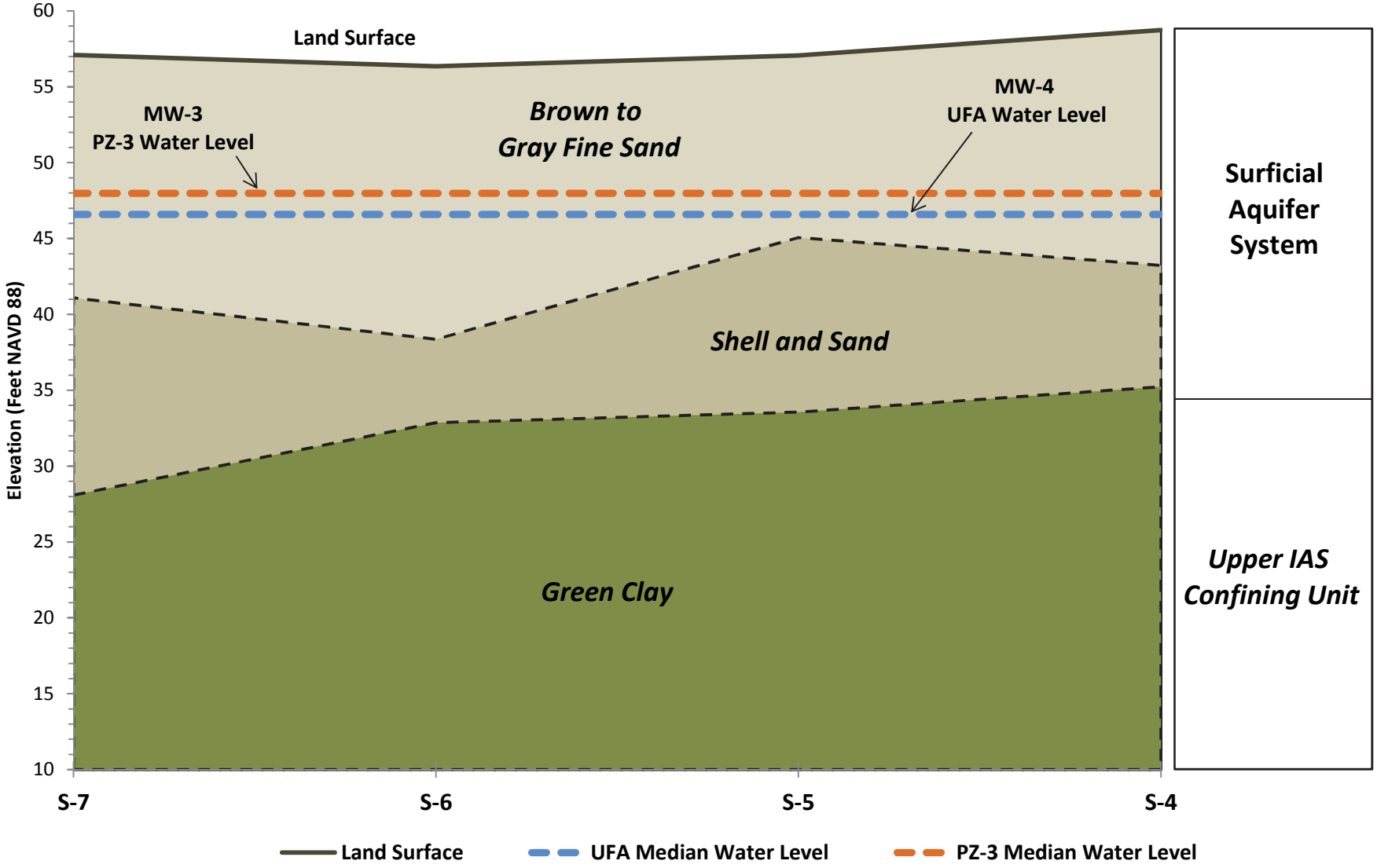

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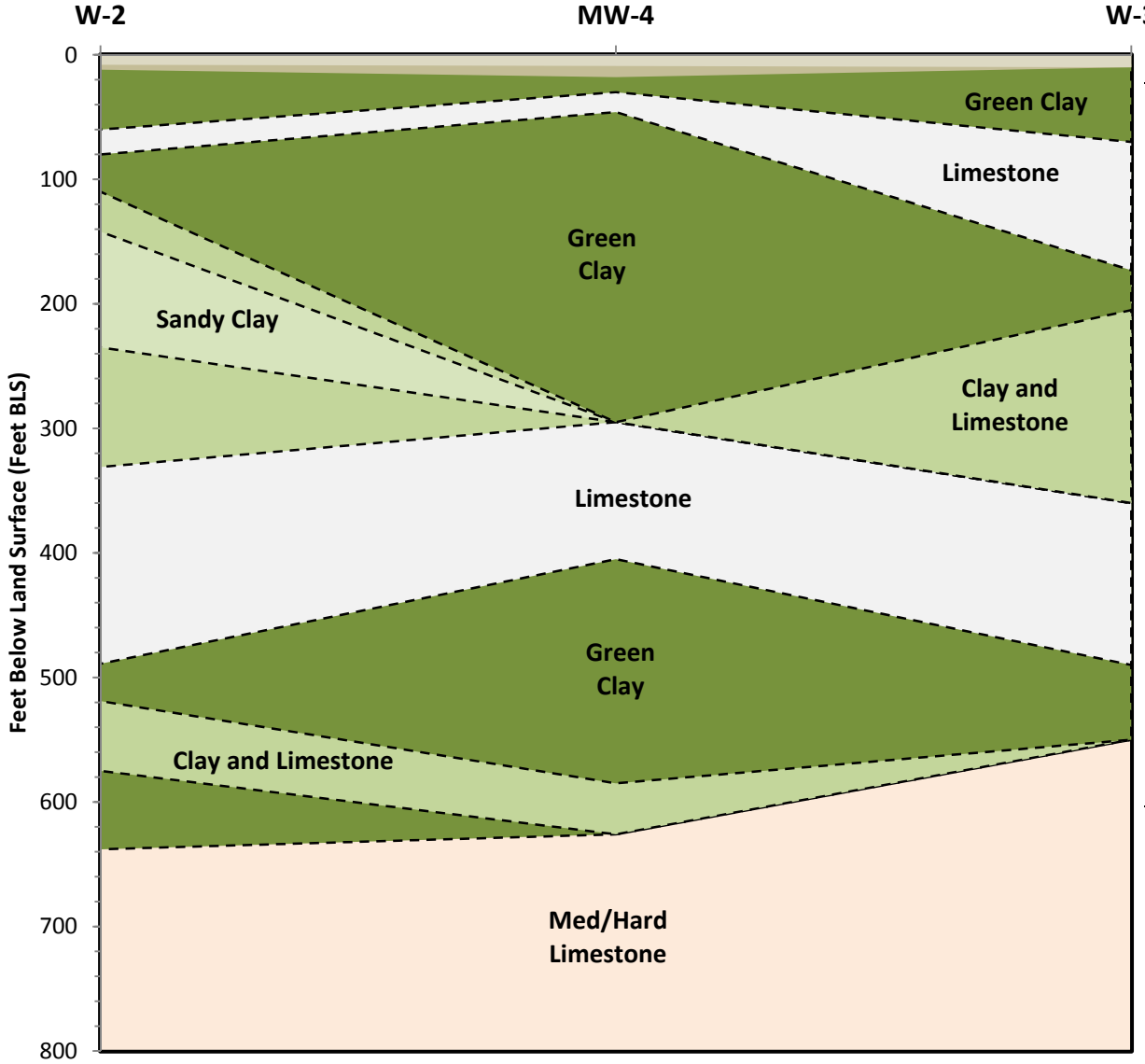
Figure 4

Deep Hydrogeologic Cross-Section

Nearby Irrigation and Water Level Monitors W-2, MW-4 and W-3



SAS	Quartz Sand and Shell Beds
Upper IAS CU	Green Clay with some Sand
IAS PZ-2	Limestone and Dolostone, Sandy Clayey, Phosphatic
Middle IAS Confining Unit	Predominantly Sandy, Clayey Dolostone and Limestone Interbedded with Sandy, Phosphatic, Dolomitic Clays
IAS PZ-3	Interbedded Light Gray Limestone and Dolostone
Lower IAS Confining Unit	Interbedded Quartz, Limestone and Phosphatic Clay
Upper Floridan Aquifer	Limestone, Very Light Orange to Yellowish Gray, Fossiliferous

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