

Evaluation of Deep Geologic Units in Florida for Potential Use in Carbon Dioxide
Sequestration

by

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Dedication

I dedicate this dissertation to my husband, Brandon, and to my two beautiful daughters, Adalaide and Abelina.

Brandon, you have always been my Number One Fan, and have never ceased to believe in me and my capabilities. You always see things in me that I just never see. When I was exhausted and lacking motivation, you were always there to encourage me and remind me why I was taking this journey. You are my rock, and I love you “for always.”

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Abstract

Concerns about elevated atmospheric carbon dioxide (CO₂) and the effect on global climate have created proposals for the reduction of carbon emissions from large stationary sources, such as power plants. Carbon dioxide capture and sequestration (CCS) in deep geologic units is being considered by Florida electric-utilities. Carbon dioxide-enhanced oil recovery (CO₂-EOR) is a form of CCS that could offset some of the costs associated with geologic sequestration. Two potential reservoirs for geologic sequestration were evaluated in south-central and southern Florida: the Paleocene Cedar Keys Formation/Upper Cretaceous Lawson Formation (CKLIZ) and the Lower Cretaceous Sunniland Formation along the Sunniland Trend (Trend). The Trend is a slightly arcuate band in southwest Florida that is about 233 kilometers long and 32 kilometers wide, and contains oil plays within the Sunniland Formation at depths starting around 3,414 meters below land surface, which are confined to mound-like structures made of coarse fossil fragments, mostly rudistids. The Trend commercial oil fields of the South Florida Basin have an average porosity of 16% within the oil-producing Sunniland Formation, and collectively have an estimated storage capacity of around 26 million tons of CO₂. The Sunniland Formation throughout the entire Trend has an average porosity of 14% and an estimated storage capacity of about 1.2 billion tons of CO₂ (BtCO₂). The CKLIZ has an average porosity of 23% and an estimated storage capacity of approximately 79 BtCO₂. Porous intervals within the CKLIZ and Sunniland Formation are laterally homogeneous, and low-permeability layers throughout the units provide

significant vertical heterogeneity. The CKLIZ and Sunniland Formation are considered potentially suitable for CCS operations because of their geographic locations, appropriate depths, high porosities, estimated storage capacities, and potentially-effective seals. The Trend oil fields are suitable for CO₂-EOR in the Sunniland Formation due to appropriate injected-CO₂ density, uniform intergranular porosity, suitable API density of formation-oil, sufficient production zones, and adequate remaining oil-in-place following secondary recovery. In addition to these in-depth investigations of the CKLIZ and Sunniland Formation, a more-cursory assessment of deep geologic units throughout the state of Florida, which includes rocks of Paleocene and Upper Cretaceous age through to rocks of Ordovician age, shows additional units in Florida that may be suitable for CO₂-EOR and CCS operations. Furthermore, this study shows that deep geologic units throughout Florida potentially have the capacity to sequester billions of tons of CO₂ for hundreds of fossil-fuel-fired power plants. Geologic sequestration has not yet been conducted in Florida, and its implementation could prove useful to Florida utility companies, as well as to other energy-utilities in the southeastern United States.

Chapter 1: Carbon Dioxide Capture and Sequestration in Deep Geologic Units

1.1 Introduction

Carbon dioxide (CO₂) is the second biggest contributor to greenhouse gases (GHGs), with an average contribution of 9-26 percent (%) of the total amount of GHGs in the atmosphere (Kiehl & Trenberth, 1997). The atmospheric concentration of CO₂ has risen from the pre-industrial level of 280 parts per million (ppm), mostly attributed to weathering of continental rocks and to photosynthesis, to the current, post-industrial level of over 370 ppm, with the increase mostly attributed to the combustion of fossil fuels for energy and heat production, as well as to deforestation (Lawrence Berkeley National Laboratory, 2007). Fossil fuels provide ~85% of the energy used worldwide, and the combustion of this resource for energy production is responsible for ~75% of anthropogenic CO₂ emissions (Haszeldine, 2009; Metz et al., 2005). The International Energy Agency (IEA) projects that CO₂ emissions resulting from energy production will increase by 130% by 2050 in the absence of new policies and constraints regarding fossil fuel usage and associated CO₂ emissions in the energy sector (IEA, 2009).

In May of 2009, H.R. 2454, also known as the American Clean Energy and Security Act (ACESA) of 2009, was introduced, and subsequently passed the House of Representatives in June of 2009. The ACESA includes, among other things, a cap-and-trade global warming reduction plan designed to reduce GHG emissions annually, so that GHG emissions from capped sources are reduced to 97% of 2005 levels by 2012,

83% by 2020, 58% by 2030, and 17% by 2050. Under Subtitle B – Carbon Capture and Sequestration of the ACESA of 2009, the Clean Air Act (CAA) and Safe Drinking Water Act (SDWA) are amended to create a role for GS and establish a permitting and regulatory system for its implementation on a large, commercial scale. In addition to providing funding for the research and development of CCS in the US, the ACESA also provides incentives to support the deployment of CCS in the electric-power and industrial industries. The ACESA also amends the CAA to include that any new coal-fired power plants permitted in 2020 or thereafter be required to adhere to specific performance standards, and plants permitted from 2009-2020 be required to meet the initial standards after certain technology criteria were met, but no later than 2025.

The latest action on the ACESA occurred in July 2009, when the bill was passed to the Senate, and the act continues to await approval/disapproval. Nevertheless, although the ACESA of 2009 is stagnant and remains to be enacted, the Federal government's interest in CO₂ emissions persists and is evident through actions by the United States (US) Environmental Protection Agency (EPA), which continues to pursue new, and enforce current, limitations and restrictions to GHG emissions through the CAA (Broder, 2010). The CAA was first introduced in 1970, and has been designed and amended to define the EPA's responsibilities in protecting and improving air quality, as well as the stratospheric ozone layer, for the US. Through the CAA, the EPA has been able to implement programs to reduce GHG and toxic, industrial emissions, such as certain energy-saving vehicle and alternative-fuel programs, and monitoring networks for industrial toxic-air-pollution, and has recently fined entities that have not followed established GHG-emission restrictions, such as BP (EPA, 2010a; The Spokesman-Review, 2010).

Locally, in July of 2007, Florida's Governor, Charlie Crist, issued Executive Order (EO) 07-127, which requires the reduction of CO₂ emissions in Florida as early as 2017. Under this EO, by 2017, CO₂ emissions must be reduced to 2000 CO₂ levels, to 1990 CO₂-emission levels by 2025, and be no more than 80% of 1990 CO₂-emission levels by 2050. As the bulk of Florida's electric-power generation comes from the combustion of fossil fuels, Florida's electric-power utilities will bear the largest burden in meeting the reductions required by EO 07-127 and any Federal cap-and-trade or carbon-tax program.

In order to reduce the dependence on fossil fuels and the associated CO₂ emissions, a number of alternative energy sources are being considered for use in Florida, and some are slowly being implemented; however, the ability of these alternative energy sources to fully replace fossil-fuel-fired power plants cannot be achieved for several more decades. Specifically, due to factors such as time involved in nuclear-power plant design and construction, strict regulatory requirements, community opposition, and associated costs, lead times for incorporating nuclear power on-line can be quite lengthy. Solar-power generation is becoming increasingly popular in Florida, and electric-power utility companies are either purchasing energy from large-scale solar-energy facilities, or are building solar-energy facilities of their own. For instance, Tampa Electric Company (TECO) recently signed a 25-year contract to purchase energy from one of the largest solar-energy facilities in the country, located in Polk County, to be completed in 2011, which will generate approximately 50,000 megawatt hours of electricity per year and provide service to more than 3,400 homes, thereby preventing the release of 1.45 million tons of CO₂ (MtCO₂) during a 25-year period (Ray, 2009). However, due to issues involving solar-energy storability, grid incorporation, and associated costs, solar-energy technology is not yet sufficiently developed to operate on

a large scale and be effectively incorporated into a 'smart' grid system; it could take a number of decades before such a goal is achieved. Similarly, Florida electric-power utility companies are implementing the use of wind-energy; however, due to issues such as low wind-energy density, offline storage, grid incorporation, and associated costs, the technology cannot be economically implemented on a large scale and be incorporated into a 'smart' grid system.

There are various options for mitigating climate change resulting from GHG contributions, including improving energy efficiency, switching to less carbon-emitting fossil fuels, and increasing the use of low- and near-zero-carbon energy sources; however, until alternative energy sources are improved and able to sustain current energy demands and the use of fossil fuels for energy supply is diminished, CO₂ capture and sequestration (CCS) has been proposed as a feasible technique to capture CO₂ emissions from fossil-fuel fired power plants on a massive scale and subsequently reduce anthropogenic GHG contributions. The use of CCS technologies has the potential of lowering future world CO₂ emissions from energy use by 20%, and is considered an interim option for the reduction of CO₂ emissions to provide for a 50-year transition away from fossil fuels (Haszeldine, 2009).

1.1.1 On-Going Carbon Dioxide Sequestration Research

1.1.1.1 Global Research

Numerous methods for sequestering CO₂ have been proposed and are currently being investigated around the world. These methods include terrestrial sequestration (TS), oceanic sequestration (OS), mineral sequestration (MS), industrial utilization (IU), and geologic sequestration (GS).

Terrestrial Sequestration

Terrestrial sequestration involves the sequestering of CO₂ via photosynthetic fixation in plants and soils. Storage capacities for TS are small, and are particularly limited by population growth and agricultural land use, which prevents the optimum implementation of this sequestration technique by reforestation and changes to land and soil management practices (Bachu, 2008).

Oceanic Sequestration

Oceanic sequestration involves deep oceanic-injection of CO₂ that will either dissolve, form hydrates, or form plumes heavier than ocean water, thereby sinking to the ocean bottom (Bachu, 2008). This process has always occurred naturally, and the idea behind OS is to increase its rate of occurrence. Oceanic sequestration has the ability to store enormous amounts of CO₂ (i.e., several MtCO₂ per year); however, this sequestration technology has numerous issues that prevent its implementation at this time, including poorly understood physical and chemical processes, storage efficiency, transportation and cost, technical feasibility, and environmental impacts (Bachu, 2008). Several bench-scale studies involving OS have been conducted in the laboratory; however, no scientific studies have been conducted in the field (Lackner, 2003). Laboratory studies have shown that marine organisms that live near the surface of ocean waters would be adversely impacted by OS within several months of its commencement, due to a decrease in ocean-water pH and to conditions such as hypercapnia, a form of metabolic suppression from too much CO₂ in the bloodstream, and that the OS process could greatly affect the productivity of marine ecosystems (Bachu, 2008; Barry et al., 2003; Lackner, 2003; Metz, et al., 2005). Therefore, further studies must be conducted before such a CCS technique could ever be implemented with little to no adverse impacts. In addition, legal, political, and international limitations

would almost certainly arise due to ocean circulation and currents.

Mineral Sequestration

Mineral sequestration involves storing CO₂ in solid, inorganic carbonate minerals, much like the natural carbonate-mineralization process. The MS technique is not widely accepted due to factors such as: its dependence upon specific minerals, such as olivine and serpentine (which will subsequently form magnesium-carbonates upon sequestration); its requirement for large-scale mining and subsequent adverse environmental effects; energy requirements for heating, and processes such as mineral crushing and milling; and its need for transportation and storage of the newly created inorganic carbonate minerals (Bachu, 2008; Gerdemann et al., 2003).

Industrial Utilization

Industrial utilization of CO₂ involves its storage in the “carbon chemical pool” and its use in biological and chemical processes as a reactant, or feedstock for carbon-containing chemicals. The IU of CO₂ ‘stores’ approximately 120 MtCO₂ per year, and examples include its use in urea, which is subsequently used in the manufacturing of fertilizer, and menthanol production, or in more direct applications such as refrigeration (via dry ice), food-packaging, welding, carbonated-beverages, fire extinguishers, and in the horticulture industry (Metz et al., 2005). The IU of CO₂ cannot have a significant impact on CO₂ emissions and consequent climate change mitigation unless the quantity and storage time of CO₂ are significant; however, long-term storage of CO₂ is about 1 MtCO₂ per year at this time for industrial processes before it is re-emitted into the atmosphere. The short storage-time-duration of the IU of CO₂ in conjunction with the fact that only 120 MtCO₂ are stored per year indicate that this means of CO₂ sequestration has a minimal effect on net CO₂ emissions. In addition, some types of

industrial uses of CO₂ can result in an increase, rather than a decrease, in net CO₂ emissions (Metz et al., 2005).

Geologic Sequestration

Geologic sequestration involves the injection of CO₂ deep into the subsurface, typically into sedimentary basins, and into geologic media that have suitable characteristics required for storing CO₂ for millennia. Geologic sequestration has already been shown to be a successful option for CCS, and has been shown to have enough storage capacity worldwide to have a significant impact on GHG emissions; therefore, it is currently the most widely accepted CCS technique.

Each of these approaches offers unique advantages to identifying reservoirs for sequestered carbon, which is important in offsetting the transition to more carbon-neutral power and transportation; however, of these approaches, only OS and GS have the ability to store large amounts of CO₂ (i.e. MtCO₂ per year) for millennia, generated annually by fossil-fuel-fired power plants, and thus have a significant effect on GHG emissions and associated climate change, as shown in Figure 1-1. Considering the many issues still associated with OS and the inability to implement such a technique at this time, GS is currently the most prominent sequestration technique for large-scale storage of CO₂.

With the continued use of fossil fuels for electric-power generation over the next several decades and the obligation to meet the mandates of EO 07-127, as well as any federal cap-and-trade, carbon-tax, or newly proposed CO₂-emission regulations that may be enacted, CCS in deep geologic units will almost certainly be required for Florida electric-power utility companies.

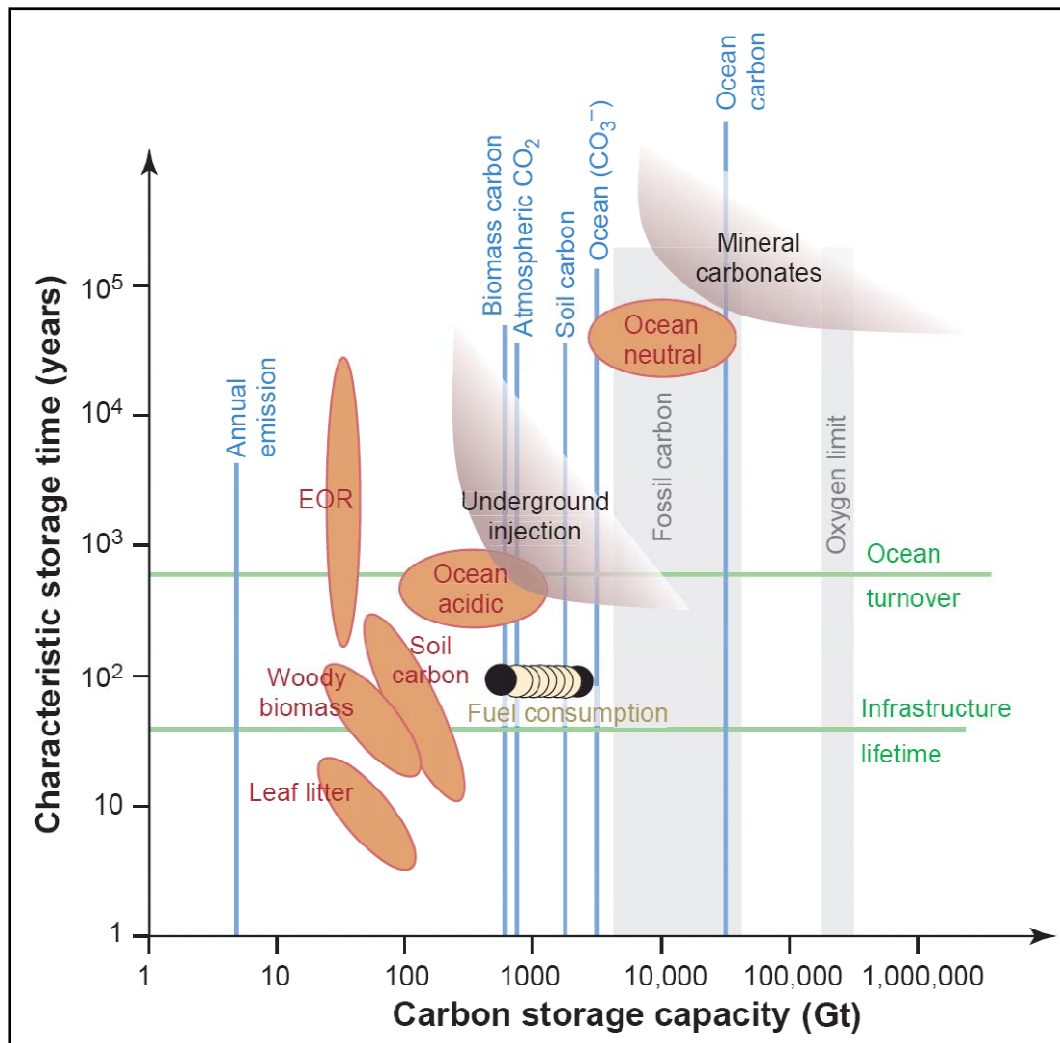


Figure 1-1: Estimated storage capacities and storage times for different CO₂ sequestration methods (from: Lackner, 2003).

1.1.1.2 Local Research

Currently, there are four major types of CCS being investigated by a multi-Florida-university team known as the Florida Energy Systems Consortium. These types of CCS include GS, biomass-based sequestration, biochemical sequestration, and chemical sequestration. Geological sequestration by CO₂ injection into saline carbonate aquifers is being developed and tested by the University of South Florida in collaboration with other schools and the Los Alamos National Laboratory. Biomass-based, or biochemical, sequestration is a type of TS that is being explored at the University of Florida (UF) using trees and other Florida crops, selected for high-lignin content in their root systems, to increase the levels of CO₂ sequestered above and beneath the soil surface. Exploring the use of Florida land as a carbon sink has widespread support of the Florida agricultural industry, and research in this area is currently being funded by Arbogen (Summerville, South Carolina), a world leader in the development of highly productive varieties of trees for paper, construction, fuel, and other commercial uses. Biochemical sequestration is a novel approach built upon the known stability of lignin as a form of carbon storage. Innovative new research at UF focuses on purified lignin, a by-product of renewable fuel production, as a carbon sink. Purified lignin is further modified and polymerized with carbohydrate-based fermentation products to produce even more inert forms of carbon. Chemical sequestration by the reduction of human-related and natural methane sources and CO₂ to elemental carbon has been achieved by the Florida Solar Energy Center using a novel catalytic process that includes small amounts of solar-derived hydrogen. This research is being done in collaboration with Environmental Energy Systems, Inc. of Hialeah, Florida. Both the resulting elemental carbon and lignin-based polymers can be stored and transported at ambient

temperatures and pressures, and stored in geologic units or used as possible commercial products.

1.2 Background

The subsurface has been storing CO₂ naturally for millions of years in the earth's upper crust, in solid form as a component of carbonate minerals, as a liquid dissolved in formation fluid, or in a gaseous, fluid-like supercritical form. The anthropogenic injection of CO₂ originated in a Texas, US oil field in the 1970s during a tertiary oil recovery process called carbon dioxide-enhanced oil recovery (CO₂-EOR) (Metz et al., 2005), and has been implemented successfully worldwide ever since. The storage of anthropogenic CO₂ in geologic units was considered during this time, but was never extensively studied and accepted as a possible solution to GHG emissions until the 1990s, when the concept was strengthened by the release of several credible studies (Metz, et al., 2005). The Norway-company, Statoil, began the Sleipner Project in the North Sea in 1996, which was the first large-scale CCS project in the world. Several large-scale CCS operations have commenced since the Sleipner Project began, and intensive monitoring has shown that all have been operating without any significant signs of leakage (Metz et al., 2005).

Leaders at the 2009 G-8 Summit called for at least 20 CCS projects in geologic units worldwide by 2010, and in July of 2009, the US Secretary of Energy announced a new US-China Clean Energy Research Center that will house joint research in numerous 'clean energy' ventures, including CCS (G8 Factsheet, 2009; Chu, 2009). The US Department of Energy (DOE) is currently supporting preliminary research and development (R&D) projects, as well as small- and large-scale pilot projects, with the aspiration of establishing widespread commercial deployment of CCS throughout the country by 2017 to 2020.

The US EPA controls and regulates the construction, operation, permitting, and closure of wells that inject any fluid underground for storage or waste disposal via the Underground Injection Control (UIC) Program and the SDWA. Ultimately, the UIC Program and SDWA are meant to protect the current and future conditions of underground sources of drinking water (USDWs). Currently, there are five different types of UIC wells: Class I wells are used for industrial and municipal waste disposal hundreds to thousands of meters below the lowermost USDW; Class II wells are used by the oil and gas industries for enhanced oil and gas production via the injection of fluids, namely brine, into reservoirs; Class III wells are used by the mining industry to inject fluids meant to dissolve and extract certain minerals from geologic units; Class IV wells, which were banned from waste-disposal operation in 1984 by the EPA, are shallow wells that once injected radioactive or hazardous waste into or above a geologic unit that contains a USDW, but are currently only used as part of groundwater-cleanup actions; and Class V wells are shallow wells used to inject non-hazardous fluids into or above geologic units containing USDWs (EPA, 2010b).

Currently, CO₂-EOR projects in the US are regulated by the EPA under the SDWA as Class II UIC wells. All on-going GS experimental pilot projects are regulated under the SDWA as Class V UIC wells, and must adhere to the provisions outlined in the EPA's Class V Experimental Technology Well Guidance for Pilot Geologic Sequestration Projects, released in March of 2007; however, the EPA is in the process of enacting a new set of more-stringent regulations specifically for GS wells, which will soon be classified as Class VI UIC wells. Once the new Class VI UIC well regulations are released, CO₂-EOR wells will retain the Class II UIC well classification; however, if they are converted to strictly GS wells, they will be re-classified as Class VI UIC wells.

1.3 Processes in Geologic Sequestration

The use of CCS in deep geologic units by Florida electric-power utility companies would involve several steps: 1) capturing pure or nearly pure CO₂ from the flue gas or pre-combustion syngas at fossil-fuel-fired power plants, 2) compressing the CO₂ to ~100 atmospheres, or 74 bar, to form a supercritical (or dense, fluid-like) phase, 3) transporting the liquid CO₂ to an identified injection site, and 4) injecting the liquid CO₂ into the appropriate geologic unit via a vertical or horizontal injection well. When CO₂ is injected into the storage reservoir, it forms a plume around the injection well that displaces the formation fluid (both water and oil) vertically and horizontally within the injection sphere, and triggers the onset of various geochemical and physical processes that determine the trapping or mobility of CO₂.

During CO₂ injection, the pressure near the well increases, which displaces formation fluid and allows for CO₂ to occupy the pore spaces within the rock material. Injection rates will vary with each storage reservoir, and will directly affect the amount and spatial distribution of pressure buildup during injection, which is further dependent upon the permeability and thickness of the storage reservoir, the presence or absence of permeability barriers within the storage reservoir, and the geometry of the regional groundwater flow system (Metz et al., 2005). Once CO₂ is injected, the primary flow and transport mechanisms that determine the migration and expansion of the CO₂ plume are:

- fluid flow promoted by pressure differences created by the injection of CO₂;
- fluid flow created by natural hydraulic gradients;
- buoyancy effects as a result of differences in density between the CO₂ and the formation fluid;
- diffusion;

- dispersion and fingering due to heterogeneity within the storage reservoir and differences in mobility between the CO₂ and formation fluid;
- dissolution of CO₂ into formation fluid;
- mineralization;
- pore space trapping; and
- adsorption of CO₂ onto organic material (Metz et al., 2005).

Mobility Contrast

Because the viscosity of CO₂ in its supercritical phase is significantly less than water and oil, migration of the CO₂ plume is predominantly controlled by the mobility contrast between CO₂ and the formation fluid. The mobility of CO₂ is comparatively high; therefore, only a portion of the formation water and/or oil will be displaced following injection, resulting in an average saturation of CO₂ ranging from 30% to 60% (Metz et al., 2005). In addition, viscous fingering can occur due to heterogeneity and anisotropy, which may cause the CO₂ to bypass much of the pore space within the storage reservoir and subsequently migrate elsewhere, probably into the overlying strata.

Buoyancy

The vertical migration of the CO₂ plume due to the effects of buoyancy is dependent upon the difference in density between the CO₂ and formation fluids. In saline aquifers, a large density contrast exists between the saline formation water and CO₂; therefore, a strong buoyancy force drives the plume upward. In oil reservoirs, the density differences are not as large; therefore, the buoyancy effect is not as significant, especially where CO₂ is miscible with oil (Metz et al., 2005). Heterogeneity, specifically low-permeability layers, within the storage reservoir affects the shape and vertical migration of the buoyant CO₂ plume (Figure 1-2), and can significantly decrease the rate at which the plume migrates upward by forcing the plume to expand laterally, as well.

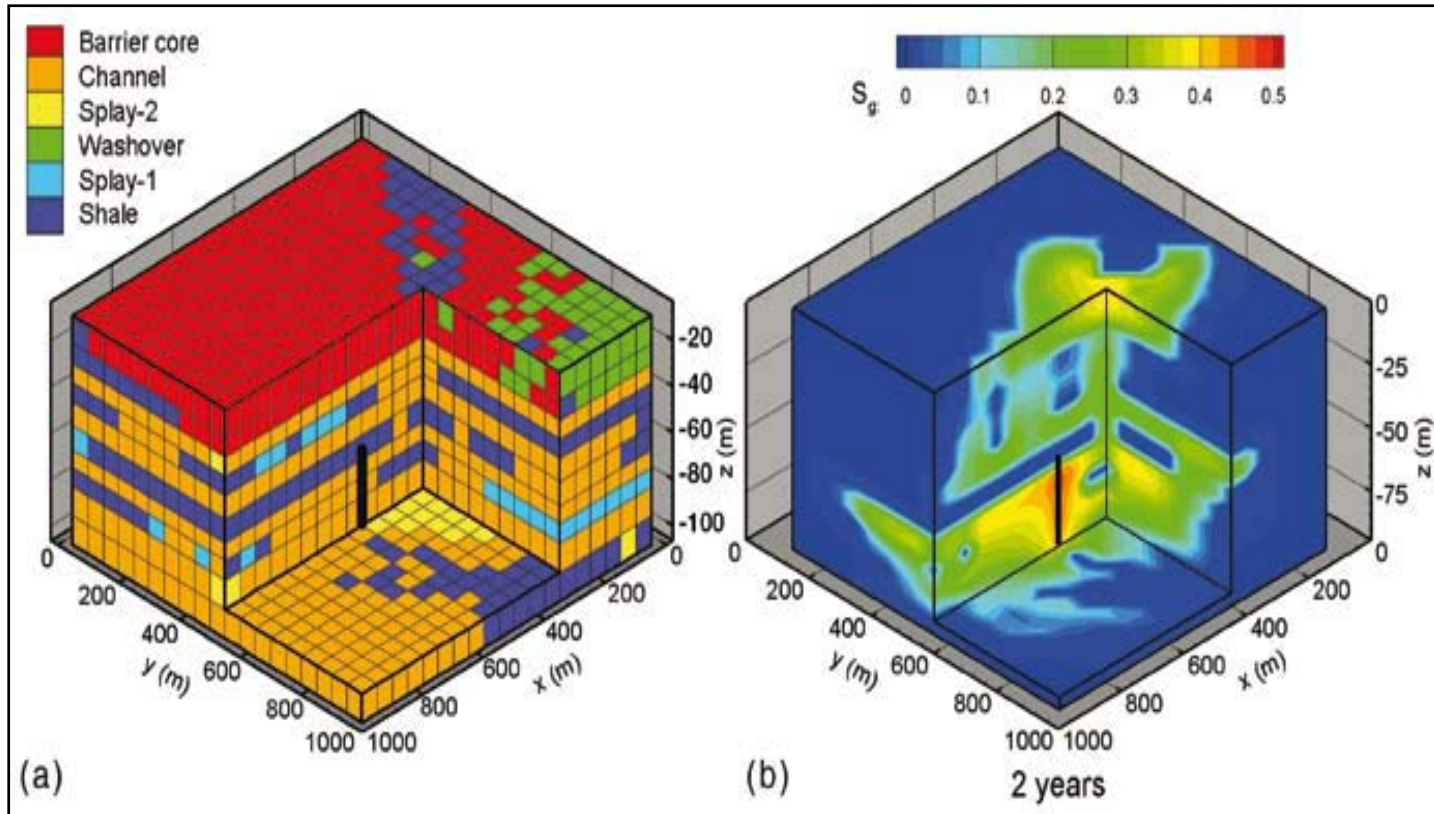


Figure 1-2: Examples of simulated distribution of a CO₂ plume in a heterogeneous geologic unit, with low-permeability layers throughout that inhibit the upward migration of injected-CO₂ and cause the plume to spread laterally, as well. (a) Facies grid-model for a heterogeneous unit. The location of the injection well is indicated by the thick, vertical line in the grid. (b) The CO₂-plume distribution after two years of injection, showing the influence (i.e., lateral expansion of the CO₂ plume) of the low-permeability layers (from: Metz et al., 2005).

Dissolution

For storage reservoirs containing flow systems, dissolution of CO₂ into the formation fluid (i.e., 'solubility trapping') begins to occur as the plume migrates following its injection. Reservoir-scale models have shown that in slowly flowing systems, CO₂ dissolution is significant (up to 30%) in relatively short periods of time (i.e., tens of years), whereas basin-scale models have shown complete dissolution of the CO₂ plume within centuries (Metz et al., 2005). For storage reservoirs with no flow systems, reduced contact with formation water causes much slower dissolution of CO₂.

The solubility of CO₂ in water increases with increasing pressure, decreasing temperature, and decreasing salinity (Figure 1-3; Bachu, 2000; Chang et al., 1998). In deep sedimentary basins with low-permeability and high-salinity geologic units, flow velocities for regional groundwater flow are comparatively low (i.e., millimeters to centimeters per year) (Bachu, 2000); therefore, the migration of CO₂ in dissolution is a much slower process than the migration of separate-phase CO₂. Formation waters saturated with CO₂ are slightly denser than unsaturated waters (by about 1-2%); therefore, if certain conditions allowing for the onset of free convection exist, the negative buoyancy of the CO₂-saturated water will drive the water to the bottom of the storage reservoir aquifer and eventually it will migrate down-dip in the aquifer (Bachu and Adams, 2003; Bachu, 2008; Metz et al., 2005). Furthermore, in storage reservoirs where free convection exists due to high vertical permeability, the replacement of the heavier, CO₂-saturated water with lighter unsaturated water produces faster rates of CO₂ dissolution (Metz et al., 2005).

Capillary Forces

Capillary forces can immobilize CO₂ as the plume migrates through the storage reservoir, storing the CO₂ in pore spaces within the geologic media in a process known

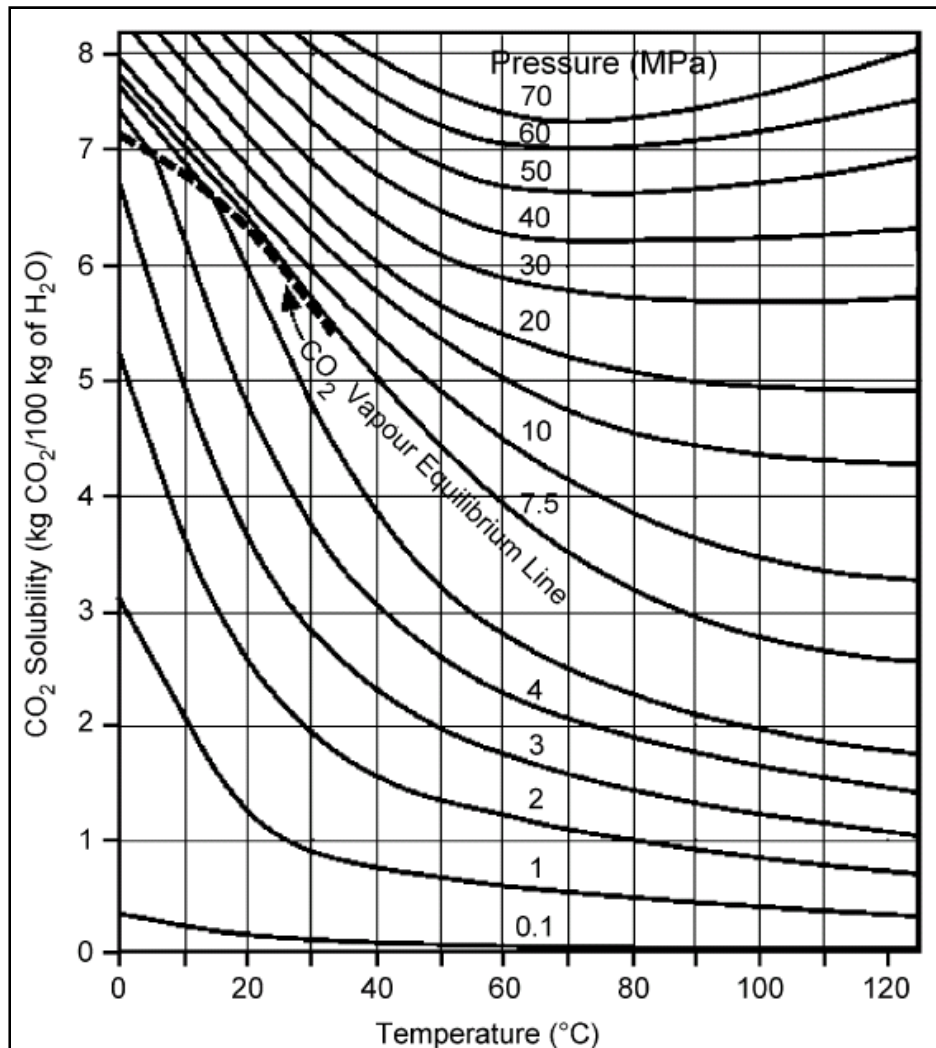


Figure 1-3: CO₂ solubility in water as a function of temperature and pressure (from: Bachu, 2008).

as 'residual trapping'. Residual trapping can play a significant role in the sequestering of CO₂, and studies have shown that this trapping mechanism can store nearly all of the injected CO₂ when the extent of trapping is high, which is unit- and lithologic-specific, and the injection occurs at the bottom of a thick storage reservoir (Metz et al., 2005). As shown in Figure 1-4, simulations for saline aquifers show that 50 years after CO₂ injection, a majority of the CO₂ plume is still mobile and driven upward by buoyancy forces; however, after 1,000 years, the flow driven by buoyancy has expanded the volume affected by CO₂, and a majority of the CO₂ is stored via residual CO₂ saturation or by dissolution into the formation water (Metz et al., 2005). Although these conditions are storage-reservoir-specific, studies have shown that for most geologic storage zones, residual trapping can account for 15-25% of the injected CO₂ (Doughty and Pruess, 2004). Each of the processes involved with CCS have been operating successfully globally and within the US for many years. The capture of CO₂ has been an on-going commercial process for high concentration, high-pressure CO₂ sources, and the transfer of CO₂ has been successfully conducted for approximately 30 years, as the US has several thousand miles of pipeline that transport CO₂ from industrial sites to injection sites nationwide (IEA, 2009). Globally, GS has been safely conducted on a large scale for over a decade. The success of CCS in geologic units is governed by:

- geographical relationship – The distance between the emission source (i.e., Florida power plant) and the subsurface storage reservoir and injection site is important because it influences the method by which CO₂ will be transferred to the injection well, as well as the cost of transportation. In some scenarios, an injection well can be installed at an emission-source site; thereby only requiring on-site storage and injection equipment and alleviating the need for transportation of CO₂ and associated costs. However, more commonly the

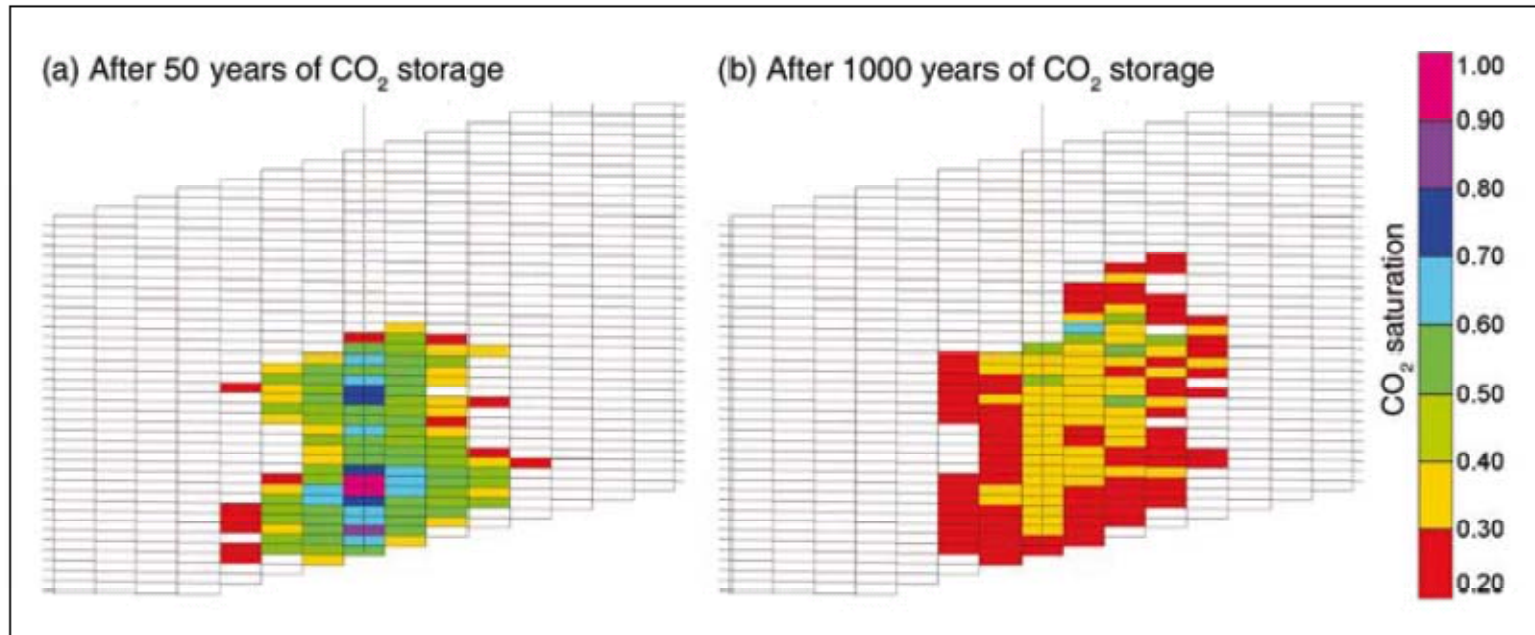


Figure 1-4: Simulation of CO₂ migration in a saline aquifer showing the effects of capillary forces: a) 50 years after injection, when most CO₂ is still mobile and driven upwards by buoyancy forces; and b) 1,000 years after injection, when buoyancy-driven flow has expanded the CO₂ plume and a significant amount of the injected CO₂ is trapped via residual trapping or dissolution in brine (not shown) (from Metz et al., 2005).

emission source is not on site, and CO₂ must be transported to the injection well. Means of transportation and distance between the injection site and emission source greatly affect the economic feasibility of a CCS project, as greater distances and more complex means of transportation can result in increased costs.

- infrastructure and transportation – Emission sources must have the infrastructure (i.e., retrofitted power plant or Integrated Gasification Combined Cycle [IGCC] plant) to properly capture and compress CO₂ prior to transport. The means of transportation of CO₂ to the injection site(s) (i.e., via road tanker, ship, or pipeline) must be suitable both topographically and economically.
- cost – The cost effectiveness and technical feasibility must be more competitive and suitable for a given emission source compared to other options for CO₂-emission reductions. In addition, adequate funding must be made available, typically through governmental, industrial, and/or institutional entities.
- geology – An ample assessment must be made of the geologic unit designated as the CO₂ storage reservoir, including porosity and permeability of the unit, effective seal(s), storage capacity, and geologic stability of the environment. Environmental concerns, such as leakage, must also be addressed appropriately.
- storage capacity and time – The volume of CO₂ that may be stored (i.e., on the order of several MtCO₂ per year) should be such that a relatively significant impact will be made on CO₂ emissions for a given source. In suitable storage reservoirs, storage time for geological units increases as post-injection time increases due to physical and geochemical process that create CO₂ trapping, such as structural and stratigraphic trapping, mineral trapping, residual-phase

trapping, and solubility trapping (Metz et al., 2005). These trapping mechanisms can store CO₂ for millennia, provided that stability of the geologic environment is not disrupted.

- injection-well operation – It is imperative that proper design, installation, operation, and maintenance of an injection well be practiced in order to ensure that the correct injection rate is used to avoid overpressurization, and to avoid potential CO₂ leakage during injection-well operation.
- monitoring – Intensive monitoring during injection-well operation is crucial to the success and safety of a CCS project. As CO₂ needs to be sequestered for millennia, leakage rates of less than 0.1% per year are necessary (Metz et al., 2005). Monitoring should be conducted to ensure safety to the public, environment, and to on-site workers; to identify and observe the injected-CO₂-plume in order to modify its migration and potential impacts to the local ecology and groundwater; and to estimate the impact and effectiveness of the CCS project on GHG emissions (Benson, 2005a). Properties observed during the monitoring process should include wellhead formation pressures; CO₂-injection rates; leakage from the injection well or nearby wells; leakage from the storage reservoir; and surface seepage from the ground and/or from nearby abandoned wells (Benson, 2005a). Different methods of geophysical monitoring can be conducted, including seismic, electrical, and electromagnetic geophysics; gravity monitoring; tilt measurements; airborne- or satellite-based land surface deformation; and micro-seismicity.

1.4 Storage Reservoir Selection

Site characterization involves geological, geophysical, and geomechanical assessments to determine the suitability and safety of a potential GS site. Choosing the

appropriate geologic unit, using the criteria discussed in Section 1.4.1 through Section 1.4.8 that follow, is probably the most critical component to a successful CCS project. Typically, sedimentary basins are considered the most suitable setting for CCS storage, and include existing and depleted oil fields, depleted gas fields, deep unmineable coal seams, and deep saline aquifers; however, caverns/cavities, basalts, and organic-rich shales are also potential options for storage (Figure 1-5; Metz et al., 2005). Existing and depleted oil fields, as well as saline carbonate aquifers, are the sequestration reservoirs being considered for CCS operations in Florida.

1.4.1 Storage Capacity

The geologic unit chosen for CO₂ storage must have sufficient porosity, permeability, and continuity, and be of significant thickness and extent to provide the appropriate storage capacity for CCS. The storage capacity must be large enough to have a significant effect on CO₂ emissions and be a cost-effective solution and technology. As mentioned earlier, existing/depleted oil fields and saline aquifers have been identified as potential storage reservoirs in Florida.

1.4.1.1 Existing and Depleted Oil Fields

The sequestration of CO₂ in existing and depleted oil reservoirs can be conducted via CO₂-EOR operations or, once the oil reservoir is depleted, strictly CCS operations. Global CO₂ storage capacities for oil reservoirs are estimated to be 126 to 400 gigatons of CO₂ (GtCO₂), including the potential in undiscovered oil reserves, while CO₂ storage capacities via CO₂-EOR operations alone are estimated to be approximately 61 to 123 GtCO₂, although modern CO₂-EOR technologies are unable to store CO₂ at the full capacity of a given field (Metz et al., 2005). The storage of CO₂ is assumed to occur in the pore spaces that previously contained oil.

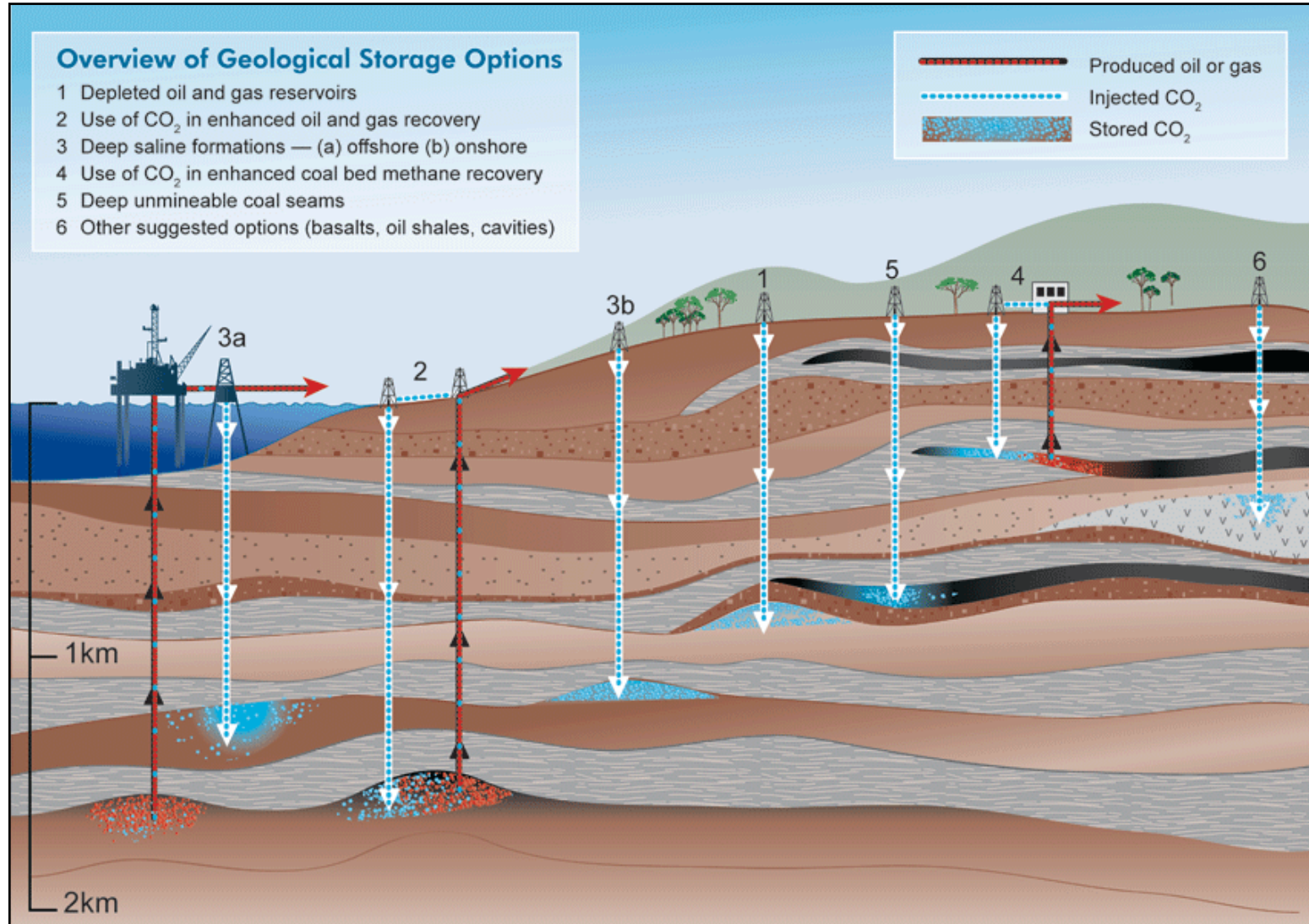


Figure 1-5: Geologic formations considered for CCS (from: Metz et al., 2005).

1.4.1.2 Deep Saline Aquifers

A deep saline aquifer is, “a deep underground rock formation composed of permeable materials and containing highly saline fluids” (Metz et al., 2005). These rock units are abundant worldwide, and can occur in relatively massive thicknesses and lateral extents. Nonetheless, estimating storage capacities for deep saline aquifers can be challenging for the following reasons:

- there are various ways in which CO₂ can be stored (i.e., various trapping mechanisms);
- each trapping mechanism functions on a unique time-scale and can occur simultaneously with another, so the estimation of storage capacity is affected by the time-frame of each trapping mechanism;
- the interactions between trapping mechanisms are complex, evolve over time, and are highly dependent upon local conditions;
- various methods for calculating storage capacity exist, and each method uses different variables which do not allow for comparison; and
- in many cases, there is limited geologic and geophysical data available, unlike that available for oil and gas reservoirs (Hassanzadeh et al., 2009; Metz et al., 2005).

According to the Intergovernmental Panel on Climate Change (IPCC) (2005), the global estimate of CO₂ storage capacity in deep saline aquifers is at least 1,000 GtCO₂; however, in many cases, limited data are available to accurately calculate storage capacity (e.g., unit-specific porosity values and total thickness and lateral extent of each deep saline aquifer) on a large scale, and so this estimate is considered to be conservative.

Unlike CO₂ sequestration in oil or gas reservoirs during CO₂-EOR operations, where CO₂ storage is essentially limited to the pore spaces within the producing-horizon of a petroleum reservoir, CO₂ storage in deep saline aquifers can be open to the pore spaces throughout an entire geologic unit.

1.4.2 Seal Characterization

The density of supercritical CO₂ is less than the density of saline fluids that occur in sedimentary basins identified as potential sites for GS; therefore, following injection into a geologic unit, due to the effects of buoyancy, CO₂ will be driven vertically. An extensive cover of low-permeability rock must overlie the CO₂ storage reservoir and provide an effective 'seal' to the vertical migration of injected-CO₂. Additionally, an effective seal should also slow the vertical migration of formation brines as a result of the increase in fluid-pressure created by CO₂ injection, which will propagate fairly rapidly throughout the formation fluid. The migration of increased pressure into units that overlie the CO₂-injection reservoir could cause the migration of saline waters into potable aquifers, or USDWs.

1.4.3 Structural Properties

Another important feature of a sequestration reservoir is the structural setting and associated features of the rock units that surround the reservoir geologic unit. Specifically, no faults or fractures should exist in the CO₂-storage-reservoir seals, unless such faults and fractures are adequately sealed.

1.4.4 Depth of Storage Reservoir

A CO₂ sequestration reservoir should be located at a depth which has hydrostatic pressures and temperatures exceeding the critical point for CO₂, as defined in Figure 1-6. Specifically, storage-reservoir pressure should be greater than approximately 74 bar

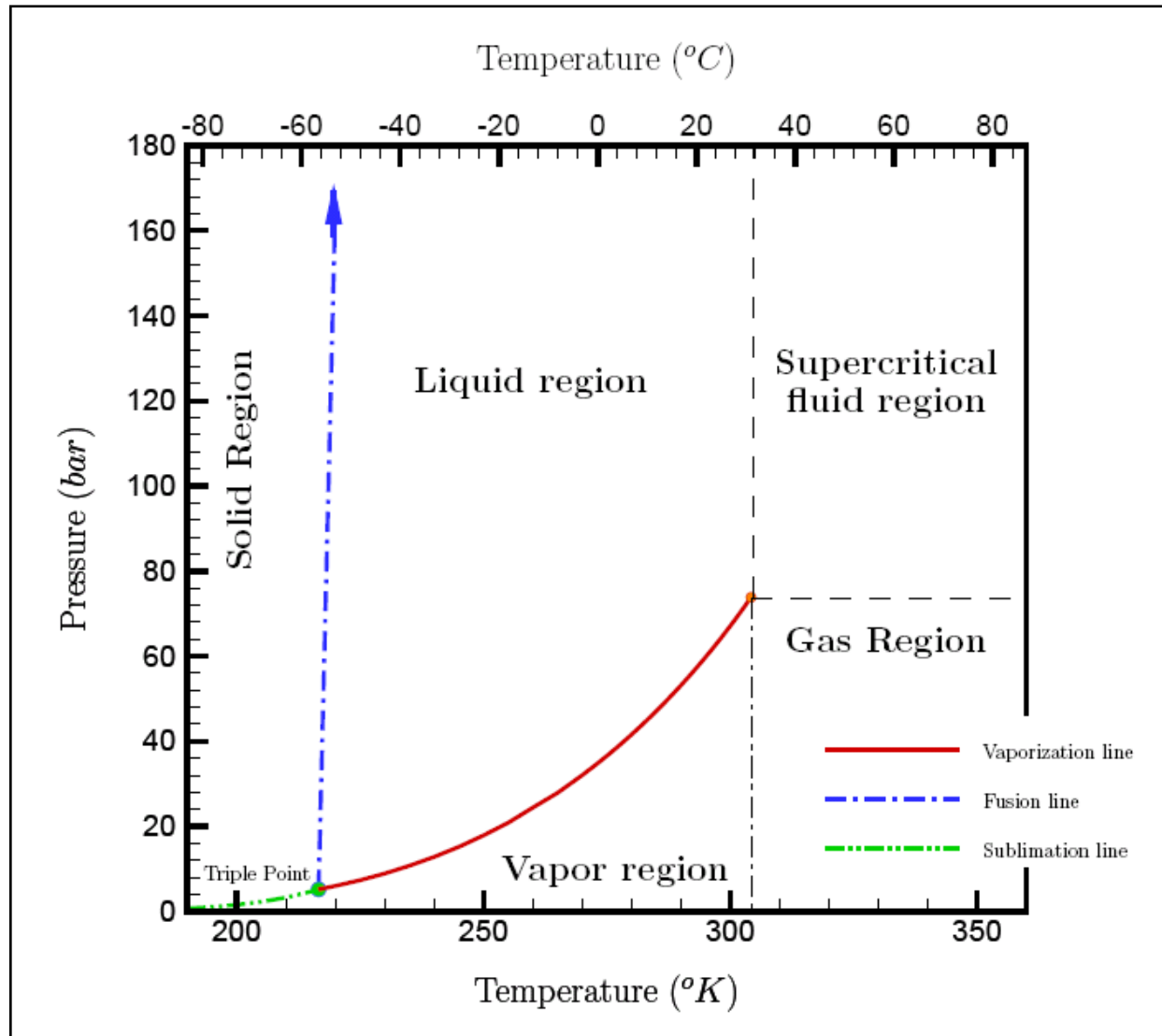


Figure 1-6: Pressure-temperature phase diagram for CO₂ (from: Garcia, 2003).

and temperatures should be greater than about 31 degrees (°) Celsius (C) in order for CO₂ to remain in supercritical phase (Garcia, 2003; Metz et al., 2005).

For relatively cold sedimentary basins such as Florida, storage reservoirs should be at least 914 meters (m) (3,000 feet [ft]) below land surface (bls) in order to meet the pressure and temperature requirements for supercritical CO₂. Furthermore, pressures that exist below 914 m (3,000 ft) bls in Florida also affect the density of CO₂. As displayed in Figure 1-7, increased pressures increase the density of CO₂, which consequently affects the degree of buoyancy between water and the injected-CO₂.

1.4.5 Trapping Mechanisms

Once CO₂ is injected into the pore space and fractures of a permeable geologic unit, several chemical and physical processes can occur, including: CO₂ can displace, dissolve in, or mix with the formation fluid; CO₂ can react with the minerals of the rock unit; or a combination of these processes can occur (Metz et al., 2005). The most effective storage sites have strong trapping mechanisms that immobilize injected CO₂ and aid in the sequestering process. Types of trapping mechanisms include structural and stratigraphic trapping, solubility trapping, hydrodynamic trapping, residual trapping, ionic trapping, and mineral trapping. Over time, many of these processes increase and further promote the storage capabilities of the sequestration reservoir, likewise further securing CO₂ storage (Figure 1-8; Benson, 2005b; Metz et al., 2005).

1.4.5.1 Structural and Stratigraphic Trapping

Structural and stratigraphic trapping include buoyancy trapping within anticlines, folds, fault blocks, and pinch-outs, as well as trapping by layers of low permeability (or caprock), all of which act as barriers to CO₂ migration. As depicted in Figure 1-8, structural and stratigraphic trapping is responsible for most of the trapping immediately following the injection of CO₂. Not only does the major caprock or seal to the storage

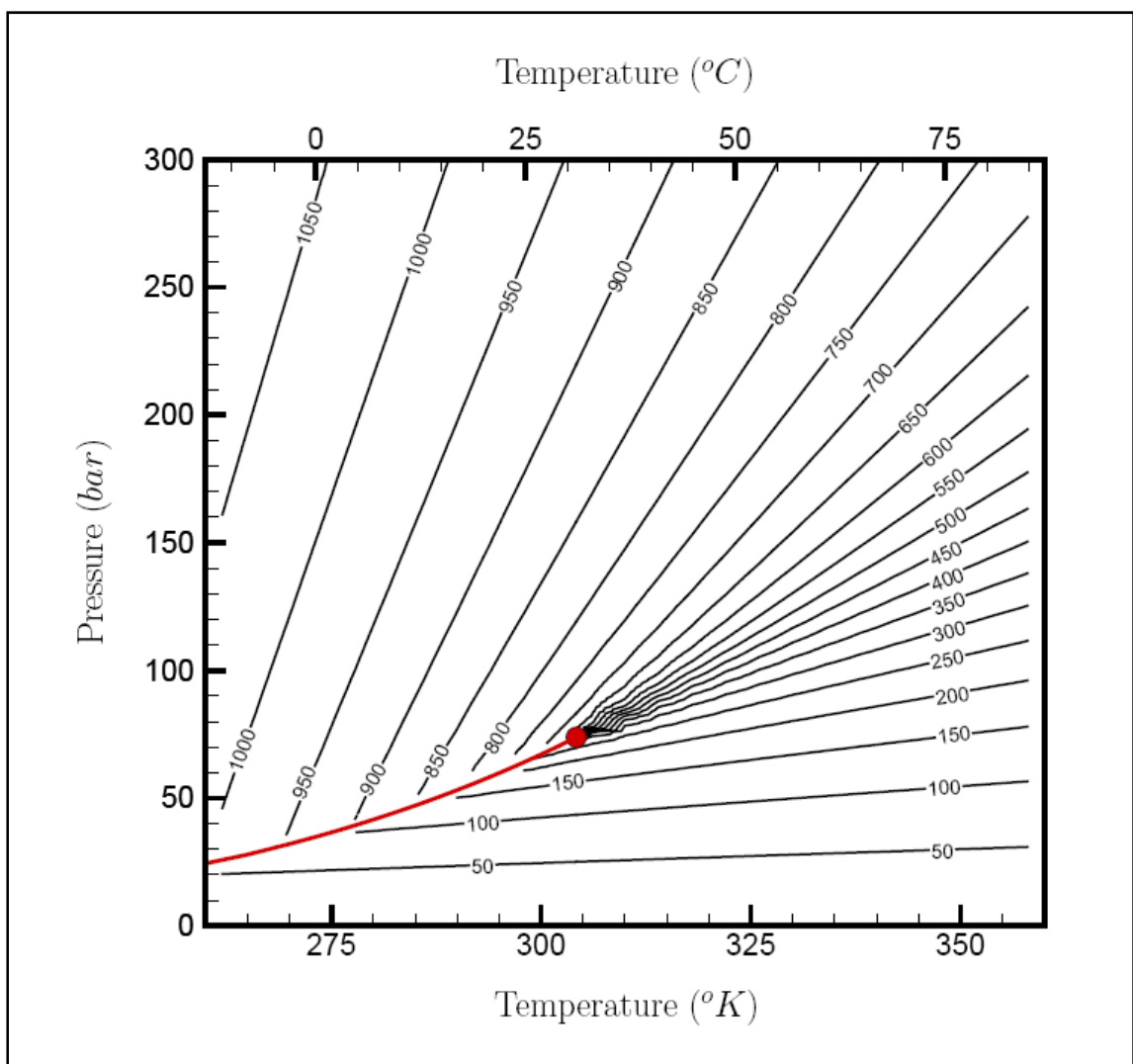


Figure 1-7: Calculated CO₂ density as a function of pressure and temperature (from: Garcia, 2003).

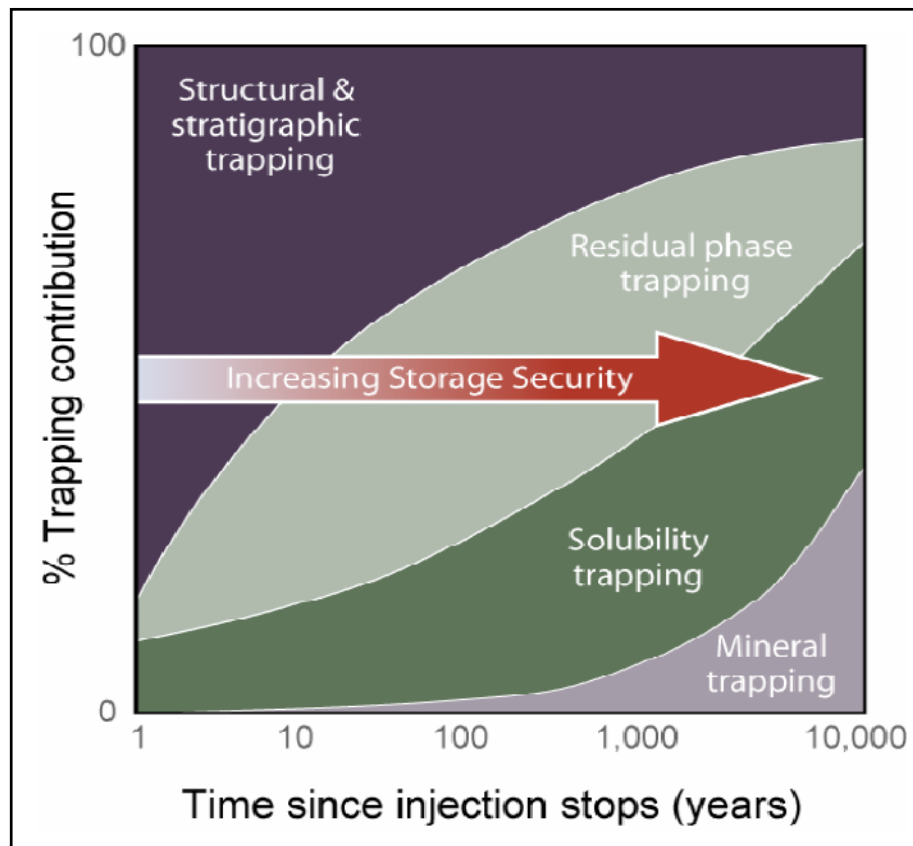
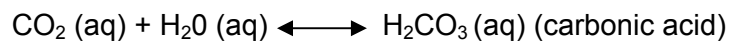


Figure 1-8: Storage security over time due to physical and geochemical processes (from Benson, 2005a).

reservoir serve as a stratigraphic trap, but low-permeability layers within the storage reservoir provide stratigraphic trapping as well, and force the lateral movement of the CO₂ plume, where it would otherwise move vertically due to its buoyancy, causing the CO₂ to fill any structural trap that it may encounter (Metz et al., 2005). The occurrence of structural or stratigraphic trapping is dependent upon the tectonic and depositional history and evolution of the storage basin, and can vary from hundreds of small traps to single, capacious traps (Bradshaw et al., 2007).

1.4.5.2 Solubility Trapping

As the CO₂ plume migrates throughout the storage reservoir beneath any low-permeability seals, CO₂ dissolution into formation fluid will eventually occur, producing carbonic acid.



Dissolution of CO₂ can begin immediately after its injection; however, complete dissolution typically takes hundreds to thousands of years, and the rate depends upon the thickness, extent, and permeability of the storage reservoir, as well as the existence of a storage reservoir flow system. Solubility trapping is also dependent upon the CO₂ plume's contact with under-saturated formation water, the rate at which the CO₂ plume migrates (i.e., the faster the plume migrates, the more dissolution that occurs because the area of the plume subsequently increases with increasing migration, thereby increasing the area of the CO₂ plume that is in contact with under-saturated formation water), and the salinity of the formation water (i.e., the less saline, the more dissolution) (Bradshaw et al., 2007; Metz et al., 2005). Once CO₂ dissolves into formation fluid within the storage reservoir, it no longer exists as a separate phase, and it will migrate with the regional groundwater flow system and be driven only by density flow and the

aquifer hydrodynamics, without the impacts of its buoyancy (Bachu & Adams, 2003; Metz et al., 2005).

1.4.5.3 Hydrodynamic Trapping

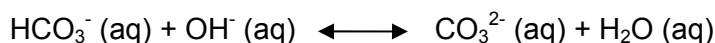
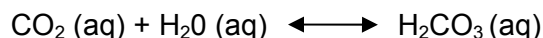
Hydrodynamic trapping involves the storage of CO₂ in its plume prior to its reaction and storage in geochemical trapping mechanisms. A plume of free-phase CO₂, notwithstanding the fact that it is flowing and dispersing in the storage reservoir aquifer that has its own buoyancy and aquifer hydrodynamics as driving forces, can have an extremely long residence time and be effectively trapped within the formation flow system via hydrodynamic trapping if the flow of formation water and CO₂ plume is very slow (i.e. 10⁻³ to 10⁻² m/year [yr]), as is the case for deep saline aquifers in Florida, as well as most sedimentary basins (Bachu & Adams, 2003). This type of trapping mechanism is based upon the timescale of the process and the slow migration of the post-injection CO₂ plume, rather than the permanency of sequestration (Bachu & Adams, 2003; Bradshaw et al., 2007).

1.4.5.4 Residual Trapping

In residual trapping, CO₂ fills the pore spaces of the storage reservoir along the migration path of the CO₂ plume and is held in place by capillary forces. In this process, CO₂ is immobile due to the interfacial tension between CO₂ and the formation water, resulting in the complete inability of flow, regardless of whether a flow pathway exists (Bachu, 2008). Essentially, CO₂ is left in the wake of a migrating CO₂ plume when formation water moves back into pore spaces following its displacement caused by the injection of CO₂ and/or the migration of the CO₂ plume; thus, residual trapping occurs largely, if not entirely, once CO₂ injection has ceased (Bachu, 2008).

1.4.5.5 Ionic Trapping

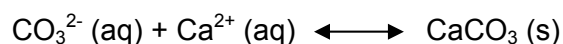
Ionic trapping is a geochemical process where ionic species are formed as the minerals of the geologic media into which CO₂ is injected are dissolved by the H₂CO₃ created during solubility trapping, which is accompanied by a decrease in pH, or as silicate minerals (i.e., clays, micas, fluorites, and feldspars) are altered directly by the aqueous CO₂. In this process, H₂CO₃ or CO₂ reacts with sodium and/or potassium silicates, or calcium (Ca²⁺), magnesium (Mg²⁺), and iron (Fe²⁺) carbonates and/or silicates, of the storage reservoir rock to form carbon-bearing ionic species such as bicarbonate (HCO₃⁻) and carbonate (CO₃²⁻) ions, or carbonate species such as magnesium carbonate (MgCO₃), as shown in the following examples (Bachu, 2008; Caldeira & Rau, 2000; Metz et al., 2005; National Energy Technology Laboratory [NETL], 2003; Raistrick et al, 2009):



OR



Certain carbon-bearing ionic species created during the reactions above (e.g., CO₃²⁻ and HCO₃⁻) could react with the dissolved Ca²⁺, Mg²⁺, K⁺, and/or Fe²⁺ of the storage reservoir, created during mineral dissolution or alteration, to form new carbonate minerals (mineral trapping) if the minerals of the rock unit continue to be dissolved or altered (Bachu, 2008; Metz et al., 2005; Raistrick et al., 2009). An example of such a carbonation reaction is shown below:



1.4.5.6 Mineral Trapping

The extent of mineral trapping is dependent upon the mineralogy of the aquifer into which CO₂ is injected. For carbonate aquifers, like those considered for CCS in peninsular Florida, limited amounts of CO₂ can be trapped via mineral immobilization (Gunter et al., 1996). The injected CO₂ is neutralized as it is dissolved and bicarbonate ions are formed from the dissolution of the carbonate unit, whereas the effect of ion exchange is to minimize the amount of dissolved calcium from the dissolution of calcite; however, in both cases only a limited geochemical reaction takes place, and mineral trapping alone does not serve as a strong storage mechanism in carbonate aquifers (Gunter et al., 1996). Conversely, Gunter et al. (1996) demonstrated that siliciclastic aquifers had the potential to store significant amounts of CO₂ via mineral trapping and replace the need for stratigraphic trapping. Mineral-trapping carbonation reactions in siliciclastic aquifers are slow (i.e., tens to hundreds of years); however, given the long residence times of certain deep siliciclastic formation waters, ample time for CO₂-trapping via mineral immobilization is provided.

Dissolution of storage reservoir minerals can be rapid (i.e., days), such as the case for carbonate minerals, or comparatively slow (i.e., hundreds to thousands of years), such as the case for silicate minerals (Metz et al., 2005). Solubility trapping, ionic trapping, and mineral trapping are all dependent upon the amount of formation water or rock available for reactions, as well as the contact area between free-phase CO₂ and the water or mineral, and the extent of CO₂ saturation at the interface (Bachu, 2008).

1.4.6 Lithology of Storage Reservoir

The basic lithology of the CO₂ storage reservoir (e.g., organic-rich shale, sandstone, or carbonate) should be determined and evaluated in order to assess the

homogeneity of the unit, the porosity and permeability of the unit, and to identify the occurrence of any layers of low permeability by analyzing geophysical data. To ensure sufficient size of a sequestration reservoir that has the capacity to store significant amounts of CO₂, horizontal homogeneity is required in the geologic storage reservoir; however, some vertical heterogeneity could be useful within the storage unit, as it could provide relatively thin permeability barriers within the unit that can hinder the vertical migration of CO₂ and prolong its storage (refer to Figure 1-2).

1.4.7 Pressure and Flow Regimes

The approximate pressure of the storage reservoir under injection should be estimated prior to the injection of CO₂, so that the rate of CO₂ injection can be adjusted and monitored to avoid overpressuring the storage reservoir, which could potentially lead to fracturing of the caprock and seal(s) and the consequent leakage of CO₂. The flow regime in a storage unit is also important to estimating the migration and potential leakage of CO₂. Flow velocities and flow paths of CO₂-laden waters are affected by the presence of low-permeability layers within the storage reservoir. In an open-flow system, CO₂ can migrate laterally for some distance and be made available to numerous types of trapping mechanisms; however, in restricted-flow regimes, like those typical of existing and depleted oil and gas reservoirs, CO₂ is not subjected to the various types of trapping mechanisms, and is typically stored in the sequestration reservoir via solubility trapping and stratigraphic and structural trapping (Metz et al., 2005).

1.4.8 Stable Geologic Environment

The CO₂-injection site must be located in a relatively stable geologic environment, in order to avoid compromising the site's integrity as a storage reservoir. Stable sites are typically found mid-continent or on passive margins, where there is little

tectonic activity that could potentially create faults or fractures in storage reservoir caprock and seals (Metz et al., 2005).

1.5 Carbon Dioxide Sequestration in Existing and Depleted Oil Reservoirs

Existing and depleted oil reservoirs are considered primary targets for GS because substantial subsurface investigations have been conducted and the oil reservoir's lithological and hydrogeological characteristics are known; the reservoirs have demonstrated their ability to store oil for millions of years and are known to contain natural underground fluid 'traps'; the reservoirs have known sufficient porosity, permeability, and flow characteristics; and the reservoirs already have a field, sequestration, and transportation infrastructure in place (EPA, 2008; IEA GHG R&D Programme, 2000; Mackintosh, 2006).

1.5.1 Carbon Dioxide-Enhanced Oil Recovery

The technology of CO₂-EOR involves the injection of CO₂ for the purpose of increased oil recovery from existing oil fields, which in turn also involves the sequestering of a portion of the injected CO₂. Up to half of the injected CO₂ is stored in the petroleum reservoir during CO₂-EOR, while the remaining CO₂ is collected with the oil produced at the production well and re-injected for continued use with EOR (IEA GHG R&D Programme, 2000). Commercial-scale CO₂-EOR projects are mostly conducted in the US and have already shown success. Approximately 74 CO₂-EOR projects are being conducted in the US, injecting some 33 MtCO₂ annually (IEA GHG R&D Programme, 2000).

Of the original oil in place (OOIP) within an oil reservoir, 5-40% is recovered using conventional primary recovery methods, which involves using the natural, existing pressures in the oil reservoir to move oil toward production wells (Metz et al., 2005). An additional 10-20% of the OOIP is recovered via a secondary recovery method known as

'water flooding', where water is injected into the geologic unit to repressure the reservoir and drive residual oil toward the production wells (Metz et al., 2005). Following water flooding, oil-saturation of the portion of the source rock 'swept' during the secondary recovery process is approximately 20-35%, in the form of isolated droplets trapped in the pore spaces of source rock or as film surrounding rock grains; however, saturation is typically significantly higher in the 'unswept' volume of the petroleum reservoir (Tzimas et al., 2005). An effective tertiary recovery method, such as CO₂-EOR, must be able to mobilize the remaining oil droplets and film in the petroleum reservoir to form an oil bank that can be moved toward production wells. Experience in the US suggests an additional range of recovery of 9-18% of the OOIP using CO₂-EOR methods in the nation's oil fields (Tzimas et al., 2005).

During CO₂-EOR, CO₂ that is injected into the oil reservoir interacts both chemically and physically with the source rock and the formation's oil, which creates favorable conditions for oil recovery by:

- reducing the capillary forces that inhibit oil flow within the source rock;
- expanding the volume of the reservoir oil (known as 'oil swelling'), which in turn reduces its subsequent viscosity;
- developing favorable, complex phase changes in the formation oil that increase its fluidity;
- increasing the pressure in the oil reservoir via the insoluble portion of the injected CO₂, which creates a 'sweep' of the oil towards the production well; and
- allowing for the maintenance and adjustment of favorable mobility characteristics for the formation-oil and CO₂, in order to improve the volumetric sweep efficiency (generally, the volumetric sweep efficiency decreases as the mobility ratio

between CO₂ and oil increases) (IEA GHG R&D Programme, 2000; Tzimas et al., 2005).

In order for CO₂-storage in EOR operations to be successful, several criteria may need to be met in addition to the basic criteria outlined previously for successful CCS operations. These additional criteria can include:

- uniform intergranular porosity within the oil/storage reservoir;
- remaining oil-in-place greater than 50-60% of the estimated OOIP, following primary and secondary recovery in a given oil field;
- density of CO₂ ranging between 400 and 750 kilograms (kg) per cubic meter (m³) for an effective CO₂-sweep during EOR;
- appropriate miscibility of injection fluid (specifically, immiscible fluids are often used for heavy- to medium-gravity oils [12-25 API] while the preferred miscible fluids are used for low-gravity, low-viscosity oils [25-48 API]);
- relatively thin storage reservoirs (i.e., less than 21 m [70 ft]);
- high reservoir angle; and
- for miscible flooding operations, the oil-/storage-reservoir pressure must be greater than the minimum miscibility pressure (100-150 bar) that is required in order for miscibility to exist between the reservoir oil and the injected CO₂ (Metz et al., 2005; Tzimas et al., 2005).

There are two methods for CO₂-EOR: the water alternating gas (WAG) method and the gravity stable gas injection (GSGI) method. The type of method chosen for CO₂-EOR projects is important, as it has an impact on the amount of CO₂ captured from fossil-fuel-fired power plants that can be subsequently sequestered. In the WAG method, CO₂ injection is alternated with an injected “water flood”. The injected CO₂ improves the mobility of the oil via oil swelling (i.e., the volume of the oil is expanded and

the subsequent viscosity is reduced) and the water flood forms an oil bank that is swept toward adjacent production wells. The use of WAG means that CO₂ injection may be intermittent, requiring offline storage of CO₂ if the CO₂-EOR project is using a captured CO₂ stream from a fossil-fuel-fired power plant. In addition, a significant amount of the injected-CO₂ is recovered at the oil-production wells, where it is subsequently separated from the oil and then is recycled back into the WAG process.

In the GSGI method, CO₂ is injected at the top of the oil trap in the reservoir, resulting in an increase in gas pressure, which enhances the natural gravity drive, increases oil mobility, and sweeps the oil bank that is created to adjacent oil-production wells at the bottom and edges of the trap (Tzimas et al., 2005). The GSGI method can utilize a continuous flow of CO₂, and therefore would not require offline storage of CO₂; however, GSGI is typically used in shallow reservoirs where pressures are below the critical point for CO₂, and CO₂ is hence injected as a gas (Tzimas et al., 2005). The injection of CO₂ as a gas greatly reduces the mass to volume ratio of the sequestered CO₂.

More than 50% and up to 67% of injected-CO₂ is recovered with oil production during CO₂-EOR operations (Tzimas et al., 2005). This CO₂ is then separated and re-injected into the oil reservoir for continued use in EOR. Without consideration for CCS, most oil companies prefer the WAG method over the GSGI method because less CO₂ needs to be purchased and reused, making it a more cost-efficient EOR method. In addition, water is used in the WAG method, which sweeps through the oil reservoir more uniformly than CO₂ and therefore can be more efficient at recovering oil than using CO₂ alone.

1.5.2 Geologic Sequestration in Depleted Oil and Gas Fields

Depleted oil and gas fields are exhausted of substantial oil/gas supply and are no longer operated and used for commercial oil/gas production. They include fields that have undergone CO₂-EOR and those that have not; notwithstanding, a large portion of the pore space that once contained oil or natural gas is subsequently available for the sequestering of CO₂ following the extraction of the reservoir oil or gas. Significant benefits exist in using depleted oil and gas reservoirs for GS versus saline aquifers that have never been explored as hydrocarbon reservoirs, such as: 1) known structural and stratigraphic traps that held reservoir hydrocarbons in place for millions of years, thus displaying the effectiveness of the reservoir seal(s); 2) known geologic structure and physical properties of the reservoir; 3) known movement and displacement behavior of reservoir hydrocarbons; and 4) the existence of a transportation and injection infrastructure previously used for commercial oil production.

1.6 Carbon Dioxide Sequestration in Deep Saline Aquifers

Deep saline aquifers are located in sedimentary basins throughout the world, both onshore and offshore, and contain formation fluid with high concentrations of dissolved salt. Deep saline aquifers are widespread, and are expected to be the most popular storage reservoirs for GS due to their location and depth, accessibility, availability, and injectability (NETL, 2007). Expansive areas of the US are underlain by saline aquifers at depths as great as 3,048-6,096 (10,000-20,000 ft) bls, with total dissolved solid concentrations exceeding those suitable for drinking water supply and agricultural use (EPA, 2008). These types of saline reservoirs typically have few penetrating wells; therefore, the danger of CO₂ leakage via nearby wells following the injection of CO₂ is greatly reduced or potentially alleviated.

1.7 Current and Planned Geologic Sequestration Projects

There are numerous planned or existing commercial or pilot CCS projects underway around the world that have been operating since the 1990s. Existing projects are operating successfully due to appropriate designs and operational standards, as well as sufficient monitoring, measurement, and verification requirements.

Large-scale CCS projects can be costly (up to one billion US dollars in some cases); however, governments and industries around the world are beginning to address the economic issues by participating in proposed and on-going large-scale and small-scale CCS R&D operations. Specifically, in May 2009, the US federal government announced \$3.4 billion in new funding from the American Recovery and Reinvestment Act to be invested by the US DOE for CCS R&D projects (Chu, 2009). Additionally, the DOE is supporting seven other CCS pilot projects occurring in geologic units of the US.

Currently, there are five fully integrated, large-scale and commercial CCS projects that are operating successfully around the world. Sleipner, Snøhvit, In Salah, and Salt Creek are all CCS projects in which CO₂ is captured from a natural gas production facility and transferred to the injection sites, while the Weyburn Project receives CO₂ from a synfuel plant. All five CCS projects securely store CO₂ underground in deep geologic units. Collectively, these CCS demonstrations store more than seven MtCO₂ per year (IEA, 2009; Metz, et al., 2005).

1.7.1 Sleipner Project

The Sleipner Project was the world's first commercial GS project in a saline aquifer, and has been successfully operating in the North Sea since 1996. The Norwegian oil company, Statoil, injects CO₂, captured from a nearby natural gas plant, ~240 kilometers (km) (149 miles [mi]) off the coast of Norway into the Tertiary Utsira

Formation, a saline aquifer composed of an unconsolidated sandstone located 800-1,000 m (2,624-3,280 ft) bls (Figure 1-9).

Approximately 2,700 tons of CO₂ (tCO₂) are sequestered daily at this site, and total anticipated CO₂ storage by project-end is 20 MtCO₂, although total estimated storage capacity for the reservoir is about 600 billion tCO₂, meaning its role in CCS will likely continue beyond the life of the Sleipner Project (IEA, 2009; Metz, et al., 2005). Secondary thin shale layers throughout the formation influence the slow migration of injected-CO₂, while the primary seal to CO₂ leakage is an overlying extensive and massive shale layer. The CO₂ plume in the Utsira Formation has been monitored effectively by seismic time-lapse surveys, which have demonstrated that the shale caprock is an effective seal that prevents CO₂ leakage (Metz, et al., 2005). As of 2005, the CO₂ plume at the Sleipner injection site extended over an area of ~5.2 square kilometers (km²) (~2 square miles [mi²]). According to the IPCC (2005), studies and simulations covering hundreds to thousands of years indicate total dissolution of CO₂ into pore water, which will consequently become heavier and sink, thus minimizing the potential for long-term leakage of CO₂. The CO₂ treatment module for the Sleipner Project cost more than \$526 million (M) US dollars (USD), and was funded by Statoil and other project partners (IEA GHG R&D Programme, 2000).

1.7.2 Snøhvit Project

Statoil also injects CO₂ beneath the Barents Sea, 2,600 m (8,530 ft) bls into the saline aquifer of a Lower Jurassic sandstone formation that is 45-75 m (147-246 ft) thick, called the Tubåsen Formation. A pipeline ~160 km (~100 mi) in length transports CO₂ from a liquid natural gas facility in Norway to the injection site in the Barents Sea. Approximately 0.7 MtCO₂ are sequestered in the Tubåsen Formation per year, which is approximately half of what the natural gas facility produces (Heiskanen, 2006). The

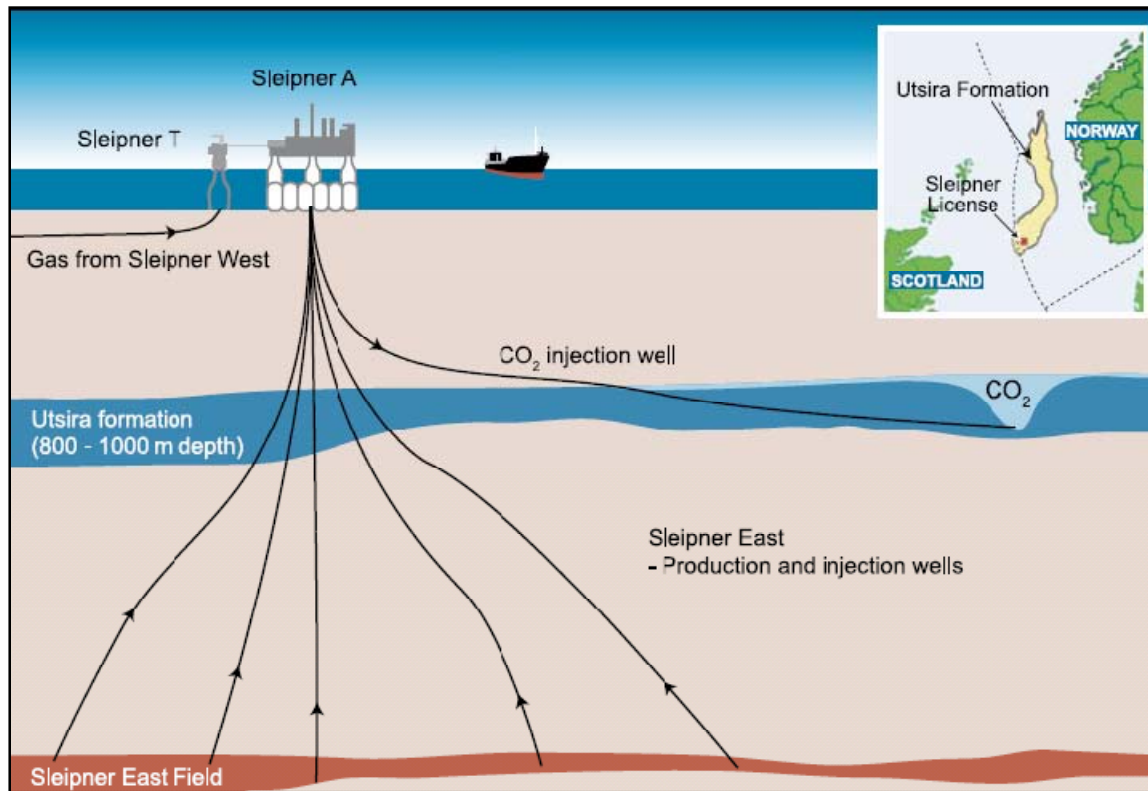


Figure 1-9: General diagram of Sleipner Project (from: Metz, et al., 2005).

Snøhvit Project has been conducting CO₂ injection since 2008, and CO₂-plume monitoring is still underway. The Tubåsen Formation is sealed by a thick shale layer, and although CO₂ leakage has not been reported to date, a complete monitoring report is not due to the Norwegian government until sometime in 2010. About 30% of the project, including the costs for the natural gas facility, was funded by the Norwegian government, while the remaining costs were funded by Statoil and other industrial project partners. The total cost for the CO₂ pipeline and injection well was around \$110M USD (IEA GHG R&D Programme, 2009).

1.7.3 In Salah Project

The In Salah Gas Project, a large-scale, commercial joint venture between Sonatrach, Statoil, and BP, has been operational since 2004 in the central Saharan region of Algeria. Approximately 3,000-4,000 tCO₂ are sequestered daily, with 17 MtCO₂ anticipated by project-end (IEA, 2009; Metz, et al., 2005). The storage reservoir is a depleted hydrocarbon reservoir of Carboniferous age, known as the Krechba Formation. The Krechba Formation is a 20-m (66-ft) thick sandstone unit located ~1,800 m (5,904 ft) bls, which is overlain and sealed by a massive succession of mudstones 950 m (3,116 ft) thick (Figure 1-10).

The Krechba Project has four natural-gas-production wells and three long-reach, horizontal, CO₂-injection wells. The CO₂ is injected down-dip from the gas/water interface within the natural-gas-bearing reservoir, and is expected to eventually migrate into the area of the Krechba gas field upon depletion of the gas zone (Metz, et al., 2005). Deep faults have been mapped with three-dimensional seismic surveys and with well data, but no shallow faults have been identified; therefore, the storage zone within the reservoir poses minimal structural uncertainty or risk (Metz, et al., 2005). Any processes that could result in CO₂ migration from the injection zone have been identified and a

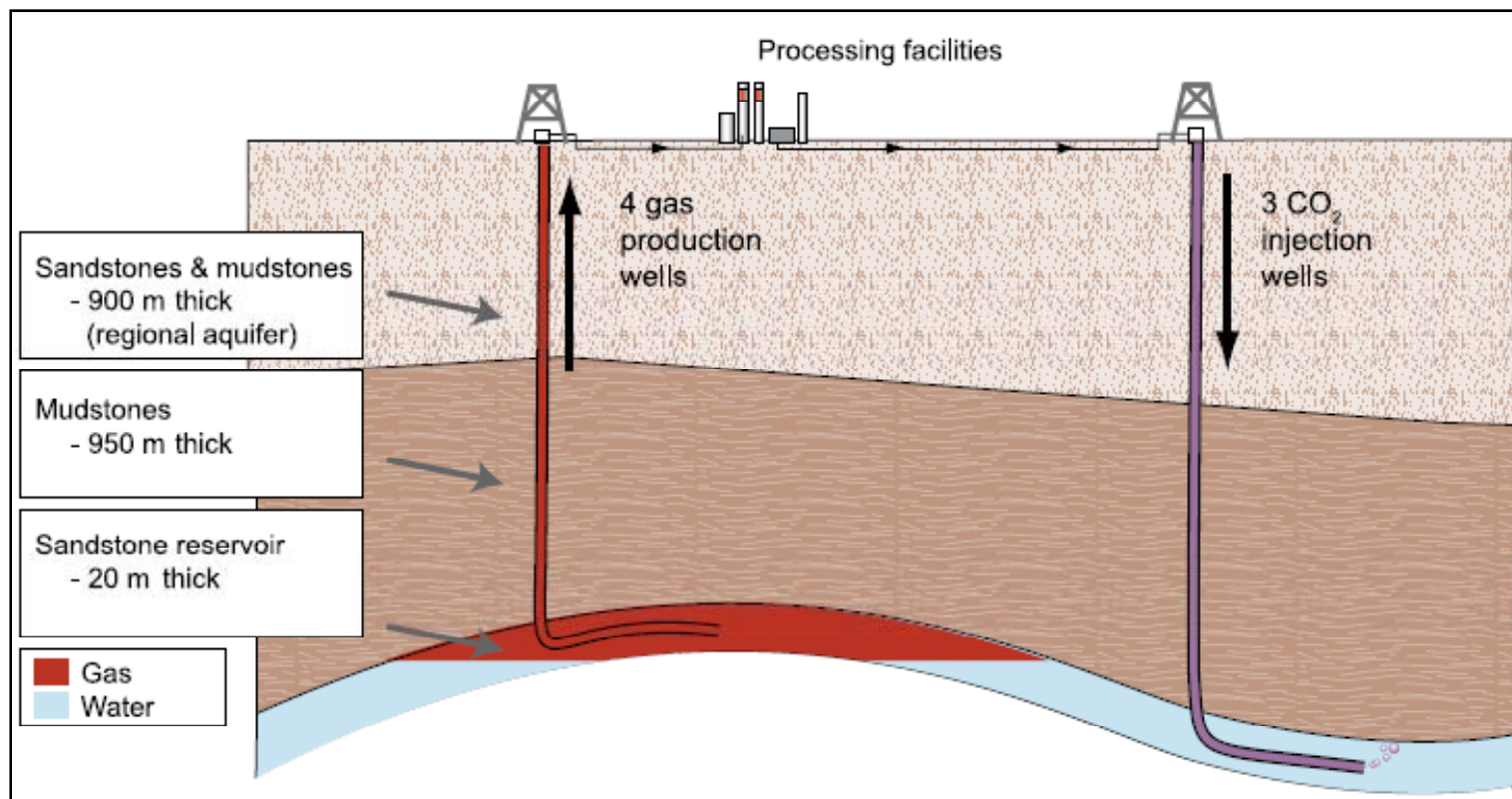


Figure 1-10: Schematic of In Salah Gas Project in Algeria (from: Metz et al., 2005).

monitoring program exists that includes noble gas tracers, pressure surveys, tomography, gravity baseline studies, microbiological studies, four-dimensional seismic, and geomechanical monitoring. The entire project, including the natural gas wells and facilities and CO₂-injection wells, costs \$30M USD and is funded by Statoil, BP, and Sonatrach, as well as other industrial, governmental, and institutional project partners.

1.7.4 Weyburn Project

The Weyburn Project, a commercial large-scale CO₂-EOR project, is currently operating within the Midale Formation of Mississippian age in Saskatchewan, Canada. The Midale Formation is a fractured-carbonate with anhydrite seals both above and below (Figure 1-11). The captured CO₂ is originally generated at a natural gas plant in North Dakota, US and transported 200 mi to Canada via pipeline, where it is injected into depleting oil fields for enhanced oil recovery and sequestration. Approximately 3,000-5,000 tCO₂ are sequestered per day and 23 MtCO₂ are expected to be stored by project-end that would normally be released during the end of the field life (Metz et al., 2005). The IEA GHG R&D Programme Weyburn-Midale CO₂ Monitoring and Storage Project was the first scientific study to monitor and observe the CO₂ plume in the reservoir and assess the nature of its migration and the effectiveness of the caprock and seals; however, researchers from around the world have had great interest in the Weyburn CO₂-EOR project and have been actively monitoring the CO₂ plume, as well. To date, the project has been operating successfully and intensive monitoring has shown no leakage. The monitoring effort, managed by Canada's Petroleum Technologies Research Centre, is currently in its second and final phase (due to end in 2011), and results will be used to build a framework and best practices manual for global implementation of GS of CO₂ (IEA, 2009). The Weyburn Project costs \$1.4 billion USD, and is funded by numerous governmental and industrial project partners.

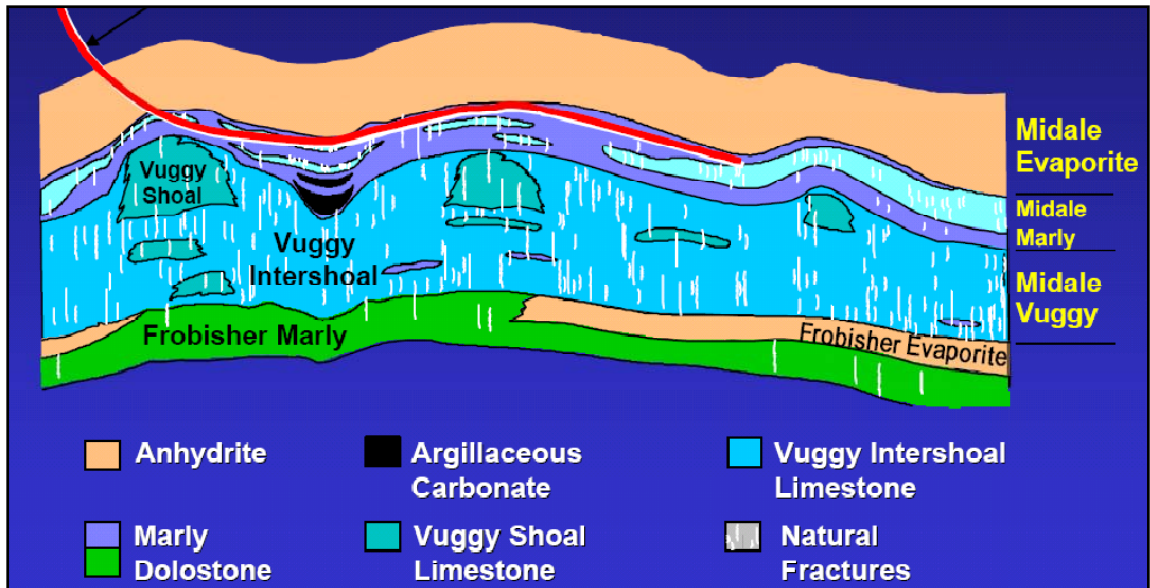


Figure 1-11: Schematic of Weyburn Project CO₂ injection zone and seals (from Petroleum Technology Research Centre, 2005). The red line represents the well path.

1.7.5 Salt Creek Project

In 2004, Anadarko Petroleum's Salt Creek CO₂-EOR Project began CO₂ injection for enhanced oil recovery into the Salt Creek Field. Salt Creek Field, located 45 mi north of Casper, Wyoming, is one of the largest oil fields in the Rocky Mountains and encompasses approximately 45 mi² (Wyland, 2009). The oil and sequestration reservoir is an Upper Cretaceous sandstone unit about 183 m (600 ft) thick, known as the Frontier Formation, which is overlain and sealed by a massive shale unit. A 200-km (125-mi) pipeline transports CO₂ from the Exxon-Mobile LaBarge natural gas processing facility in Wyoming to Salt Creek Field, where 5,000-6,000 tCO₂ is sequestered per day (Metz, et al., 2005; Wyland, 2009). Total anticipated CO₂ sequestration is 27 MtCO₂ by project-end. To date, no CO₂ leakage has been reported. The Salt Creek Project costs >\$750 M USD, and funding was provided by the Rocky Mountain Oil Testing Center of the DOE, National Lab consortium, and other industrial and institutional project partners.

1.8 Challenges for Carbon Dioxide Capture and Geologic Sequestration Technologies

The implementation of CCS in geologic media on a large, commercial scale as a widely accepted and utilized means of industrial GHG emission reductions faces numerous challenges in Florida and throughout the country. These challenges include establishing funding sources for the implementation of CCS, including feasibility studies, development of capture and transportation infrastructure, injection operation, and monitoring of CCS operations, and integrating the technology into GHG policies; compensating for the higher cost and lower efficiency penalty of CCS; the development of stringent and practical regulatory guidelines to ensure safe sequestration of CO₂ for millennia; sufficient public notice and education to address community concerns; and establishing CCS on a large-enough scale that ensures the technology truly has a

significant effect on anthropogenic GHG emissions (Bachu, 2008; Sneider & Young, 2009).

1.8.1 Costs of Operation

The cost of materials, supplies, equipment, and labor fluctuate annually; therefore, cost estimation will inevitably have a level of uncertainty. In addition, costs for individual CCS projects will vary due to differences in storage reservoir hydrogeological and lithological characteristics, capture and transportation infrastructures, injection and sequestration methods, rates and amounts of CO₂ injected, and monitoring techniques.

The IEA GHG R&D Programme (2000) estimated that the cost involved with capturing CO₂ from a source (i.e., power plant), transporting the CO₂ ~300 km (~186 mi) (as an example), and sequestering the CO₂ in geologic media of the subsurface to be between \$30 and \$50 USD per tCO₂, which is approximately equivalent to \$13 USD per barrel of oil or \$0.25 USD per gallon of gas (Lackner, 2003). As of 2005, the IPCC estimated CCS costs to be between \$40 USD and \$70 USD per tCO₂, which means, for example, that the annual cost to sequester 1 GtCO₂ at \$50 USD per tCO₂ is \$50 billion USD per year (Metz et al., 2005; Sneider and Young, 2009). A preliminary study conducted in 2008 to examine the feasibility of GS of CO₂ in Ireland estimated CCS costs to be between €28 and €56 per tCO₂, or \$38-\$76 USD per tCO₂, with cost variance mostly dependent upon the type and size of a given power plant, as well as the CO₂ transport distance (CSA Group, 2008).

During the initial phases of CCS operations, however, these costs can be offset by the use of CO₂-EOR, where applicable. Electric-power utility companies can sell CO₂ produced at their facility to oil-production companies for use in EOR, thereby requiring less, if any, CO₂ sequestration by the utility company during this process, and thus saving them significant costs. In this scenario, the electric-power utility companies are

only responsible for capturing and compressing CO₂ to supercritical form for its transportation to an oil field for injection. The construction and operation of the CO₂-injection wells are the responsibility of the oil-field operator, and as far as costs for oil-field operation, any existing water-flood wells used in secondary recovery can also be used for the injection of CO₂ during CO₂-EOR, with minor modifications. However, the lifespan of an individual oil field during CO₂-EOR operations is typically less than 20 years, which is considerably less than the 40-year lifespan of one power plant. Unless captured-CO₂ can be used in multiple oil fields in sequence, the EOR portion of a power plant's CCS project may end well before the end of the operating-life of that power plant. This would result in the remaining portion of the CCS project being principally a sequestration project, with significantly less recovery of oil and increased costs to the electric-power utility company.

The major cost in CCS is the capturing of CO₂ from an emission source, specifically from power plants. For IGCC plants, retrofitting will not be necessary, as the power plants already have the necessary infrastructure to separate and capture CO₂; however, many power plants do not have this technology and will have to be retrofitted to capture and separate CO₂ produced at their facility. Retrofitting a power plant for CO₂ capture accounts for the greatest cost in CCS (Lackner, 2003). In the near future, new power plants will be built with the technology to capture CO₂ before it is emitted into the atmosphere, such as is mandated by the proposed ACESA of 2009. This will mean that capture costs for CCS could potentially decrease, along with the further establishment of capture and transportation infrastructures; however, disposal and storing costs will most likely increase as inexpensive sequestration sites (i.e., existing and depleted oil and gas fields) meet their capacities, and demands on permanence and safety increase (Lackner, 2003).

1.8.2 Environmental Concerns

Environmental concerns predominantly involve leakage issues, which can occur due to instances such as: the use of old and/or poor-quality injection wells; nearby unplugged or poorly plugged abandoned wells; inadequate caprock and seal characterization; or overpressuring the storage reservoir due to improper injection rates. In order to avoid leakage issues during operation of CO₂ injection, extensive monitoring and mitigation of both the injection well and any identified potential leakage points should be performed at all times. In addition, observation wells can be used to monitor any potential leakage in the shallower strata. In order for CCS to be an effective CO₂ emissions-reduction strategy, leakage rates must be less than 0.1% per year.

1.8.3 Community Opposition and Public Concerns

The costs for CCS operations can be astounding to many, and concerns about the health of the environment for all inhabitants, both plant and animal, are justifiable. For example, the 2007 McKinsey report states that the US has the potential of reducing CO₂ emissions by approximately 40% just by reducing energy consumption, such as driving more fuel-efficient or alternative energy vehicles and implementing combined heat and power generation, which appeals to many individuals in opposition to CCS based upon the reduced costs and reduced environmental impact (Bressand et al, 2007; Sneider and Young, 2009). These options, along with others outlined in the 2007 McKinsey report, are plausible solutions to the reduction of anthropogenic CO₂ emissions; however, problems still remain in implementing such measures on a nationwide-scale due to associated economical, technological, and social barriers.

In order to address the issues associated with CCS, large-scale commercial and pilot projects should continue to operate in various geologic settings around the world, with varying sources of CO₂, capture and transportation infrastructure, sequestration

techniques, and monitoring, in order to gain a more complete and diverse understanding of the capabilities and available storage capacities of GS, and thus a better understanding of how the technology may impact anthropogenic CO₂ emissions and our environment. As mentioned earlier, until alternative energy technologies and capacities have been improved and are able to meet the current demands for energy consumption in the US, thereby alleviating the ardent dependency on fossil-fuel-fired power plants, CCS in geologic units is a proposed solution to anthropogenic CO₂-emission reductions that is worth pursuing as long as fossil-fuel-fired power plants remain in operation. As stated by the US Secretary of Energy, “There are many hurdles to making CCS a reality, but none appear insurmountable” (Chu, 2009).

1.9 Potential for Carbon Capture and Geologic Sequestration in Florida

In order to meet current and potential future CO₂-emission requirements enforced on both a regional and national level, Florida electric-power utility companies must rely on newly developed technologies to assist in their CO₂-emission reductions. Currently, Florida electric-power utility companies are either buying renewable or alternative energy, or building their own facilities which supply these energy resources (i.e., solar-energy, wind-energy, or nuclear-energy); however, use of these alternative energy resources cannot fully assist the electric-power utility companies in meeting their respective CO₂ emission-reduction requirements. Therefore, CCS in deep geologic units of Florida, including CO₂-EOR, has been proposed as the next significant step for CO₂-emission reductions; however, the use of these technologies has never been fully investigated or implemented in the state of Florida, nor has CCS without CO₂-EOR ever been applied to carbonate units internationally. In addition, some southeastern states within the US do not have significant potential CO₂ sequestration reservoirs (NETL,

2007); therefore, Florida may serve as a sequestration site for other states, which could be a potential economic benefit for Florida.

Before CCS in geologic units and CO₂-EOR can be implemented in Florida, an assessment must be made of the state's deep geologic units that appear suitable for such technologies, and benefits and risks must be identified and evaluated. Factors that must be further investigated and assessed involve the identification of: appropriate geologic storage units, to include an assessment of associated porosity, permeability, and continuity, as well as the extent and thickness of the units; effective caprocks or seals for geologic storage units, including the identification of any structural inadequacies; and any potential CO₂ leakage points, including, but not limited to, abandoned wells. An understanding of what may potentially occur once CO₂ is injected into these stratigraphic units is also an important process that must be evaluated. The Lower Cretaceous Sunniland Formation and Paleocene Cedar Keys Formation/Upper Cretaceous Lawson Formation have been identified as two major carbonate injection zones in Florida that may potentially serve as reservoirs for CO₂ storage, and are further discussed in chapters 2 and 3, respectively.

Chapter 2: Evaluation of the Lower Cretaceous Sunniland Formation within the Sunniland Trend of the South Florida Basin for Carbon Dioxide Sequestration and Enhanced Oil Recovery

2.1 Introduction

The Florida Platform has been a highly cyclic, shallow-marine environment intermittently throughout geologic history, resulting in relatively thick, porous carbonate units (i.e., dolostone and limestone) associated with various shallow-water marine depositional environments. These carbonate units are separated in many instances by evaporite units of low permeability that were originally deposited in environments such as sabkhas, mud flats, or restricted lagoons. These highly cyclic stratigraphic units of the Florida Platform, specifically those located beneath the emergent portion of the Florida Platform known as the state of Florida, are believed to be suitable storage zones with adequate seals for successful CCS and CO₂-EOR operations.

The Sunniland Formation of southwest Florida could be a viable zone for CO₂-EOR and CCS activities due to its geographic location, lithology, porosity, potential CO₂ storage capacity, estimated amount of recoverable oil via tertiary methods, and because the formation appears to be adequately sealed. Not only could the commercial oil fields along the Sunniland Trend (Trend) in the South Florida Basin (SFB) potentially benefit from EOR via CO₂ injection, but Florida electric-power utility companies could as well, by offsetting a portion of the costs of CCS through sales of CO₂ for EOR. This chapter

evaluates the Sunniland Formation within the Trend of the SFB, for its potential use in CO₂-EOR and CCS operations.

2.2 Study Area

As depicted in Figure 2-1, the study area lies throughout the entire extent of the Trend of southern Florida. Eighty-five exploratory/discovery oil wells were utilized to evaluate the Sunniland Formation within the Trend. Beginning in 1947, all oil and gas wells drilled in Florida required a permit and were subsequently issued a permit number (P#). All wells drilled between 1943 and 1946 were retroactively assigned a P#, as well. For the purpose of this investigation and for simplified identification, all evaluated wells are referenced by their P#. Table 2-1 provides a list of exploratory/discovery wells evaluated in this study, along with well details and locations. Each study well is either an oil-production well (P) in a given Trend oil field, a non-producing/dry-hole well near that production well (NP), or an isolated, dry-hole well (I) located within the outer extent of the given oil field, or outside the oil fields and within the boundaries of the Trend.

2.3 Geologic Setting

2.3.1 Florida Platform

The Florida Platform is an ancient carbonate platform with an east-west dimension of 500 km (310 mi), extending from the shelf-break off the east coast of Florida west to the Florida Escarpment, which plunges 1,800 m (5,900 ft) into the Gulf of Mexico and marks the western boundary of the SFB (Hine et al., 2001). Relatively high sea levels and environmental stresses, considered by many to be the result of world-wide oceanic anoxic events, affected sedimentation rates within the Florida Platform (Hine et al., 2001). Ultimately, sediment production and accumulation could not keep pace with tectonic subsidence associated with a relatively young passive margin, and by the mid-Cretaceous the western portion of the Florida Platform was submerged (Hine et al., 2001). Figure 2-2 displays the Florida Platform and some of the major features of

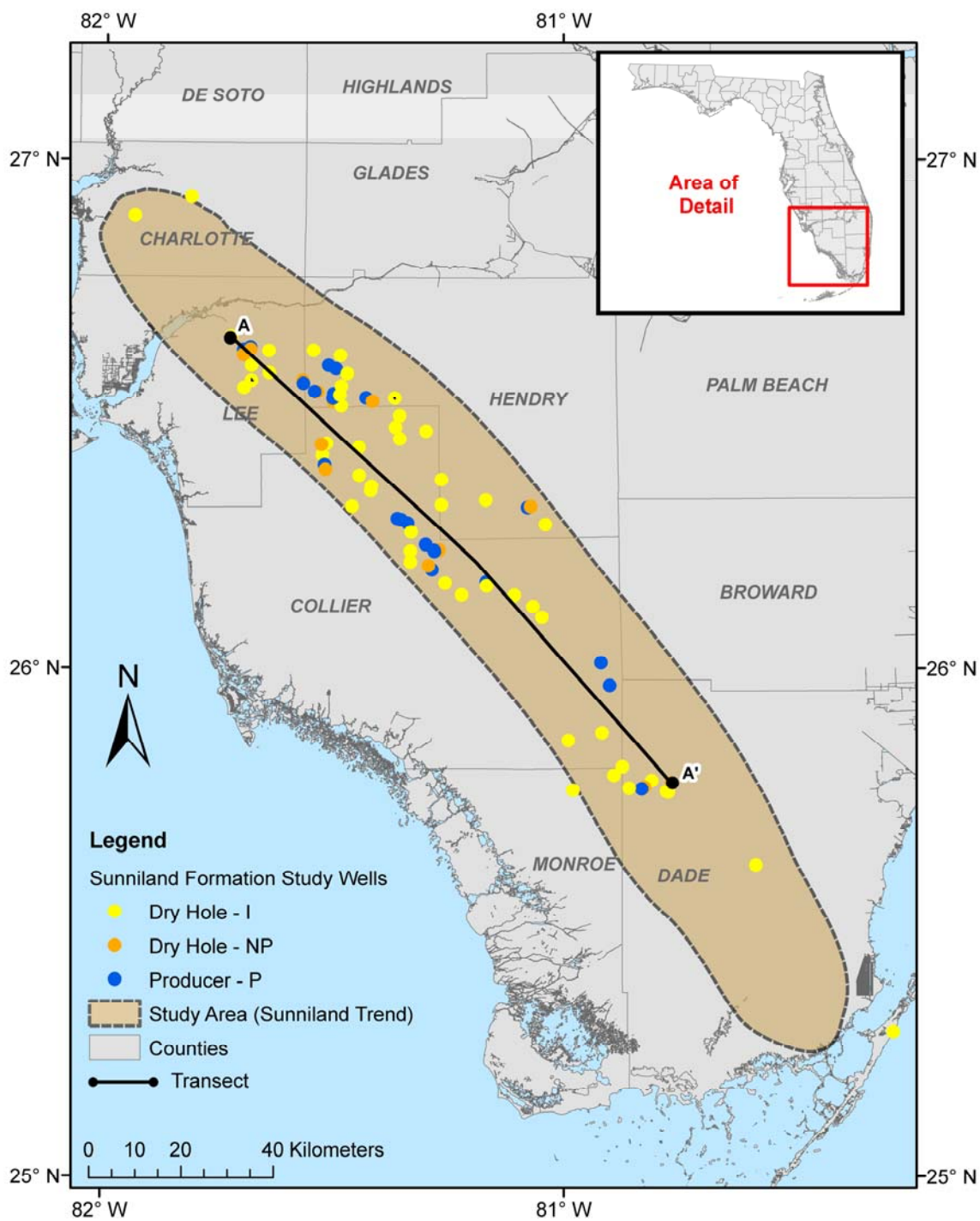


Figure 2-1: Map of study area depicting the Trend and the evaluated exploratory/discovery oil wells.

Table 2-1: List of exploratory/discovery oil wells evaluated within Trend study area.

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
92	7	48 South	29 East	-81.4605	26.31918	7	3,625	Collier	N/A	Dry Hole - I
103	19	47 South	28 East	-81.5553	26.36939	6	3,722	Collier	N/A	Dry Hole - I
115	25	55 South	37 East	-80.5836	25.61477	3	3,511	Miami-Dade	N/A	Dry Hole - I
129	31	35 South	53 East	-80.8726	25.80759	3	3,623	Miami-Dade	N/A	Dry Hole - I
130	27	50 South	26 East	-81.6985	26.09176	3	3,815	Collier	N/A	Dry Hole - I
167	16	54 South	35 East	-80.8305	25.76439	3	3,523	Miami-Dade	Forty Mile Bend	Producer
205	19	54 South	36 East	-80.7729	25.75773	2	3,535	Miami-Dade	Forty Mile Bend	Dry Hole - I
214	19	54 South	36 East	-80.7769	25.75896	2	3,540	Miami-Dade	Forty Mile Bend	Dry Hole - I
278	11	54 South	35 East	-80.809	25.78057	3	3,559	Miami-Dade	Forty Mile Bend	Dry Hole - I
279	23	45 South	28 East	-81.4846	26.55531	12	3,550	Hendry	Mid-Felda	Dry Hole - I
300	20	48 South	30 East	-81.3397	26.28616	6	3,603	Collier	Sunniland	Producer
311	28	48 South	30 East	-81.3317	26.26861	5	3,565	Collier	Sunniland	Dry Hole - I
326	28	45 South	29 East	-81.4308	26.53225	11	3,539	Hendry	Sunoco-Felda	Producer

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
331	15	54 South	35 East	-80.8245	25.76728	3	3,540	Miami-Dade	Forty Mile Bend	Dry Hole - NP
360	34	45 South	29 East	-81.4168	26.52562	10	3,548	Hendry	Sunoco-Felda	Dry Hole - NP
376	18	54 South	36 East	-80.7659	25.77651	3	3,517	Miami-Dade	Forty Mile Bend	Dry Hole - NP
384	19	48 South	30 East	-81.3536	26.29275	5	3,568	Collier	Sunniland	Producer
386	17	54 South	35 East	-80.8577	25.76533	3	3,537	Miami-Dade	Forty Mile Bend	Dry Hole - I
401	9	47 South	28 East	-81.5208	26.40116	7	3,654	Collier	Lake Trafford	Producer
425	8	45 South	27 East	-81.6418	26.58187	9	3,579	Lee	West-Felda	Dry Hole - I
437	35	45 South	28 East	-81.4849	26.5167	10	3,563	Hendry	Sunoco-Felda	Dry Hole - I
472	22	45 South	26 East	-81.6973	26.55211	9	3,962	Charlotte	N/A	Dry Hole - I
475	9	41 South	25 East	-81.8133	26.92706	12	4,034	Charlotte	N/A	Dry Hole - I
477	16	47 South	28 East	-81.5188	26.39204	6	3,673	Collier	Lake Trafford	Dry Hole - NP
486	20	45 South	28 East	-81.5431	26.54446	10	3,574	Hendry	West-Felda	Producer
488	12	45 South	28 East	-81.4718	26.58037	10	3,510	Hendry	Sunoco-Felda	Dry Hole - I
527	2	45 South	26 East	-81.681	26.59635	9	3,570	Lee	N/A	Dry Hole - I

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
561	6	48 South	32 East	-81.1693	26.33145	6	3,532	Hendry	N/A	Dry Hole - I
564	14	54 South	33 East	-80.9922	25.7623	3	3,859	Monroe	N/A	Dry Hole - I
565A	28	48 South	33 East	-81.0395	26.28328	6	5,189	Hendry	Seminole	Dry Hole - I
596	14	53 South	33 East	-80.9897	25.85882	3	5,016	Collier	N/A	Dry Hole - I
662	12	48 South	32 East	-81.0782	26.31699	6	3,551	Hendry	Seminole	Producer
683	20	41 South	24 East	-81.9368	26.89104	8	3,505	Charlotte	N/A	Dry Hole - I
684	14	45 South	26 East	-81.6812	26.56629	9	3,578	Lee	N/A	Dry Hole - I
697	23	46 South	30 East	-81.2998	26.46772	9	3,962	Collier	N/A	Dry Hole - I
700	7	48 South	31 East	-81.2658	26.32234	7	3,631	Hendry	N/A	Dry Hole - I
702	7	48 South	33 East	-81.0714	26.31897	6	3,548	Hendry	Seminole	Dry Hole - NP
735	13	45 South	27 East	-81.5678	26.56058	9	3,658	Lee	West-Felda	Producer
736	17	49 South	30 East	-81.333	26.21036	5	3,634	Collier	Bear Island	Dry Hole - I
754	11	54 South	34 East	-80.8907	25.79069	2	3,921	Monroe	Forty Mile Bend	Dry Hole - I
758	16	44 South	26 East	-81.7256	26.65206	6	3,841	Lee	Lehigh Park	Dry Hole - I
760	30	46 South	30 East	-81.3567	26.45256	9	3,591	Collier	N/A	Dry Hole - I
803	5	52 South	31 East	-81.243	25.97692	6	4,040	Collier	Bear Island	Dry Hole - I

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
821	1	49 South	30 East	-81.271	26.23323	5	3,554	Collier	Bear Island	Dry Hole - NP
829	33	51 South	34 East	-80.9253	25.98274	3	3,553	Collier	Raccoon Point	Producer
831	31	49 South	31 East	-81.2576	26.16844	3	3,640	Collier	N/A	Dry Hole - I
838	1	49 South	30 East	-81.281	26.23113	5	3,540	Collier	Bear Island	Producer
853	28	46 South	28 East	-81.5166	26.44338	7	3,601	Collier	Corkscrew	Dry Hole - I
858	23	44 South	26 East	-81.6831	26.6321	6	3,607	Lee	Lehigh Park	Producer
859	26	44 South	26 East	-81.6834	26.62793	6	3,592	Lee	Lehigh Park	Dry Hole - NP
864	19	47 South	31 East	-81.2658	26.37209	8	3,616	Hendry	N/A	Dry Hole - I
865	31	49 South	32 East	-81.168	26.17112	5	3,604	Collier	Baxter Island	Producer
871	4	50 South	31 East	-81.2218	26.14556	4	3,633	Collier	Pepper Hammock	Dry Hole - I
897	23	49 South	30 East	-81.2863	26.19512	5	3,626	Collier	Pepper Hammock	Producer
904	27	45 South	28 East	-81.5029	26.53181	10	3,562	Hendry	Mid-Felda	Producer
926	34	45 South	28 East	-81.5021	26.5246	10	3,568	Hendry	Mid-Felda	Dry Hole - NP
928	35	51 South	34 East	-80.9007	25.9832	4	3,960	Collier	Raccoon Point	Producer

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
947	33	47 South	29 East	-81.4199	26.35023	8	3,647	Collier	N/A	Dry Hole - I
951	29	44 South	28 East	-81.5454	26.62583	9	3,841	Hendry	N/A	Dry Hole - I
982	14	49 South	30 East	-81.2941	26.20284	5	3,637	Collier	Pepper Hammock	Dry Hole - NP
983	27	45 South	28 East	-81.5013	26.5404	11	3,503	Hendry	Mid-Felda	Producer
990	26	45 South	28 East	-81.4881	26.53767	11	3,512	Hendry	N/A	Dry Hole - I
1014	29	44 South	27 East	-81.6427	26.62512	7	3,565	Lee	N/A	Dry Hole - I
1016	32	46 South	29 East	-81.4458	26.43568	11	3,609	Collier	N/A	Dry Hole - I
1026	30	45 South	30 East	-81.368	26.53217	9	3,565	Hendry	N/A	Dry Hole - I
1057	18	46 South	30 East	-81.3662	26.47506	9	3,527	Collier	N/A	Dry Hole - I
1059	3	50 South	32 East	-81.1071	26.14512	5	3,606	Collier	Baxter Island	Dry Hole - I
1063	20	50 South	33 East	-81.0469	26.10114	4	3,584	Collier	N/A	Dry Hole - I
1065	6	50 South	32 East	-81.1673	26.16305	5	3,597	Collier	Baxter Island	Dry Hole - NP
1070	2	45 South	28 East	-81.4964	26.58967	9	3,494	Hendry	Townsend Canal	Producer
1086	10	53 South	34 East	-80.9166	25.87392	3	3,560	Collier	N/A	Dry Hole - I
1118	1	49 South	30 East	-81.2821	26.23247	5	3,655	Collier	Bear Island	Producer

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Oilfield	Well Type
1119	2	49 South	30 East	-81.3	26.24408	6	3,688	Collier	Bear Island	Producer
1127	28	47 South	29 East	-81.4183	26.35895	7	3,656	Collier	N/A	Dry Hole - I
1131	13	45 South	27 East	-81.5691	26.56667	9	3,581	Lee	West-Felda	Dry Hole - NP
1134	20	47 South	29 East	-81.445	26.3806	7	3,667	Collier	N/A	Dry Hole - I
1142	19	48 South	30 East	-81.3618	26.29494	6	3,584	Collier	Sunniland	Producer
1147	20	45 South	28 East	-81.5365	26.54412	9	3,508	Hendry	West-Felda	Dry Hole - NP
1151	3	45 South	28 East	-81.5123	26.59638	9	3,503	Hendry	Townsend Canal	Producer
1201	28	46 South	28 East	-81.5277	26.44145	7	3,612	Collier	Corkscrew	Dry Hole - NP
1202	7	46 South	30 East	-81.3572	26.49726	10	3,540	Collier	N/A	Dry Hole - I
1208	4	47 South	28 East	-81.5256	26.41997	7	3,612	Collier	Lake Trafford	Dry Hole - I
1216	18	50 South	33 East	-81.0667	26.12249	4	3,583	Collier	N/A	Dry Hole - I
1240	5	49 South	30 East	-81.3334	26.23072	5	3,621	Collier	Bear Island	Dry Hole - I
1292	26	44 South	28 East	-81.4864	26.61627	9	3,542	Hendry	N/A	Dry Hole - I

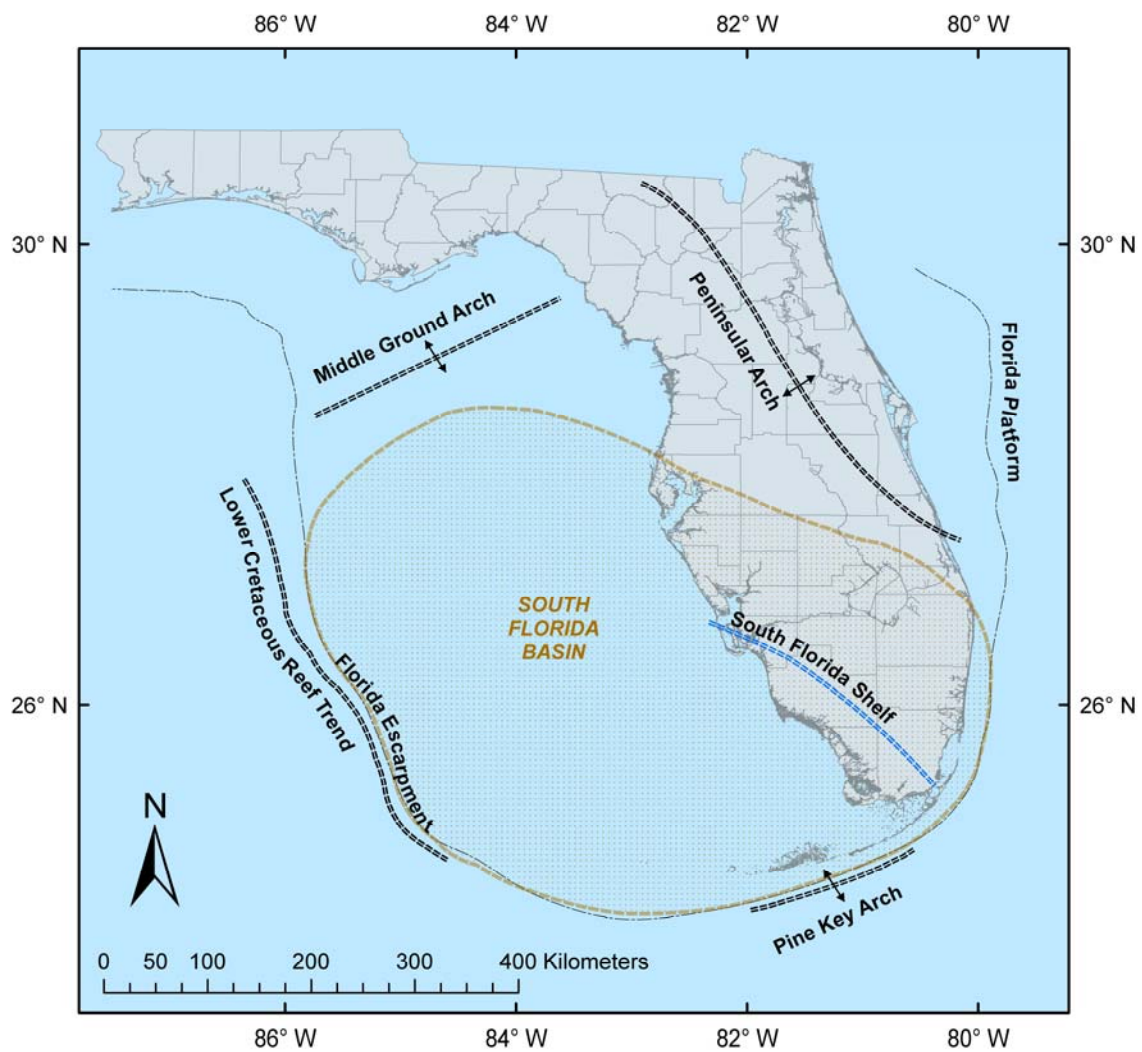


Figure 2-2: The Florida Platform and some of the major features of the region (adapted from: Ferber, 1985; Grinnell, 1976; Scott, 1997; Winston, 1971).

the region that are important to this study, including the SFB, Middle Ground Arch, Pine Key Arch, the Peninsular Arch, the South Florida Shelf, the Florida Escarpment, and the Lower Cretaceous Reef Trend.

2.3.1.1 Major Features of the Florida Platform

South Florida Basin

Throughout Florida, Mesozoic and Cenozoic rocks overlie an eroded Precambrian to Jurassic basement-rock complex (Duncan et al., 1994). The SFB is a differentially subsiding area centered in Florida Bay that has a maximum sediment thickness of 4,572 m (15,000 ft) to 5,182 m (17,000 ft), and is part of the larger, regionally subsiding South Florida Embayment that includes the southeastern Gulf of Mexico, south Florida, and the Bahamas (Grinnell, 1976). The SFB comprises approximately 199,429 km² (77,000 mi²), with the onshore portion representing about half of the basin (Applegate & Pontigo, 1984). During the Late Jurassic and Early Cretaceous, shallow-water carbonates and gypsiferous rocks were deposited in the SFB in water no more than a hundred meters deep (Halley, 1985). Throughout deposition in the basin during this time, carbonate mud rich in organic matter accumulated during the intermittent occurrence of salinity-stratified interior lagoons; however, sedimentation typically kept pace with subsidence of the basin and shallow-water marine deposition was dominant (Halley, 1985).

Lower Cretaceous Reef Trend

The Lower Cretaceous Reef Trend, a long arcuate reef system that built up or accentuated the Florida Escarpment, also bounds the SFB to the west, and extends from Mexico both eastward and southward, with the southerly extension of the ancient reef trending around the Gulf of Mexico to Cuba (Ferber, 1985; Grinnell, 1976; Halley, 1985). The extensive reef growth associated with the ancient reef system is thought to be the result of factors such as geologic continuity, uniform geologic history, and uniform

subsidence, especially for the foundation on which the reef system prospered (Grinnell, 1976). The Lower Cretaceous Reef Trend probably acted as a sediment trap that consequently created a shallow, back-reef environment and enhanced back-reef fill between the ancient reef trend and the peninsular-Florida land area (Grinnell, 1976; Klopp, 1975).

Peninsular Arch

The Peninsular Arch is a major north-northwest to south-southeast trending anticlinal fold, or topographic high, about 443 km (275 mi) long that is the dominant structural feature of Florida, especially in the northern two-thirds of the Florida peninsula (Applin & Applin, 1965; Duncan, et al., 1994; Klopp, 1975; Puri & Banks, 1959). According to Duncan et al (1994), the Peninsular Arch is a positive basement element cored by a large block of Precambrian rock that is overlain by Paleozoic stratigraphic units. The Peninsular Arch consists of igneous and metamorphic, pre-Mesozoic rocks (Klopp, 1975) that affected the deposition of sediments from the Jurassic into the Early Cenozoic, with sediments being deposited around but not completely covering the Arch (Ferber, 1985; Miller, 1986).

Pine Key Arch

The Pine Key Arch forms the southern flank of the SFB, and parallels the Florida Keys. The structural feature is thought to have affected deposition of sediments in the Early Cretaceous (Klopp, 1975).

South Florida Shelf

The South Florida Shelf is a broad and relatively flat, carbonate and evaporite platform that expanded outward into the SFB along its northern and eastern margins, becoming well-developed in the Early Cretaceous, but probably best-developed in the Trinity age of the Early Cretaceous (Ferber, 1985; Grinnell, 1976). The shelf is ~322 km (200 mi) long, extending from Charlotte County south to the Florida Keys, and is more or

less coincident with the oil-producing Trend (Applin & Applin, 1965). During the Cretaceous and through much of the Tertiary, sedimentation on the South Florida Shelf was dominated by shallow-water carbonates that were deposited on a slowly subsiding platform (Ferber, 1985). The highly cyclic nature of these deposits, controlled by local sea level changes, is indicated by sequences of marine limestones with thin, alternating deposits of evaporite-dolomite facies (Ferber, 1985).

2.3.1.2 Sunniland Trend

Onshore, the more porous units of the SFB are within the Sunniland Trend, a slightly arcuate band about 233 km (145 mi) long and 32 km (20 mi) wide (Figure 2-1; Applegate & Pontigo, 1984). Numerous oil plays are located along the Trend and are confined to mound-like structures thought to be Cretaceous shallow-water bioherms, banks, bars, and barrier beaches made of coarse fossil fragments, mostly rudistids. Wave action in these shallow-water environments probably winnowed the source rock carbonates, thereby creating the existing porosity and permeability, while in some areas porosity within the Trend has been enhanced by dolomitization (Applegate & Pontigo, 1984; Lane, 1994).

Commercial oil production in the Trend is restricted to the locations of these ancient coastal mounds within the South Florida Shelf, which are surrounded laterally by finer-grained and less permeable limestones, and are overlain and underlain by evaporite deposits (Mitchell-Tapping, 1986).

2.3.2 Stratigraphic Units

An oil-producing and porous geologic unit considered for CO₂-EOR and CCS operations in southern Florida is the Sunniland Formation, which is the major focus of this chapter. The stratigraphic traps and lateral decrease in permeability beyond the region of the Trend form the seals that hold the oil of the Sunniland Formation in place. These seals, together with the overlying Lake Trafford Formation and the underlying

Punta Gorda Anhydrite, would serve as the seals for the Sunniland Formation during potential CO₂-injection operations. The stratigraphic layout of these geologic units is displayed in the cross-section of Figure 2-3 and the stratigraphic column of Figure 2-4. For Figure 2-3, the cross-section shows stratigraphic variation with decreasing elevation, using sea level as the datum, and the location of the cross-section transect is located in Figure 2-1. Table 2-2 provides information on the depths of occurrence and thicknesses of these formations based upon the wells evaluated in this study. The following provides a detailed description of the Sunniland Formation, with a brief discussion of the underlying Punta Gorda Anhydrite and the overlying Lake Trafford Formation.

2.3.2.1 *Punta Gorda Anhydrite*

The basal Sunniland Formation was deposited upon the low-relief, upper surface of the Lower Cretaceous Punta Gorda Anhydrite. This underlying unit is a massive anhydrite (on average, about 83% anhydrite) that forms the Sunniland Formation's lower seal. It also contains irregularly interbedded layers of micritic limestone, gray and non-porous dolomite, and minor amounts of calcareous shale (Applegate & Pontigo, 1984; Applin & Applin, 1965; Oglesby, 1965). Salt beds were also observed within the lower portion of the unit in the Florida Keys, and are not known to exceed 9 m (30 ft) in thickness (Applin & Applin, 1965; Applegate & Pontigo, 1984). The Punta Gorda Anhydrite is a wedge-like unit that is approximately 183 m (600 ft) thick along the Trend; however, thicknesses of up to 250 m (820 ft) have been observed in Collier County (Applegate & Pontigo, 1984).

2.3.2.2 *Sunniland Formation*

The Lower Cretaceous Sunniland Formation was deposited on a very-slowly subsiding platform in a shallow-water marine environment, and sedimentation was greatly affected by sea level transgressions and regressions, which resulted in several sequences of carbonates and evaporites within the formation (Lane, 1994). The contact

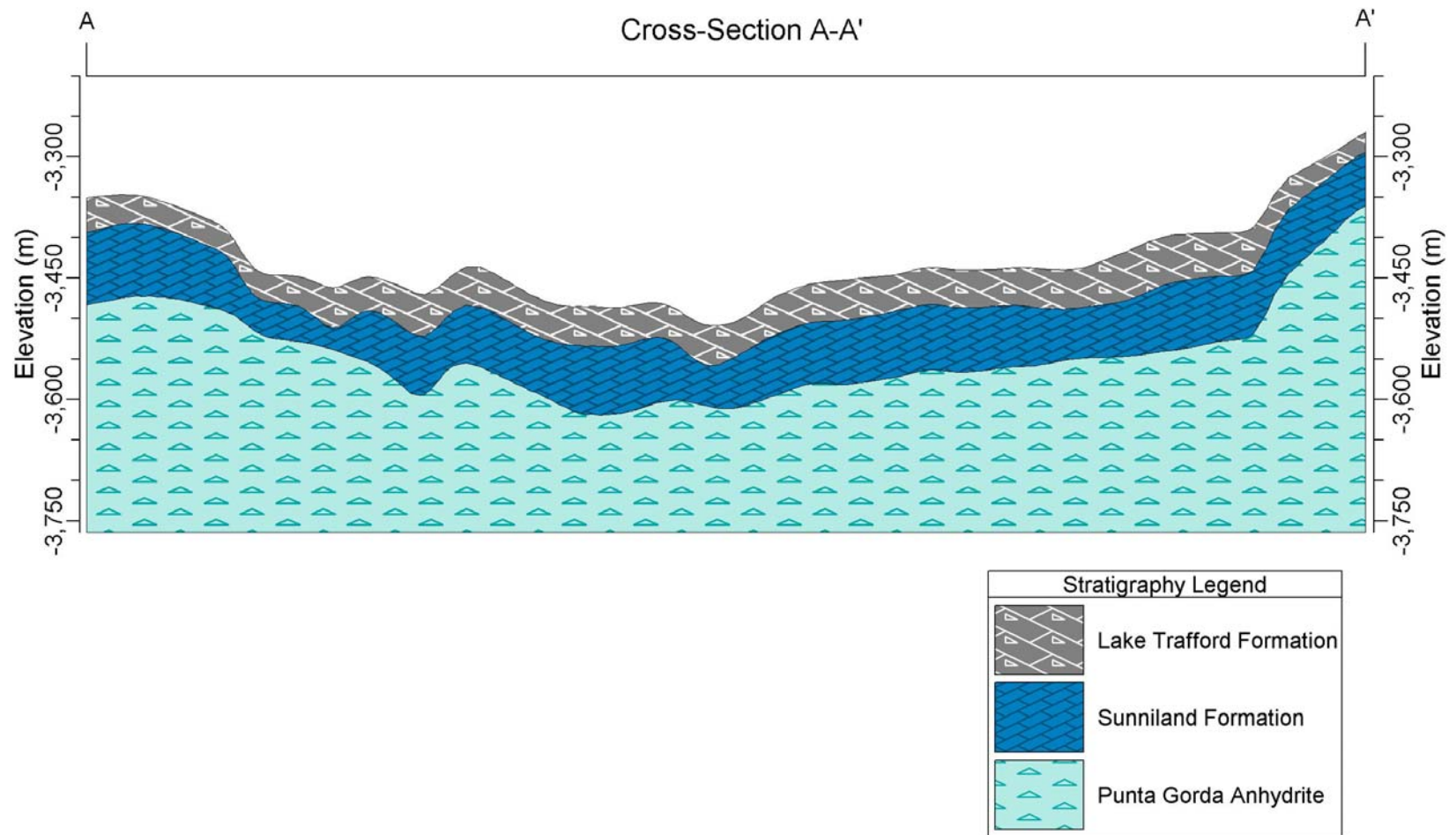


Figure 2-3: Stratigraphic cross-section along the length of the Trend, as denoted in Figure 2-1.

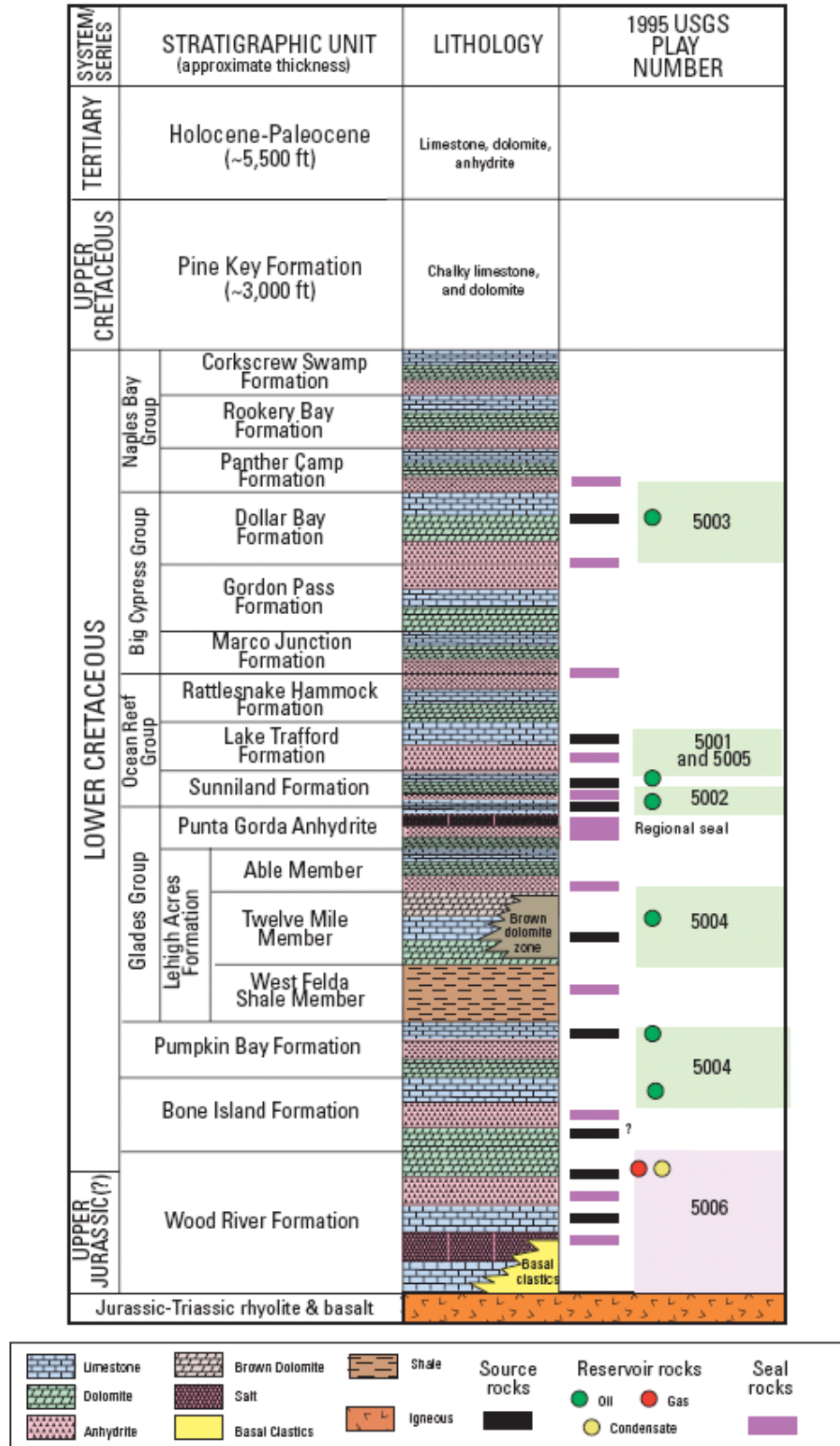


Figure 2-4: Stratigraphic column of the SFB along the Trend (from: Pollastro et al., 2001).

Table 2-2: Formation picks for exploratory/discovery oil wells evaluated in this study.

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
92	Collier	7	3,468	55	3,523	73	3,597
103	Collier	6	3,551	44	3,595	62	3,656
115	Miami-Dade	3	3,222	52	3,274	79	3,353
129	Miami-Dade	3	3,441	45	3,487	64	3,551
130	Collier	3	3,441	67	3,508	99	3,607
167	Miami-Dade	3	3,378	68	3,446	66	3,512
205	Miami-Dade	2	3,392	55	3,447	78	3,525
214	Miami-Dade	2	3,395	50	3,446	79	3,524
278	Miami-Dade	3	3,419	52	3,471	79	3,550
279	Hendry	12	3,436	45	3,481	--	--
300	Collier	6	3,475	40	3,515	80	3,596
311	Collier	5	3,487	45	3,532	--	--
326	Hendry	11	3,439	51	3,490	--	--
331	Miami-Dade	3	3,392	62	3,453	70	3,523
360	Hendry	10	3,444	38	3,482	64	3,546
376	Miami-Dade	3	3,400	53	3,453	85	3,539

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
384	Collier	5	3,483	43	3,525	--	--
386	Miami-Dade	3	3,381	72	3,454	62	3,516
401	Collier	7	3,501	60	3,561	73	3,634
425	Lee	9	3,449	47	3,496	77	3,573
437	Hendry	10	3,442	48	3,490	67	3,557
472	Charlotte	9	3,332	48	3,380	76	3,456
475	Charlotte	12	3,284	42	3,326	80	3,406
477	Collier	6	--	--	3,549	79	3,628
486	Hendry	10	3,439	41	3,480	75	3,555
488	Hendry	10	3,433	32	3,465	45	3,510
527	Lee	9	3,428	51	3,479	72	3,551
561	Hendry	6	3,443	43	3,485	--	--
564	Monroe	3	3,507	54	3,560	45	3,605
565A	Hendry	6	3,418	52	3,470	69	3,539
596	Collier	3	3,509	63	3,573	90	3,663
662	Hendry	6	3,427	43	3,470	73	3,543

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
683	Charlotte	8	3,365	46	3,412	84	3,495
684	Lee	9	3,445	52	3,497	73	3,570
697	Collier	9	3,450	52	3,502	67	3,569
700	Hendry	7	3,493	48	3,541	75	3,616
702	Hendry	6	3,427	43	3,470	73	3,542
735	Lee	9	3,516	51	3,567	72	3,639
736	Collier	5	3,500	50	3,550	77	3,628
754	Monroe	2	3,413	86	3,499	53	3,552
758	Lee	6	3,415	45	3,460	70	3,530
760	Collier	9	3,464	49	3,513	70	3,584
803	Collier	11	3,467	56	3,523	87	3,610
821	Collier	5	3,490	46	3,535	--	--
829	Collier	3	3,415	53	3,467	81	3,548
831	Collier	3	3,470	50	3,520	90	3,610
838	Collier	5	3,482	42	3,524	--	--
853	Collier	7	3,479	45	3,524	78	3,602

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
858	Lee	6	3,520	44	3,564	--	--
859	Lee	6	3,513	42	3,555	--	--
864	Hendry	8	3,483	43	3,525	84	3,609
865	Collier	5	3,452	47	3,500	83	3,582
871	Collier	4	3,488	55	3,543	76	3,619
897	Collier	5	3,490	45	3,535	90	3,625
904	Hendry	10	3,439	50	3,489	64	3,554
926	Hendry	10	3,445	47	3,492	68	3,560
928	Collier	4	3,416	51	3,467	87	3,555
947	Collier	8	3,514	49	3,563	83	3,646
951	Hendry	9	3,418	43	3,461	68	3,529
982	Collier	5	3,505	45	3,550	84	3,634
983	Hendry	11	3,442	48	3,490	--	--
990	Hendry	11	3,399	43	3,442	67	3,509
1014	Lee	7	3,439	43	3,482	76	3,558
1016	Collier	11	3,482	55	3,537	69	3,606

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
1026	Hendry	9	3,443	47	3,490	62	3,552
1057	Collier	9	3,453	37	3,489	--	--
1059	Collier	5	3,456	54	3,509	79	3,588
1063	Collier	4	3,450	40	3,490	83	3,573
1065	Collier	5	3,459	48	3,506	74	3,581
1070	Hendry	9	3,420	40	3,460	--	--
1086	Collier	3	3,455	37	3,492	59	3,551
1118	Collier	5	3,570	43	3,612	--	--
1119	Collier	6	3,598	55	3,652	--	--
1127	Collier	7	3,509	43	3,552	91	3,643
1131	Lee	9	3,527	39	3,566	--	--
1134	Collier	7	3,519	43	3,562	92	3,654
1142	Collier	6	3,477	46	3,523	--	--
1147	Hendry	9	3,443	52	3,495	--	--
1151	Hendry	9	3,421	40	3,461	--	--
1201	Collier	7	3,476	42	3,518	82	3,600

Well P#	County	Ground Elevation (m)	Top of Lake Trafford Formation (m bls)	Total Thickness (m)	Top of Sunniland Formation (m bls)	Total Thickness (m)	Top of Punta Gorda Anhydrite (m bls)
1202	Collier	10	3,451	38	3,489	--	--
1208	Collier	7	3,484	43	3,527	82	3,609
1216	Collier	4	3,442	50	3,492	80	3,571
1240	Collier	5	3,499	46	3,545	--	--
1292	Hendry	9	3,419	48	3,467	60	3,528

between the Sunniland Formation and the underlying Punta Gorda Anhydrite is generally sharp; however, in some instances the contact is gradational and thin beds of anhydrite interfinger with limestone and dolomite lenses of the Sunniland Formation. The Sunniland Formation is a saline formation that was initially referred to as the “Sunniland Limestone;” however, because the unit also contains various amounts of dolomite and anhydrite, as opposed to solely being a limestone, the unit was also referred to as the “Sunniland Formation.” The name was officially changed to the “Sunniland Formation” by Applegate and Pontigo (1984) around the mid-1980s.

The “reefs” which make up the Sunniland Formation are not considered true patch reefs, but are instead referred to as “localized mounds” which were originally composed of marine animals, primarily rudistids, as well as pellets and other organic, sea-floor debris (Lane, 1994). These mounds were also created by calcareous algae, seaweed, and various types of foraminifera and gastropods (Lane, 1994). Several different lithologic units can be characteristic of the Sunniland Formation, each of which was either deposited during a sea level regression or transgression, although not all units are found locally. The lowermost unit of the formation (Unit 5), sometimes called the “Rubble Zone” due to its tendency to fracture during drilling operations, consists of a dark-gray or dark-brown, organic-rich, indurated, conchoidally fracturing, occasionally argillaceous, micritic limestone that often contains stylolites infilled with bitumous or argillaceous residue indicative of post-depositional alteration (Applegate & Pontigo, 1984; Pontigo, 1980). The overlying black shale unit (Unit 4) is a dense, organic-rich, argillaceous limestone that, together with the underlying “Rubble Zone” is known as the Cape Sable Member of the formation, and is considered a potential petroleum source rock in certain areas of the SFB (Applegate & Pontigo, 1984; Ferber, 1985). A confining unit consisting of a light-brown to cream-colored, miliolid-rich, occasionally dolomitic limestone overlies the Black Shale unit, and forms a local seal for the formation’s oil

plays. The remaining 30.5 m (100 ft) of the Sunniland Formation (Units 1, 2, and 3) consists of the most oil-productive units of the formation, and is generally bioclastic limestone composed mainly of rudistids, algal plates, foraminifera, and pelletal debris that grades laterally into miliolid-rich, non-porous limestone (Applegate & Pontigo, 1984). Thin layers and nodules of anhydrite are located throughout the Sunniland Formation in varying abundance and thickness, and were predominantly deposited as gypsum that were later altered to anhydrite, although some may have primarily been deposited as anhydrite (Klopp, 1975). Dolomite beds within the Sunniland Formation reach a maximum thickness of 18 m (60 ft) along the Trend, which is approximately 20% or more of the total thickness of the formation. Up-dip and to the northeast of the Trend, dolomite thickness decreases to 6 m (20 ft) and then gradually increases to 30.5 m (100 ft) in Palm Beach County, while down-dip and to the southwest of the Trend, in the deeper part of the SFB, dolomite abruptly pinches out (Figure 2-5; Applegate & Pontigo, 1984; Pollastro et al., 2001).

The Sunniland Formation has been penetrated by oil exploratory/discovery wells in central and southern Florida. The up-dip limit of the Sunniland Formation extends across the Florida peninsula from just south of St. Petersburg east to the vicinity around Stuart. The thickness and depth of occurrence for the formation generally increase toward the southwest within the SFB (Klopp, 1975). Figure 2-6 and Figure 2-7 were created based upon data from wells evaluated in this study, and display the thickness of the Sunniland Formation and the top of the Sunniland Formation, respectively, along the Trend.

According to Applin & Applin (1967), all wells that have penetrated the entire Sunniland Formation indicate that the unit is continuously underlain by the Punta Gorda Anhydrite, with the exception of two wells in Palm Beach County, where the Punta Gorda Anhydrite is missing and the Sunniland Formation is underlain by lower Trinity-

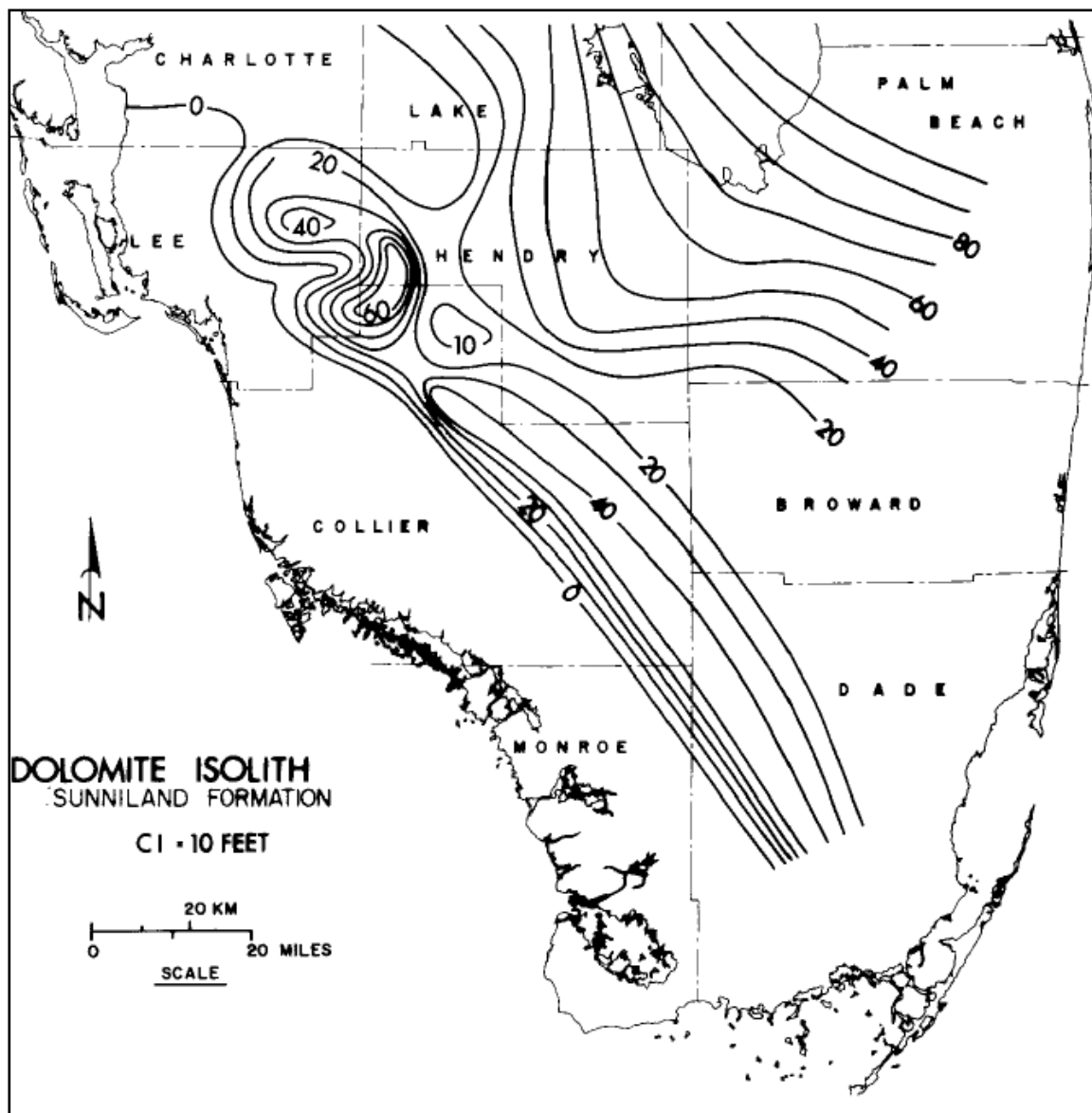


Figure 2-5: Contour map displaying the thickness of dolomite within the Sunniland Formation (from: Applegate & Pontigo, 1984).

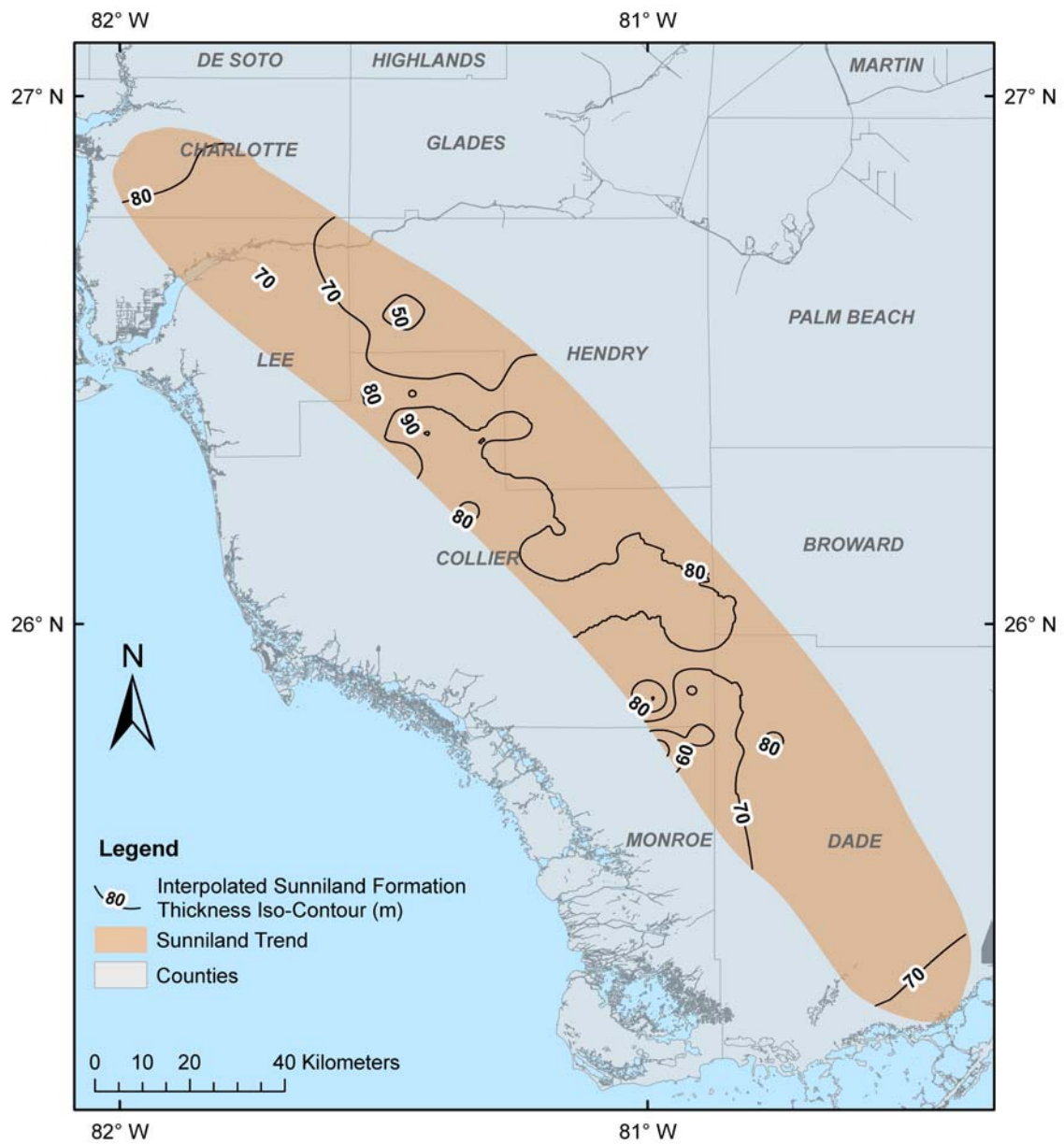


Figure 2-6: Isopach contour of the Sunniland Formation along the Trend.

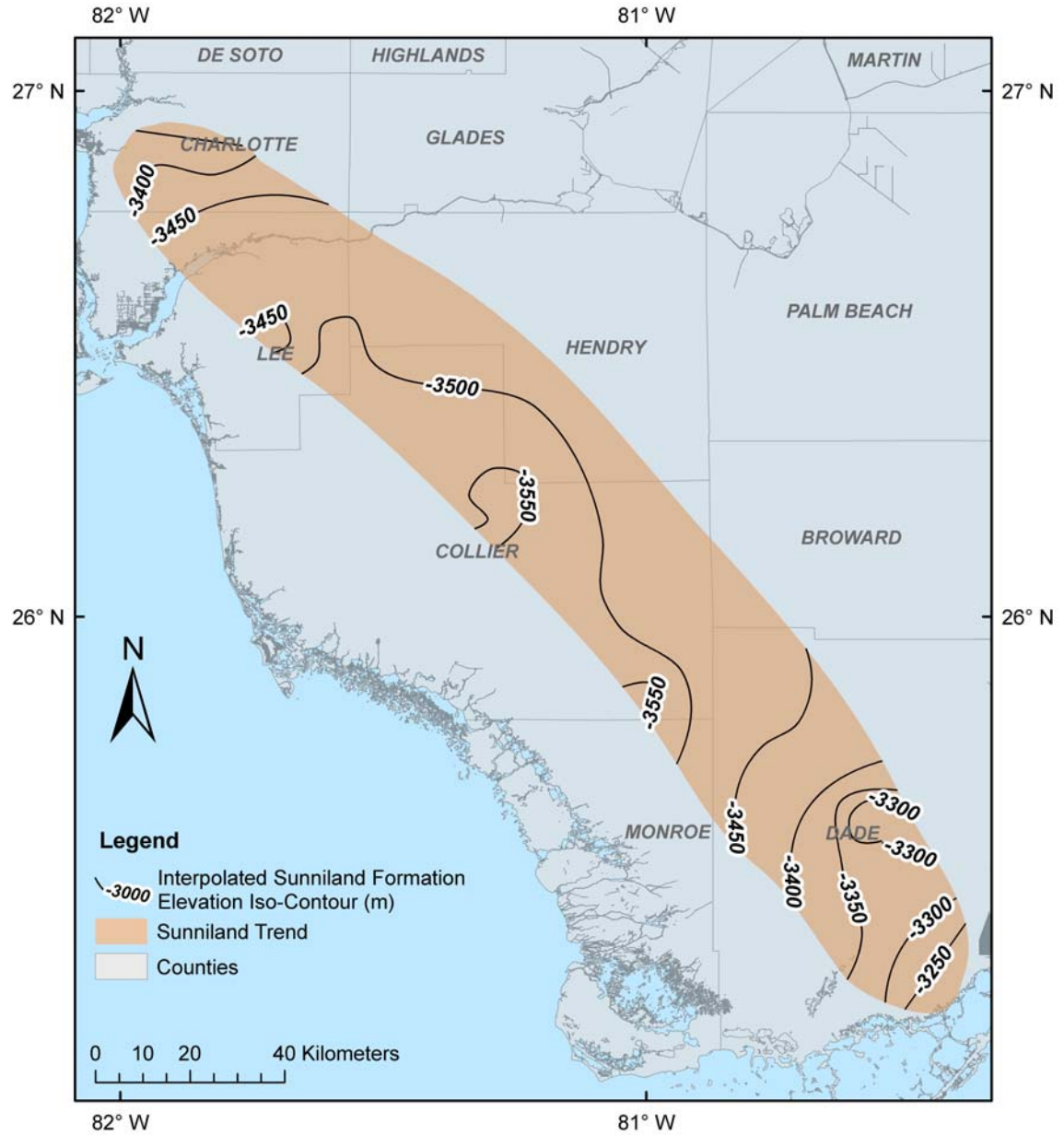


Figure 2-7: Isolith contour of the Sunniland Formation along the Trend.

age rocks of the Lower Cretaceous. The thickness of the Sunniland Formation varies throughout its extent, and ranges from 21-91 m (69-300 ft) thick (Applin & Applin, 1967); however, in the study area along the Trend, the formation generally ranges from 61-99 m (200-325 ft) thick, with two, spatially limited locations having thicknesses less than 61 m (200 ft), as seen in Figure 2-8. The variation in thickness for the formation is thought to be due to the sedimentation impacts of the Peninsular Arch, as well as to the effects of a small anticline flexure that formed contemporaneously with the deposition of the Sunniland Formation (Klopp, 1975).

Oil in the Sunniland Formation originated from algal source beds present in the formation, and subsequently migrated via stylolites and filled reservoirs in porous skeletal and pelletal, as well as micritic, limestone (Klopp, 1975). Dolomicrites or anhydrites of low permeability form the stratigraphic traps that restrict further oil migration. Because oil migration and restriction occurs in this manner, source rocks are consequently located within several carbonate-evaporite sequences of the Sunniland Formation (Klopp, 1975). The majority of the oil production in the Trend comes from dark, organic-rich limestone, which can be found in the individual bioclastic mounds that are typically located in the upper Sunniland Formation (Lane, 1994; Pollastro et al., 2001). Southwest of the Trend, the upper Sunniland Formation is replaced by anhydrites and the dark, organic-rich carbonates are instead found in the micrites of the lower Sunniland Formation (Applegate & Pontigo, 1984). Applegate (1983) points out that productive segments within the top 30.5 m (100 ft) of the Sunniland Formation along the Trend have a miliolid content of around 5%, whereas the non-productive segments of the formation have a miliolid content of around 20%. Wave-action probably winnowed away the chalky, calcareous ooze deposited where miliolids once flourished in calm waters, therefore contributing to the highly porous nature of the bioclastic, productive mounds. In other areas, the productive mounds were replaced by chalky, non-

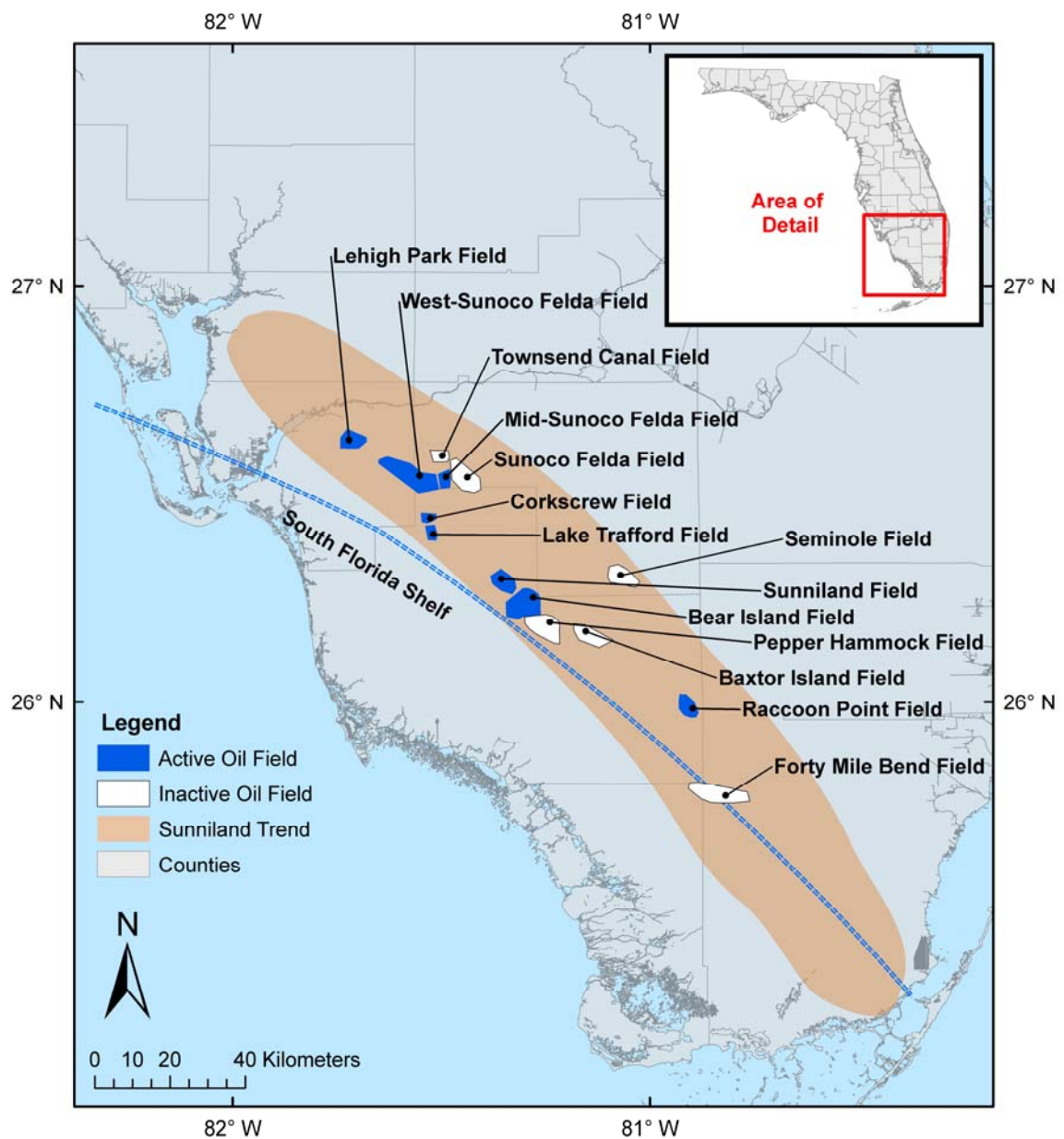


Figure 2-8: Map displaying the active and inactive oil fields of the Trend, as well as the South Florida Shelf (revised from: Applegate & Pontigo, 1984; Ferber, 1985).

porous/non-permeable, miliolid-rich beds that formed stratigraphic traps, such as those seen in Sunoco Felda and West-Sunoco Felda fields (Applegate, 1983). Specifically, up-dip and to the northeast of the Trend, the Sunniland Formation thins and the dark, organic-rich micrites are partially replaced by dolomite, while the porous bioclastic mounds grade laterally into miliolid-rich limestone of low porosity and permeability (Applegate, 1983; Applegate & Pontogo, 1984; Grinnell, 1976; Lane, 1994).

The general producing zone in the Sunniland Formation is within the upper portion, from about 3,451 m (11,322 ft) bls to 3,625 m (11,892 ft) bls, although in some areas it can be as deep as 3,810 m (12,500 ft) bls, with each productive zone averaging approximately 6-15 m (20 to 50 ft) in thickness (Applegate & Pontigo, 1984). Lake Trafford Field has the only commercial oil well producing from the lower Sunniland Formation. Production in this area is believed to be due to fracture porosity, as oil in this portion of the formation is typically trapped in the micritic limestone and is not easily recovered (Applegate & Pontigo, 1984).

2.3.2.3 Lake Trafford Formation

Once Sunniland Formation deposition ceased, the SFB anhydrites spread laterally out of the lower basin and across the South Florida Shelf, forming a broad, flat evaporite surface known as the top of the Lake Trafford Formation (Grinnell, 1976). The contact between the Lake Trafford Formation and the Sunniland Formation is typically gradational, with lenses of limestone containing nodular anhydrite interfingering with limestone and dolomite. The Lower Cretaceous Lake Trafford Formation, also known as the “Upper Massive Anhydrite,” would provide the upper seal and caprock for the Sunniland Formation during CCS operations, as displayed in Figure 2-4. The Lake Trafford Formation was deposited in a tidal flat/sabkha depositional environment that created a sequence of anhydrite, fine dolomite, and gray, micritic, skeletal limestone (Ferber, 1985; Halley, 1985). In the SFB, thickness for the unit ranges from

approximately 61 m (200 ft) to ~107 m (350 ft) (Applegate & Pontigo, 1984; Halley, 1985); however, within the study area along the Trend, thicknesses range from 32-86 m (105-281 ft), and average 40-49 m (130-160 ft) thick.

2.4 Sunniland Trend Oil Fields

There are two oil- and gas-producing regions in Florida: Santa Rosa County in northwest Florida, or the Panhandle, and the Trend of the SFB in Charlotte, Lee, Collier, Hendry, Monroe, and Miami-Dade counties. In 2007, the Trend oil fields came under the control of a single operator, BreitBurn Energy Partners L.P. (BreitBurn), a company that specializes in extracting the final recoverable oil volume from post-mature oil fields, although several individual oil-production wells are currently run by other operators.

The Trend was discovered in 1940 at Sunniland Siding in Collier County, via a discovery well drilled by Humble Oil Company known as Humble Oil Company Gulf Coast Realities Well No. 1. This discovery well consequently led to the exploration of the Trend and to the development of its first commercial oil field, Sunniland Field. Sunniland Field comprises 2,080 acres and had an estimated 38 million barrels of OOIP upon discovery, of which 19 million barrels were recovered during primary and secondary recovery (Applegate & Pontigo, 1984; Pontigo, 1980), for a recovery efficiency of ~50%. As shown in Figure 2-8, 13 additional commercial oil fields were later established within the Trend; however, six are currently inactive due to low productivity, according to the 2008 Florida Geological Survey (FGS) Annual Production Report (FGS, 2008). For all 14 Trend oil fields, there were an estimated 261 million barrels of OOIP and 106 million barrels of estimated recoverable oil, giving a recovery rate of ~41%. For comparison, the three oil fields in the Florida Panhandle (Jay Field, Blackjack Creek Field, and McClellan Field) have collectively produced about 480 million barrels of oil since their establishment. The largest and most productive Trend oil field is West-Sunoco Felda (approximately 7,660 acres), which has yielded ~47 million barrels of oil since 1966 out

of an estimated 143 million barrels of OOIP (FGS, 2008; Pollastro et al., 2001). Next in size are the two most recently discovered commercial oil fields within the Trend, Bear Island and Raccoon Point fields. Bear Island Field has produced nearly 13 million barrels of oil since 1972, and Raccoon Point Field has produced 18 million barrels of oil since 1978 (FGS, 2008). Of the remaining Trend commercial oil fields, Sunoco-Felda, Mid-Sunoco Felda, Lehigh Park, and Corkscrew fields produced no more than ~10 million barrels of oil, while Lake Trafford, Baxter Island, Seminole, Pepper Hammock, Townsend Canal, and Forty Mile Bend produced no more than a few hundred thousand barrels of oil.

As shown in Figure 2-9, and later discussed in sections 2.6 and 2.7 of this chapter, the porosity of the source rocks in the isolated mounds of the Trend is quite high, averaging 15% and reaching 45% in some sections; however, not all of the higher porosity sections support oil production, and the area underlain by porous units within the upper Sunniland Formation is much larger than the area of the producing oil fields (Applegate & Pontigo, 1984; Lloyd, 1996). In addition, Beinert (1976) reports that an area more than 50 mi² within the Trend may be underlain by geologic units, at least 8 m (25 ft) thick, that contain porosity values of 15% or greater.

Griffin et al. (1969) reported a geothermal gradient in the Trend of 0.98°F/30.5 m (100 ft) to 1.08°F/30.5 m (100 ft). Bottom-hole temperatures (BHTs) for the Sunniland Formation within the study area and along the Trend range from 36-128 degrees (°) Celsius (C), with an average temperature of 84°C. The BHTs for the production/dry-hole wells completed in the Sunniland Formation are comparatively low, and low BHTs typically represent conditions that are inadequate for the generation of light, mature oils. The thermal maturity of the Sunniland Formation is moderately immature in up-dip wells and grades to moderately mature in down-dip wells, with a gradual increase in thermal

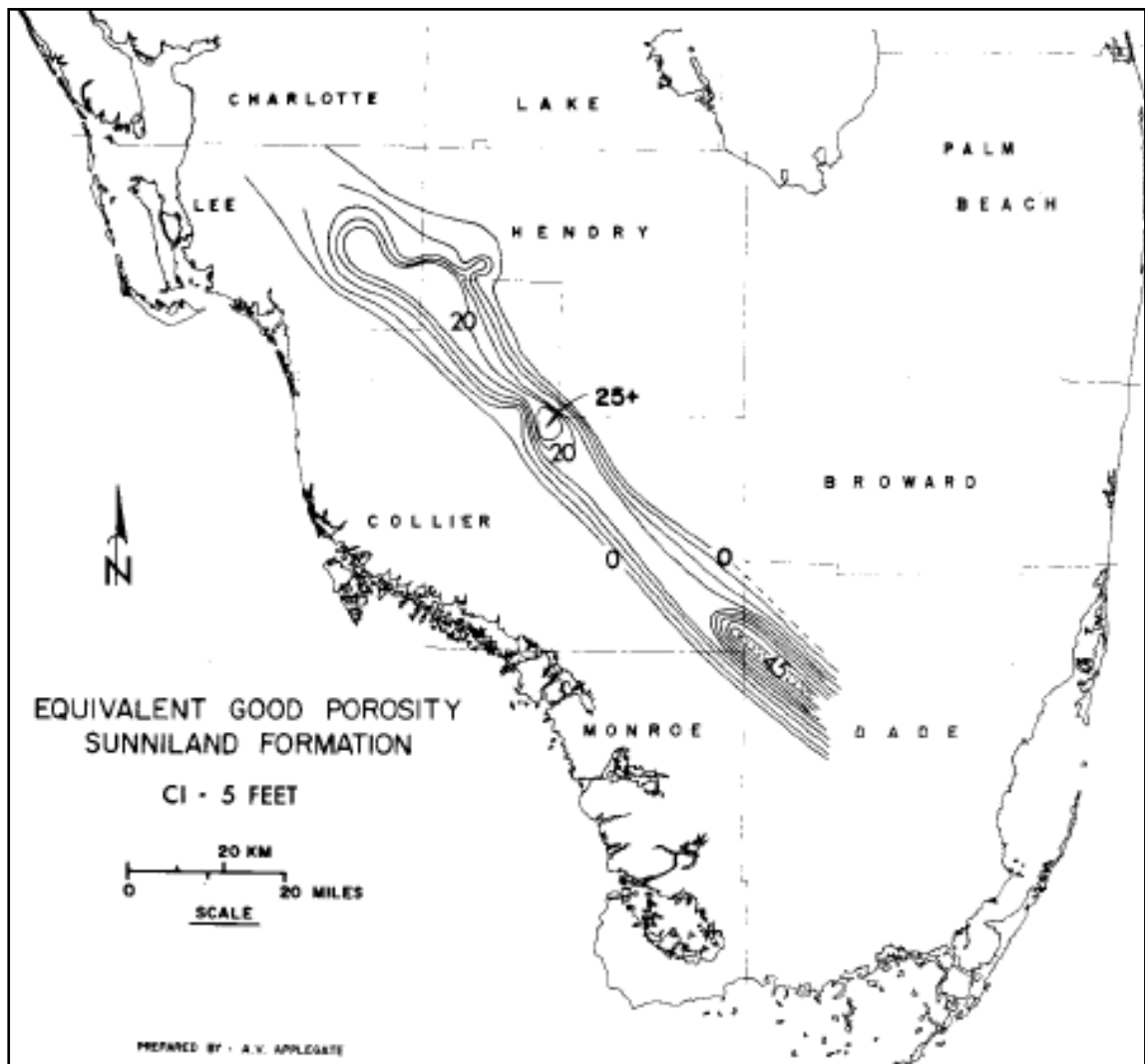


Figure 2-9: Equivalent porosity of Sunniland Formation (from: Applegate & Pontigo, 1984).

maturity with depth; therefore, the hydrocarbon-generating potential of the formation is poor up-dip, but is excellent down-dip in the fore-reef environment (Applegate & Pontigo, 1984).

Oil produced from the upper Sunniland Formation shell mounds has an American Petroleum Institute (API) gravity that ranges from 24°-28° (Lloyd, 1996). For comparison, light, Texas crude-oil typically has an API gravity of about 40° (U.S. Energy Information Administration, 2009). An API gravity value is an indication of how heavy or light liquid-petroleum is when compared to water. If liquid-petroleum has an API gravity value greater than 10°, it is lighter than water; conversely, if the API gravity value is less than 10°, it is heavier than water and therefore sinks. All API gravities are viewed in terms of relative density when comparing reservoirs of oil. Specifically, the higher the API gravity, the less dense and lighter the oil. Oils with API gravities of 40°-45° are the most ideal and sought-after types of oil, as they have shorter hydrocarbon chains, are less viscous, are more mature, and require less refining (French, 1989). Crude oil with API gravities less than 10° is called bitumen, which is a sticky, tarry form of petroleum that must be heated or diluted before it will flow. Bituminous residue generally fills stylolitic traceries that are common in the Sunniland Formation. In addition, bituminous material fills small fractures and coats the walls of small pores and microfossils within the formation (Applin & Applin, 1967). The gas to oil ratio for the Sunniland Formation within the Trend is 100:1, and this fact coupled with the low API gravities of the formation's oil are thought to be due to the oil's generation near the low-temperature limits for oil formation (Applegate & Pontigo, 1984).

According to Oglesby (1966) and Applegate & Pontigo (1984), there are several pronounced minimum gravity anomalies that are aligned in a northwest-southeast trending direction, from Lee County to Miami-Dade County (Figure 2-10). The Trend oil

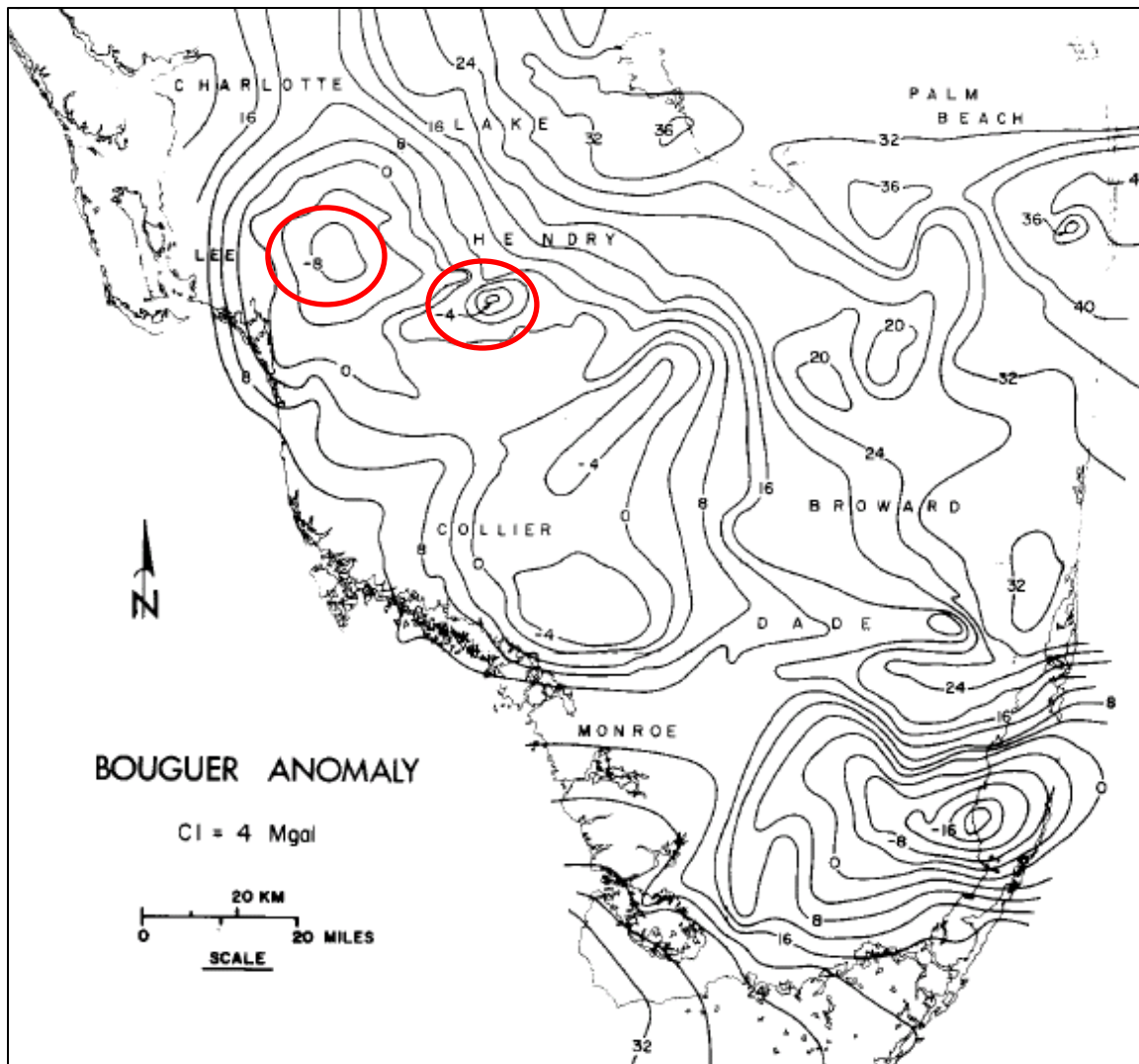


Figure 2-10: Bouguer anomaly map of south Florida, depicting minimum gravity anomalies (from: Applegate & Pontigo, 1984). The two northernmost anomalies are outlined in red.

fields that have been established to date are located on or near the two northernmost anomalies. Oglesby (1966) believed that during the Early Cretaceous, subtle topographic highs were probably created due to rhyolite of the Late Triassic and Early Jurassic ages, which subsequently provided a suitable environment for the development of porous zones within the Sunniland Formation, and ultimately led to the creation of the gravity anomalies. The high density areas of southern Florida are thought to be due to the presence of anhydrite units.

2.5 Methods and Procedures

2.5.1 Well Selection

Collectively, 85 exploratory/discovery oil wells were studied throughout the Trend, for evaluation of the Sunniland Formation in both the Trend and the Trend oil fields. The location of each of these wells is depicted in Figure AIII-1 of Appendix III. All evaluated wells provided information for Lake Trafford Formation, Sunniland Formation, or Punta Gorda Anhydrite picks; however, only 69 of these wells were used to derive porosity values for the Sunniland Formation. For those wells used for porosity derivation, there were three major criteria for the well-selection process: 1) the well had to penetrate the entire Sunniland Formation, 2) the well had to have at least one geophysical log available that covered the entire Sunniland Formation, from which porosity could be derived, and 3) for wells that had intentional or unintentional curves in the wellbore, the porosity log had to be reported in true vertical depth (TVD). In rare cases where no porosity logs could be identified that covered the entire formation for a specific area, wells with porosity logs that covered most of the Sunniland Formation, minus about +/-15 m (50 ft) in the lower portion of the unit, were selected for evaluation, as typically the major porous and potential injection zones were located within the upper 30.5-46 m (100-150 ft) of the formation; however, there could only be one of these types of wells located in a specific area of interest (e.g., an oil field).

For each of the Trend oil fields, at least three wells were chosen for a field-wide evaluation of the Sunniland Formation and its porosity, as well an evaluation of the nature of the seals or caprock for the formation for use in CCS operations. Typically, these three wells consisted of an oil-production well, a non-producing/dry-hole well near the production well, and an isolated, dry-hole well located within the outer extent of the oil field, herein denoted as P, NP, and I, respectively; however, limitations existed for this type of well-selection in certain fields, specifically the smaller and less-explored or developed fields, due to the challenges of identifying wells that both penetrated the entire extent of the Sunniland Formation, as well as providing at least one porosity log. Where such limitations existed, every effort was made to identify three wells that met the two major well-selection criteria, regardless of production or non-production/dry-hole status. Additionally, there were three Trend oil fields (Corkscrew Field, Raccoon Point Field, and Townsend Canal Field) where only two exploratory/discovery wells could be identified that met the three major well-selection criteria.

All 85 discovery/exploratory wells located throughout the extent of the Trend, including the 41 wells that were used to evaluate the Trend oil fields, were used to evaluate and interpolate the porosity of the Sunniland Formation throughout the extent of the Trend, as well as to examine the potential seals or caprock for the formation. Similar limitations existed in the well-selection process for the full extent of the Trend. Evaluation of the Trend was limited to the existing well-coverage, which in some regions was dense due to the presence of past or current oil production or exploration, while in some regions well-coverage was sparse, such as the eastern boundary of the Trend and the northern and southern extent of the Trend in Charlotte and Miami-Dade counties, respectively. In addition to well-coverage limitations throughout the extent of the Trend, challenges existed in meeting the three major well-selection criteria; therefore, efforts were made to select wells that provided the best possible coverage of the north

northwestern, western, eastern, and south southeastern extents of the Trend which also met the three major well-selection criteria.

2.5.2 Porosity Determination

Geophysical logs for exploratory/discovery wells within the Trend were examined in order to obtain data for the estimation of porosity for the Sunniland Formation, and to identify the upper and lower boundaries of the Lake Trafford Formation and Sunniland Formation, as well as the top of the Punta Gorda Anhydrite. All geophysical porosity logs were provided by the Florida Department of Environmental Protection (FDEP) Bureau of Mining and Minerals Regulation Oil and Gas Section. With the exception of P# 1292, all geophysical logs reviewed in this study were created by Schlumberger and were interpolated using figures created by the company specifically for Schlumberger geophysical-log interpretation. Geophysical logs created for P# 1292 were created by Halliburton; therefore, figures designed for Halliburton geophysical-log interpretation were used for porosity derivation. Schlumberger (1989) provided all Schlumberger porosity-log interpretation figures for porosity determination, an example of which is provided in Figure 2-11, and Halliburton (2008) provided all Halliburton porosity-log interpretation figures for porosity determination, all of which are located in Appendix II. The types of geophysical porosity logs used in this study for the purpose of deriving porosity values included bulk density logs, borehole-compensated sonic (BCS) logs (i.e., acoustic logs), compensated neutron logs (CNL), and dual-porosity, compensated neutron-compensated formation density (CNL-FDC) logs.

The measurements made during the generation of sonic, neutron, and density logs depend upon the porosity (Φ) of the penetrated formation, the lithology of the formation, the type of formation fluid, and, in some instances, the geometry of the pore structure (Schlumberger, 1989). When the lithology of the formation is known, correct porosity values can be obtained using a single porosity log; however, when the lithology

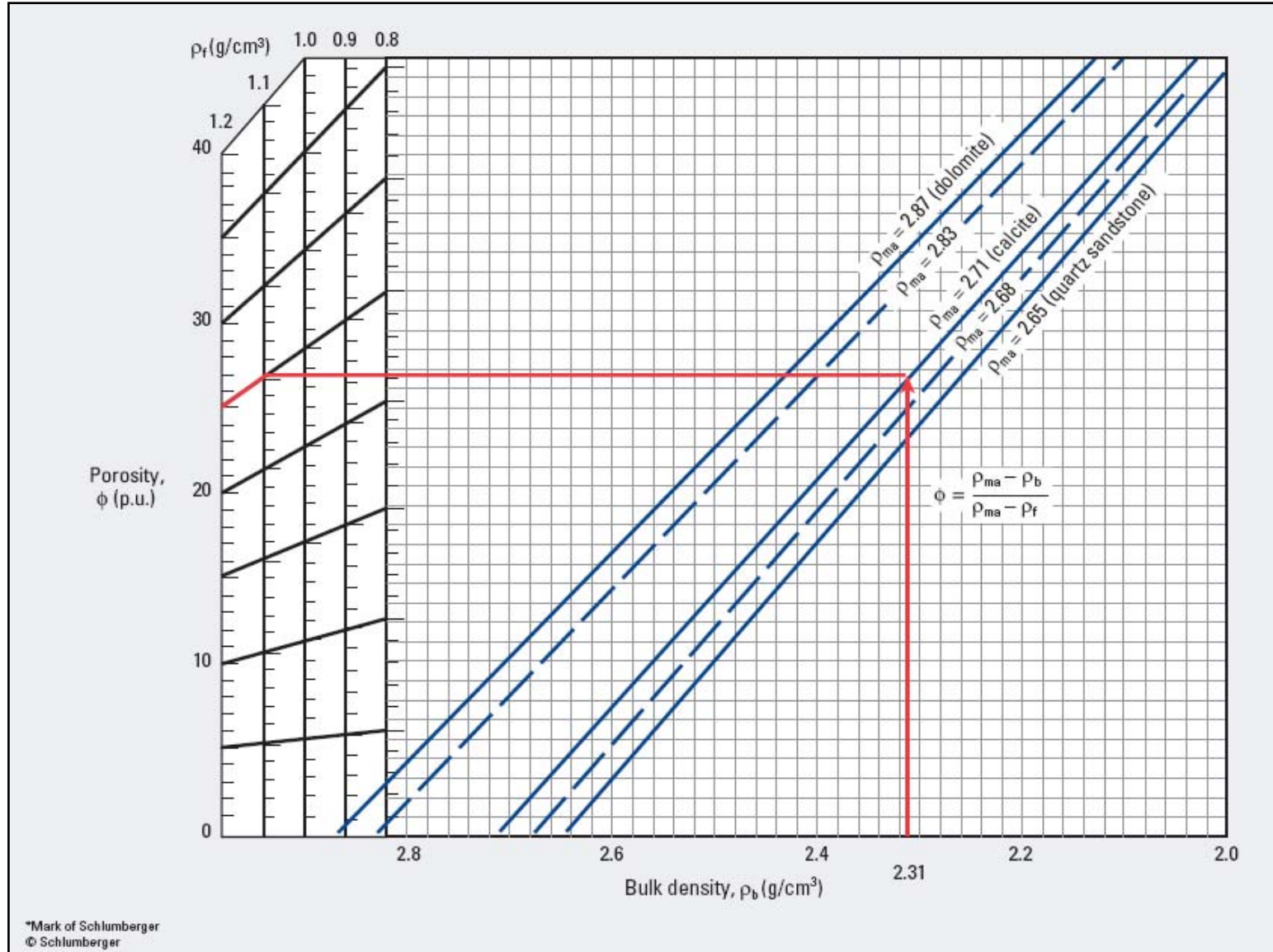


Figure 2-11: Determination of porosity from true bulk density (from: Schlumberger, 1989).

is not known, more than one geophysical log has to be used or the lithology has to be confirmed using cores or well cuttings for the corresponding well, or by using mud logs and core descriptions or analyses which describe the lithology of the formation at various intervals. Rock cores and well cuttings were provided by the FGS, when necessary. For this study, every effort was made to use wells that had more than one porosity log available, so that more than one method of porosity determination could be used to ultimately derive the most accurate value of porosity for the Sunniland Formation. In addition, cross-plots were used when multiple porosity logs were available, which were effective tools for critiquing porosity and lithology determinations.

Porosity for bulk density logs was derived by applying the corrected bulk density (ρ_b) value determined from Figure All-1 to Figure All-2. Figure All-2 uses log-derived bulk density (ρ_{log}) corrected for borehole size, matrix density (ρ_{ma}) of the formation (i.e., dolomite, calcite [limestone], or quartz sandstone), and fluid density (ρ_f), which is the density of the fluid saturating the rock immediately surrounding the borehole (i.e., mud-filtrate), to determine the density-porosity of the formation (Schlumberger, 1989). Lithology has to be known in order to use bulk density logs and Figure All-2 for porosity derivation.

For BCS logs, interval transit times (in microseconds per ft [$\mu\text{sec/ft}$]) were used to derive porosity values using Figure All-3. There are two sets of curves for matrix velocity (v_{ma}) in this figure: a blue set that employs a weighted average transform, and a red set that is based upon the empirical observation of the lithology (Schlumberger, 1989). For both sets of curves, the fluid velocity (v_f) of the formation is assumed to be 5,300 ft/s. The red set is recommended for porosity derivation, as it does not require the selection of different matrix times for a given lithology and it gives adequate porosity values for unconsolidated formations (Dewan, 1983). For this method of porosity derivation, lithology for the examined interval has to be known, or the BCS log has to be

used in conjunction with a bulk density, CNL, or CNL-FDC porosity log for accurate porosity and lithology determination. When bulk density or CNL logs were used for porosity derivation in addition to the BCS log for a given well, a cross-plot, provided in figures All-4 and All-5, was used to cross check the porosity and lithology determination that was made using the porosity logs. Figure All-4 is a cross-plot of BCS interval transit time versus ρ_b from a bulk density log and figures All-5 and All-6 are cross-plots of BCS interval transit time versus porosity derived from a CNL. All cross-plots are for freshwater drilling-fluid and contain two sets of curves: 1) porosity values for each matrix using the sonic time-average algorithm, and 2) the field-observation algorithm. For this study, porosity values were determined using the sonic time-average algorithm, as recommended by Schlumberger for use with carbonate units (Schlumberger, 1989).

Figure All-7 was used to convert CNL porosity values from limestone to dolomite, when necessary. Lithology has to be known in order to use a CNL for porosity derivation; therefore, additional porosity logs, mud logs, core descriptions, or rock cores were used to determine lithology and thus aid in determining the correct porosity values. The figure can be used with environmentally corrected thermal neutron porosities (TNPH) or with ratio-method thermal neutron porosities (NPHI), both of which can be reported in CNLs.

Porosity was determined from the CNL-FDC porosity log by using figures All-8 and All-9, which plot the density response against neutron porosity for the formation using freshwater drilling-fluid. Because the equiporosity lines for these cross-plots are virtually straight, porosities can be determined without the knowledge of lithology type (Dewan, 1983); however, in order to use the cross-plots, the limestone matrix noted on the geophysical log must be 'limestone' (Dewan, 1983).

2.5.3 Storage Capacity Calculation

Storage capacities for the Sunniland Formation were calculated using the volumetric equation for capacity calculation in saline formations provided by the NETL in the Carbon Sequestration Atlas for the United States and Canada (2007). A saline formation evaluated for storage is defined as a porous and permeable body of rock containing water with total dissolved solids exceeding 10,000 milligrams per liter, and therefore deemed unsuitable for drinking, that has the capacity to store large volumes of CO₂ (NETL, 2007). The storage capacity calculation for saline formations was used to assess and evaluate storage capacities for the Sunniland Formation within the entire Trend, including each Trend oil field. A separate volumetric equation for capacity calculation in oil and gas reservoirs is provided in NETL (2007); however, the equation can only be applied to production wells, as it requires the height of the hydrocarbon column in the reservoir, and many of the Trend oil field wells used in this study were non-productive (i.e., dry holes). In addition, pertinent data for use of the oil and gas reservoir storage capacity calculation was not available, such as percent oil saturation and amount of OOIP for each well field; therefore, since the Sunniland Formation is a saline formation throughout its extent, including its occurrence in the Trend oil fields, the saline formation equation was deemed more applicable for storage capacity evaluation in each Trend oil field. The volumetric equation for capacity calculation in saline formations uses consistent units and is as follows, with each parameter defined in Table 2-3:

$$G_{CO_2} = A h_g \Phi_{tot} \rho E$$

This equation estimates the storage capacity of a given formation within a given area, and does not specify the various CO₂ storage mechanisms that may be used in the process (i.e., structural and stratigraphic trapping, solubility trapping, hydrodynamic trapping, residual trapping, ionic trapping, and mineral trapping); however, displacement

Table 2-3: Definition of parameters for storage equation (adapted from: NETL, 2007).

Parameter	Units*	Description
G_{CO_2}	M	Mass estimate of Sunniland Formation CO_2 storage capacity
A	L^2	Geographical area that defines the region assessed for CO_2 storage capacity calculation
h_g	L	Gross thickness of the portion of the Sunniland Formation for which storage capacity is assessed within the region defined by A
Φ_{tot}	L^3/L^3	Average porosity of entire Sunniland Formation over thickness h_g
ρ	M/L^3	Density of CO_2 evaluated at pressure and temperature that represents the storage conditions anticipated for Sunniland Formation averaged over thickness h_g
E	L^3/L^3	CO_2 Storage Efficiency Factor that represents a fraction of the total pore volume that is filled by CO_2

*L is length; M is mass

of saline waters in the pore spaces of the formation by immiscible CO₂ is the fundamental trapping mechanism implicit in the calculation.

If the CO₂-injection wells are located regularly throughout the region of interest (i.e., an oil field) to maximize storage in the injection zone, the storage capacity estimate is the maximum amount available within the region because there is no restriction on the number of wells that could be used for injection (NETL, 2007). In addition, since formation heterogeneity is accounted for in the volumetric equation for storage capacity calculation, this estimate can be considered a fair approximation of the maximum storage capacity.

Polygons were created in ArcGIS™ Suite that encompassed a given region of interest (i.e., a Trend oil field or the entire Trend), such as those depicted in Figure 2-8. These polygons were used with ArcGIS™ Suite to calculate the area (A) of each region in order to estimate its storage capacity.

Brennan et al. (2010) presents methodology recently developed by the US Geological Survey (USGS) for evaluating geologic CO₂ storage units, and identifies porous units with porosity values of at least 8% as suitable for CO₂ sequestration. This investigation had an even more conservative approach, and identified porous zones within the Sunniland Formation with porosity values greater than or equal to 10% as appropriate for injection and storage of CO₂. Each exploratory/discovery oil well that was evaluated for porosity in this study has multiple porous zones within the Sunniland Formation that are at least 3 m (10 ft) thick and have porosities greater than 10%, which are separated by layers of dolomite or anhydrite of low porosity (<10%) and permeability and varying thickness. This vertical heterogeneity is displayed in the striplogs created for each well, located in Appendix V.

For each well evaluated for porosity in the study area, if a low-permeability layer occurred within the Sunniland Formation that exceeded 10% of the total thickness of the

unit for that well, then multiple, separate storage sub-zones were assigned to that well as part of the Sunniland Formation “storage zone,” which were separated by the low-permeability layer(s). Specifically, if there were two separate storage sub-zones in each well, they were termed the “upper” and “lower” storage zones, and if there were three separate storage sub-zones in each well, they were termed the “upper,” “middle,” and “lower” storage zones.

The value of h_g for each well was calculated in two different ways depending upon the use of the Sunniland Formation for either CO₂-EOR or CCS alone. During CO₂-EOR operations, CO₂ would only be injected and subsequently stored in the depth interval where residual oil content is highest in a given oil field. The injected-CO₂ would not be exposed to the entire Sunniland Formation for potential trapping and storage; therefore, for calculating the CO₂ storage capacity for the Sunniland Formation in each Trend oil field for use in CO₂-EOR operations, only the top major porous zone or oil-production zone within the formation was used for h_g determination in each well. This h_g interval may have also included thin lenses of low permeability units no more than 0.6 m (2 ft) thick. Conversely, for CCS operations, all major porous zones within the Sunniland Formation of the Trend could potentially be used for CO₂ storage, and therefore h_g needed to account for all storage sub-zones. For calculating the CO₂ storage capacity for the Sunniland Formation for the entire extent of the Trend for use in CCS operations, the value of h_g for each evaluated well was the total thickness of all the storage sub-zones in that well, or the sum of all of the thicknesses estimated for each sub-zone within that well. The final value of h_g that was actually used in the storage capacity calculation for either a given oil field or for the entire extent of the Trend was the average of each h_g value calculated for each well located in the region of interest.

In order to calculate the value of Φ_{tot} for the Sunniland Formation used in the storage capacity estimation for either a given oil field or for the entire extent of the Trend,

a Φ_{tot} value was first determined for each well. Each well's Φ_{tot} value was based upon an average of all the porosity values that were derived from the well's geophysical logs throughout the vertical extent of the Sunniland Formation within that well. If there were multiple storage sub-zones assigned to a given well, then an average porosity (Φ_{avg}) value was first estimated for each sub-zone, and then Φ_{tot} for that well was the average of each sub-zone's estimated Φ_{avg} value. The final value of Φ_{tot} that was used in the storage capacity calculation for either a given oil field or for the entire extent of the Trend was an average of the Φ_{tot} values that were estimated for each well.

The density of CO_2 and the ρ value used in the storage capacity estimation was 642.57 kg/m^3 , which was calculated using the hydrostatic pressure of the Sunniland Formation (~120 bar) and the average temperature for every h_g assigned to each evaluated well (84°C).

The CO_2 Storage Efficiency Factor (E) in the volumetric equation for storage capacity calculation is the "...multiplicative combination of volumetric parameters that reflect the portion of a basin's or region's total pore volume that CO_2 is expected to actually contact," and accounts for net- to effective-porosity, areal displacement efficiency, vertical displacement efficiency, gravity effects, and microscopic displacement efficiency (NETL, 2007). For saline formations, E accounts for the variables that act as physical barriers in a system that prevent CO_2 from contacting the entire available pore volume in the storage reservoir, and can also account for the volumetric difference between bulk, total-pore, and effective-pore volumes (NETL, 2007). Additionally, because the thickness of the geologic unit (h_g) and its total porosity (Φ_{tot}) are included in the storage capacity equation, E must account for adjusting gross thickness to net thickness, and total porosity to effective porosity (or interconnected porosity). Because E represents a number of variables, mechanisms, and processes that are typically unknown or may not be well-understood initially, specifically during preliminary basin-

scale storage capacity assessments, and because the subsurface can be highly diverse, determining an accurate and representative value of E can be challenging. According to NETL (2007), the value of E generally ranges from 0.01 to 0.04 with a confidence range of 15 to 85%, as concluded from numerous Monte Carlo simulations conducted by NETL, while others report an E value range of 0.01 to 0.06 (Brennan et al., 2010; van deer Meer, 1995). An E value of 0.03 was chosen to represent the storage efficiency of the Sunniland Formation in this study, which is in agreement with the results of the Monte Carlo simulations found in the NETL Atlas (2007); with simulations that have been conducted to date by individuals at the University of South Florida (USF), which demonstrate a significant increase in post-CO₂-injection reservoir pressure that results in large brine displacement and consequent increased storage capacity (Okwen, 2009); and because of the vertical heterogeneity within the geologic unit.

2.5.4 Data Modeling, Interpolation, and Presentation

Porosity values derived from geophysical logs for each well evaluated were recorded in 5% range-increments. This dataset is located in Table IV-1 of Appendix IV. For porosity interpolations and cross-sections in this study, porosity values in 10% range-increments were used for graphical clarity.

The RockWare® program RockWorks™ Version 14, as well as ArcGIS™ Suite Version 9.3, were used to graphically represent geometries and lithologies in the Sunniland Formation, the overlying Lake Trafford Formation, and the underlying Punta Gorda Anhydrite, using strip logs, cross-sections, solid models, and isolith- and isopach-contour maps. RockWorks™ and ArcGIS™ Suite were also used to interpolate, model, and visualize the porosity data for the Sunniland Formation within the study area.

ArcGIS™ Suite was used to interpolate and model the estimated CO₂ storage capacity throughout the Trend. In addition to the borehole-specific data, cross-sectional interpolations, and tabular storage capacity calculations created during the course of this

study, a series of planar interpolations were developed in order to examine the distribution of the variables in the storage capacity equation across the study area. Furthermore, a geospatially-derived storage capacity interpolation was developed using the Spatial Analyst toolbox in ArcGIS™. The purpose of developing the interpolations was twofold: 1) to establish and better understand the distribution of CO₂ storage capacity in the Sunniland Formation throughout the study area, as well as the distribution of each of its variables; and 2) to verify and cross-check the CO₂ storage capacity that was calculated manually for the Sunniland Formation.

Algorithms, specific methods and functions, and procedures that were utilized with these programs are discussed below.

RockWorks™

Because data ranges cannot be entered into RockWorks™, porosity data had to be entered into the program as a “Lithology Type”, or lithology value (i.e., “Porosity 10-20%”) for its use in modeling and interpolation. For the porosity interpolations conducted between wells throughout a given region of interest, RockWorks™ used the “Horizontal Lithoblending” solid-modeling method, which assigns solid-model voxel nodes by looking outward horizontally from each well in the model in “search circles” of ever-increasing diameter (RockWare, 2008). First, the model assigns the voxels immediately surrounding each well the closest lithology value, which in this study, were actually porosity ranges, such as “Porosity 10-20%”, “Porosity 20-30%”, and so on. Then, the model moves out by a voxel and assigns the next “circle” of voxels the closest lithology value. The model continues in this manner until the program encounters a voxel that has already been assigned a lithology value (presumably from another well in the model). When this occurs, the model skips the node-assignment step for that voxel and continues its progression. Once all nodes have been assigned a lithology value, the model terminates the searching and assigning process. Solid-model nodes above the

highest well lithology entry and those below the lowest well lithology entry are not assigned a lithology value, or in other words, the model does not extrapolate below the lowest or above the highest control point in the project (RockWare, 2008). This particular solid-modeling method results in “lithozones” around each well, which can end abruptly when the zone from a neighboring well is encountered. This abrupt ending of lithozones is evident in the porosity interpolations of Section 2.6.1.

ArcGIS™ Suite

“Inverse Distance Weighted” (IDW) methods were used for the Sunniland Formation isopach- and isolith-contour interpolations, which are interpolation methods that are part of the Geostatistical Analyst graphical user interface of the ArcGIS™ Suite. Geostatistical Analyst allows for the user to test multiple interpolation functions based upon data quality, extent, and purpose. The software also allows for the calculation of uncertainty and data variance. The IDW interpolations assume that data points that are relatively close together within a given region have similar parameter values compared to those data points that are farther apart. When predicting parameter values within a region that lacks measured-parameter values (or imported, known parameter values), the IDW method will use the measured-parameter values that immediately surround that region to conduct its predicted-interpolation; therefore, the measured-parameter values of data points that are closest to the region being predicted will have a greater influence on the predicted values than those data points that are farther away, and thus, the “local influence” will diminish with distance (ESRI, 2007).

“Radial Basis Function” (RBF) spline methods were used for the storage capacity interpolations conducted in this study using ArcGIS™, and are also part of Geostatistical Analyst. The RBF methods are generally considered to be the least-predictive modeling method available in Geostatistical Analyst, and are instead considered a more exact-interpolation technique (i.e., the interpolated surface must go through each data point

that is entered) (ESRI, 2007). Furthermore, the RBF spline method is more of a triangulation between the hard data as opposed to a best-fit approach, such as kriging methods. The RBF spline methods were chosen for this study due to the sparse and widespread distribution of the study wells which provided porosity data within the Trend, and were considered to be the most appropriate methods for modeling storage capacity because they have the least inherent-error of all the interpolation methods available in Geostatistical Analyst. However, because interpolated surfaces only go through actual data points when using the RBF methods, simulations created interpolated contour-surfaces that were bound by the outermost data points in the study area. This resulted in small regions within the Trend that contained no predicted raster surface, and were subsequently identified in each figure as having “Insufficient Porosity Data.” Specifically, data-availability constraints resulted in the interpolation of 70% of the total study area for the Sunniland Formation.

The Map Algebra and Raster Math tools in the ArcGISTM Spatial Analyst toolbox were used to perform the CO₂ storage capacity calculation for the Sunniland Formation. The interpolated sequestration reservoir thickness (h_g) and average porosity (Φ_{tot}) variable rasters were multiplied by the storage efficiency factor (E) and the CO₂ density (ρ) constants to derive a single raster output. The interpolated area (70% of the Trend) was also factored into the storage capacity equation using the Raster Math tool. The output raster layer, which contained the results of the storage capacity calculation, was reclassified into 15,340 1-km² cells in order to determine the amount of CO₂ that could potentially be sequestered in each square kilometer of the interpolated-area. The final raster was a functional display of CO₂ storage capacity in 1,000 tCO₂ per 1-km² model cell.

2.6 Results

2.6.1 Porosity

Table AIV-1 of Appendix IV provides the Sunniland Formation porosity values derived for each exploratory/discovery oil well evaluated throughout the extent of the Trend, including those wells in the Trend oil fields. Appendix V provides striplogs for each of these wells, which display porosity and lithology variation with depth for the Sunniland Formation.

Interpolated-porosity cross-sections of the Sunniland Formation were created for each Trend oil field, with locations displayed in Figure 2-12. Figures 2-13 through 2-26 are the cross-sections created for each Trend oil field, which show interpolated-porosity variation with decreasing elevation within a given field, using sea level as the datum. Additionally, data used in calculating storage capacities for each oil field (i.e., h_g , Φ , and BHT) are displayed in each of these figures. Figure 2-27 shows transect locations for interpolated-porosity cross-sections that were created for the Sunniland Formation throughout the entire extent of the Trend, which are displayed in Figure 2-28 through Figure 2-35. Like the porosity cross-sections created for the oil fields, the Trend porosity cross-sections show interpolated-porosity variation with decreasing elevation, using sea level as the datum. Figure 2-36 is a porosity-contour map that displays average-porosity variation for the Sunniland Formation throughout the Trend.

2.6.2 Storage Capacity

A summary of the estimated CO₂ storage capacities calculated for the Sunniland Formation within each of the Trend oil fields during CO₂-EOR is provided in Table 2-4. Collectively, the Trend oil fields have a conservative, total estimated CO₂ storage capacity of just over 26 MtCO₂. The values of G_{CO_2} in each field were averaged with the geometric-mean, as the geometric-mean is the most-appropriate measure of central tendency when variables are multiplied.

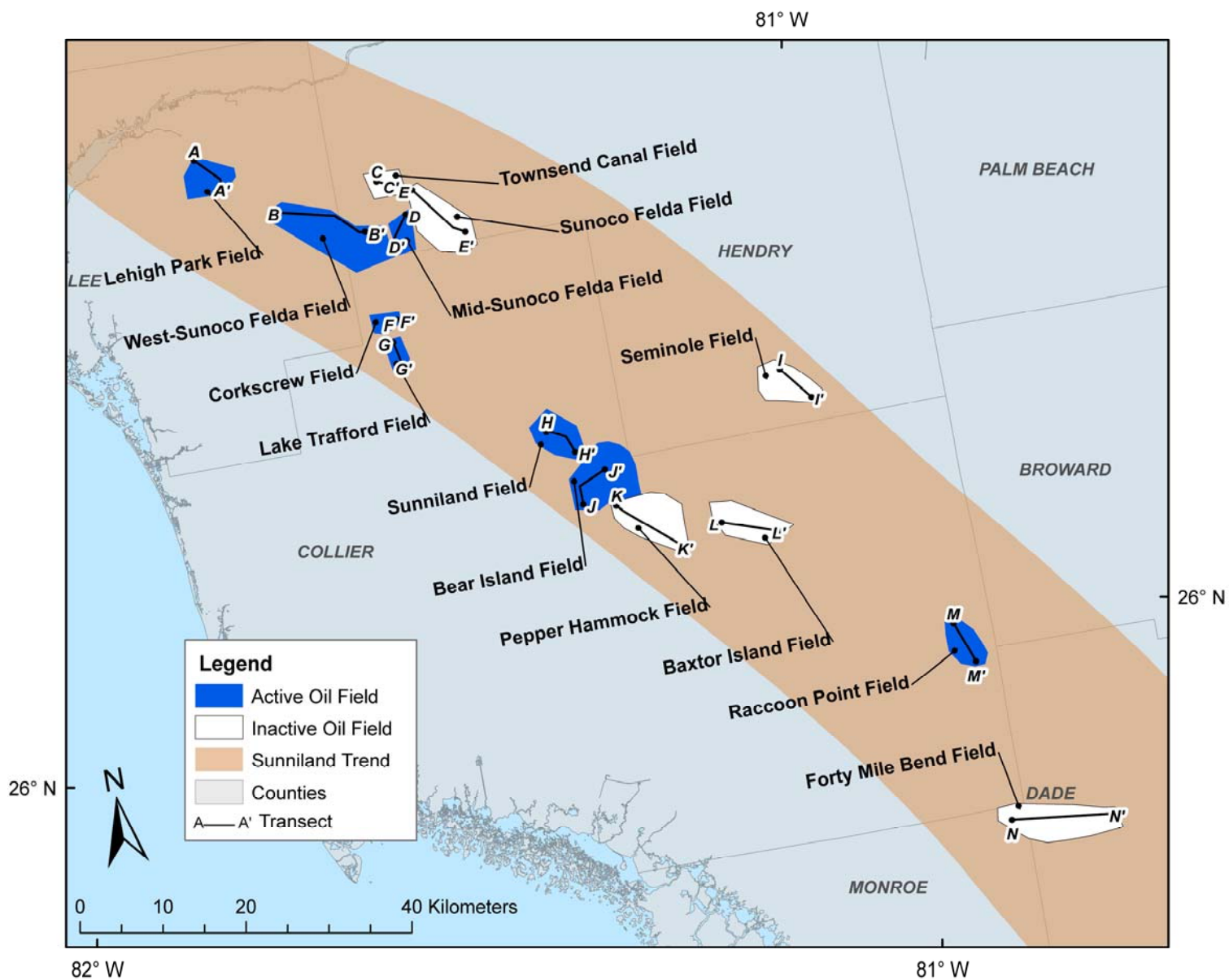


Figure 2-12: Location map displaying cross-section transects for Trend oil fields.

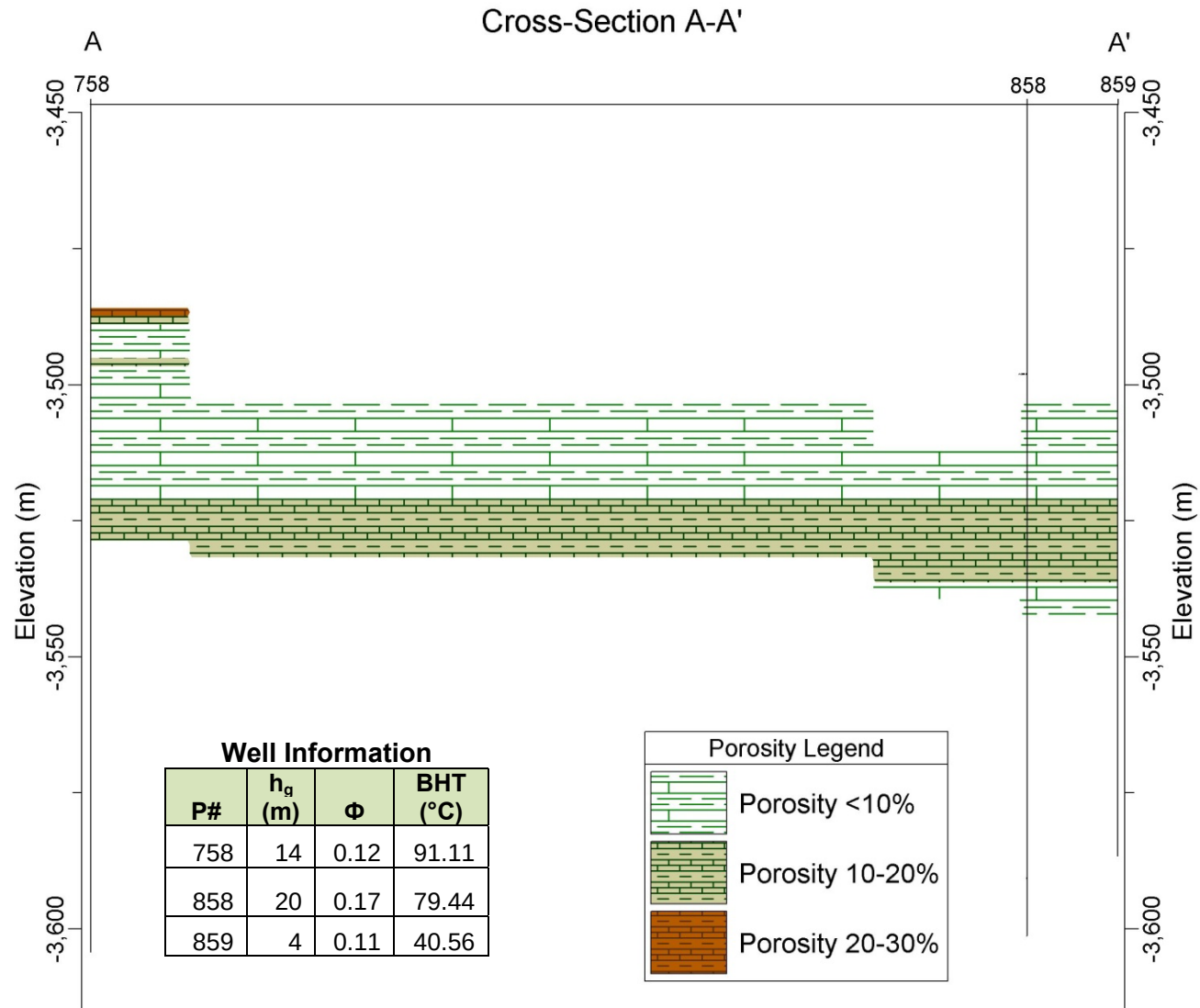


Figure 2-13: Cross-section displaying interpolated porosity for Lehigh Park Field (Transect A-A'). Transect location is depicted in Figure 2-12.

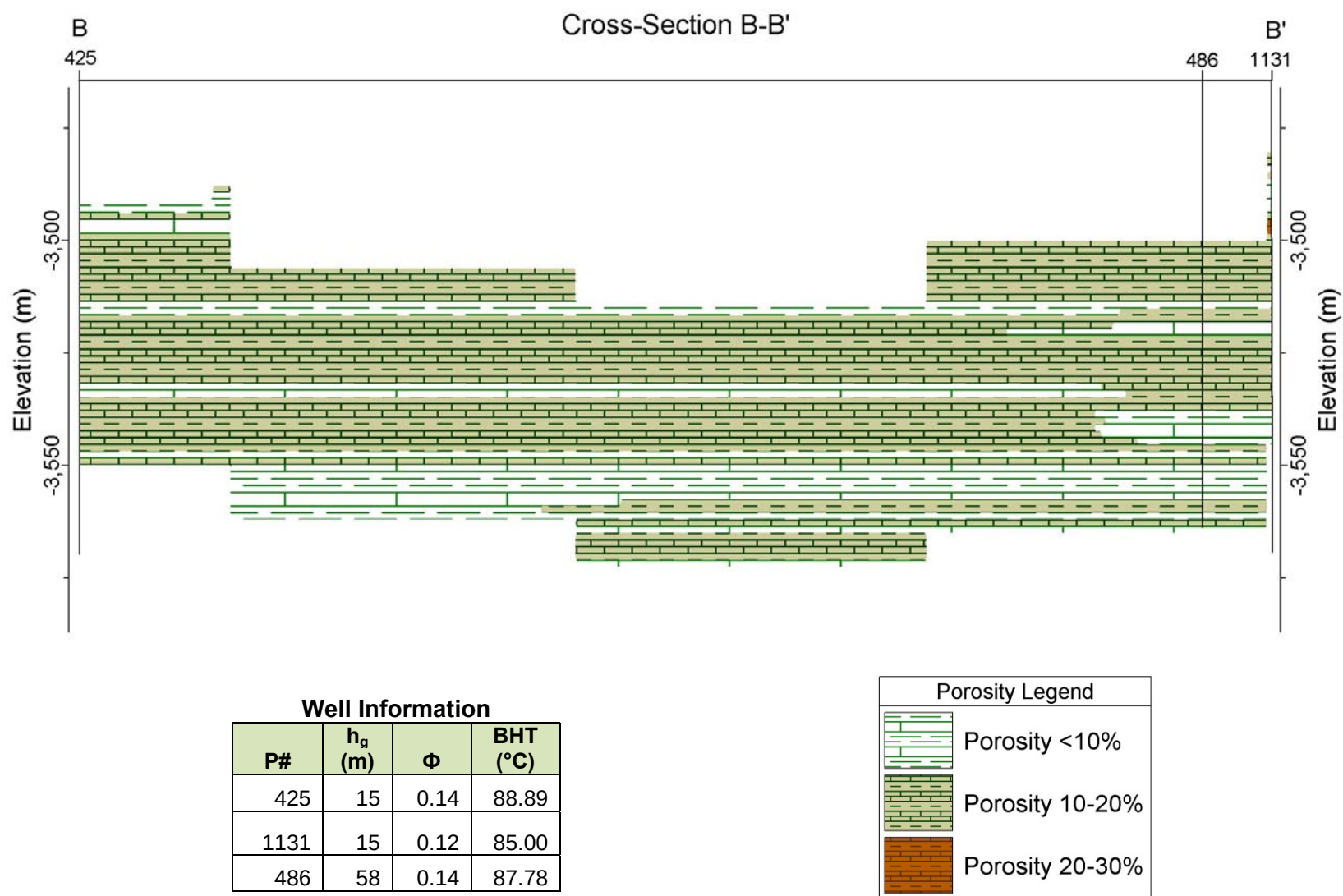


Figure 2-14: Cross-section displaying interpolated porosity for West-Sunoco Felda Field (Transect B-B'). Transect location is depicted in Figure 2-12.

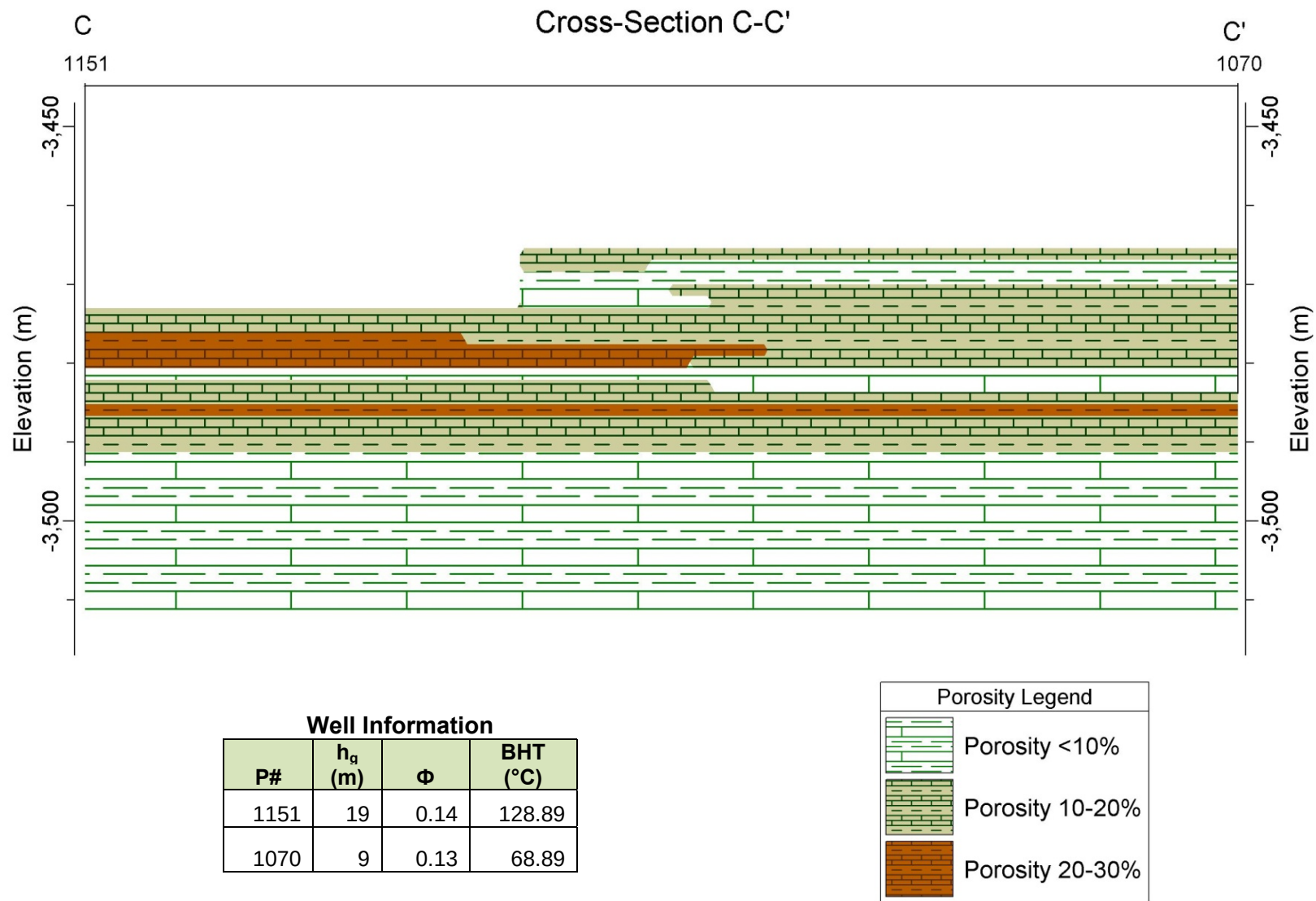


Figure 2-15: Cross-section displaying interpolated porosity for Townsend Canal Field (Transect C-C').
 Transect location is depicted in Figure 2-12.

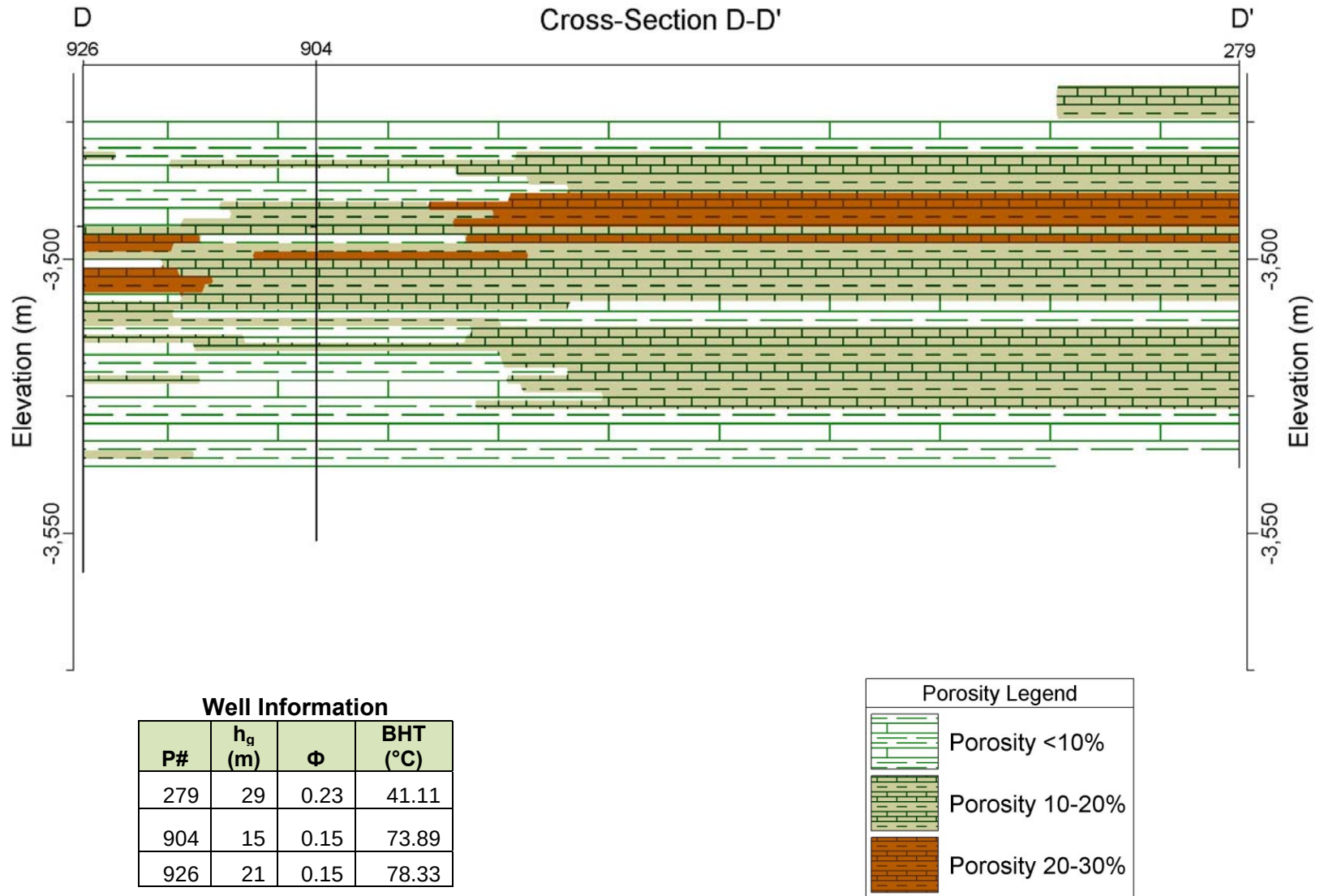


Figure 2-16: Cross-section displaying interpolated porosity for Mid-Sunoco Felda Field (Transect D-D'). Transect location is depicted in Figure 2-12.

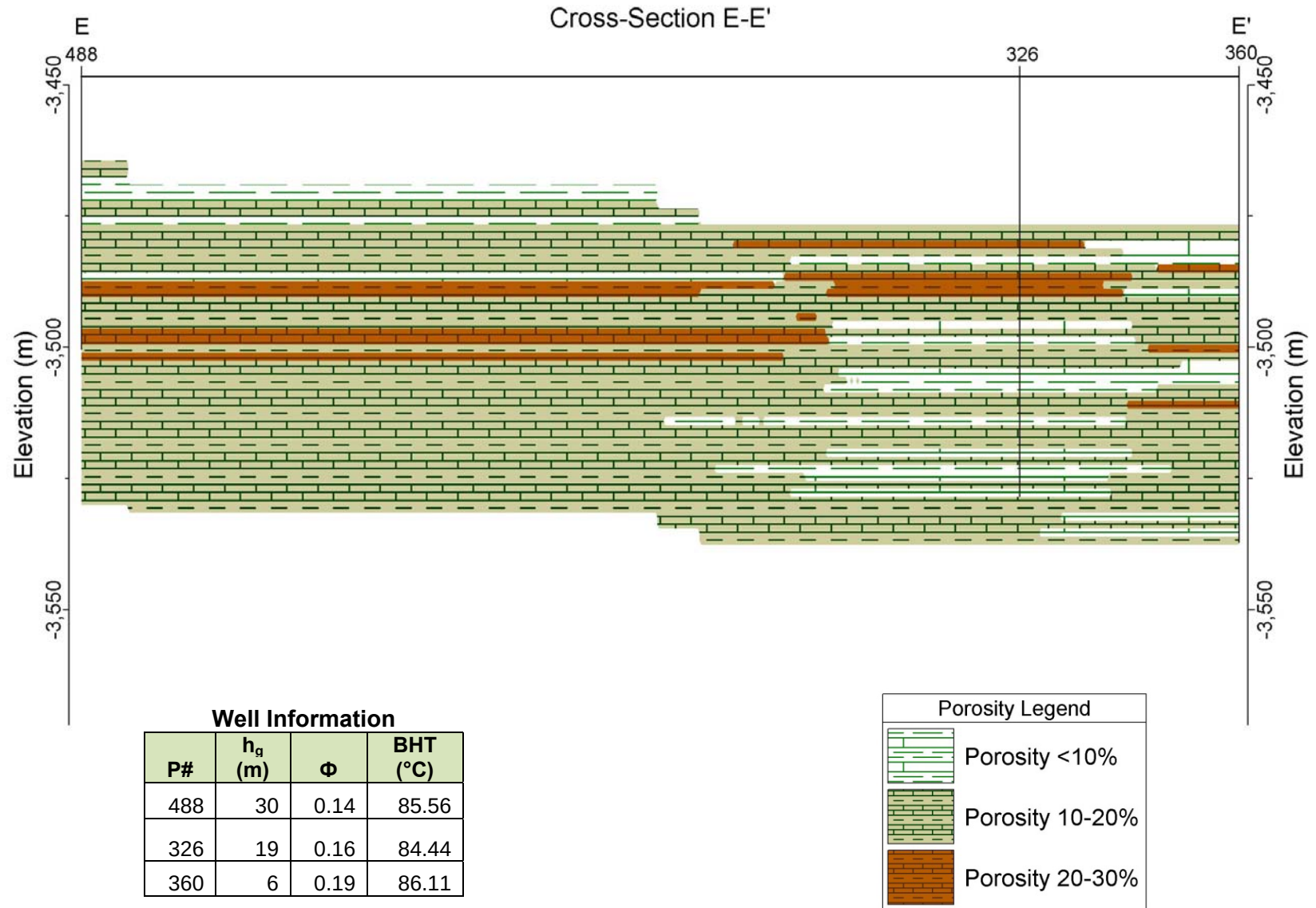


Figure 2-17: Cross-section displaying interpolated porosity for Sunoco Felda Field (Transect E-E'). Transect location is depicted in Figure 2-12.

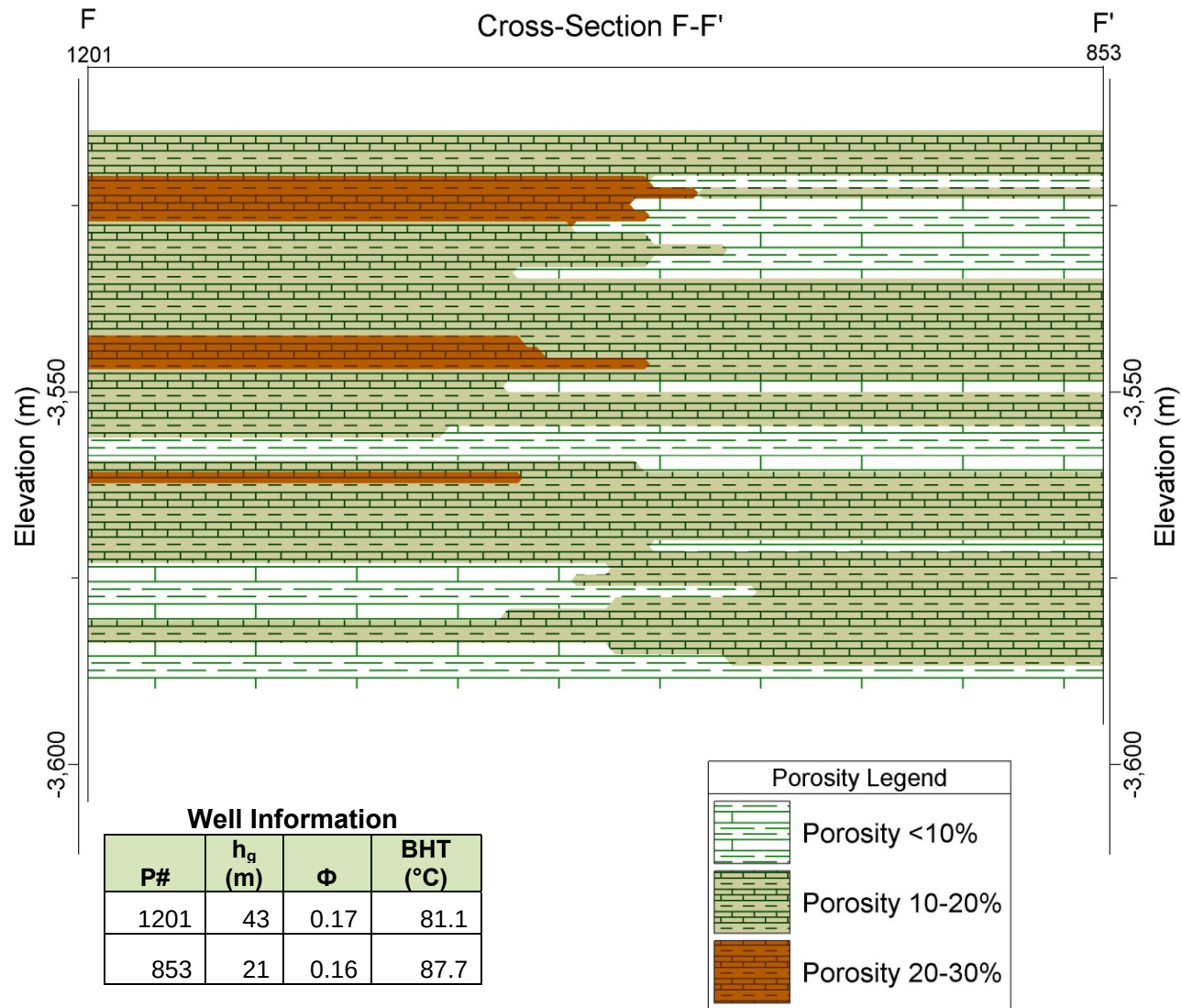


Figure 2-18: Cross-section displaying interpolated porosity for Corkscrew Field (Transect F-F'). Transect location is depicted in Figure 2-12.

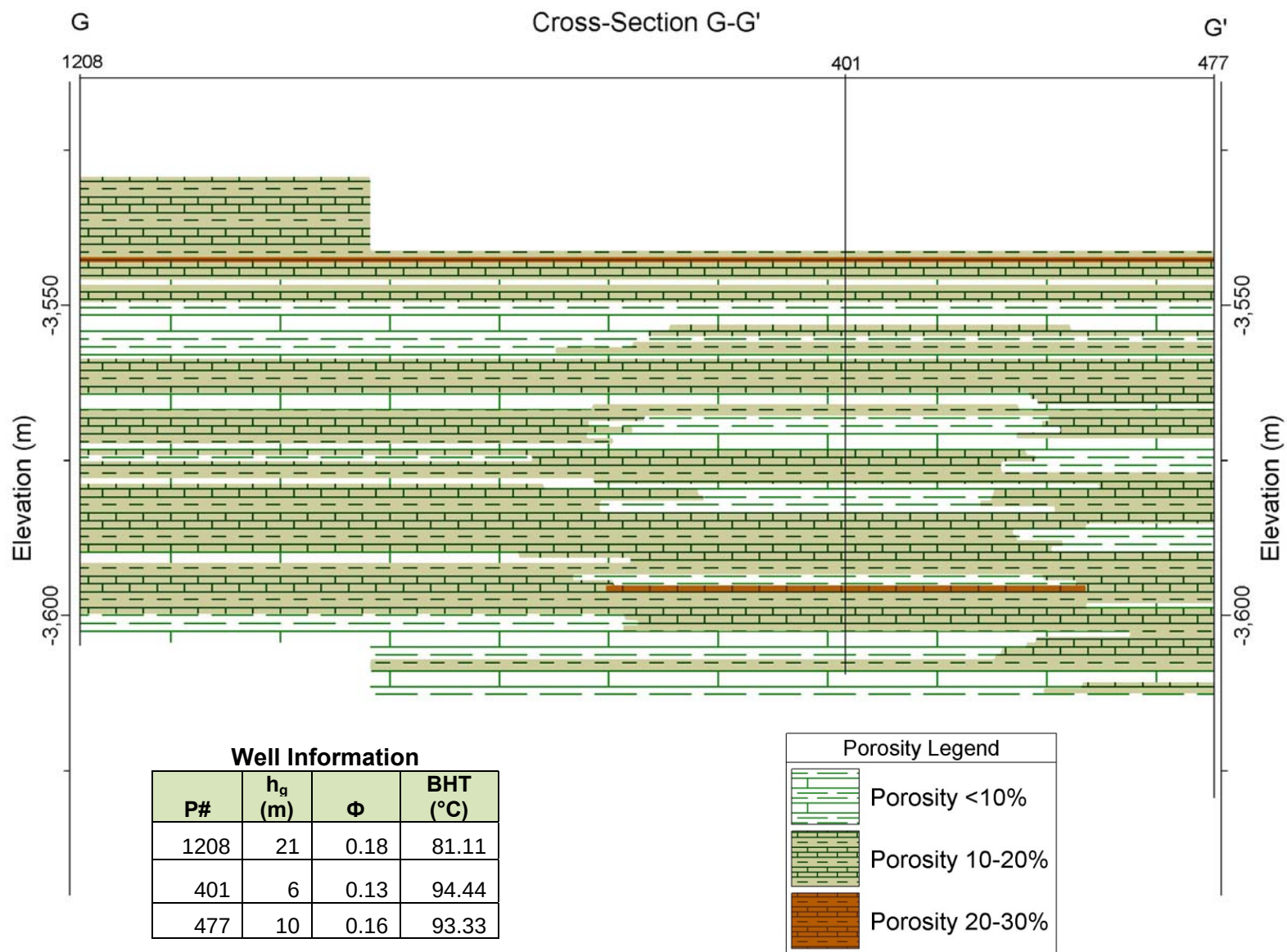


Figure 2-19: Cross-section displaying interpolated porosity for Lake Trafford Field (Transect G-G'). Transect location is depicted in Figure 2-12.

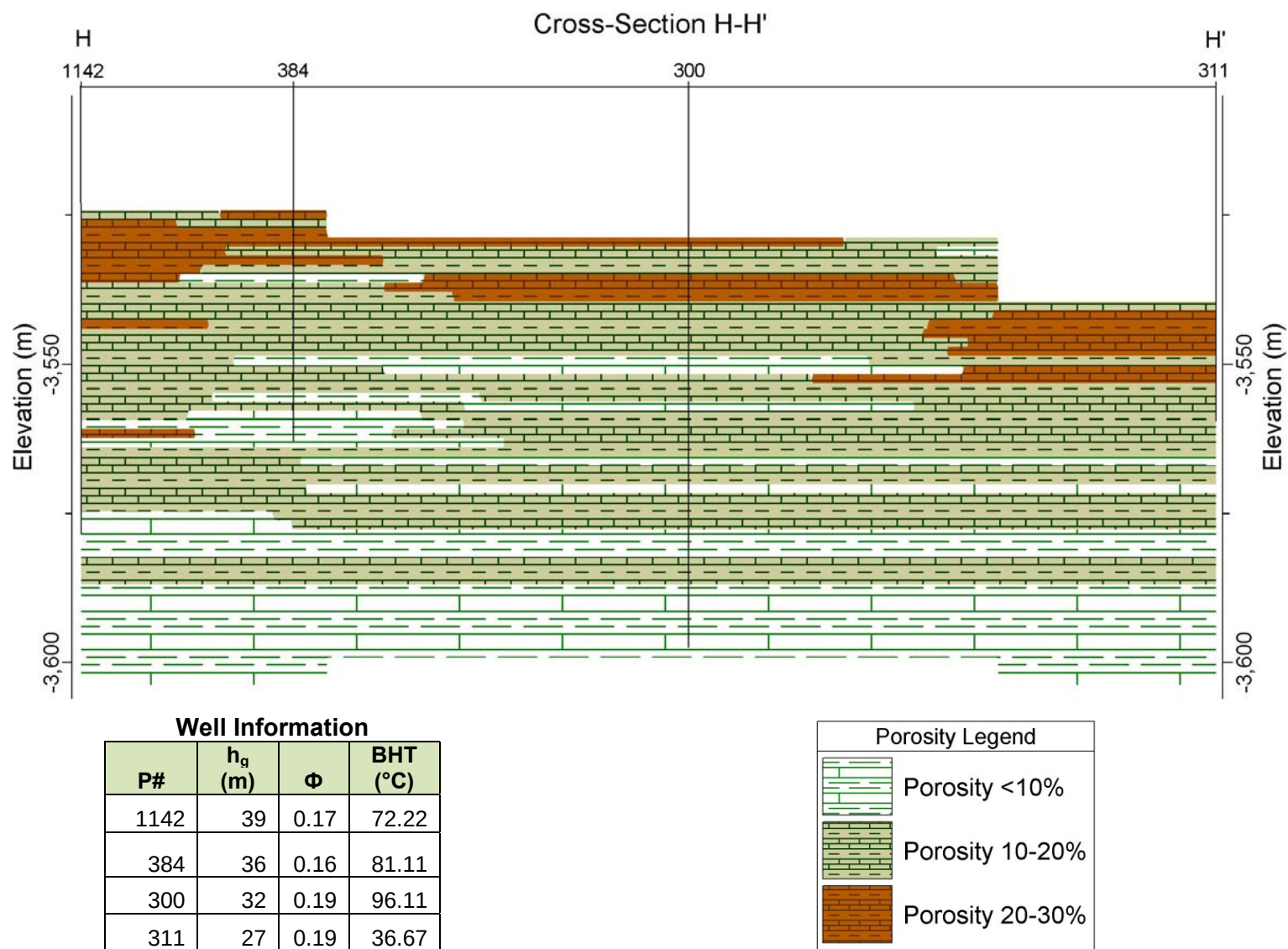


Figure 2-20: Cross-section displaying interpolated porosity for Sunniland Field (Transect H-H'). Transect location is depicted in Figure 2-12.

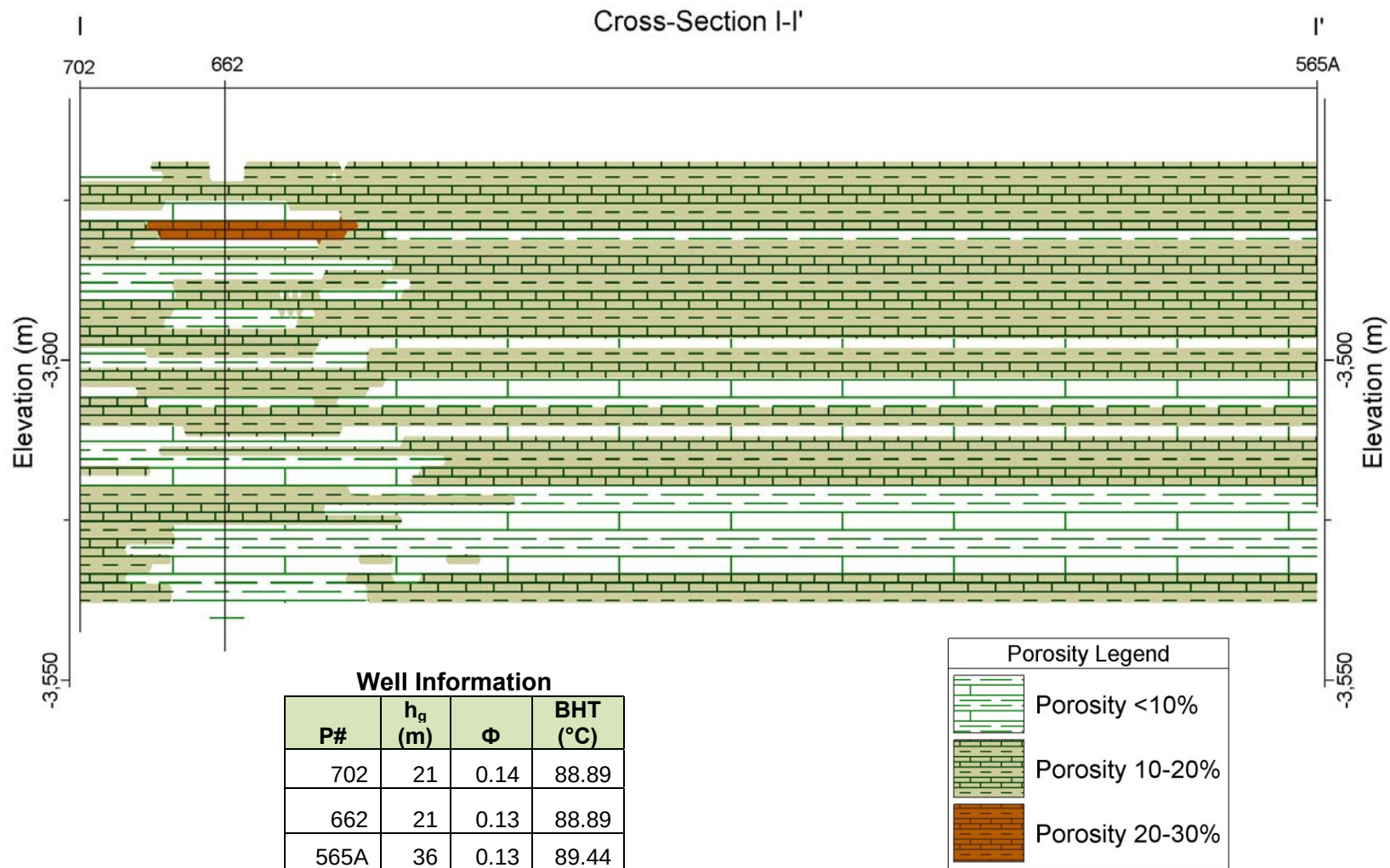


Figure 2-21: Cross-section displaying interpolated porosity for Seminole Field (Transect I-I'). Transect location is depicted in Figure 2-12.

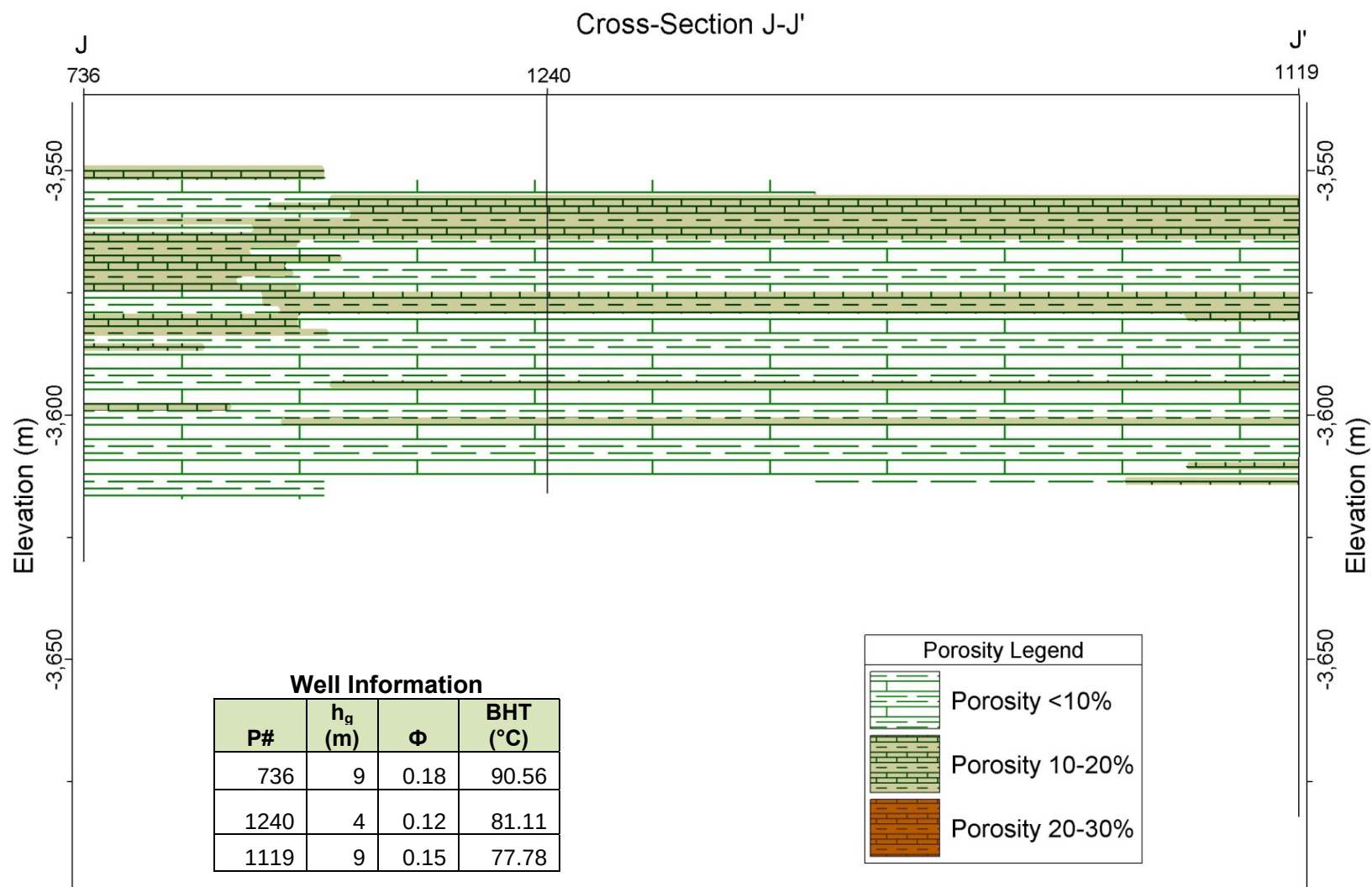


Figure 2-22: Cross-section displaying interpolated porosity for Bear Island Field (Transect J-J'). Transect location is depicted in Figure 2-13.

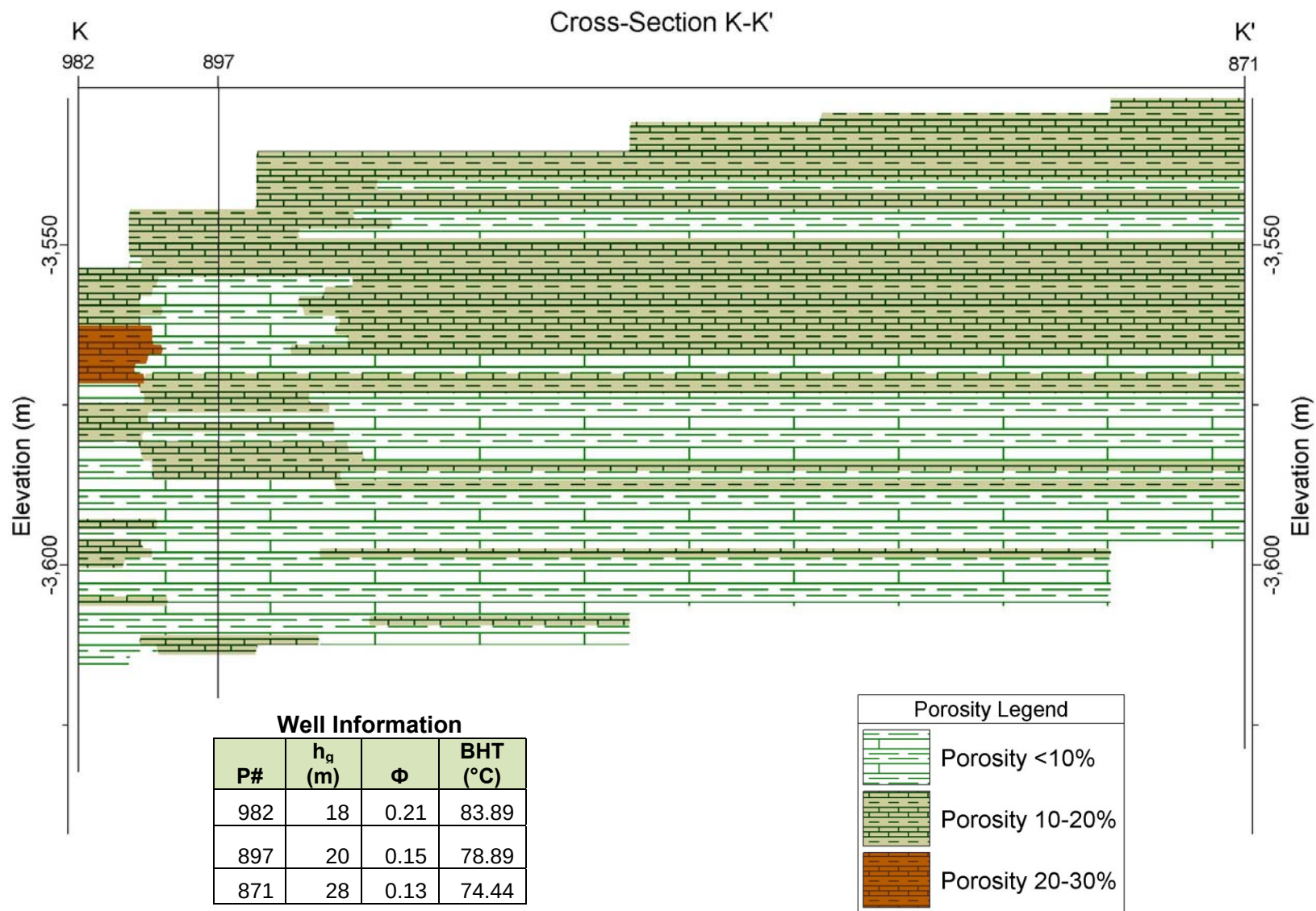


Figure 2-23: Cross-section displaying interpolated porosity for Pepper Hammock Field (Transect K-K'). Transect location is depicted in Figure 2-12.

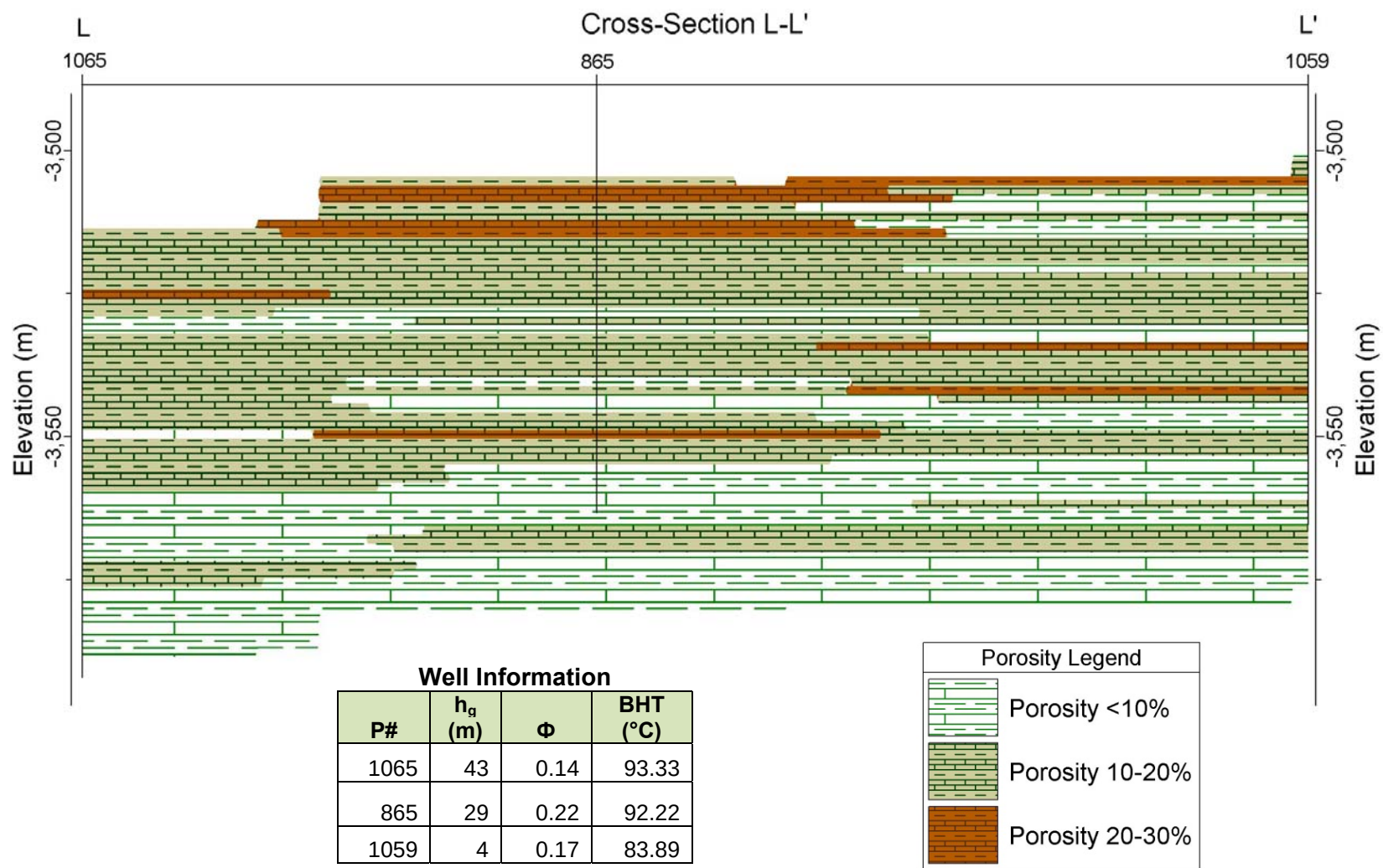


Figure 2-24: Cross-section displaying interpolated porosity for Baxter Island Field (Transect L-L'). Transect location is depicted in Figure 2-12.

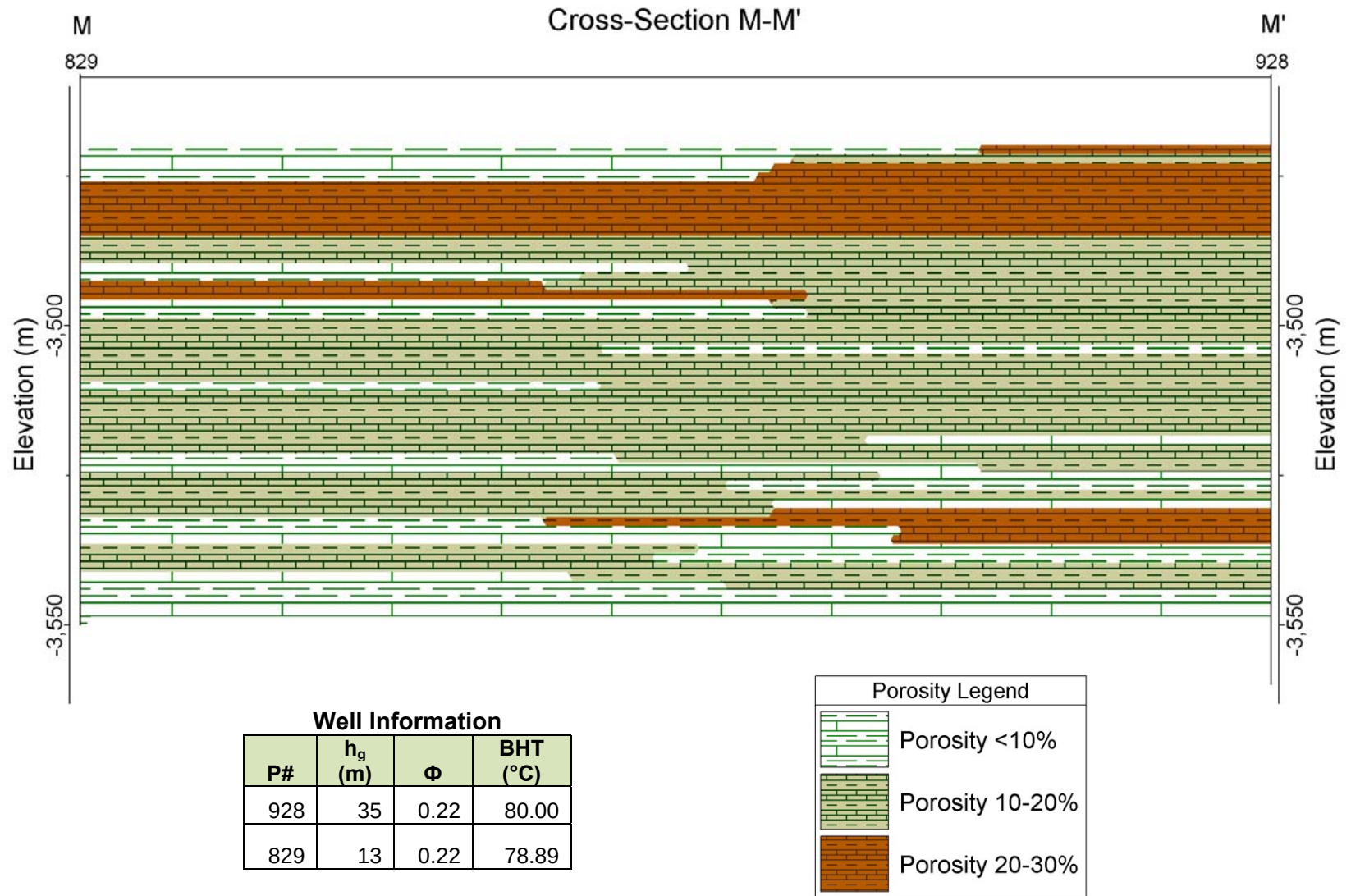


Figure 2-25: Cross-section displaying interpolated porosity for Raccoon Point Field (Transect M-M'). Transect location is depicted in Figure 2-12.

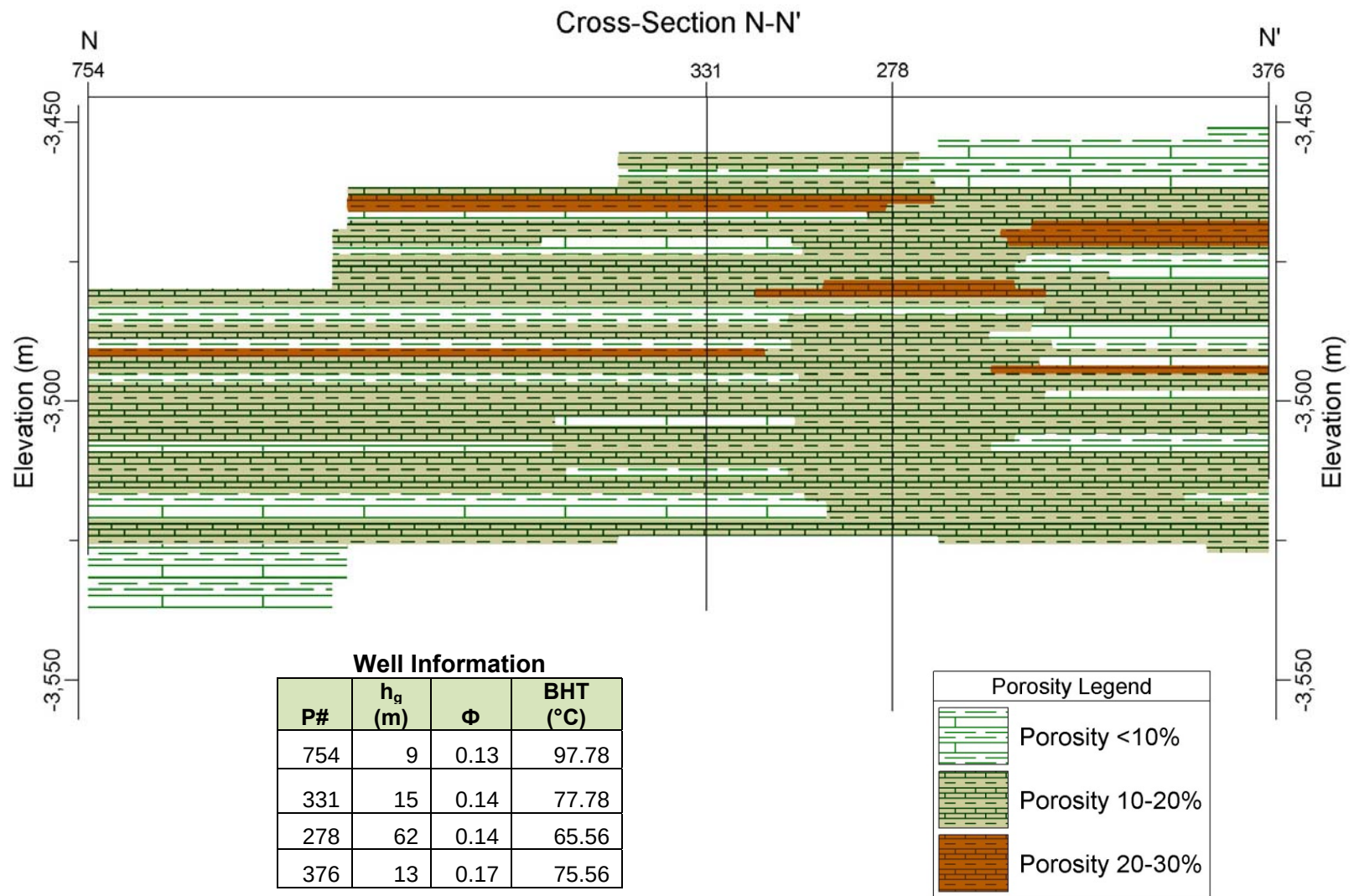


Figure 2-26: Cross-section displaying interpolated porosity for Forty-Mile Bend Field (Transect N-N'). Transect location is depicted in Figure 2-12.

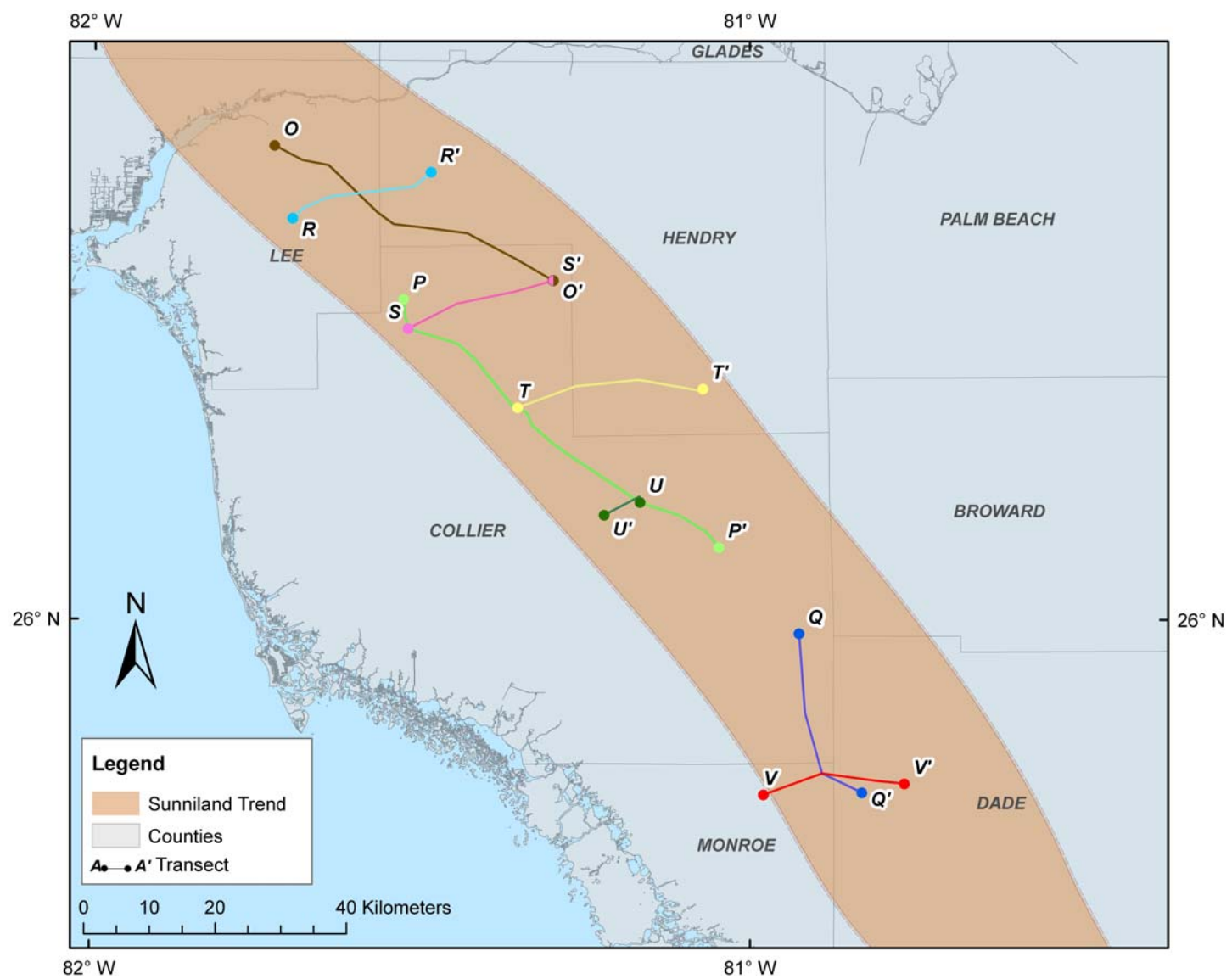


Figure 2-27: Location map displaying Trend porosity cross-section transects.

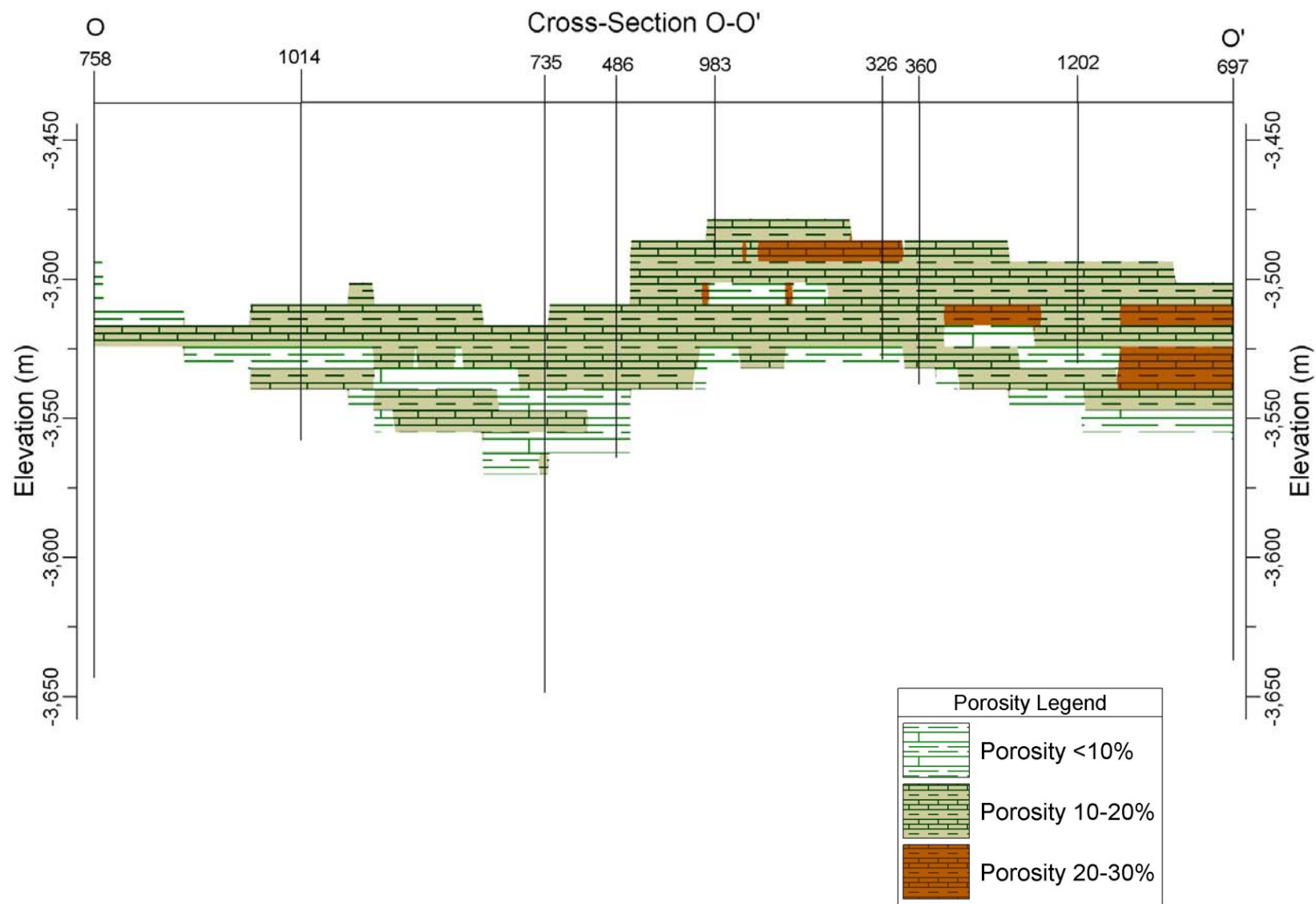


Figure 2-28: Cross-section displaying interpolated porosity for Transect O-O'. Transect location is depicted in Figure 2-27.

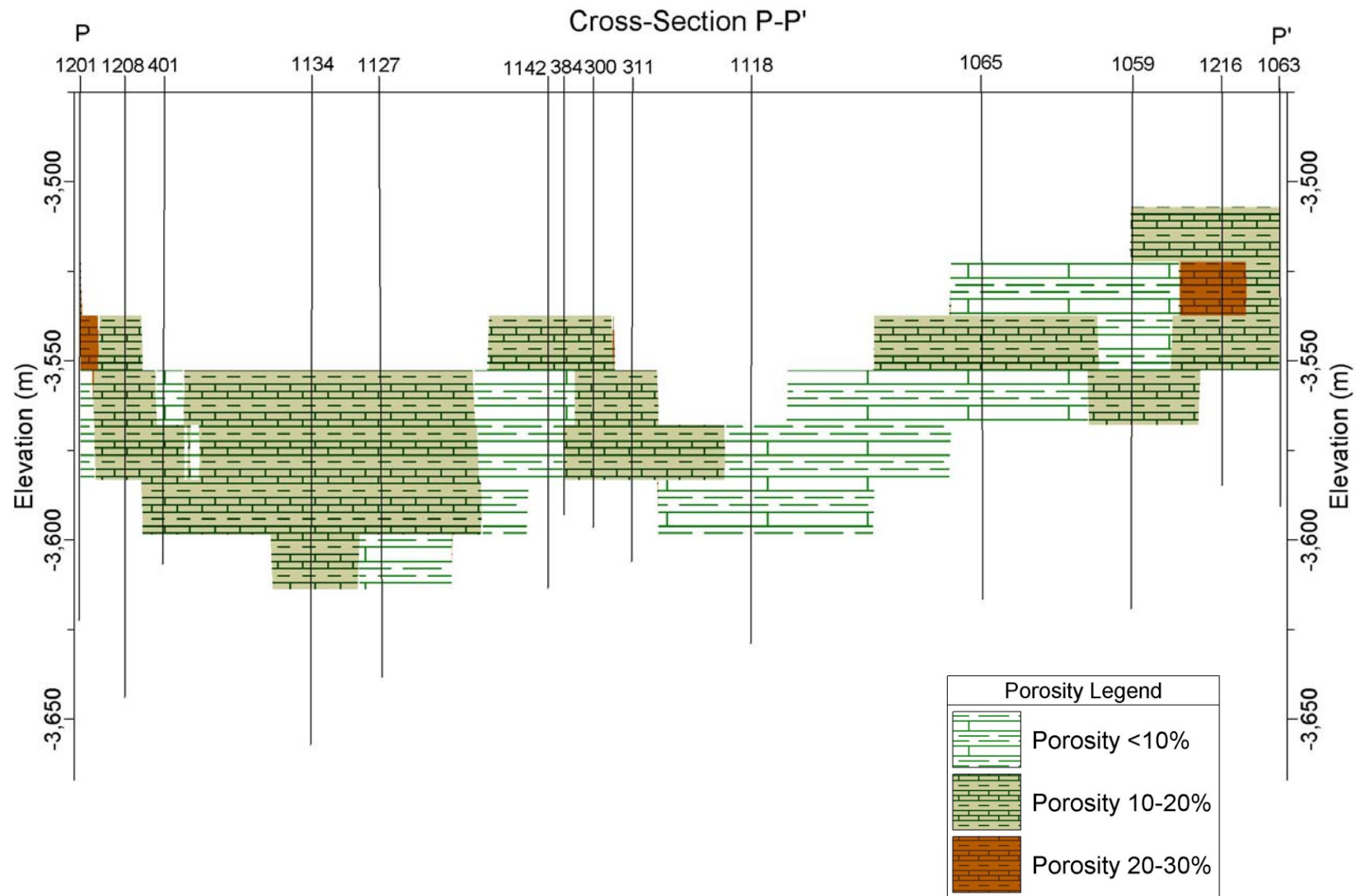


Figure 2-29: Cross-section displaying interpolated porosity for Transect P-P'. Transect location is depicted in Figure 2-27.

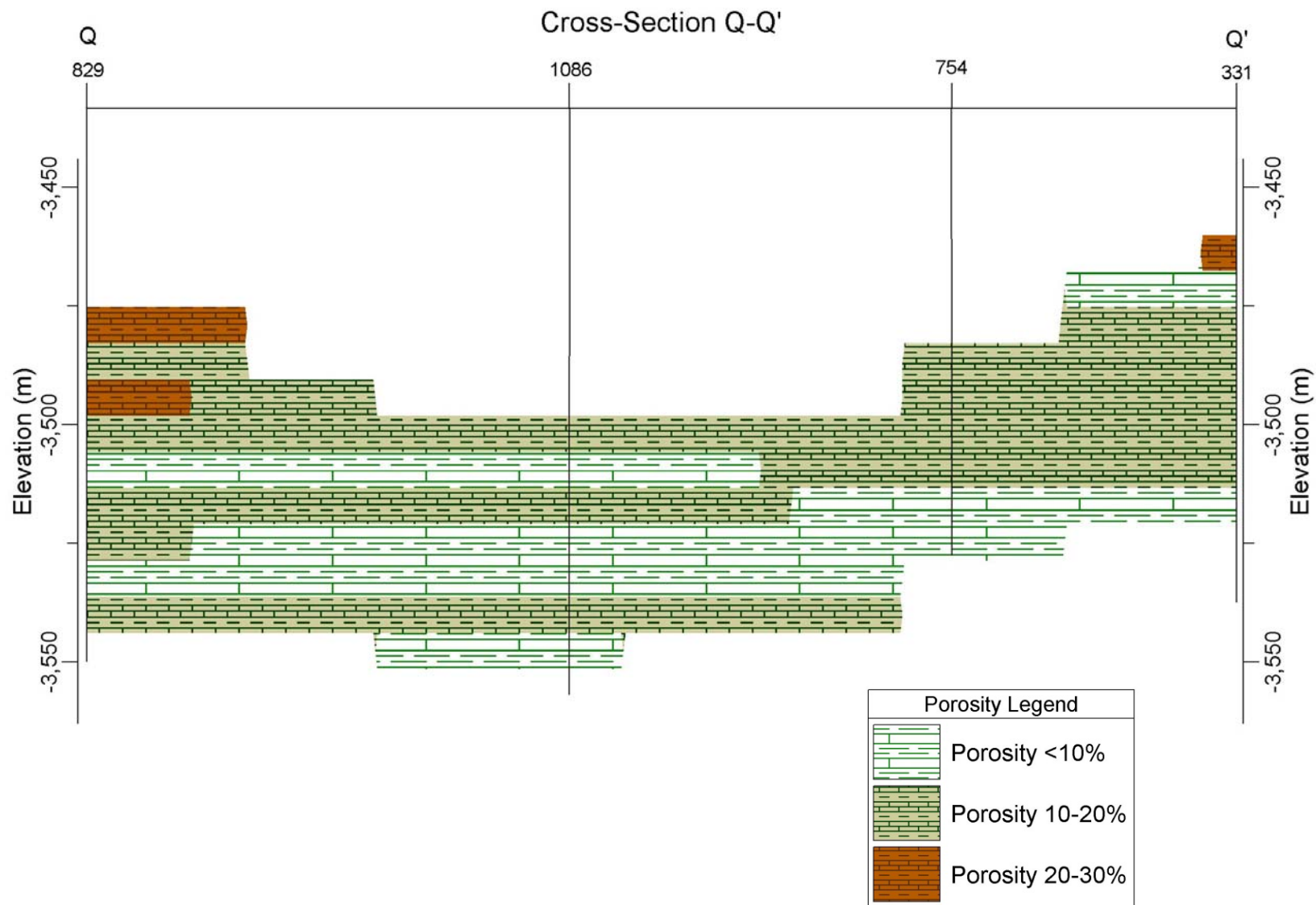


Figure 2-30: Cross-section displaying interpolated porosity for Transect Q-Q'. Transect location is depicted in Figure 2-27.

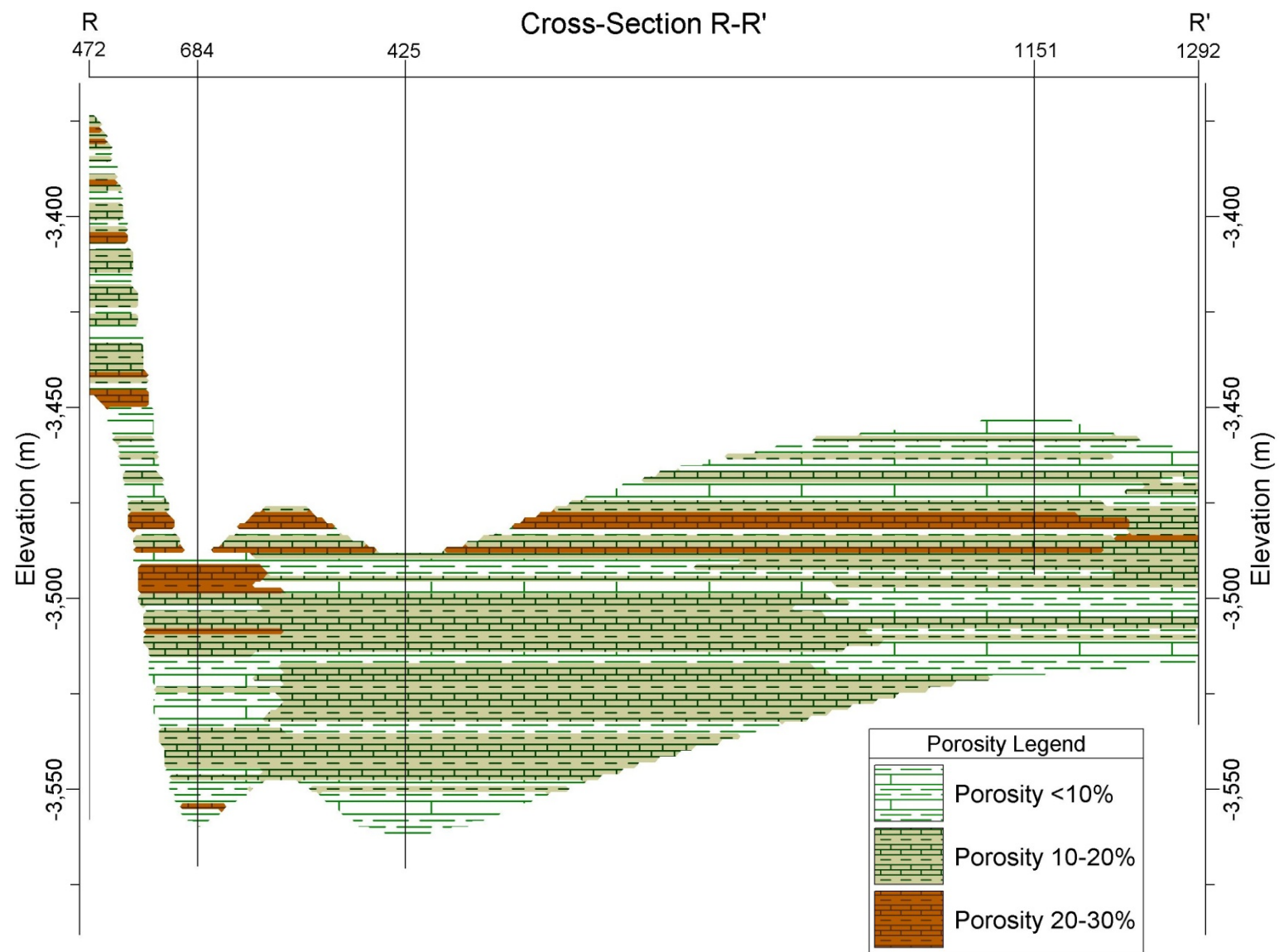


Figure 2-31: Cross-section displaying interpolated porosity for Transect R-R'. Transect location is depicted in Figure 2-27.

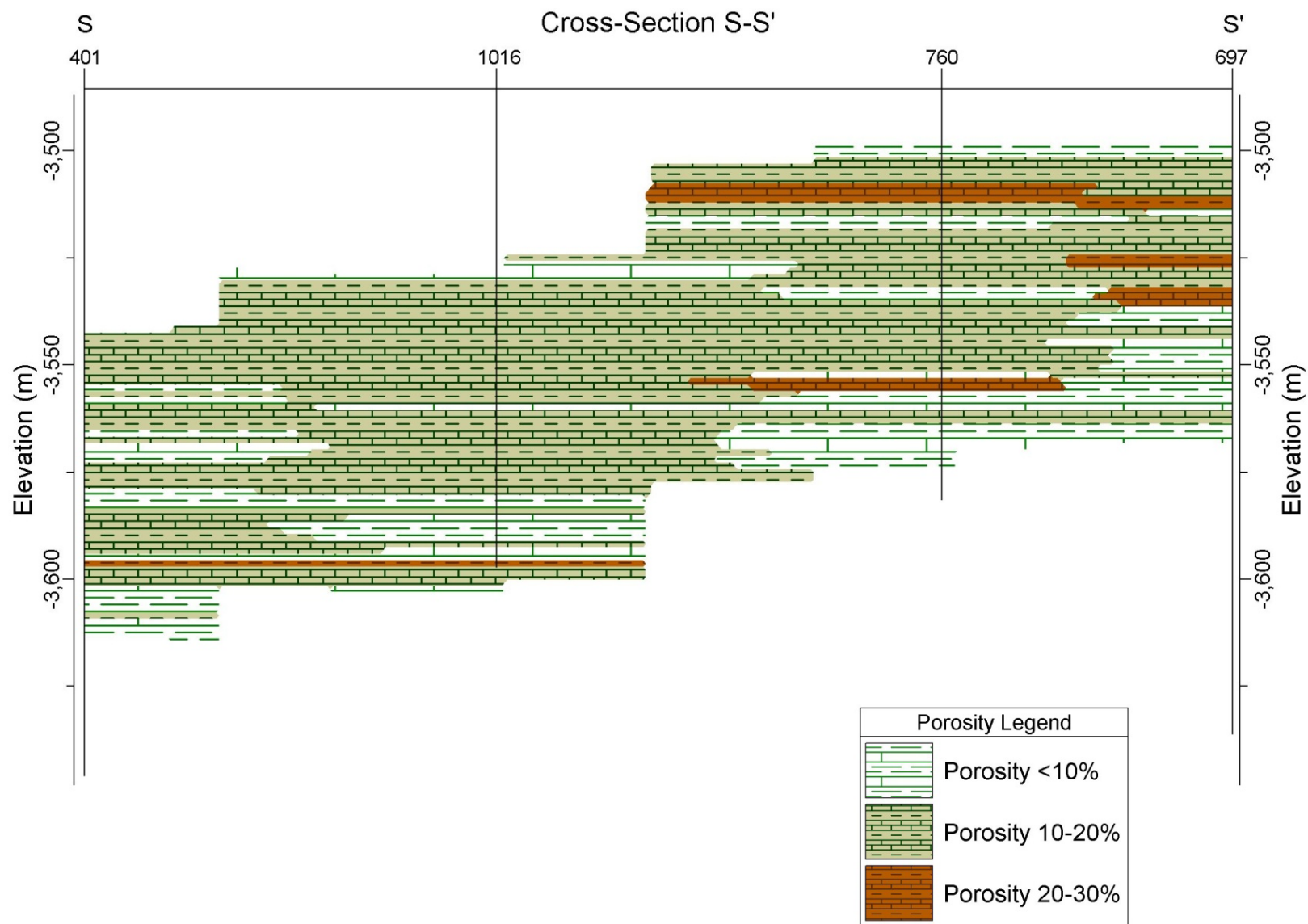


Figure 2-32: Cross-section displaying interpolated porosity for Transect S-S'. Transect location is depicted in Figure 2-27.

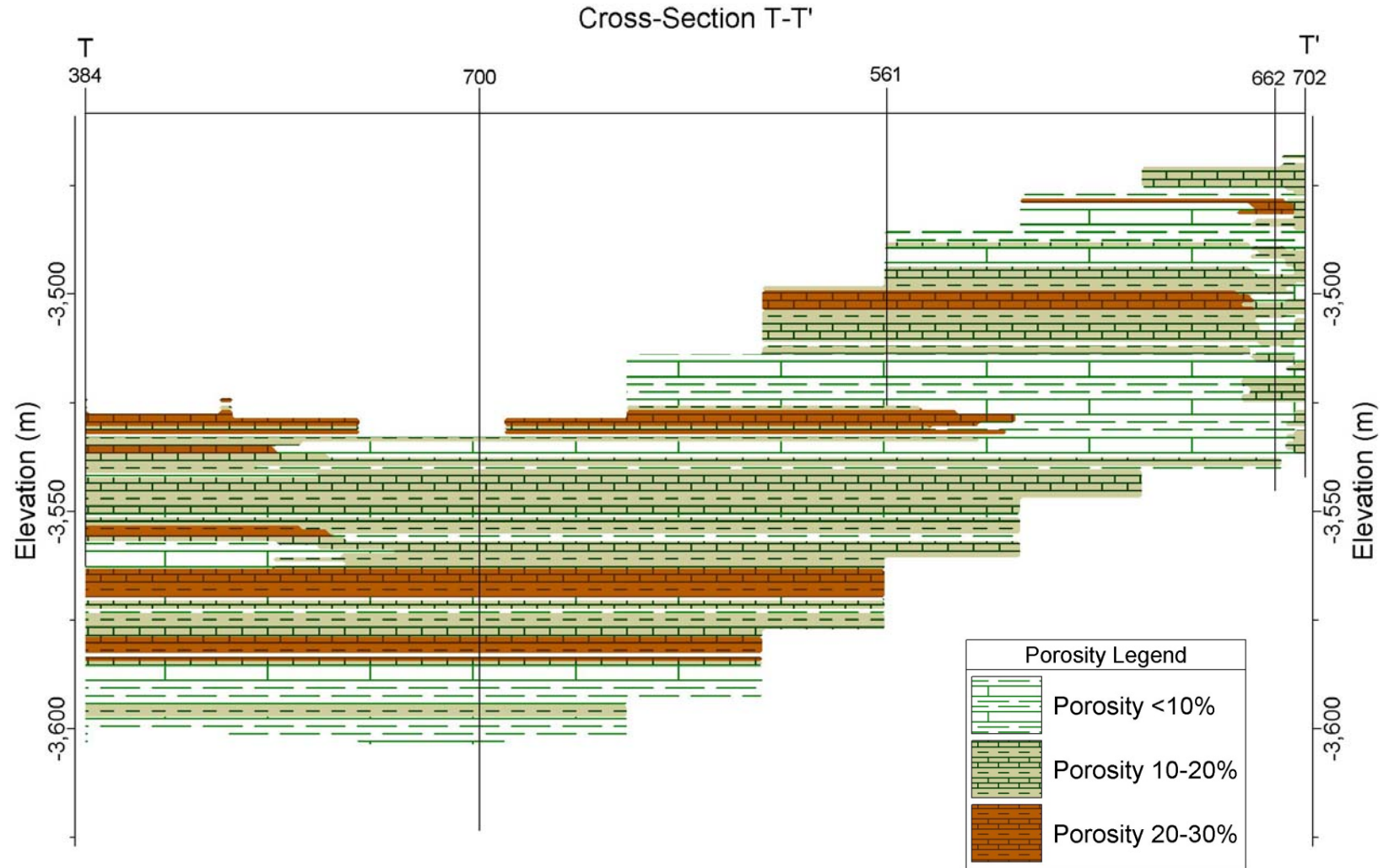


Figure 2-33: Cross-section displaying interpolated porosity for Transect T-T'. Transect location is depicted in Figure 2-27.

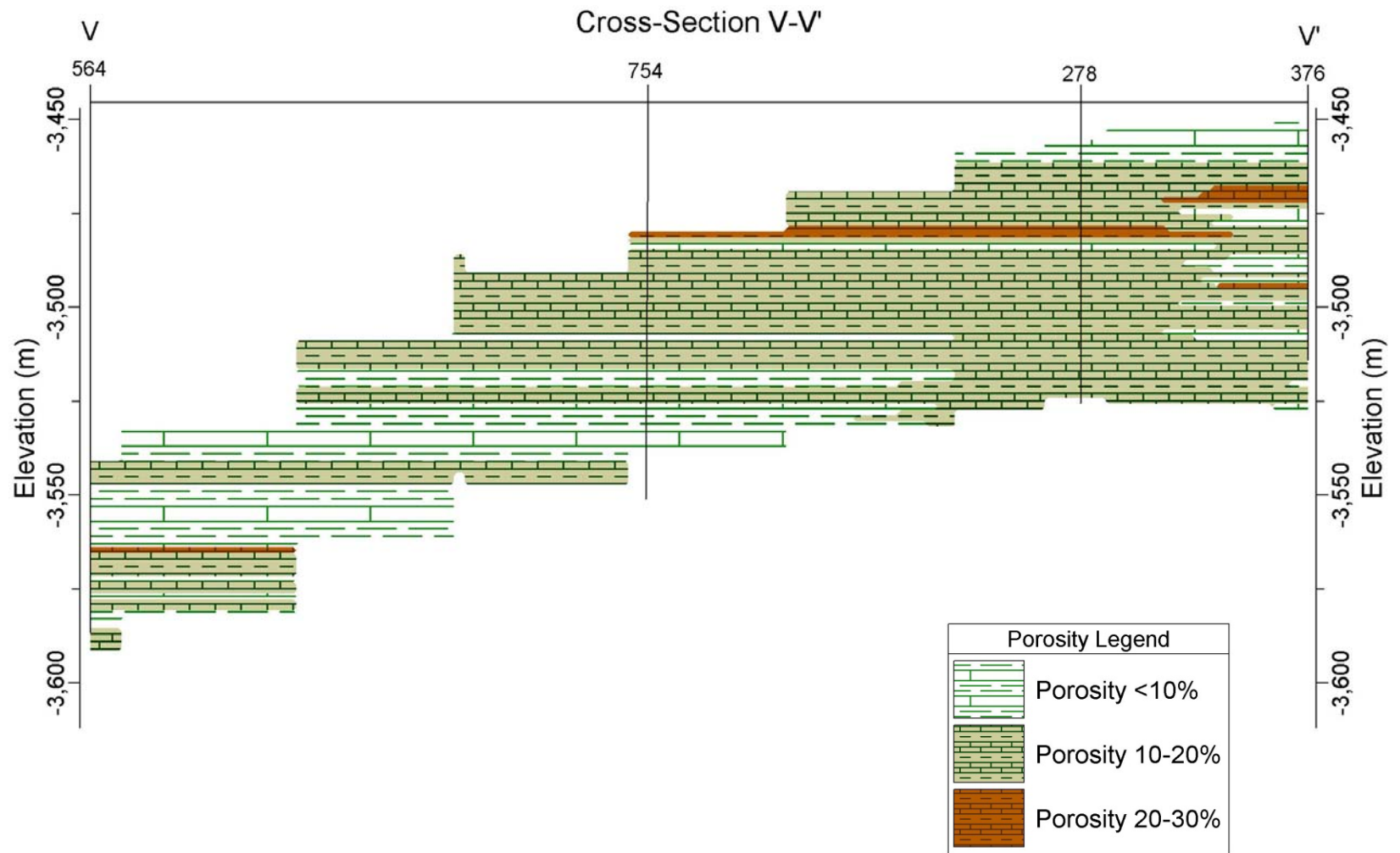


Figure 2-35: Cross-section displaying interpolated porosity for Transect V-V'. Transect location is depicted in Figure 2-27.

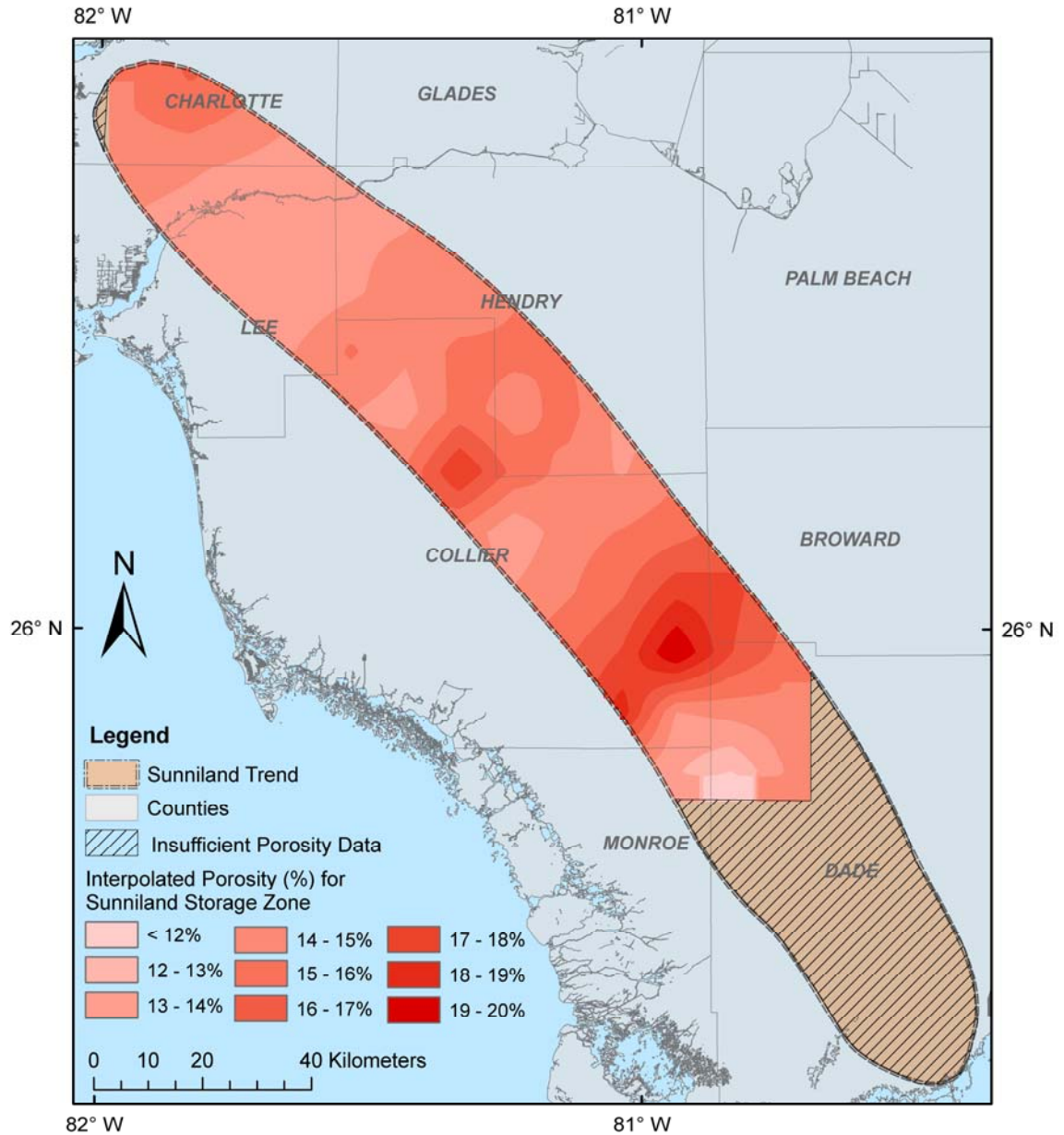


Figure 2-36: Average-porosity contours for the Sunniland Formation throughout the Trend.

Table 2-4: Estimated CO₂ storage capacities for the Trend oil fields during CO₂-EOR.

Oil Field	Area (m²)	h_g (m)	Φ_{tot}	ρ (kg/m³)	E	G_{CO2}(kg)	G_{CO2}(tons)
Baxter Island	31,551,000	17.02	0.17	642.57	0.03	1,791,863,209.98	1,975,191
Bear Island	51,120,700	6.59	0.15	642.57	0.03	962,622,706.63	1,061,110
Corkscrew	7,587,570	29.95	0.16	642.57	0.03	720,619,231.97	794,347
Forty Mile Bend	53,598,500	17.97	0.14	642.57	0.03	2,679,082,885.59	2,953,183
Lake Trafford	8,904,060	10.81	0.15	642.57	0.03	286,617,787.35	315,942
Lehigh Park	22,757,700	9.98	0.13	642.57	0.03	568,368,358.77	626,519
Mid-Sunoco Felda	11,601,800	20.90	0.17	642.57	0.03	791,562,364.04	872,548
Pepper Hammock	44,452,100	21.65	0.16	642.57	0.03	2,967,755,868.83	3,271,391
Raccoon Point	20,383,400	21.34	0.22	642.57	0.03	1,844,771,685.80	2,033,513
Seminole	28,930,100	25.39	0.13	642.57	0.03	1,887,969,107.85	2,081,130
Sunniland	24,842,800	33.17	0.18	642.57	0.03	2,830,747,420.05	3,120,365
Sunoco Felda	41,830,800	15.34	0.16	642.57	0.03	1,963,325,716.99	2,164,196
Townsend Canal	12,525,900	12.80	0.13	642.57	0.03	412,521,751.74	454,727
West-Sunoco Felda	66,669,200	23.42	0.13	642.57	0.03	4,010,026,804.59	4,420,298
TOTAL							26,144,460

The total estimated CO₂ storage capacity of the Sunniland Formation throughout the entire extent of the Trend is 1,194,794,068 tCO₂ (~1.2 billion tons of CO₂ [BtCO₂]). This value was estimated using the following variables: $A = 7,344,000,000 \text{ m}^2$; $h_g = 52.74 \text{ m}$; $\Phi_{\text{tot}} = 0.15$; $\rho = 642.57 \text{ kg/m}^3$; and $E = 0.03$. Table 2-5 is a summary of data that was extrapolated from the 69 wells used for porosity-derivation, which was ultimately used in the estimated storage capacity calculation. Figure 2-37, which shows variation in estimated CO₂ storage capacity by 1,000 tCO₂ per km², displays how storage capacity varies throughout the Trend.

2.6.3 Potential Leakage Points

Table 2-6 lists all of the unplugged wells in south Florida that are currently either producing oil, are used for waste disposal, or are “shut in.” Since these wells provide a conduit to the surface, they therefore serve as potential leakage points for CO₂ following CO₂ injection into the Sunniland Formation. No additional leakage points, including faults or fractures in the caprock, were apparent in the geophysical logs or core/well cutting samples evaluated for the Sunniland Formation within the study area.

2.7 Discussion

2.7.1 Study Limitations

Identifying exploratory/discovery wells that penetrated the entire Sunniland Formation within the Trend was challenging. In many cases, wells drilled in the Trend terminated near the top of the Sunniland Formation within the upper producing zone. Exploratory/discovery drilling in the Sunniland Formation typically ceased following the testing of the production zone, a common technique in oil exploratory drilling that is implemented to avoid penetrating the saline waters below the oil-rich zone, which would otherwise mix with the produced oil and would require more costly oil-water separation procedures (Applin & Applin, 1965; W.B. Harris, personal communication, August 18, 2009). Therefore, exploratory/discovery wells used for obtaining porosity data for this

Table 2-5: Data used to calculate estimated storage capacity for the Sunniland Formation throughout the Trend.

P#	h_g (m)	Total h_g (m)	ϕ	Avg ϕ	BHT (°C)
278	79	79	0.16	0.16	65.56
279	58	58	0.14	0.14	41.11
300	80	80	0.19	0.19	96.11
311	33	33	0.19	0.19	36.67
326	48	48	0.15	0.15	84.44
331	64	64	0.11	0.11	77.78
360	63	63	0.14	0.14	86.11
376	53	53	0.14	0.14	75.56
384	36	36	0.16	0.16	81.11
401 (Upper)	55	66	0.12	0.16	94.44
401 (Lower)	10		0.19		94.44
425	63	63	0.13	0.13	88.89
437	61	61	0.17	0.17	86.67
472	76	76	0.14	0.14	97.22
475 (Upper)	11	43	0.16	0.17	96.11
475 (Lower)	32		0.17		96.11
477 (Upper)	52	57	0.12	0.12	93.33
477 (Lower)	5		0.12		93.33
486	66	66	0.14	0.14	87.78
488	43	43	0.17	0.17	85.56
527 (Upper)	37	46	0.14	0.13	92.22
527 (Lower)	9		0.11		92.22
561	20	20	0.17	0.17	87.78

P#	h_g (m)	Total h_g (m)	ϕ	Avg ϕ	BHT (°C)
564	34	34	0.12	0.12	86.11
565A	52	52	0.13	0.13	89.44
596 (Upper)	45	72	0.14	0.22	108.33
596 (Lower)	27		0.29		108.33
662	61	61	0.13	0.13	88.89
683 (Upper)	15	76	0.16	0.15	85.00
683 (Lower)	61		0.14		85.00
684 (Upper)	34	56	0.14	0.14	94.44
684 (Lower)	22		0.14		94.44
697	51	51	0.16	0.16	95.00
700	47	47	0.15	0.15	90.56
702	73	73	0.13	0.13	88.89
735	63	63	0.13	0.13	92.22
736 (Upper)	3	30	0.18	0.15	90.56
736 (Lower)	27		0.11		90.56
754	48	48	0.12	0.12	97.78
758	33	33	0.13	0.13	91.11
760	59	59	0.15	0.15	87.78
829	64	64	0.22	0.22	78.89
853 (Upper)	7	59	0.14	0.15	87.70
853 (Lower)	52		0.15		87.70
858	39	39	0.14	0.14	79.44
859 (Upper)	4	29	0.11	0.13	40.56
859 (Lower)	25		0.15		40.56
864	62	62	0.13	0.13	79.44

P#	h_g (m)	Total h_g (m)	ϕ	Avg ϕ	BHT (°C)
865 (Upper)	59	64	0.17	0.16	92.22
865 (Lower)	5		0.14		92.22
871 (Upper)	32	48	0.13	0.12	74.44
871 (Lower)	16		0.10		74.44
897 (Upper)	26	51	0.15	0.14	78.89
897 (Middle)	17		0.12		78.89
897 (Lower)	8		0.16		78.89
904	36	36	0.13	0.13	73.89
926	21	21	0.14	0.14	78.33
928	81	81	0.18	0.18	80.00
947 (Upper)	44	65	0.13	0.12	75.56
947 (Lower)	21		0.10		75.56
951 (Upper)	3	30	0.13	0.14	99.44
951 (Lower)	27		0.14		99.44
982	66	66	0.14	0.14	83.89
1014	63	63	0.14	0.14	75.00
1016	62	62	0.13	0.13	91.67
1026	60	60	0.12	0.12	72.22
1057	20	20	0.17	0.17	72.78
1059	64	64	0.14	0.14	83.89
1063	77	77	0.16	0.16	88.89
1065 (Upper)	57	62	0.14	0.14	93.33
1065 (Lower)	5		0.14		93.33
1070	30	30	0.13	0.13	68.89
1086 (Upper)	41	47	0.12	0.12	70.56

P#	h_g (m)	Total h_g (m)	ϕ	Avg ϕ	BHT (°C)
1086 (Lower)	6		0.11		70.56
1118 (Upper)	23	32	0.15	0.17	70.56
1118 (Lower)	9		0.18		70.56
1119 (Upper)	12	25	0.13	0.16	77.78
1119 (Lower)	13		0.18		77.78
1127	68	68	0.14	0.14	76.11
1131	15	15	0.12	0.12	85.00
1134	89	89	0.14	0.14	80.00
1142	56	56	0.16	0.16	72.22
1151	30	30	0.15	0.15	128.89
1201	71	71	0.16	0.16	81.10
1202	28	28	0.15	0.15	110.56
1208 (Upper)	24	65	0.17	0.15	81.11
1208 (Lower)	41		0.13		81.11
1216	75	75	0.15	0.15	90.56
1240	31	31	0.12	0.12	81.11
1292	44	44	0.12	0.12	82.22

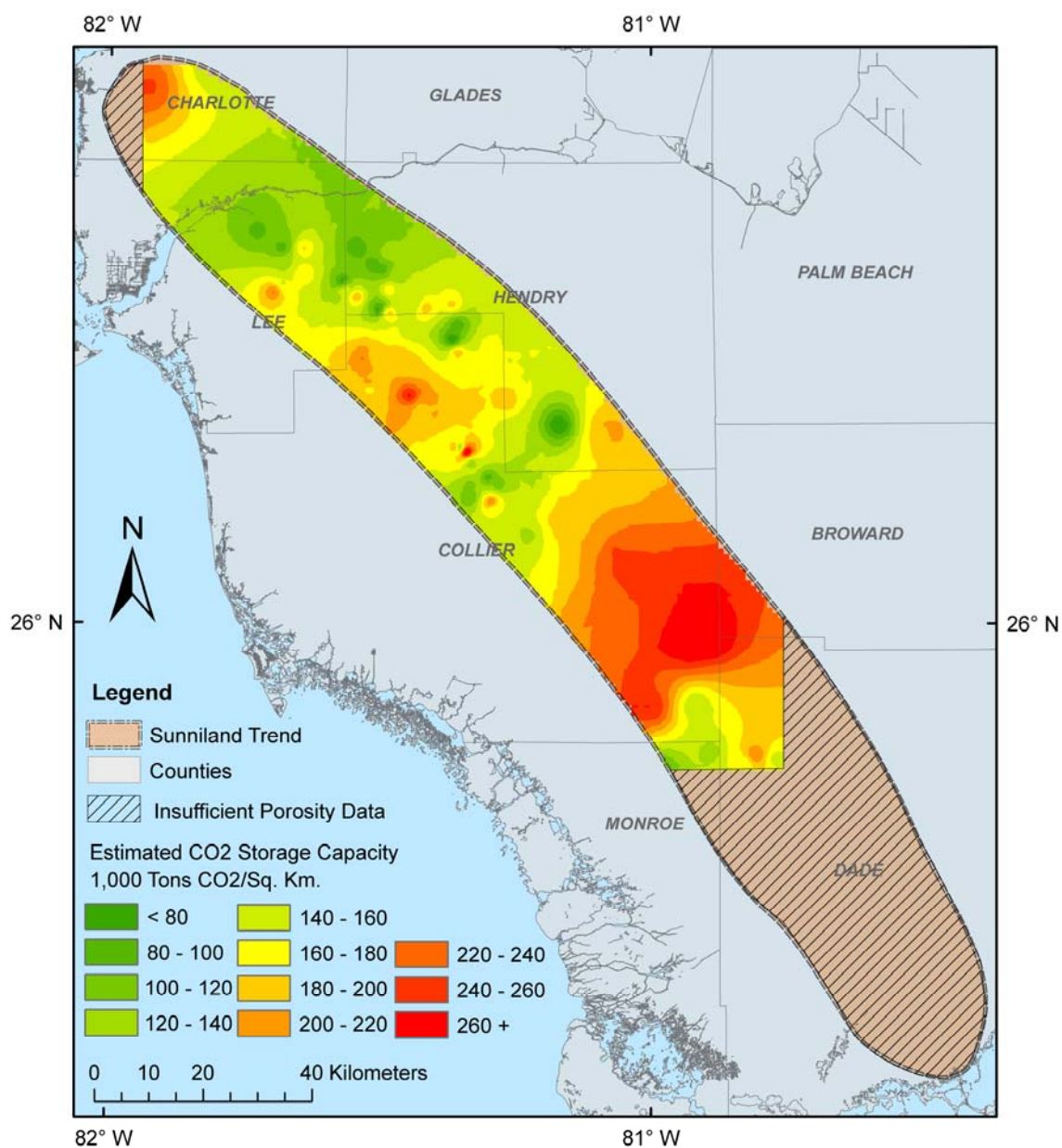


Figure 2-37: Storage-capacity-contour map of the Trend.

Table 2-6: Unplugged oil/gas and waste disposal wells in south Florida.

Well P#	Oil Field Operator	Location	Well Type	Permit Status
563	BreitBurn	Bear Island Field	Oil/Gas	Expired
640	BreitBurn	Bear Island Field	Oil/Gas	Expired
733	BreitBurn	Bear Island Field	Oil/Gas	Expired
761	BreitBurn	Bear Island Field	Disposal	Operating
800	BreitBurn	Bear Island Field	Oil/Gas	Operating
856	BreitBurn	Bear Island Field	Disposal	Operating
962AH	BreitBurn	Bear Island Field	Oil/Gas	Operating
981BH	BreitBurn	Bear Island Field	Oil/Gas	Operating
1060	BreitBurn	Bear Island Field	Oil/Gas	Expired
1064	BreitBurn	Bear Island Field	Oil/Gas	Operating
1118A	BreitBurn	Bear Island Field	Oil/Gas	Expired
1119	BreitBurn	Bear Island Field	Oil/Gas	Operating
1170	Peninsular Oil Company	Corkscrew Field	Oil/Gas	Operating
1199A	Newport Oil Corporation	Corkscrew Field	Oil/Gas	Operating
1201A	BreitBurn	Corkscrew Field	Oil/Gas	Operating
1224BH	BreitBurn	Corkscrew Field	Oil/Gas	Operating
401AH	US Capital Energy, Inc	Lake Trafford Field	Oil/Gas	Operating
841	BreitBurn	Lehigh Park Field	Oil/Gas	Operating
1019	BreitBurn	Lehigh Park Field	Oil/Gas	Operating
904	BreitBurn	Mid-Sunoco Felda Field	Oil/Gas	Operating
925	Peninsular Oil Company	Mid-Sunoco Felda Field	Oil/Gas	Operating
915	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
998	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1031	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1061	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
1082AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1121	BreitBurn	Raccoon Point Field	Disposal	Operating
1130	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1141AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1149	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1167	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
1190AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1215	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1289CH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1331AH	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
1332	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
1333	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
102	BreitBurn	Sunniland Field	Disposal	Operating
312AH	BreitBurn	Sunniland Field	Oil/Gas	Operating
323A	Oryx Energy Company	Sunoco Felda Field	Oil/Gas	Operating
416	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
442W	BreitBurn	West-Sunoco Felda Field	Disposal	Operating
645DH	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
748	BreitBurn	West-Sunoco Felda Field	Disposal	Operating
1294DH	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
1295H	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating

study were limited to those wells which penetrated the entire Sunniland Formation, although in some cases wells which penetrated most, but not all, of the Sunniland Formation were used in areas where there were little to no full-penetration wells for the formation. In addition, some wells had curved wellbores that had geophysical logs only reported in measured depth, and the associated well record lacked the information needed to convert the depths to TVD for accurate representation of the depth and extent of the Sunniland Formation and its caprock; as such, these wells could not be included in the study. Evaluation of the Trend was also limited to the existing well-coverage, which was dense due to the presence of past or current oil production or exploration in some regions, while in other regions well-coverage was sparse and widespread, such as the eastern boundary of the Trend and the northern and southernmost extents of the Trend. Well-coverage limitations affected the ability to interpolate porosity and estimated CO₂ storage capacity on a relatively small scale throughout the entire extent of the Trend, using the RBF methods in ArcGISTM. As discussed earlier in Section 2.5.4, because interpolated surfaces only go through actual data points when using the RBF methods, interpolated contour-surfaces were bound by the outermost data points in the study area. Therefore, the interpolated-surfaces for the porosity and CO₂ storage capacity contour interpolations could only be developed for approximately 70% of the Trend.

As mentioned earlier, the volumetric equation for capacity calculation in saline formations was used to calculate storage within the Trend oil fields, as opposed to using the oil and gas reservoir storage capacity calculation equation provided by NETL (2007). The purpose of using the oil and gas reservoir equation is to account for the increased storage space created when oil or gas is removed from the reservoir, typically resulting in an increased CO₂ storage efficiency factor from 0.03 to 0.2, which significantly increases the overall estimated storage capacity for a given oil field (G. Bromhal,

personal communication, October 19, 2009); however, because the oil and gas reservoir storage equation requires the sole use of production wells, it could not be applied to the Trend oil field storage capacity calculations, as this study used both production wells and dry holes, and could not be limited to production wells alone due to constraints in data availability. Therefore, the resulting storage capacity estimations for the Trend oil fields are conservative.

2.7.2 Porosity and Permeability of the Sunniland Formation

Most of the observed porosity in the CO₂ storage reservoir is intergranular, or interparticle. Porosity within the Sunniland Formation along the Trend is not confined to porous limestone, but also includes dolostone within the formation that contains relatively high porosities. For the most part, however, high-porosity zones within the Sunniland Formation are located in porous limestone, as seen in Table AIV-1 and the striplogs of Appendix V, which occur throughout the formation within the study area. For the Sunniland Formation, few fractures were observed in the geophysical logs used for this study; however, additional geophysical logs, such as seismic logs, would need to be evaluated in order to better-identify the occurrence of fractures within the storage zone.

Average porosity for the Sunniland Formation within the Trend oil fields is 16%, and ranges from 13% in Lehigh Park, Seminole, Townsend Canal, and West-Sunoco Felda fields to 22% in Raccoon Point Field, as shown in Table 2-4. The oil fields with the highest average-porosity in the Sunniland Formation are located along the western rim of the Trend, as well as in the central portion of the Trend.

Average porosity for the Sunniland Formation throughout the extent of the Trend is 15%, and ranges from 10% to greater than 40% in the porous zones of the formation. Figure 2-36 shows that porosities within the Sunniland Formation are generally greater in the central and south-central portion of the Trend, as suggested by Applegate and Pontigo (Figure 2-12; 1984).

Laterally, porosity within the Sunniland Formation is relatively homogeneous throughout the Trend, as depicted in figures 2-13 through 2-35. Vertically, however, some heterogeneity exists within the formation in the form of semi-confining anhydrite or low-permeability dolomite that range in thicknesses from 0.3-38 m (1-123 ft), as seen in Table AIV-I of Appendix IV and in the striplog created for each evaluated well (Appendix V). In many instances, the relatively thick, low-permeability layers create one or more potential storage sub-zones within the vertical extent of the sequestration reservoir that are laterally continuous. Both of these conditions are preferable for a potential CO₂ storage zone, as the lateral homogeneity increases the storage capacity of the formation, while the vertical heterogeneity slows the vertical migration of injected-CO₂ and increases the CO₂ storage efficiency of the formation.

2.7.3 Storage Capacity of the Sunniland Formation within the Trend

The average estimated CO₂ storage capacity for each Trend oil field during CO₂-EOR operations was approximately 2 MtCO₂. The oil field with the greatest estimated CO₂ storage capacity (over 5.5 MtCO₂) was West-Sunoco Felda Field, which is also the largest and most-productive oil field within the Trend. The oil field with the lowest estimated CO₂ storage capacity (nearly 371,000 tCO₂) was Lake Trafford Field.

The estimated total CO₂ storage capacity for the Trend oil fields that is available during CO₂-EOR is 26 MtCO₂, while the estimated CO₂ storage capacity for the Trend in its entirety that is available during CCS is approximately 1.2 BtCO₂. As depicted in Figure 2-37, the areas of the Trend with comparatively higher storage capacities are generally located in the same areas of the Trend that have the higher porosity values. Only 70% of the study area could be interpolated in this figure due to in.

Not only is the estimated CO₂ storage capacity calculations for the Trend oil fields conservative because the saline reservoir calculation was used as opposed to the oil and gas reservoir calculation, but the overall estimated CO₂ storage capacity

calculation for the entire Trend was relatively conservative, as well. This is because, for this study, porous intervals that had porosities $\geq 10\%$ were deemed suitable for CO₂ storage, which is a somewhat-conservative porosity delineation compared to other CCS studies that have been conducted, which use lower porosity values for storage-zone delineation (i.e., 8%) (Brennan et al., 2010). The conservative porosity delineation used in this study results in a more-conservative storage capacity estimate for the Sunniland Formation because it affects the overall thickness, or what portions of the formation are included in, the potential storage zone(s), and thus affects the estimated value of h_g used in the storage capacity calculation.

Electricity-generating power plants in Florida collectively produce approximately 151 MtCO₂/yr (Southeast Regional Carbon Sequestration Partnership, 2008). According to data provided by Carbon Monitoring for Action at carma.org, most major, large-scale power plants in south Florida produce 4-10 MtCO₂/yr. Progress Energy's Crystal River power plant in Citrus County and TECO's Big Bend power plant in Hillsborough County emit more CO₂ to the atmosphere than any other power plant in the state of Florida, at 16 and 10.5 MtCO₂/yr, respectively. Both power plants are located in south-central Florida, relatively close to the northernmost extent of the Trend. Depending upon the size of the power plant and the respective annual CO₂ emission, the Trend oil fields collectively have the ability to potentially support CO₂ storage for a large, coal-fired power plant for 3-7 years via CO₂-EOR operations, which is comparatively low considering the 40-year lifespan of a power plant. However, the entire Trend, including the full storage capacity for each oil field, has the ability to potentially support CO₂ storage for about six large-scale, coal-fired power plants for the entire lifespan of each power plant, or 12 coal-fired power plants for half the lifespan of each plant, during CCS operations. Storage capacity availability in the Trend oil fields can be maximized during CCS operations versus CO₂-EOR operations because the available storage zone(s)

within each oil field are not confined to the upper oil-producing zone of the Sunniland Formation, but rather include all portions of the formation that have porosity values $\geq 10\%$.

2.7.3.1 *Effects of Study Limitations and Uncertainties on Estimated Storage Capacity*

The CO₂ storage capacities calculated for the Sunniland Formation throughout the Trend and its oil fields are not definitive calculations, but rather are estimations based upon the available data, which have limiting factors such as availability of wells for spatial-coverage, as well as the availability of lithologic and geophysical data at each well. Errors may exist in the storage capacity estimations as a result of uncertainties in the study area and available data, as well as uncertainties that exist in the physical and geochemical processes that occur in the system following CO₂ injection, such as factors affecting plume migration, brine displacement, and trapping mechanisms. These errors and uncertainties may increase or decrease the estimated CO₂ storage capacity calculated for the Sunniland Formation in this study. Given the available data, it is difficult to estimate these uncertainties.

The area ($\sim 7.3 \times 10^9 \text{ m}^2$) used in the estimated CO₂ storage capacity for the Sunniland Formation is limited to the area of the Trend, or study area. The Trend was chosen as the study area for the Sunniland Formation in this investigation because the majority of the porosity and oil production in the formation occurs within this area; however, the porous intervals of the Sunniland Formation could extend beyond the Trend boundary to some extent, which could slightly increase the study area and resultant storage capacity.

The porosity of the Sunniland Formation was derived from geophysical logs for wells within the study area, and Φ_{tot} used in the storage capacity calculation represents the average of these derived-porosity values. When more than one geophysical log was

available, cross-plots were used to best-determine porosity values within the formation; however, in many instances only one geophysical log was available for porosity derivation, which often required that the lithology be determined in order to obtain the correct porosity value. Depending upon the type of geophysical log used, differences in lithology could result in a difference in porosity of 5-10% for a given porous interval of varying thickness (i.e., 0.5 or more meters). If the designated lithology chosen in this study does not match the true lithology within the formation for a given porous interval, the average porosity determination and Φ_{tot} value could be slightly less or slightly more, but probably not more or less than 0.5-1%, which could result in a difference of ~5-10% of the estimated storage capacity. The designated, or derived, porosity throughout the Sunniland Formation also affects the thickness of the porous intervals and ultimately the value of h_g , as designated porous intervals in this study had to have a porosity of at least 10% to be included in the storage capacity calculations.

The amount of formation-water that is displaced as a result of CO₂ injection determines the storage efficiency of a given aquifer. Including the effects of gravity, CO₂ and formation-water displacement are dependent upon the lateral homogeneity of the storage reservoir (van der Meer, 1995). Porosity interpolations presented in this study show lateral continuity with the porous intervals of the Sunniland Formation, and as discussed in Section 2.5.3, simulations conducted to date at USF show significant lateral displacement of formation-brines following CO₂ injection, both of which increase storage efficiency. Additionally, the vertical heterogeneity of the Sunniland Formation, as presented in this study, also increases the storage efficiency in the reservoir, as it slows the vertical migration of CO₂. For these reasons, an E value of 0.03 was selected to represent the storage efficiency of the Sunniland Formation; however, without knowing the residual brine saturation, which is the amount of brine remaining in the pore spaces of the unit after the CO₂ front has passed through, it is extremely difficult to determine

the value of E at such a small scale. Because the value of E typically ranges from 0.01-0.04 (NETL, 2007), the estimated storage capacity for the Sunniland Formation within the Trend potentially ranges from ~411 MtCO₂ to ~1.6 BtCO₂, depending upon which value of E is used in the storage capacity calculation, which is a difference of 31-66% of the estimated storage capacity.

This study provides numerous cross-sections and interpolations that display the vertical heterogeneity and lateral continuity of porous intervals and layers of low permeability within the Sunniland Formation; however, these interpolations are on a regional-scale and distances between each well vary throughout the study area. The wells used in this study are spatially dependent, as some wells occur in “clusters” in areas with extensive oil exploration, and other wells are separated by greater distances where no potential source rocks exist and little oil exploration has been conducted; therefore, a more-detailed, small-scale examination of the lithology in the Sunniland Formation is unavailable. As such, for this study, it is assumed that all well data are equally valid and that there is no objective basis for differentially weighting the data from individual wells.

Figure 2-37 is an interpolation of the CO₂ storage capacity within the Sunniland Formation throughout 70% of the Trend, which was created using ArcGISTM. Essentially, ArcGISTM was used to integrate each variable in the storage capacity equation on a cell-by-cell basis (using 15,340 cells), thereby resulting in a calculated CO₂ storage capacity for the Sunniland Formation. ArcGISTM also allows for the calculation of spatial-statistics associated with a raster layer. The spatial-statistics for the storage-capacity raster layer indicate that the sum of the cells in the model equate to approximately 880 MtCO₂, which is ~73% of the manually-derived CO₂ storage capacity for the Sunniland Formation (~1.2 BtCO₂). The manually-derived CO₂ storage capacity represents an extrapolated storage capacity for the entire study area (Trend), which is approximately 30% larger than the

area for which the geospatially-derived CO₂ storage capacity was calculated. Because the geospatially-derived CO₂ storage capacity was calculated for 70% of the total study area, the fact that the total storage capacity calculated using this method for the reduced study area was 73% of the manually-derived storage capacity corroborates the general accuracy of the manually-derived CO₂ storage capacity, with a 3% difference between the two storage capacity calculation methods.

2.7.4 Sunniland Formation Seals

The stratigraphic traps and lateral decrease in permeability beyond the region of the Trend form the seals that hold the oil of the Sunniland Formation in place. These seals, together with the overlying Lake Trafford Formation and the underlying Punta Gorda Anhydrite, would serve as the seals for the Sunniland Formation during potential CO₂-injection operations. Pollastro et al. (2001) states that any seals that overly or occur within petroleum-producing geologic units of the South Florida Basin are highly effective at oil-trapping and containment, and states that this is evidenced by, “the criteria for subdivision of oil sub-types among producing units and the remarkable well-to-well correlation of these oils, often where reservoirs are stratigraphically juxtaposed to one another but separated by a seal.”

Within the study area of the Trend, the average thickness for the Lake Trafford Formation was 48 m (156 ft), and ranged from 32 m (105 ft) to 86 m (281 ft), as denoted in Table 2-2. No faults or fractures were apparent in the Lake Trafford Formation, either in the background literature or within this study. If post-depositional faults and fractures ever existed within the Lake Trafford Formation, formation-anhydrites would likely have filled these features and reinforced the semi-confining nature of the unit. Based upon the core samples and geophysical logs that were evaluated in this study, and on the fact that the Sunniland Formation seals have exemplified oil-trapping and containment capabilities for millennia, the formation-seals are also believed to be potentially effective

seals for CO₂ sequestration; however, no seismic data were available for review during this study, which would likely provide a better determination of the effectiveness and suitability of the Sunniland Formation seals for such operations.

2.7.5 Carbon Sequestration in the Sunniland Formation within the Trend

Based upon the criteria outlined in Chapter 1 for successful CCS operations in geologic formations, the Sunniland Formation within the Trend of the SFB could potentially be used as a CO₂ storage zone for the following reasons:

Geographic Location

Unlike many oil fields throughout the US, the Trend oil fields, as well as the full extent of the Trend itself, are relatively close to major population centers and electricity-generating power plants. Figure 2-38 shows the proximities of the Trend and the Trend oil fields in relation to electricity-generating power plants in the SFB. The close proximity between the Trend, the Trend oil fields, and electricity-generating power plants means that not only will the supercritical CO₂ have to travel relatively short distances, but also less complex means of CO₂ transportation will be required in the SFB, both of which result in a decrease in overall costs for CCS projects.

Infrastructure and Geologic Knowledge

Because the Trend has hundreds of oil exploratory/discovery oil wells that penetrate the Sunniland Formation, an infrastructure is already in place throughout the region that can be used for CCS operations, as many existing wells, such as water-flooding wells, can be converted to CO₂-injection wells. In addition, because a significant amount of lithological and geophysical data have been collected for the Sunniland Formation within the Trend via these oil-exploration/discovery wells, a substantial amount of information is available to effectively assess the feasibility of the formation as a potential GS unit, as demonstrated in this study.

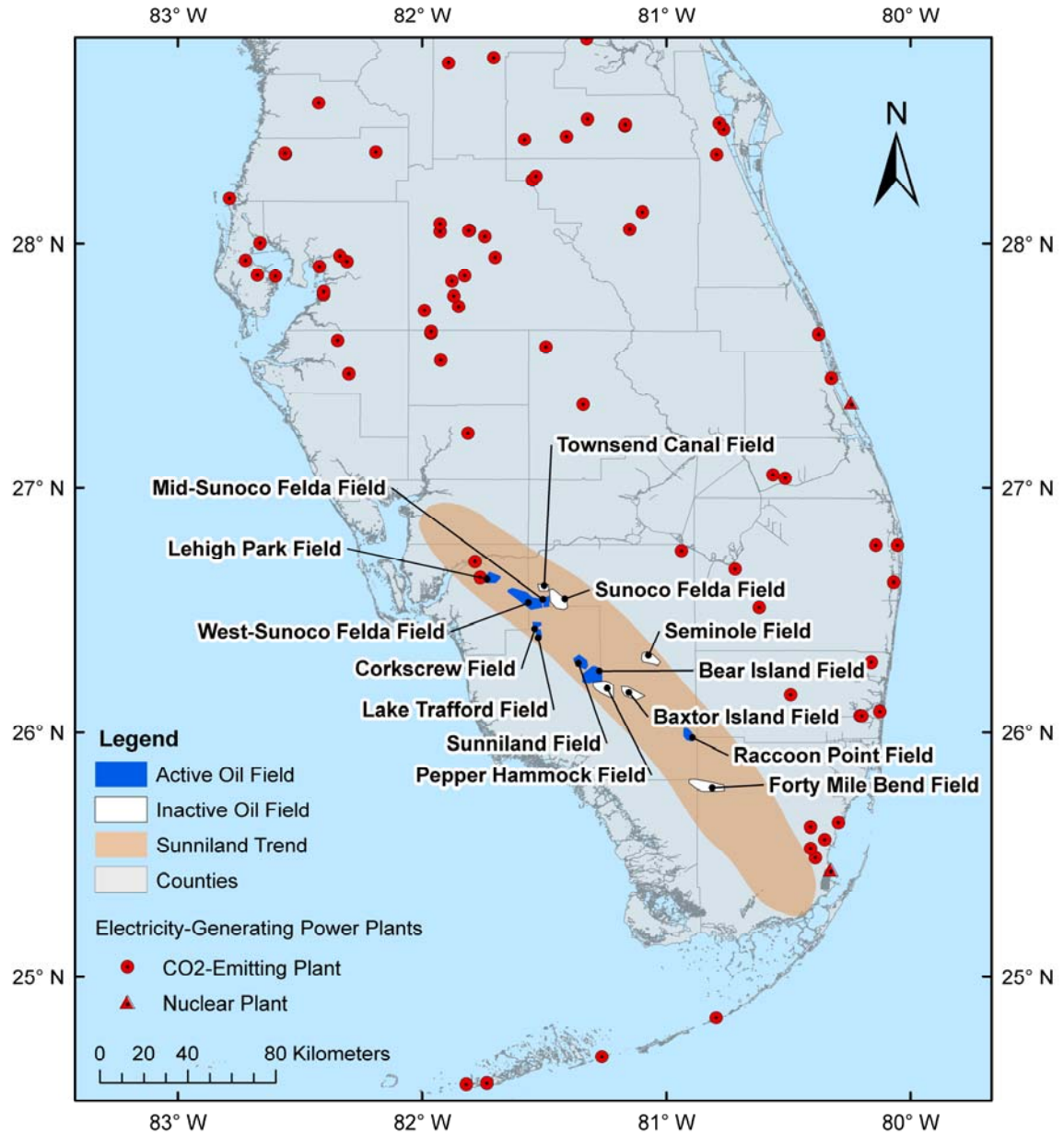


Figure 2-38: Locations of electricity-generating power plants in relation to the Trend and the Trend oil fields.

Porosity and Storage Capacity

Average porosity in the Sunniland Formation within the region of the Trend is 15%, which suggests that the formation is potentially suitable for use as a geologic storage unit for CCS. Additionally, the estimated CO₂ storage capacity of the Sunniland Formation within the Trend is 1.2 BtCO₂, which means the Trend potentially has the ability to support CCS for one or more large-scale power plants for their entire lifespan.

Seals

The Lake Trafford Formation and the Punta Gorda Anhydrite, together with the lateral decrease in permeability beyond the region of the Trend, are potentially sufficient seals for the Sunniland Formation for its use in CCS operations.

2.7.6 Enhanced Oil Recovery in the Sunniland Formation of the Trend

While the Trend oil fields are small by oil-industry standards, they do offer the possibility of using CO₂-EOR to offset CCS costs to Florida electric-power utility companies that are required to reduce annual CO₂ emissions. Furthermore, the Trend oil fields have the potential to produce additional oil worth \$1-3 billion USD (at \$100/barrel of oil) if another 10-15% of the OOIP is recovered from the Sunniland Formation during CO₂-EOR operations. In addition to the reasons provided in Section 2.7.5, the Sunniland Formation of the Trend would potentially be suitable for CO₂-EOR operations in the Trend oil fields due to the following reasons:

Density of CO₂

The effectiveness of the CO₂-sweep, or the ability of the injected-CO₂ to strip residual-oil from a source rock, during EOR in a geologic unit increases as the density of the supercritical CO₂ that is injected increases (Tzimas et al., 2005). The CO₂ density is a function of injection pressure and BHT. The higher the injection pressure and BHT, the greater the density of CO₂ will be. The recommended density range for CO₂-EOR operations is 400-750 kg/m³ (Metz et al., 2005; Tzimas et al., 2005). The average

estimated CO₂-density that was calculated for the Sunniland Formation was 642.57 kg/m³, which falls within the recommended CO₂-density range for CO₂-EOR operations.

Uniform Intergranular Porosity

If the porosity and permeability of a producing zone is not uniform, or if significant fracture porosity is present, the plume of injected-CO₂ created during CO₂-EOR will form fingers instead of a more uniform front (Tzimas et al., 2005). The fingering will bypass much of the residual oil in the reservoir, thereby reducing the effectiveness of the CO₂ injection for EOR. The producing zones in the Trend oil fields have relatively simple intergranular porosity created by the original shell hash, subsequent weathering, and some dolomitization. With the exception of production from the Lower Sunniland Limestone at Lake Trafford Field, the producing-zones do not appear to have significant fracture porosity.

API Density of Formation Oil

If the oil in a given formation is too heavy, the CO₂-flood (or CO₂-sweep) will not recover enough residual oil to make the CO₂-EOR project economic; however, the ability of CO₂ to reduce the viscosity of oil partially offsets the limitations of heavier oils for CO₂-EOR. However, low-API oils typically sell for less than light crude oil. The lower acceptable API limit for successful CO₂-EOR operations for heavy oils is 24°; therefore, because the API for oil from the Sunniland Formation ranges from 24°-28°, the Trend oil fields are considered potentially suitable for CO₂-EOR operations.

Production Zone Thickness

During CO₂-EOR, the injected CO₂ is only about 80% as dense as the formation waters, resulting in a buoyancy effect, which is further discussed in Chapter 1. This buoyancy effect can lead to the CO₂ front overriding the formation waters, thereby leaving residual oil in the reservoir behind, and creating early breakthrough of CO₂ at the

production well. This effect increases with increasing thicknesses of the producing or 'pay' zones. According to the well records for the production wells evaluated in this study, the pay zones of the Sunniland Formation within the Trend oil fields are relatively thin (6-15 m [20-50 ft] thick), which encourages an efficient CO₂-sweep during EOR.

Remaining Oil-in-Place

In order for a CO₂-EOR project to be economically sustainable, the remaining oil-in-place following primary and secondary recovery in a given oil field should exceed 50-60% of the OOIP. Following water flooding, recovery ratios of produced oil to OOIP in Trend oil fields ranged from about 0.3 to 0.5, which implies that 50-70% of the OOIP is still present in the oil fields (Lloyd, 1996), of which 30-50% is estimated to be recoverable during tertiary recovery (Applegate & Pontigo, 1984).

Storage Capacity

Collectively, the estimated CO₂ storage capacity for the Trend oil fields during CO₂-EOR is 26 MtCO₂, which is more than the estimated CO₂ storage capacity for the Weyburn Project oil fields (23 MtCO₂) and the Salt Creek Project oil field (27 MtCO₂) that are discussed in Chapter 1.

Seals

Existing and depleted oil reservoirs have a very low risk of leaking CO₂, as the available data show that stratigraphic traps and structural barriers are effective at retaining the oil within the reservoir for very long periods of time before its extraction. For the SFB, oil has been contained in the source rocks for at least 20-30 million years (Pollastro et al., 2001).

Additional concerns involved with CO₂-EOR in the Trend oil fields are the costs involved with the delivery of CO₂; the costs involved with the design, implementation, and monitoring of a CO₂-EOR project; and the potential volumes of CO₂ which can effectively be used for EOR and subsequent storage. As more CCS projects are

conducted worldwide, the range of costs for each method of CO₂ transport, as well as costs associated with the operation and monitoring of a CO₂-EOR project, will become better constrained. For the estimation of potential volumes of CO₂ needed for EOR in the Trend oil fields, oil-field operators, specifically Breitburn, can estimate the recoverable volumes of oil based upon experience in other oil fields in conjunction with operating histories and the known geology of the Trend oil fields. From the estimated recoverable oil volumes, an estimate of the CO₂ volumes needed for EOR and ultimately sequestered, as well as the overall economics of CO₂-EOR in the Trend oil fields, could then be calculated.

With the combined goal of CCS and CO₂-EOR, GSGI is the better method for CO₂-EOR operations in the Trend oil fields due to the fact that: 1) more CO₂ is used in GSGI than in WAG because there can be a continuous flow of CO₂ to the injection site as opposed to the intermittent flow involved with WAG, 2) less CO₂ is recycled and re-injected for EOR, and 3) more CO₂ is ultimately sequestered. However, the preferred method of CO₂-EOR for oil field operators is typically WAG because, as described in Chapter 1, a large portion of the injected-CO₂ is captured at the production well during oil recovery, which is subsequently re-injected for continued use in the EOR process. This method of CO₂-EOR reduces both the amount of CO₂ that would be purchased by the oil field lease-holder(s) and the amount of CO₂ left behind in the Sunniland Formation as sequestered-CO₂.

2.7.7 Potential Leakage Points for the Sunniland Formation

Wells currently or formerly used for water-flooding in the Trend oil fields could be converted to CO₂-injection wells for use in CO₂-EOR and CCS operations. According to the FDEP Bureau of Mining and Minerals Regulation Oil and Gas Section, if an exploratory well has no show of oil, it is plugged and abandoned in accordance with the rules and procedures outlined in Florida Administrative Code (FAC) 62C-29.009 (D.

Taylor, personal communication, January 21, 2010). In summation, FAC 62C-29.009 requires that for dry wells, several cement plugs must be installed throughout the vertical extent of the borehole: one cement plug must be emplaced 30.5 m (100 ft) above the perforation within the borehole and another must be emplaced 30.5 m (100 ft) below the perforation; a cement plug must be emplaced 61 m (200 ft) above and 61 m (200 ft) below any penetrated aquifers used for drinking water supply; and a cement plug must be installed from the ground surface to 30.5 m (100 ft) bls.

If a producing-well ceases oil production, operators either plug and abandon the well immediately in accordance with FAC 62C-29.009, or the well is “shut in” until a decision is made by the operator to either plug and abandon the well, deepen the well for further oil exploration, or convert the well to an injection/disposal well. Because Chapter 377 of the Florida Statutes and Rules 62C-25 through 62C-30 of the FAC do not require oil field operators to make a prompt decision regarding the handling of a previously producing oil well, many wells in Florida oil fields are typically left shut in for months, sometimes years (D. Taylor, personal communication, January 21, 2010).

Any unplugged wells in southern Florida that penetrate the seals of the Sunniland Formation, which are identified in Table 2-6, are potential leakage points for CO₂ following CO₂-injection operations. Prior to the enactment of FAC 16C-29.09 in 1981 (which, after several modifications, is now known as FAC 62C-29.009), wells, for many decades, were not always plugged, and were instead simply filled with mud-laden fluid (Metz et al., 2005); therefore, improperly plugged and abandoned wells could potentially serve as leakage points for CO₂. In addition, the condition of many plugged and abandoned wells may have deteriorated significantly over time, thereby making them a conduit for CO₂ leakage into the overlying strata. Prior to the implementation of any type of CO₂-EOR or CCS operation in the Sunniland Formation, any unplugged wells in the vicinity of the proposed injection site should be identified and plugged in accordance with

FAC 62C-29.009, and any plugged and abandoned wells in the vicinity should be identified and examined for proper and secure plugging practices. It is also imperative that the location, depth, and well-characteristics of boreholes that have penetrated the Sunniland Formation within the area of review for a proposed injection-site, but that reached total depth before penetrating the formation, be evaluated, as these wells could also represent potential leakage pathways.

As discussed earlier, no faults or fractures were apparent in the Lake Trafford Formation, based upon a background-literature review and an evaluation of core samples and geophysical logs conducted during this study; however, additional geophysical logs, such as seismic logs, would need to be evaluated in order to rule out the occurrence of these leakage-features within the upper seal.

2.8 Conclusion

The sequestering of CO₂ in deep geologic units is a technology that is quickly gaining interest nationwide as a means of reducing anthropogenic CO₂ emissions. Within the southeast, Florida has been recognized as having numerous potentially promising CO₂ storage reservoirs, in the form of deep saline aquifers and existing/depleted oil reservoirs. Specifically, the Sunniland Formation of the SFB has been identified as a potential CO₂ sequestration reservoir that would be suitable for CO₂-EOR within the oil fields of the petroleum-producing Trend, as well as for CCS throughout the entire extent of the Trend. The Sunniland Formation within the Trend of the SFB would potentially be suitable for CCS operations due to its geographic location; its high porosity and storage capacity; its efficient caprock and seal; and its existing well-infrastructure and extensively known lithological and geophysical properties, which would be a large component of the costs for a CCS operation. For the same reasons, the Sunniland Formation within the Trend oil fields would potentially be suitable for CO₂-EOR operations, in addition to the fact that the estimated density of injected-CO₂ would

be within the appropriate range, the formation has uniform intergranular porosity, the API density of the formation-oil is within the acceptable limits, the production zones within the formation are relatively thin, and the remaining oil-in-place following secondary recovery is sufficient.

The Lake Trafford Formation and the Punta Gorda Anhydrite, together with the lateral decrease in permeability beyond the region of the Trend, are potentially sufficient seals for the Sunniland Formation for its use as a CO₂ storage reservoir. From rock samples and data evaluated in this study, the Lake Trafford Formation appears to be a suitable upper seal; however, further geophysical evaluation, such as the examination of seismic logs, could provide a better determination of its suitability, and is recommended prior to the implementation of any CO₂ injections into the Sunniland Formation.

The total estimated CO₂ storage capacity of the Sunniland Formation within all of the Trend oil fields is 26 MtCO₂. The estimated CO₂ storage capacity of the Sunniland Formation throughout the entire extent of the Trend is 1.2 BtCO₂. The region of the Trend that appears to have the highest storage capacity per km² is also the region which has the highest porosity values. Given these estimated storage capacities, and depending upon the size of the power plant and the respective annual CO₂ emission, the Trend oil fields collectively have the ability to potentially support CO₂ storage for a given power plant for 3-7 years via CO₂-EOR operations, and the entire Trend, including the full storage capacity for each oil field, has the ability to potentially support CO₂ storage for about six coal-fired power plants for the entire 40-year lifespan of each power plant, or approximately 12 coal-fired power plants for half the lifespan of each plant, during CCS operations.

Average porosity for the Sunniland Formation within the oil fields of the Trend is 16%, while the average porosity of the Sunniland Formation throughout the entire extent of the Trend is 15%. Higher-porosity zones appear to be located in the central and

south central portion of the Trend. Laterally, porosity in the Sunniland Formation is relatively homogeneous, which provides for increased storage capacity; however, vertically, some heterogeneity exists in the porosity of the Sunniland Formation, which could potentially slow the vertical migration of injected- CO_2 and increase the efficiency of the formation as a CO_2 storage reservoir.

Unplugged and plugged and abandoned wells have been identified as potential CO_2 -leakage points for CO_2 injection in the Sunniland Formation. Prior to the commencement of any CCS operations, such wells should be identified and either plugged in accordance with FAC 62C-29.009, or inspected for proper and secure plugging and abandonment, in order to close and alleviate CO_2 -leakage conduits. Additionally and as suggested above, further examination of the Lake Trafford Formation via geophysical data, such as seismic logs, should be conducted prior to CCS operations in order to rule out the occurrence of faults or fractures.

For the next step in evaluating the Sunniland Formation of the SFB for CCS operations, the data provided in this study could be incorporated into preliminary mathematical models of injection, using a numerical code such as TOUGH2/ECO2N that can simulate the injection of supercritical CO_2 into brine-filled geologic units, that analyze the effects of CO_2 injection into the Trend. This type of modeling would give an estimate of the volume of CO_2 that could be injected, examine the physical effects of CO_2 injection, such as changes in fluid pressures and brine displacement, and monitor the potential for migration of the CO_2 plume after injection had ceased.

Chapter 3: Evaluation of the Paleocene Cedar Keys Formation and Upper Cretaceous Lawson Formation of South-Central and Southern Florida for Carbon Dioxide Sequestration

3.1 Introduction

The Florida Platform contains numerous porous carbonate units, separated by evaporite units of low permeability, which are believed to be suitable storage zones for successful carbon sequestration. This chapter evaluates the lower portion of the Cedar Keys Formation together with the upper member of the Lawson Formation as a potential injection zone for CCS operations, and is herein identified as the Cedar Keys/Lawson Injection Zone (CKLIZ). Like the Sunniland Formation of southwest Florida, the CKLIZ could be a viable zone for CCS activities because of its geographic location, lithology, porosity, potential CO₂ storage capacity, and seals.

Historically, little information has been available for the southern, eastern, and western extents of the Cedar Keys Formation and the Lawson Formation; therefore, in addition to the evaluation of the CKLIZ, an objective for this study was to provide further stratigraphical and hydrogeological characterizations for the Cedar Keys and Lawson formations.

3.2 Study Area

As discussed in Chapter 1, geologic units or formations in Florida that are being considered for use as potential sequestration reservoirs must be about 914 m (3,000 ft) or more bls, in order to keep the injected-CO₂ in a supercritical state and avoid

transformation into a gas phase that could travel to the surface, and to attain a sufficient CO₂ density for energy-efficient sequestration. Because the Cedar Keys and Lawson formations occur above 914 m (3,000 ft) bls in central, northern, and the Panhandle regions of Florida, the study area includes only the south-central and southern Florida regions, where the CKLIZ is deeper (Figure 3-1). One-hundred and three exploratory/discovery oil wells and one waste-disposal well were utilized to evaluate the CKLIZ, and, like the Sunniland Formation described in Chapter 2, the wells are referenced by their P# for simplified and consistent identification. Table 3-1 provides a list of all wells evaluated in this study, along with well details and locations.

3.3 Geologic Setting

The Cedar Keys Formation and Lawson Formation study area is located within the Florida Platform. A description of the Florida Platform and its major features are provided in Section 2.3.1 of Chapter 2.

3.3.1 Stratigraphic Units

Due to the high porosities of the lower Cedar Keys Formation and the upper member of the Lawson Formation, and due to the lack of significant confinement between the two units that would require their separation, the two geologic units were grouped into one primary injection zone, herein identified as the CKLIZ. The top of the CKLIZ throughout the study area is depicted in Figure 3-2, and the thickness of the injection zone throughout the study area is depicted in Figure 3-3. During potential CO₂-injection operations, the middle Cedar Keys Formation would serve as the upper seal or caprock for the CKLIZ, and the lower member of the Lawson Formation together with Taylor-age rocks would serve as the lower seal.

Nine transects were selected that best use the available spatial coverage of wells evaluated in this investigation (Figure 3-4). These transects display the stratigraphy of the principal geologic units within the region (figures 3-5 through 3-13). The cross-

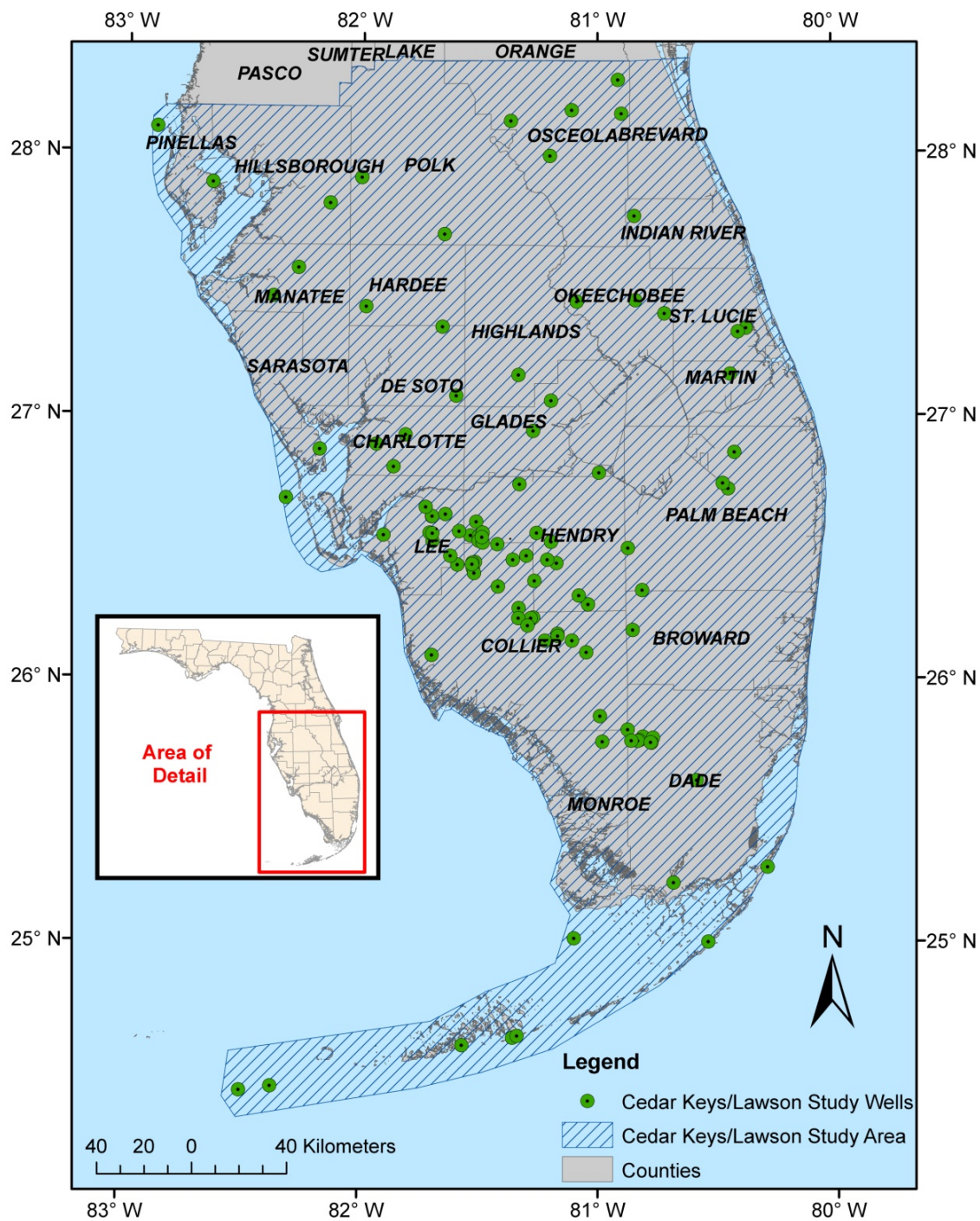


Figure 3-1: Map of the CKLIZ study area and evaluated wells.

Table 3-1: List of exploratory/discovery and waste-disposal wells evaluated in the study.

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Well Type
8	10	27 South	34 East	-80.897241	28.14686	15	2,452	Osceola	Dry Hole
12	6	60 South	35 East	-80.682025	25.2264	0	1,838	Miami-Dade	Dry Hole
16	15	67 South	27 East	-81.565297	24.6075	0	1,859	Monroe	Dry Hole
22	2	67 South	29 East	-81.354931	24.63665	0	4,711	Monroe	Dry Hole
29	7	31 South	22 East	-82.139014	27.80514	30	3,087	Hillsborough	Dry Hole
62	23	35 South	23 East	-81.983211	27.41297	34	3,637	Hardee	Dry Hole
75	7	30 South	17 East	-82.641417	27.88162	1	3,507	Pinellas	Dry Hole
81	27	25 South	34 East	-80.91189	28.27497	13	1,785	Osceola	Dry Hole
91	4	27 South	32 East	-81.109892	28.15991	17	1,984	Osceola	Dry Hole
108	32	62 South	38 East	-80.53691	25.00129	1	2,304	Monroe	Dry Hole
115	25	55 South	37 East	-80.58355	25.61477	3	3,511	Miami-Dade	Dry Hole
129	31	35 South	53 East	-80.872602	25.80759	3	3,623	Miami-Dade	Dry Hole
130	27	50 South	26 East	-81.698494	26.09176	3	3,815	Collier	Dry Hole
148	24	59 South	40 East	-80.28791	25.28515	2	3,648	Monroe	Dry Hole
152	25	42 South	33 East	-80.99351	26.78314	10	4,092	Glades	Dry Hole
161	21	45 South	24 East	-81.903787	26.54554	2	3,925	Lee	Dry Hole
167	16	54 South	35 East	-80.830464	25.76439	4	3,523	Miami-Dade	Dry Hole
178	35	42 South	21 East	-82.176651	26.87063	2	3,878	Charlotte	Dry Hole
182	19	54 South	36 East	-80.776336	25.75021	2	3,460	Miami-Dade	Oil Producer
205	19	54 South	36 East	-80.772873	25.75773	2	3,535	Miami-Dade	Dry Hole
214	19	54 South	36 East	-80.776912	25.75896	2	3,540	Miami-Dade	Dry Hole
232	N/A	N/A	N/A	-81.098331	25.01473	0	3,850	Monroe	Dry Hole
235	34	41 South	39 East	-80.419816	26.86105	8	3,362	Palm Beach	Dry Hole
236	11	35 South	19 East	-82.377846	27.45183	17	3,422	Manatee	Dry Hole
243	28	31 South	35 East	-80.842781	27.75878	15	2,892	Indian River	Dry Hole
250	22	45 South	26 East	-81.709097	26.55439	9	3,597	Lee	Dry Hole
259	19	36 South	40 East	-80.368258	27.33251	5	3,886	St Lucie	Dry Hole
265	2	48 South	35 East	-80.811058	26.33739	5	3,901	Palm Beach	Dry Hole
269	1	41 South	30 East	-81.272325	26.94169	12	3,351	Glades	Dry Hole
271	16	46 South	27 East	-81.620833	26.46667	7	3,627	Lee	Dry Hole
278	11	54 South	35 East	-80.808979	25.78057	3	3,559	Miami-Dade	Dry Hole
279	23	45 South	28 East	-81.484601	26.55531	12	3,550	Hendry	Dry Hole
280	1	67 South	29 East	-81.335637	24.64358	0	1,838	Monroe	Dry Hole
284	N/A	N/A	N/A	-82.362499	24.45001	0	4,662	Monroe	Dry Hole

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Well Type
289	N/A	N/A	N/A	-82.317444	26.68531	-5	4,267	Lee	Dry Hole
296	N/A	N/A	N/A	-82.491833	24.43396	0	2,399	Monroe	Dry Hole
304	N/A	N/A	N/A	-82.880556	28.09223	0	3,231	Pinellas	Dry Hole
310	24	42 South	24 East	-81.86312	26.80466	8	3,798	Charlotte	Dry Hole
311	28	48 South	30 East	-81.331709	26.26861	5	3,565	Collier	Dry Hole
319A	4	46 South	29 East	-81.422711	26.51126	12	3,504	Collier	Oil Producer
331	15	54 South	35 East	-80.824526	25.76728	3	3,540	Miami-Dade	Dry Hole
376	18	54 South	36 East	-80.765949	25.77651	2	3,508	Miami-Dade	Dry Hole
385	21	43 South	39 East	-80.446945	26.72295	4	3,324	Palm Beach	Dry Hole
386	17	54 South	35 East	-80.85766	25.76533	3	3,537	Miami-Dade	Dry Hole
401	9	47 South	28 East	-81.520774	26.40116	7	3,654	Collier	Oil Producer
403	19	32 South	27 East	-81.651368	27.68833	46	2,947	Polk	Dry Hole
407	14	45 South	27 East	-81.58472	26.56056	9	4,788	Lee	Oil Producer
408	35	46 South	27 East	-81.591569	26.43299	8	3,645	Lee	Dry Hole
437	35	45 South	28 East	-81.484937	26.5167	10	3,563	Hendry	Dry Hole
472	22	45 South	26 East	-81.697269	26.55211	9	3,962	Charlotte	Dry Hole
475	9	41 South	25 East	-81.813299	26.92706	12	4,034	Charlotte	Dry Hole
539	3	29 South	31 East	-81.202461	27.98615	20	2,419	Osceola	Dry Hole
543	24	27 South	29 East	-81.370355	28.1189	18	2,103	Osceola	Dry Hole
564	14	54 South	33 East	-80.992241	25.7623	3	3,859	Monroe	Dry Hole
565A	28	48 South	33 East	-81.039482	26.28328	6	5,189	Hendry	Dry Hole
596	14	53 South	33 East	-80.989682	25.85882	3	5,016	Collier	Dry Hole
597	3	30 South	23 East	-82.005204	27.90272	37	1,524	Polk	Waste Disposal
606	16	43 South	30 East	-81.329481	26.73922	7	3,478	Hendry	Dry Hole
609	22	39 South	27 East	-81.599143	27.07486	18	3,962	Desoto	Dry Hole
620	31	46 South	32 East	-81.172407	26.43967	8	3,563	Hendry	Dry Hole
662	12	48 South	32 East	-81.07817	26.31699	6	3,551	Hendry	Dry Hole
679A	19	36 South	27 East	-81.658429	27.33689	29	3,554	Desoto	Dry Hole
683	20	41 South	24 East	-81.936797	26.89104	8	3,505	Charlotte	Dry Hole
697	23	46 South	30 East	-81.299818	26.46772	9	3,962	Collier	Dry Hole
710	34	35 South	36 East	-80.714736	27.3884	13	3,444	Okeechobee	Dry Hole
732	9	35 South	35 East	-80.838375	27.43833	21	3,284	Okeechobee	Dry Hole
740	7	46 South	35 East	-80.870807	26.49695	4	2,985	Palm Beach	Dry Hole
758	16	44 South	26 East	-81.725574	26.65206	6	3,841	Lee	Dry Hole
759	35	33 South	20 East	-82.272231	27.55968	8	3,353	Manatee	Dry Hole
760	30	46 South	30 East	-81.356722	26.45256	9	3,591	Collier	Dry Hole

Well P#	Section	Township	Range	Longitude	Latitude	Elevation (m)	Total Depth (m)	County	Well Type
768	19	45 South	31 East	-81.256613	26.55392	9	4,877	Hendry	Dry Hole
772	26	36 South	39 East	-80.403071	27.31924	29	3,856	St Lucie	Dry Hole
804	27	44 South	26 East	-81.699618	26.61641	7	3,722	Lee	Oil Producer
813	27	44 South	26 East	-81.6984	26.61717	8	3,708	Lee	Dry Hole
821	1	49 South	30 East	-81.27102	26.23323	5	3,554	Collier	Dry Hole
838	1	49 South	30 East	-81.280972	26.23113	5	3,540	Collier	Oil Producer
853	28	46 South	28 East	-81.516649	26.44338	7	3,601	Collier	Dry Hole
864	19	47 South	31 East	-81.265841	26.37209	8	3,616	Hendry	Dry Hole
865	31	49 South	32 East	-81.167956	26.17112	5	3,604	Collier	Oil Producer
871	4	50 South	31 East	-81.22176	26.14556	4	3,633	Collier	Dry Hole
926	34	45 South	28 East	-81.502066	26.5246	10	3,568	Hendry	Dry Hole
947	33	47 South	29 East	-81.419879	26.35023	8	3,647	Collier	Dry Hole
972	8	43 South	39 East	-80.470002	26.74389	4	3,353	Palm Beach	Dry Hole
979	34	45 South	26 East	-81.695949	26.52246	9	3,599	Lee	Dry Hole
982	14	49 South	30 East	-81.294068	26.20284	5	3,637	Collier	Dry Hole
983	27	45 South	28 East	-81.501326	26.5404	11	3,503	Hendry	Dry Hole
990	26	45 South	28 East	-81.488067	26.53767	11	3,512	Hendry	Dry Hole
1014	29	44 South	27 East	-81.642737	26.62512	7	3,565	Lee	Dry Hole
1032	21	38 South	39 East	-80.436322	27.15888	9	4,023	Martin	Dry Hole
1050	35	45 South	31 East	-81.195907	26.52109	9	3,754	Hendry	Dry Hole
1059	3	50 South	32 East	-81.107102	26.14512	5	3,606	Collier	Dry Hole
1063	20	50 South	33 East	-81.046892	26.10114	4	3,584	Collier	Dry Hole
1065	6	50 South	32 East	-81.167314	26.16305	5	3,597	Collier	Dry Hole
1085	27	46 South	31 East	-81.211712	26.45274	9	3,559	Hendry	Dry Hole
1147	20	45 South	28 East	-81.536457	26.54412	9	3,508	Hendry	Dry Hole
1151	3	45 South	28 East	-81.512333	26.59638	9	3,503	Hendry	Dry Hole
1169	32	49 South	35 East	-80.851365	26.18556	4	3,537	Broward	Dry Hole
1193	26	39 South	31 East	-81.196711	27.05695	10	2,816	Glades	Dry Hole
1199	32	46 South	28 East	-81.529249	26.43484	8	3,573	Collier	Oil Producer
1201	28	46 South	28 East	-81.527657	26.44145	7	3,612	Collier	Dry Hole
1208	4	47 South	28 East	-81.525551	26.41997	7	3,612	Collier	Dry Hole
1240	5	49 South	30 East	-81.333435	26.23072	5	3,621	Collier	Dry Hole
1264	13	35 South	32 East	-81.087868	27.43274	16	2,495	Okeechobee	Dry Hole
1323A	20	38 South	30 East	-81.335244	27.15456	53	3,812	Highlands	Dry Hole

N/A = Not Applicable (offshore well)

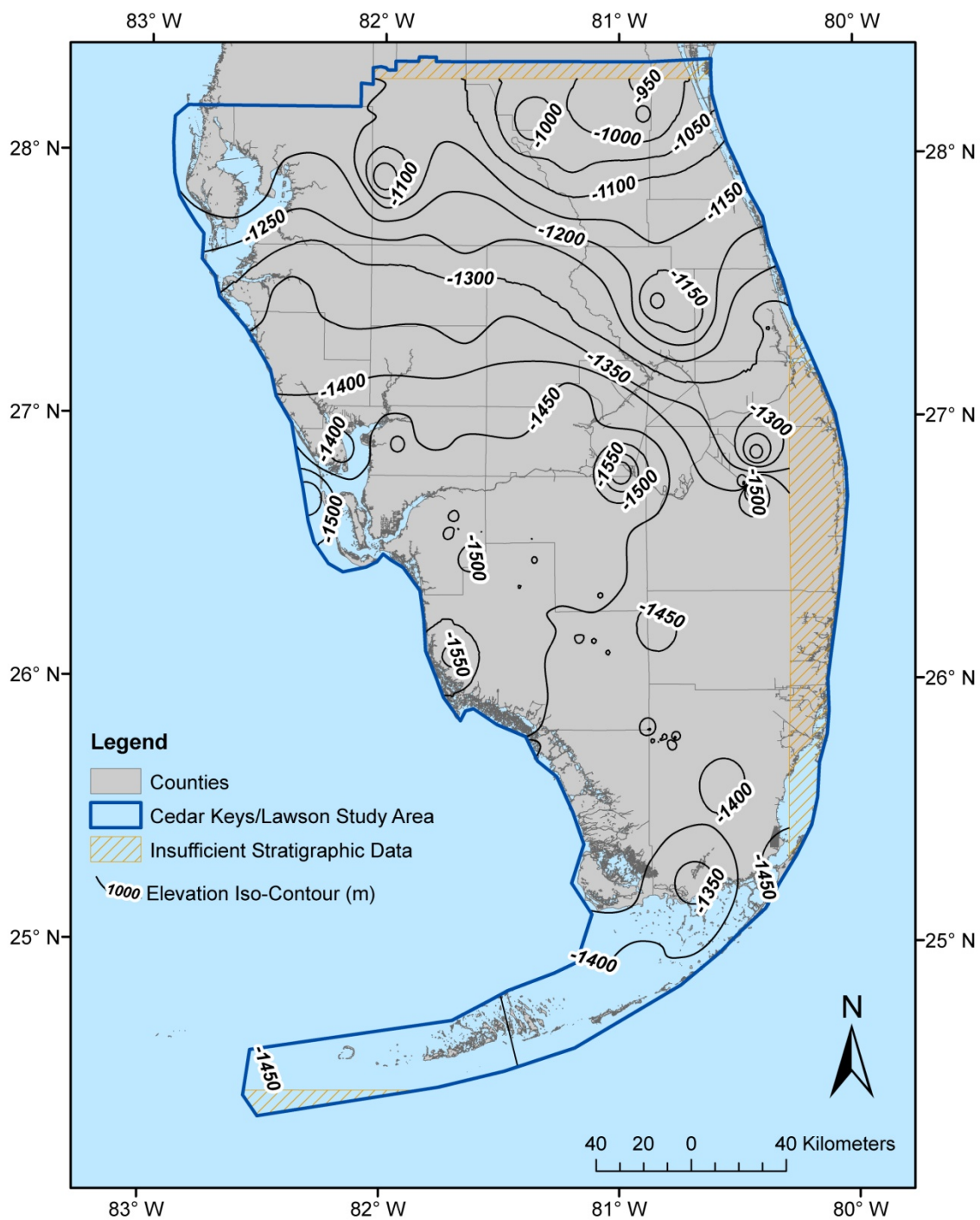


Figure 3-2: Isolith map of the top of the CKLIZ.

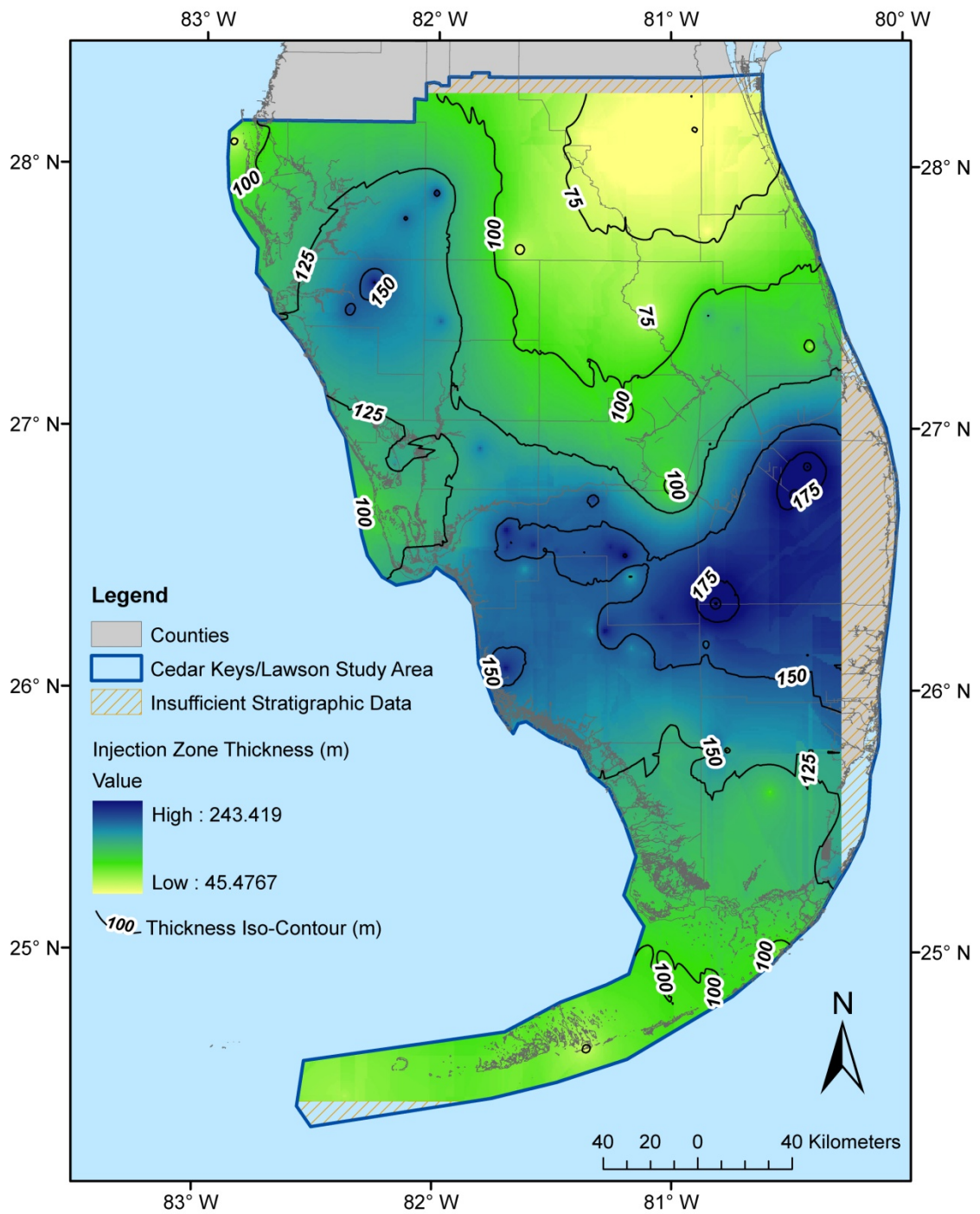


Figure 3-3: Isopach map of the CKLIZ.

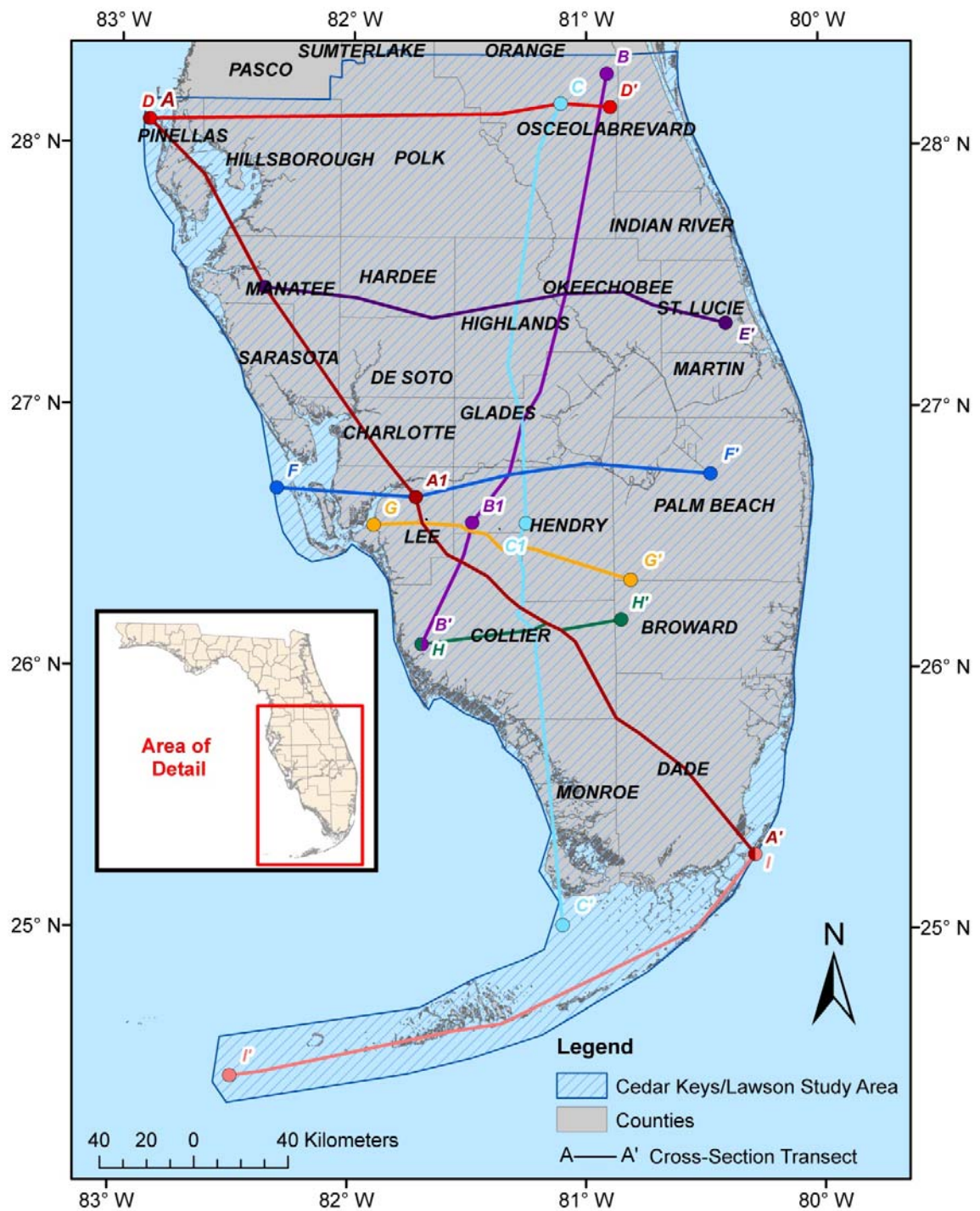


Figure 3-4: Map displaying the location of transects A-A' through I-I'.

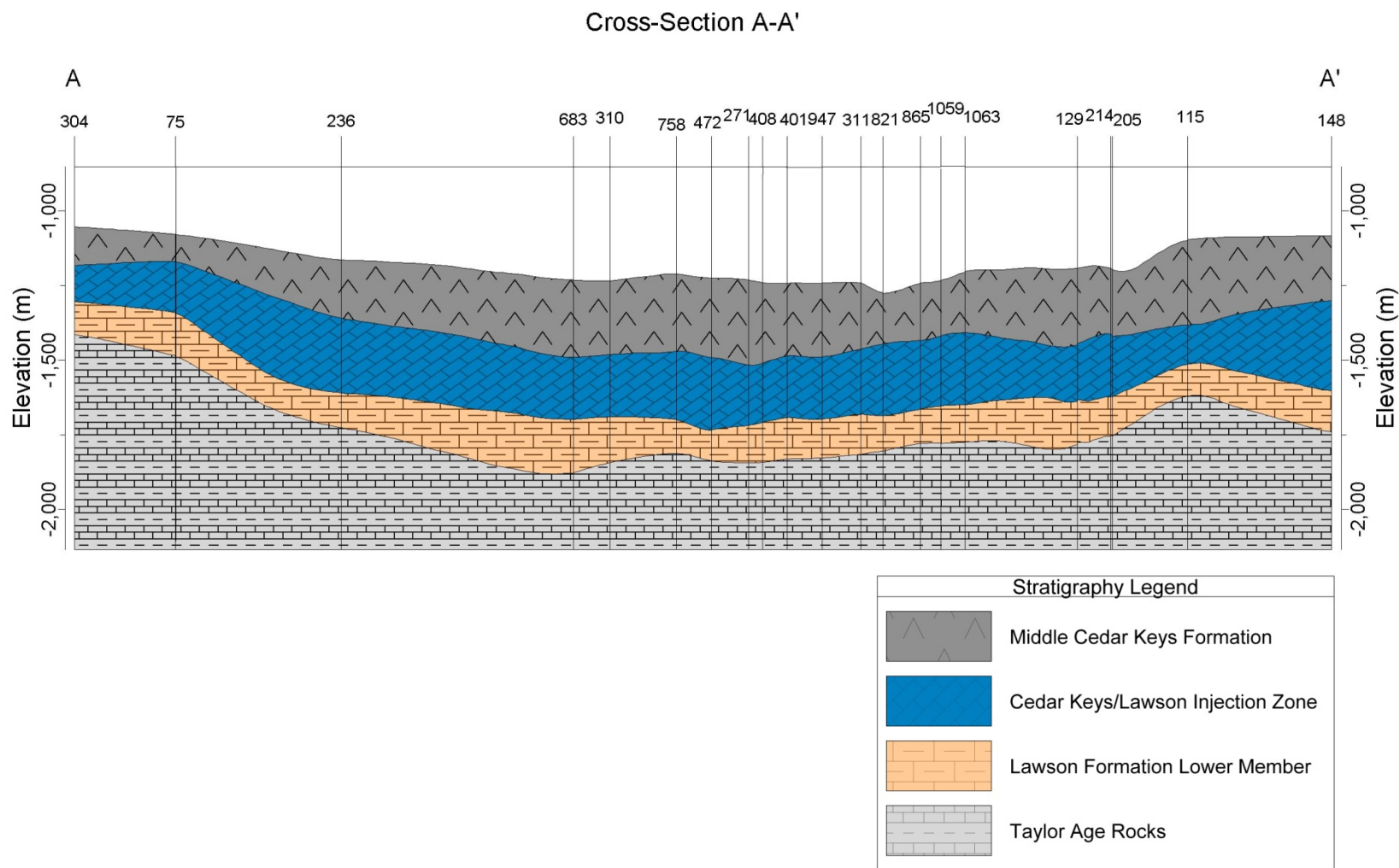


Figure 3-5: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect A-A'. Transect location is depicted in Figure 3-4.

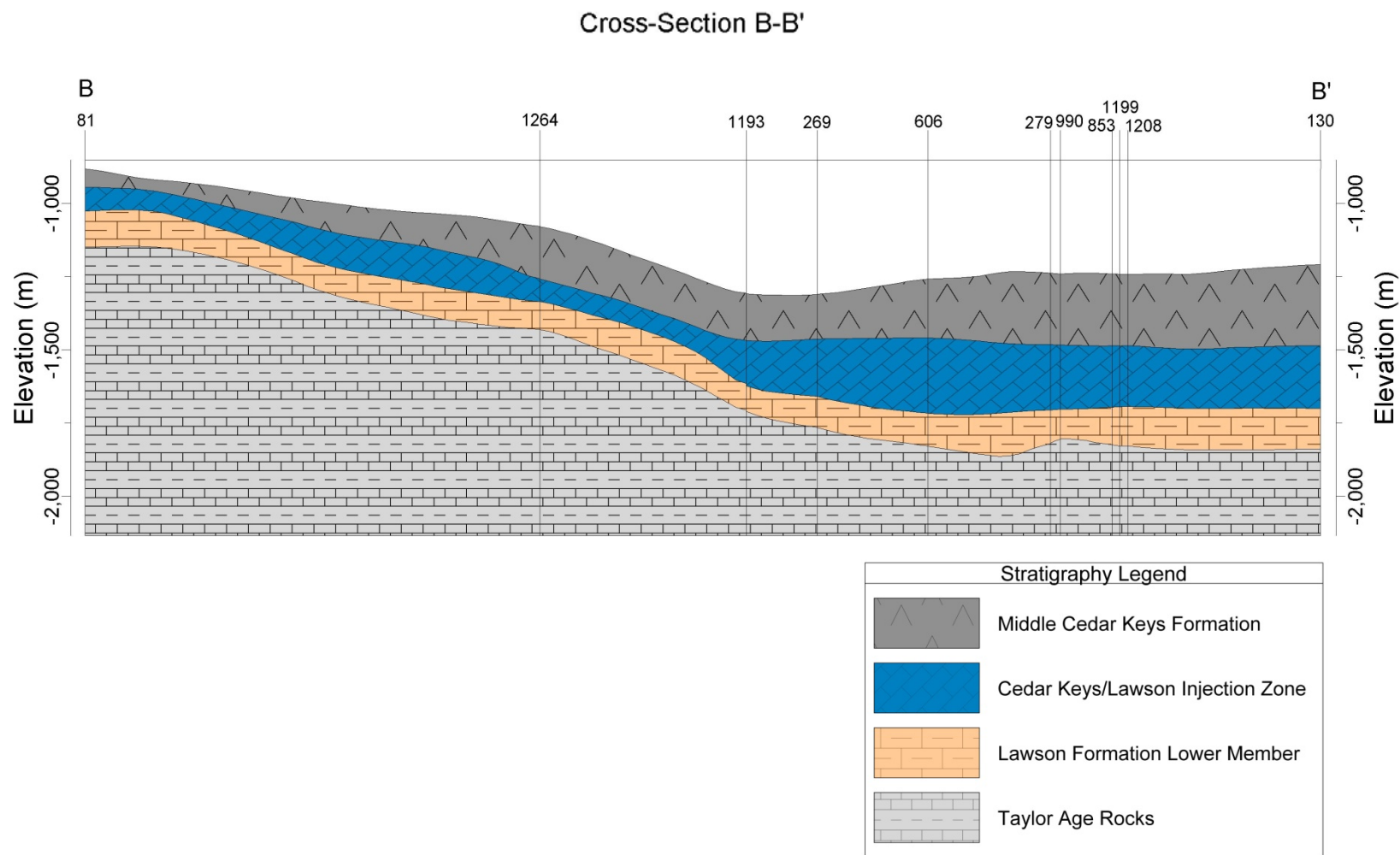


Figure 3-6: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect B-B'. Transect location is depicted in Figure 3-4.

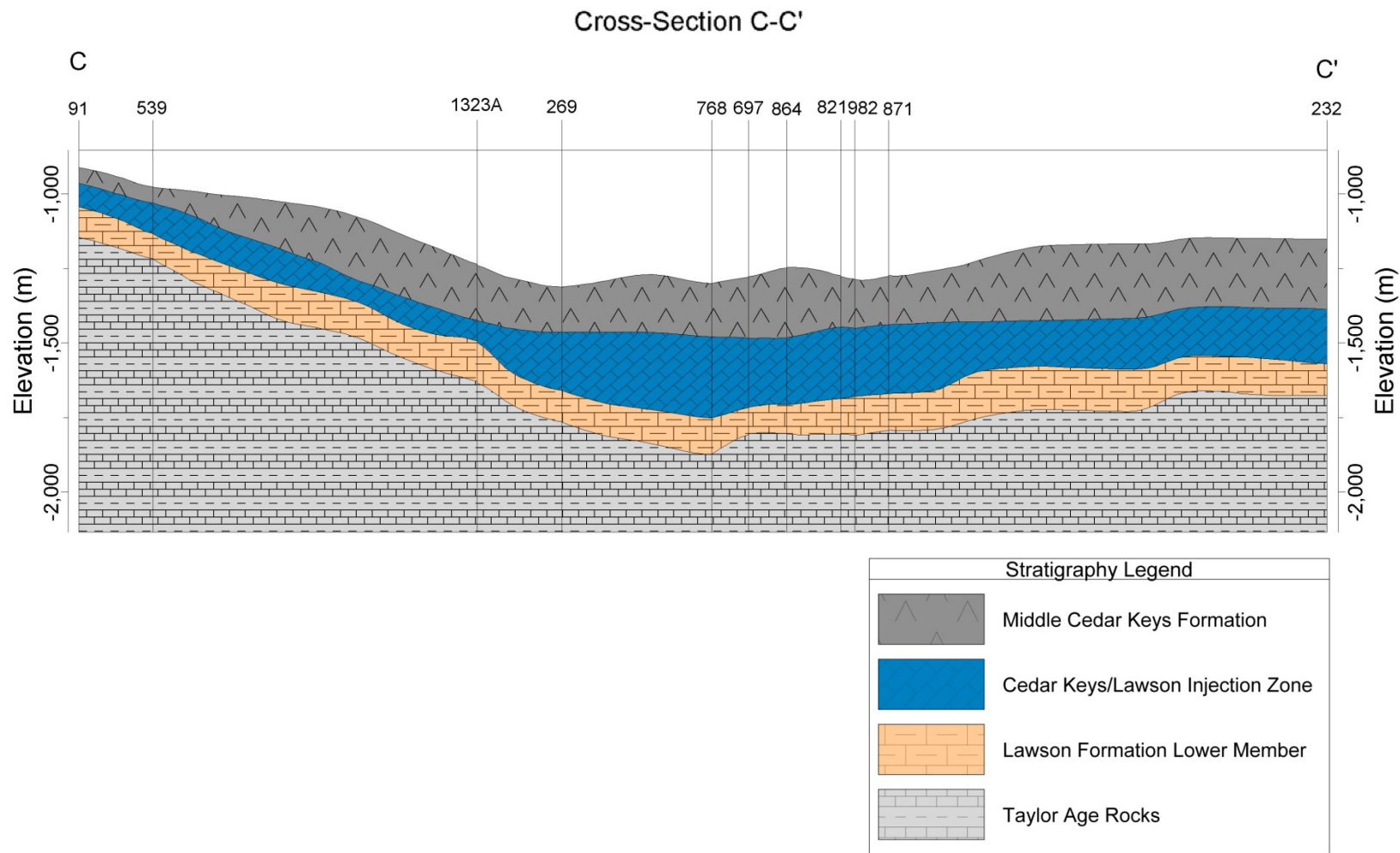


Figure 3-7: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect C-C'. Transect location is depicted in Figure 3-4.

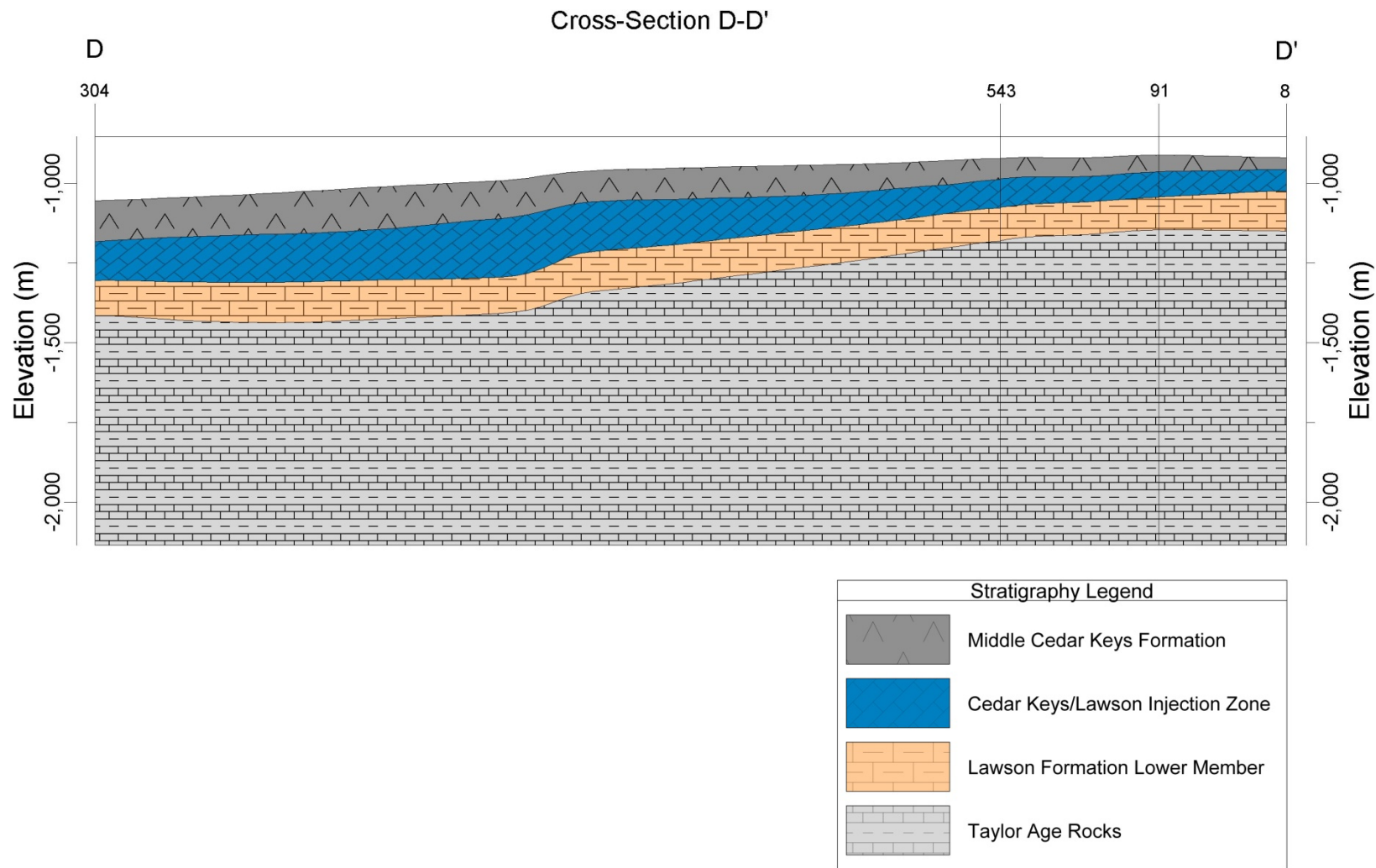


Figure 3-8: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect D-D'. Transect location is depicted in Figure 3-4.

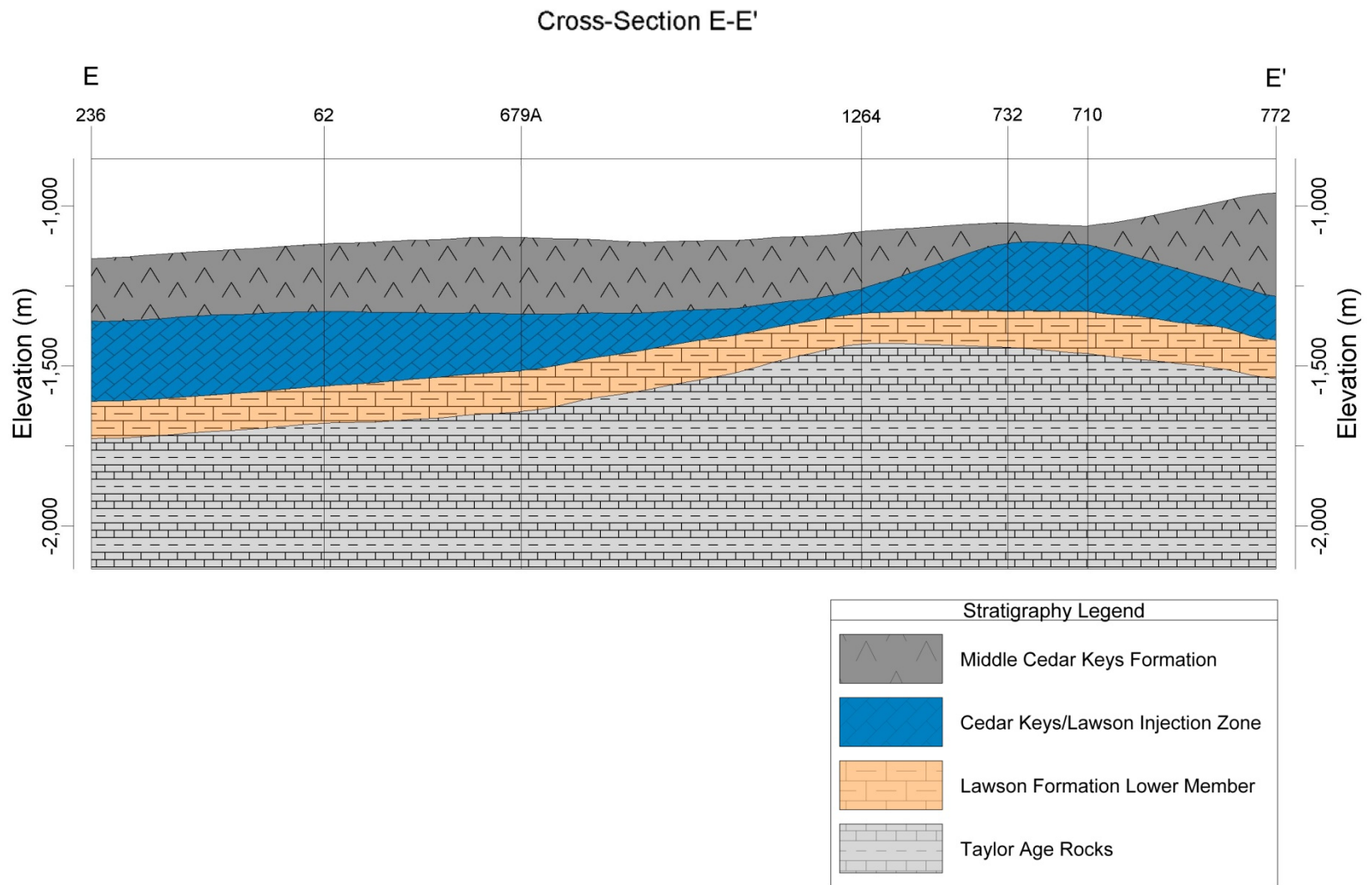


Figure 3-9: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect E-E'. Transect location is depicted in Figure 3-4.

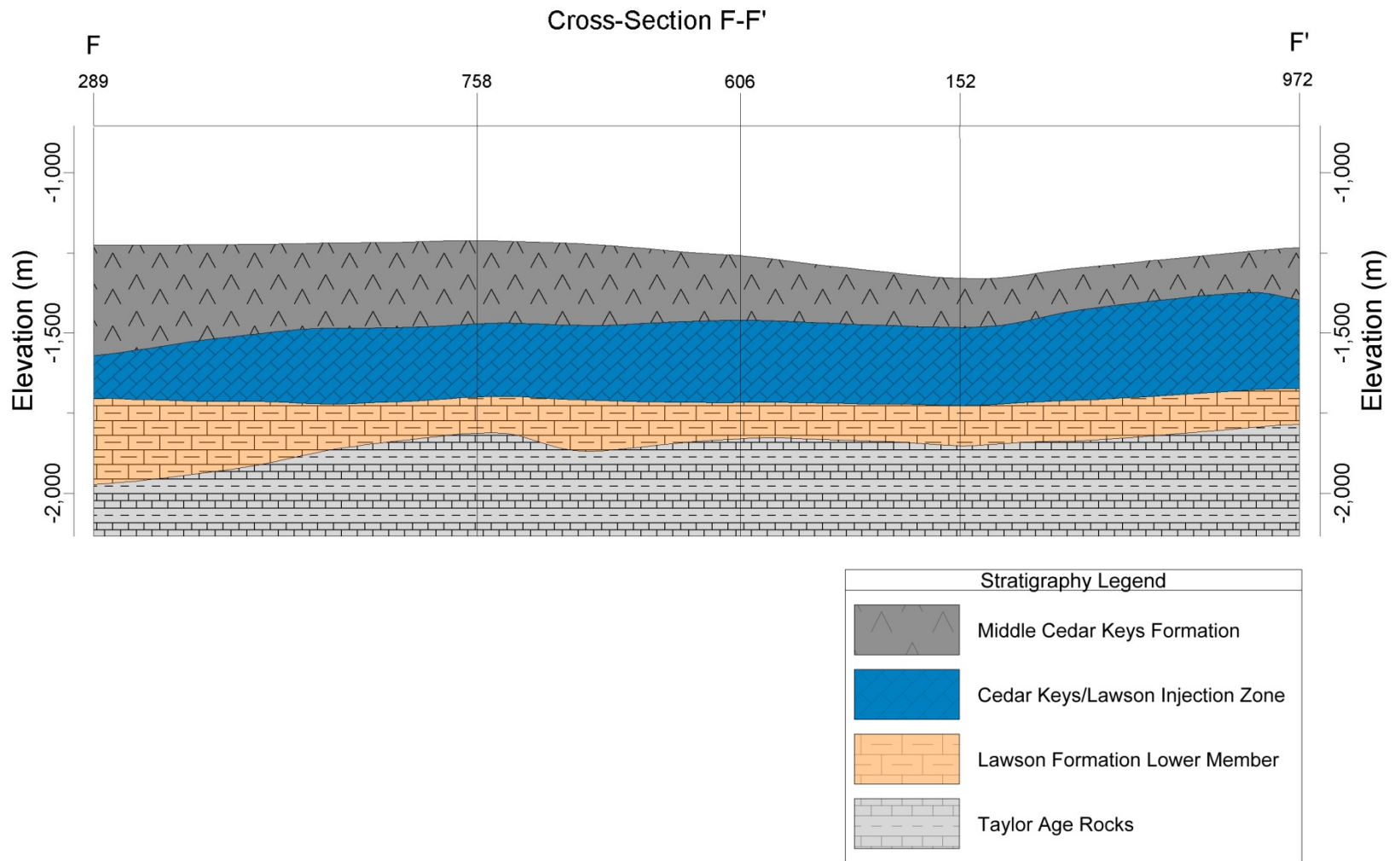


Figure 3-10: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect F-F'. Transect location is depicted in Figure 3-4.

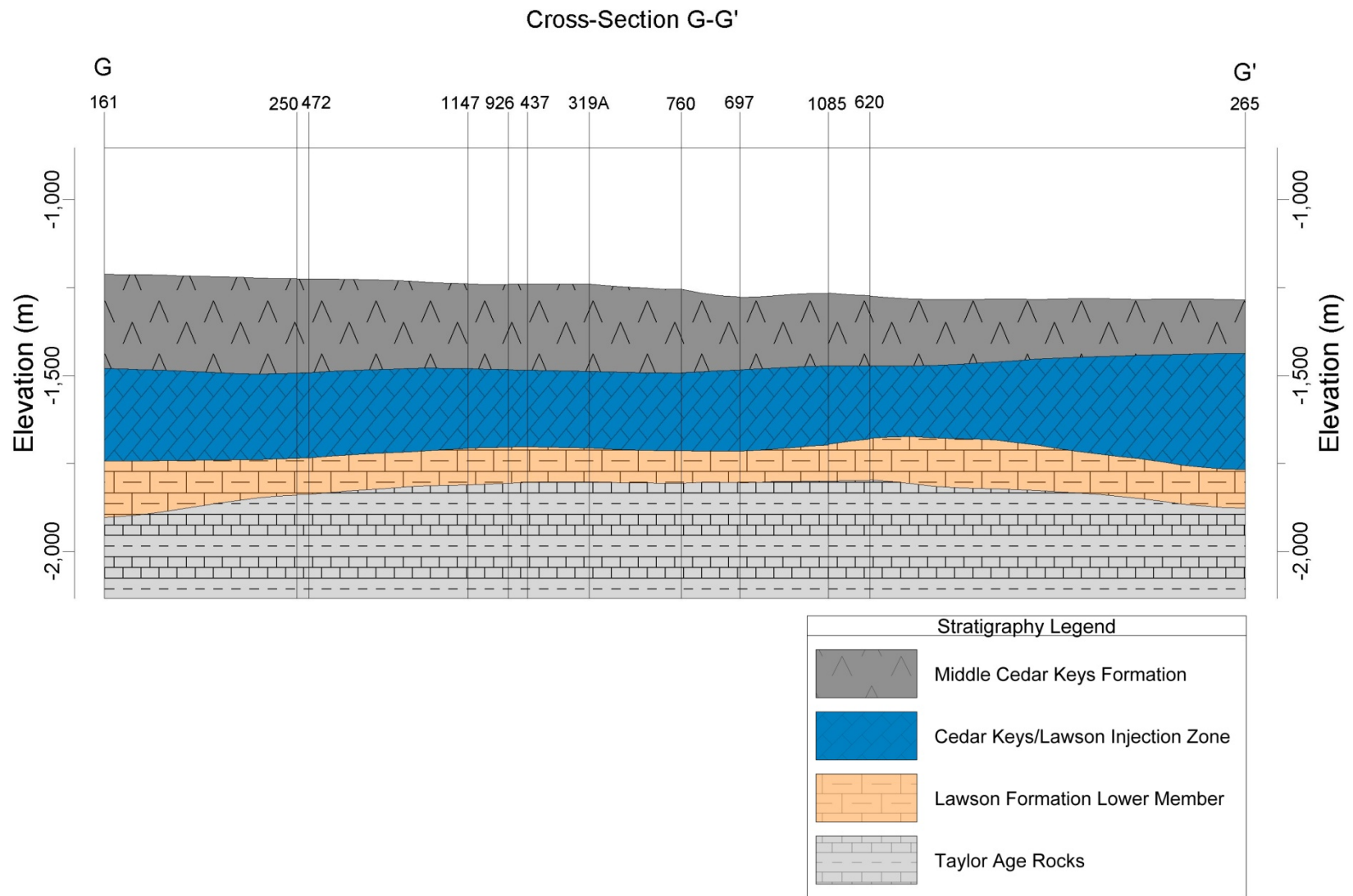


Figure 3-11: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect G-G'. Transect location is depicted in Figure 3-4.

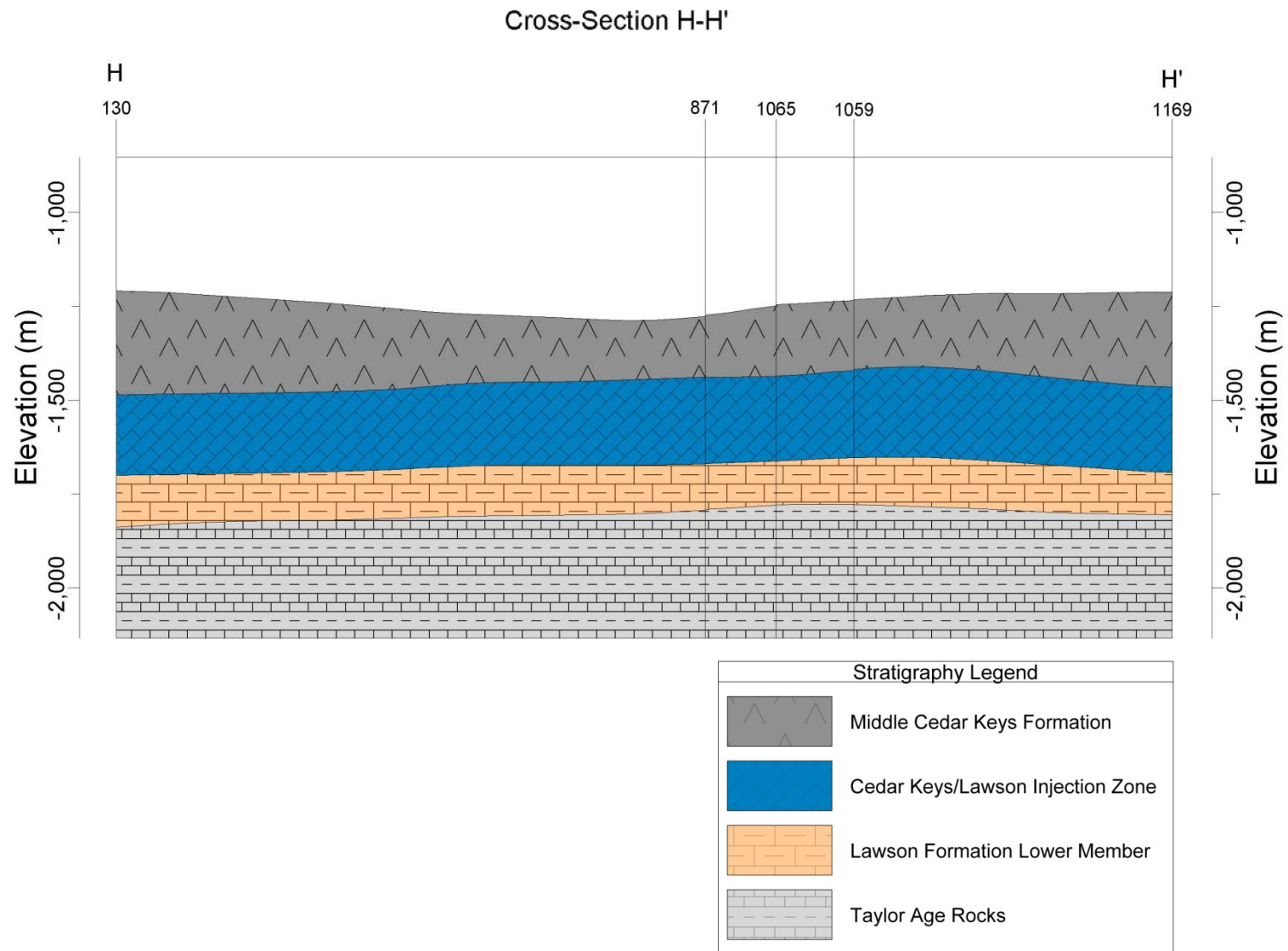


Figure 3-12: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect H-H'. Transect location is depicted in Figure 3-4.

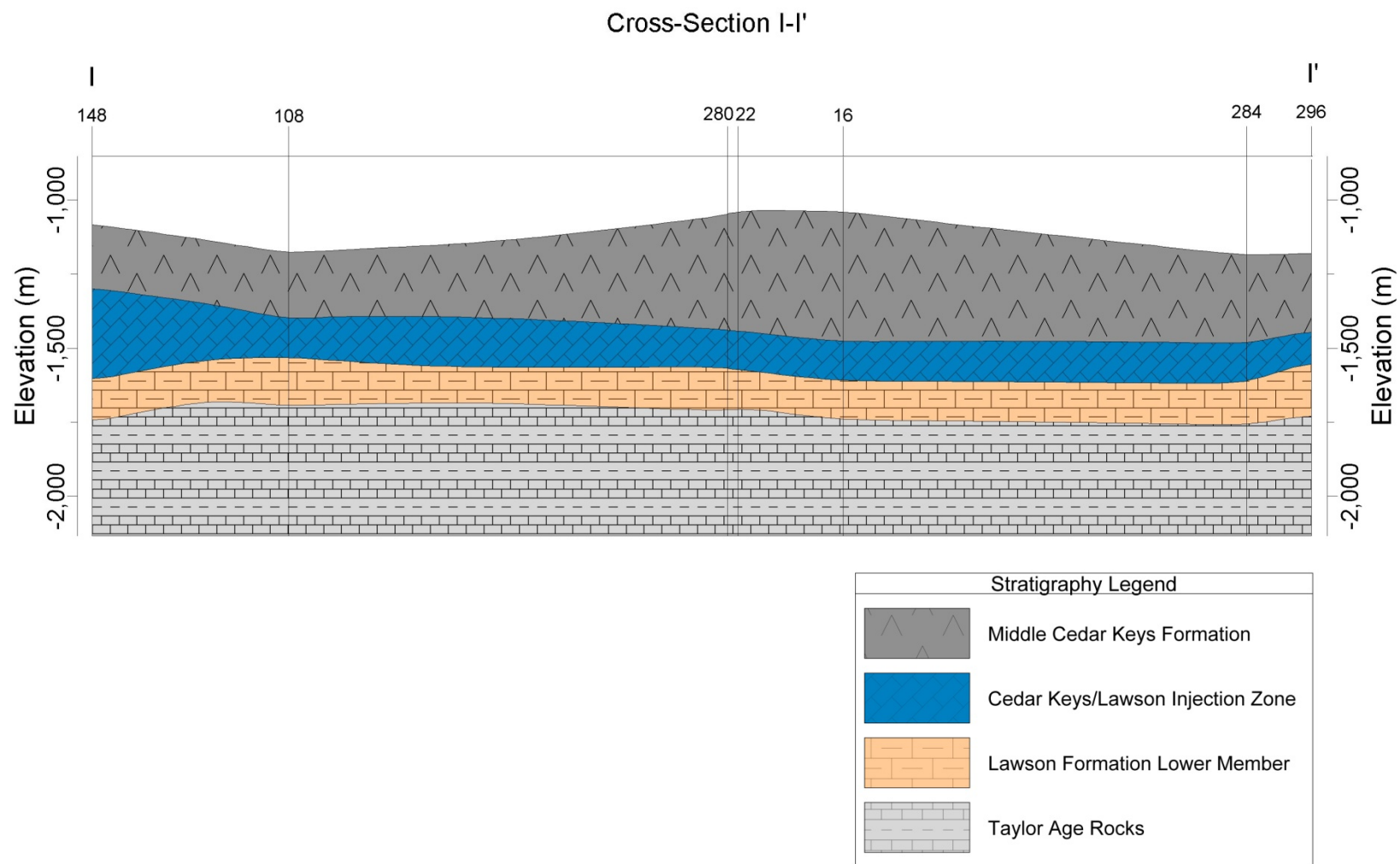


Figure 3-13: Stratigraphic cross-section displaying the CKLIZ, as well as upper and lower seals, for Transect I-I'. Transect location is depicted in Figure 3-4.

sections show stratigraphic variation with decreasing elevation, using sea level as the datum. Table 3-2 summarizes the depths of occurrence and thicknesses of these geologic units based upon the wells evaluated in this study.

3.3.1.1 Taylor-Age Rocks

Upper Cretaceous units of Taylor age underlie the lower member of the Lawson Formation, and exist throughout most of Florida. Taylor-age rocks are composed of carbonate facies, such as chalk or argillaceous-chalk, in most of peninsular Florida, clastic facies, such as marl or marly shale, in north-central Florida, and calcareous-clay in the Panhandle (Applin & Applin, 1967; Miller, 1986). The carbonate facies in the northern region of peninsular Florida are mostly chalky dolomite and dolomitic chalk with gypsum and anhydrite inclusions, while southwest of the Peninsular Arch the unit is mostly chalk containing random, intermittent lenses of low-porosity dolomite and anhydrite (Applin and Applin, 1967). Specifically, in south-central and southern Florida the carbonate facies are mainly composed of hard, white or cream-colored, chalky limestone of low porosity and permeability that is irregularly interbedded with thin lenses of dolomite, dolomitic chalk, and anhydrite (Applin & Applin, 1944; Applin & Applin, 1967; Kaiser, 1971). Rocks of Taylor age deepen southward in the study area, but generally they are first encountered at approximately 1,700 m (5,577 ft) to 1,800 m (5,906 ft) bls. Thickness of these rocks varies throughout Florida; however, essentially in central peninsular Florida the unit is ~122 m (400 ft) thick and thickens considerably toward the south to 396 m (1,299 ft) or more.

Inoceramus fragments, as well as several distinct foraminifera, are indicative of Taylor-age rocks and aid in the distinction between the chalks of Taylor age and those of the lower member of the Lawson Formation (Applin & Applin, 1967).

Table 3-2: Geologic unit picks for exploratory/discovery and waste-disposal wells evaluated in this study.

Well P#	County	Elev (m)	Top of Middle Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lower Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lawson Formation Upper Member (m bls)	Total Thick. (m)	Top of Lawson Formation Lower Member (m bls)	Total Thick. (m)	Top of Taylor Age Rocks (m bls)
8	Osceola	15	938	22	960	26	985	44	1,029	130	1,159
12	Miami-Dade	0	1,131	184	1,315	126	1,442	77	1,519	117	1,635
16	Monroe	0	1,037	446	1,483	92	1,575	37	1,612	134	1,746
22	Monroe	0	1,023	424	1,447	43	1,490	86	1,576	107	1,684
29	Hillsborough	30	1,055	205	1,260	168	1,427	62	1,489	125	1,615
62	Hardee	34	1,153	212	1,366	166	1,531	65	1,597	115	1,711
75	Pinellas	1	--	--	1,154	126	1,280	47	1,327	144	1,471
81	Osceola	13	888	66	954	40	994	44	1,038	122	1,160
91	Osceola	17	926	49	975	41	1,017	42	1,059	96	1,155
108	Monroe	1	1,183	231	1,414	59	1,473	58	1,530	169	1,699
115	Miami-Dade	3	1,079	299	1,378	72	1,450	46	1,496	97	1,593
129	Miami-Dade	3	1,202	307	1,508	118	1,626	68	1,694	132	1,826
130	Collier	3	1,262	306	1,568	105	1,673	75	1,748	179	1,926
148	Monroe	2	1,082	207	1,289	197	1,486	129	1,614	148	1,762
152	Glades	10	1,348	154	1,502	174	1,676	71	1,747	139	1,886
161	Lee	2	1,212	267	1,478	178	1,656	94	1,750	175	1,925
167	Miami-Dade	4	1,215	171	1,386	117	1,503	99	1,602	72	1,674
178	Charlotte	2	1,247	229	1,475	189	1,664	52	1,716	174	1,890
182	Miami-Dade	2	1,215	161	1,376	142	1,518	74	1,592	77	1,669
205	Miami-Dade	2	1,218	159	1,377	142	1,519	77	1,596	73	1,669
214	Miami-Dade	2	1,214	159	1,373	144	1,517	63	1,580	88	1,668
232	Monroe	0	1,154	232	1,385	92	1,477	96	1,573	101	1,675
235	Palm Beach	8	1,110	75	1,185	271	1,456	40	1,496	94	1,590
236	Manatee	17	1,184	208	1,392	176	1,568	66	1,633	119	1,752
243	Indian River	15	--	--	1,150	41	1,190	68	1,258	106	1,364
250	Lee	9	1,234	332	1,567	151	1,718	81	1,798	64	1,862
259	St Lucie	5	--	--	1,359	143	1,502	110	1,612	91	1,703
265	Palm Beach	5	1,298	137	1,435	294	1,729	64	1,793	115	1,908
269	Glades	12	1,335	140	1,475	106	1,581	92	1,673	94	1,767
271	Lee	7	1,219	356	1,574	114	1,689	59	1,748	104	1,852

Well P#	County	Elev (m)	Top of Middle Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lower Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lawson Formation Upper Member (m bls)	Total Thick. (m)	Top of Lawson Formation Lower Member (m bls)	Total Thick. (m)	Top of Taylor Age Rocks (m bls)
278	Miami-Dade	3	1,094	298	1,392	224	1,616	61	1,677	186	1,863
279	Hendry	12	1,244	253	1,497	149	1,646	63	1,709	87	1,796
280	Monroe	0	1,056	377	1,433	74	1,507	53	1,559	165	1,724
284	Monroe	0	1,190	303	1,494	71	1,564	59	1,624	142	1,766
289	Lee	-5	--	--	1,585	48	1,633	62	1,695	287	1,981
296	Monroe	0	1,179	255	1,434	72	1,506	32	1,539	182	1,721
304	Pinellas	0	1,054	132	1,186	35	1,221	79	1,300	101	1,401
310	Charlotte	8	1,248	247	1,495	118	1,613	80	1,694	144	1,837
311	Collier	5	1,227	241	1,468	138	1,607	71	1,677	137	1,814
319A	Collier	12	1,252	253	1,505	154	1,659	62	1,721	94	1,815
331	Miami-Dade	3	1,214	167	1,381	212	1,594	80	1,674	128	1,802
376	Miami-Dade	2	1,215	305	1,520	75	1,595	74	1,669	182	1,851
385	Palm Beach	4	1,251	373	1,624	41	1,666	61	1,727	121	1,847
386	Miami-Dade	3	1,208	185	1,394	62	1,456	59	1,514	161	1,675
401	Collier	7	1,235	247	1,483	150	1,633	60	1,692	136	1,828
403	Polk	46	1,037	241	1,277	30	1,307	68	1,375	183	1,558
407	Lee	9	1,238	220	1,458	184	1,642	91	1,733	73	1,806
408	Lee	8	1,272	242	1,514	151	1,665	53	1,718	157	1,875
437	Hendry	10	1,239	262	1,501	149	1,650	63	1,713	95	1,807
472	Charlotte	9	1,238	244	1,482	178	1,660	91	1,752	91	1,843
475	Charlotte	12	1,212	226	1,438	166	1,605	104	1,709	197	1,906
539	Osceola	20	1,009	52	1,061	40	1,101	59	1,160	78	1,238
543	Osceola	18	932	53	985	43	1,028	55	1,083	100	1,184
564	Monroe	3	1,163	269	1,432	114	1,546	30	1,576	141	1,718
565A	Hendry	6	1,254	160	1,414	177	1,591	73	1,664	176	1,840
596	Collier	3	1,221	211	1,432	110	1,542	31	1,572	181	1,753
597	Polk	37	998	53	1,051	197	1,248	71	1,319	104	1,423
606	Hendry	7	1,259	201	1,460	179	1,639	86	1,725	107	1,832
609	Desoto	18	1,200	231	1,431	92	1,523	77	1,600	193	1,793
620	Hendry	8	1,307	167	1,474	86	1,560	65	1,625	123	1,748
662	Hendry	6	1,263	250	1,512	165	1,677	74	1,752	112	1,864
679A	Desoto	29	1,119	243	1,362	85	1,447	99	1,546	127	1,673
683	Charlotte	8	1,245	274	1,520	112	1,631	77	1,708	187	1,895

Well P#	County	Elev (m)	Top of Middle Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lower Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lawson Formation Upper Member (m bls)	Total Thick. (m)	Top of Lawson Formation Lower Member (m bls)	Total Thick. (m)	Top of Taylor Age Rocks (m bls)
697	Collier	9	1,321	166	1,487	149	1,636	93	1,729	75	1,804
710	Okeechobee	13	1,087	31	1,118	133	1,251	78	1,329	140	1,469
732	Okeechobee	21	1,069	40	1,109	145	1,254	88	1,342	118	1,460
740	Palm Beach	4	1,306	122	1,429	160	1,588	86	1,675	127	1,802
758	Lee	6	1,206	273	1,479	141	1,620	75	1,695	119	1,814
759	Manatee	8	1,150	187	1,337	205	1,542	75	1,617	97	1,714
760	Collier	9	1,253	260	1,513	151	1,665	63	1,728	85	1,813
768	Hendry	9	1,324	168	1,492	180	1,672	91	1,763	121	1,884
772	St Lucie	29	968	339	1,307	34	1,341	49	1,390	107	1,497
804	Lee	7	1,228	195	1,423	208	1,632	76	1,708	105	1,813
813	Lee	8	1,227	229	1,456	182	1,639	73	1,712	101	1,813
821	Collier	5	1,303	145	1,448	180	1,628	78	1,706	100	1,806
838	Collier	5	1,284	144	1,428	198	1,626	73	1,699	104	1,803
853	Collier	7	1,233	259	1,492	148	1,640	60	1,699	132	1,831
864	Hendry	8	1,243	254	1,497	148	1,646	77	1,723	92	1,815
865	Collier	5	1,200	217	1,416	137	1,553	111	1,664	103	1,767
871	Collier	4	1,285	141	1,426	152	1,578	99	1,677	123	1,800
926	Hendry	10	1,244	258	1,503	142	1,645	78	1,723	75	1,798
947	Collier	8	1,257	252	1,509	147	1,656	58	1,713	135	1,848
972	Palm Beach	4	1,248	42	1,290	351	1,641	38	1,680	105	1,785
979	Lee	9	1,235	255	1,490	154	1,644	69	1,713	153	1,866
982	Collier	5	1,340	130	1,470	148	1,618	59	1,677	146	1,823
983	Hendry	11	1,265	231	1,496	148	1,644	68	1,712	101	1,813
990	Hendry	11	1,266	210	1,476	172	1,647	68	1,715	104	1,819
1014	Lee	7	1,227	260	1,487	144	1,631	77	1,708	103	1,811
1032	Martin	9	--	--	--	--	1,312	57	1,369	187	1,555
1050	Hendry	9	1,313	173	1,486	212	1,698	101	1,799	140	1,939
1059	Collier	5	1,254	146	1,400	138	1,538	112	1,650	135	1,786
1063	Collier	4	1,179	223	1,403	166	1,569	79	1,647	121	1,769
1065	Collier	5	1,268	229	1,497	132	1,629	33	1,661	109	1,770
1085	Hendry	9	1,236	243	1,479	150	1,629	84	1,713	97	1,810
1147	Hendry	9	1,266	227	1,493	146	1,639	68	1,707	115	1,822
1151	Hendry	9	1,233	256	1,489	156	1,645	84	1,729	204	1,933

Well P#	County	Elev (m)	Top of Middle Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lower Cedar Keys Formation (m bls)	Total Thick. (m)	Top of Lawson Formation Upper Member (m bls)	Total Thick. (m)	Top of Lawson Formation Lower Member (m bls)	Total Thick. (m)	Top of Taylor Age Rocks (m bls)
1169	Broward	4	1,209	280	1,489	125	1,614	89	1,704	99	1,802
1193	Glades	10	1,329	166	1,495	74	1,569	83	1,652	86	1,738
1199	Collier	8	1,247	240	1,487	151	1,638	61	1,700	136	1,836
1201	Collier	7	1,327	165	1,492	147	1,639	61	1,700	138	1,839
1208	Collier	7	1,243	239	1,482	150	1,632	59	1,690	144	1,834
1240	Collier	5	1,226	241	1,468	122	1,590	91	1,680	154	1,834
1264	Okeechobee	16	1,094	190	1,284	28	1,311	36	1,347	85	1,433
1323A	Highlands	53	--	--	--	--	1,449	65	1,514	133	1,647

-- = No data available

3.3.1.2 Lawson Formation

The Lawson Formation was deposited on a shallow, partly restricted marine shelf during the Late Upper Cretaceous (Applin & Applin, 1967). The formation occurs in the northeastern and peninsular regions of Florida, and is generally about 274 m (900 ft) thick. The Lawson Formation is divided into a lower and an upper member, each with unique lithology and fossil assemblages. Figures 3-14 through 3-22 are cross-sections for the nine transects depicted in Figure 3-4. These cross-sections display the stratigraphy of the upper and lower members of the Lawson Formation with decreasing elevation, using sea level as the datum.

Lower Member

The lower member of the Lawson Formation is generally ~91 m (300 ft) to 122 m (400 ft) thick, although in the study area it is as thin as 64 m (210 ft) and as thick as 287 m (940 ft). The unit tends to deepen southward from around 671 m (2,200 ft) bls in north Florida (Applin & Applin, 1944) to 1,799 m (5,902 ft) bls in south Florida. Figure 3-23 is an isolith map that displays the top of the lower member of the Lawson Formation throughout the study area.

In south-central and southern Florida, the lower member has low permeability throughout, and is mostly a soft, white chalk that is interbedded with lenses of chalky dolomite and dolomitic chalk. Minor amounts of gypsum and anhydrite can also be found in lenses throughout the lower member. The boundary between the lower and upper members of the Lawson Formation is gradational, where the soft, white chalk of the top portion of the lower member grades upward into a dolomitic chalk found in the basal portion of the upper member (Applin & Applin, 1967). The chawks of Taylor age and the lower member of the Lawson Formation form the lower seal for the CKLIZ.

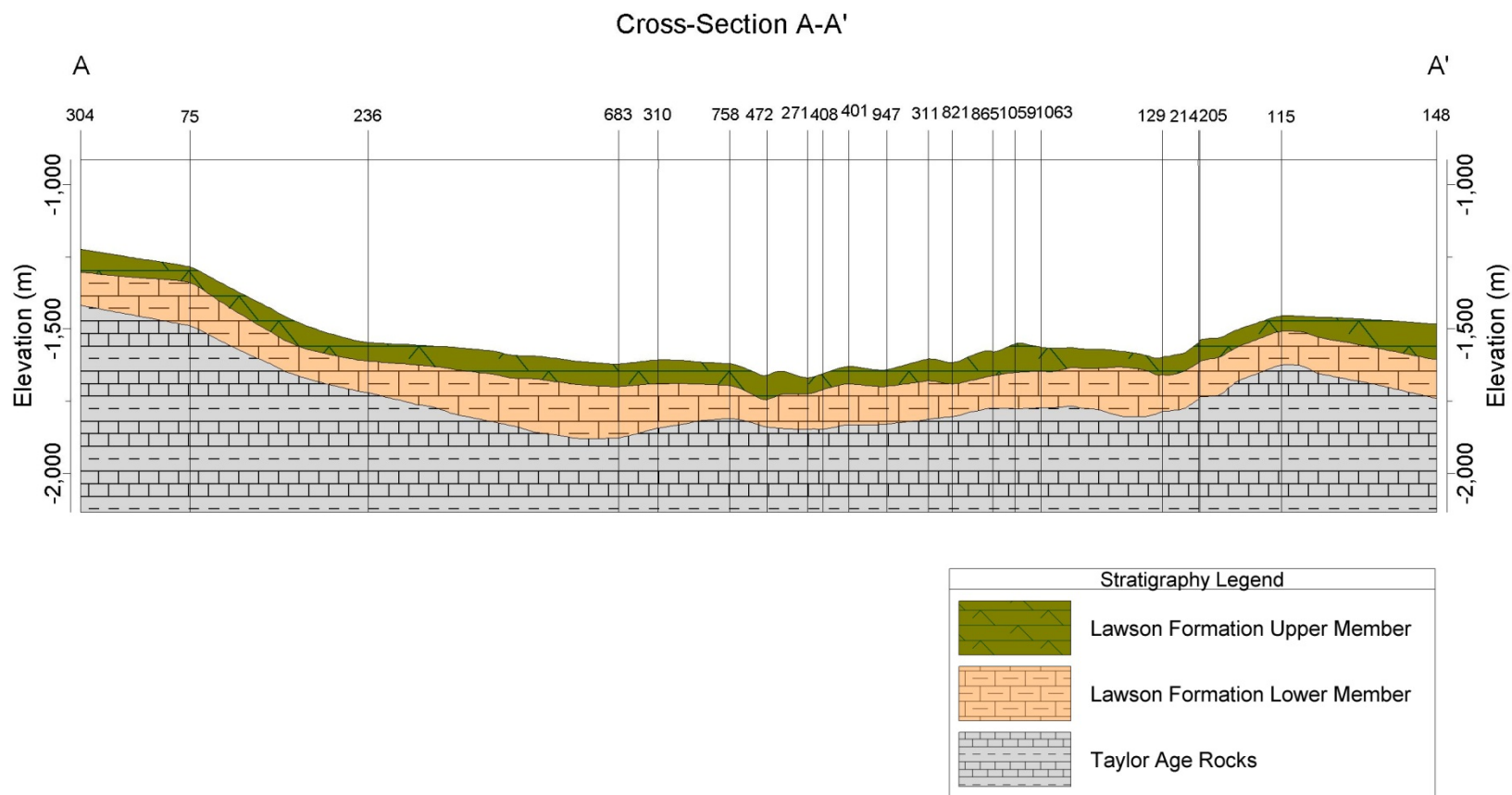


Figure 3-14: Stratigraphic cross-section displaying the Lawson Formation for Transect A-A'. Transect location is depicted in Figure 3-4.

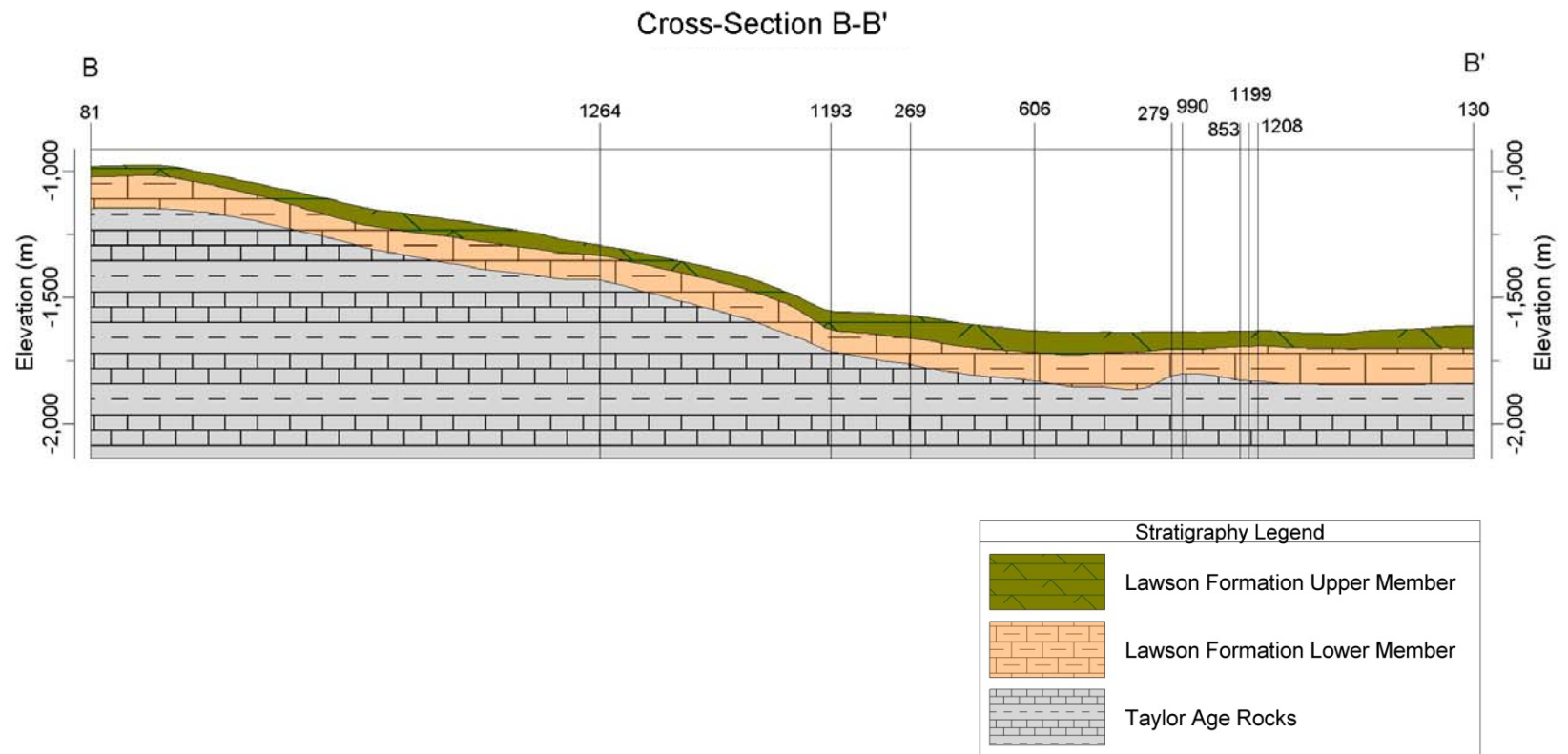


Figure 3-15: Stratigraphic cross-section displaying the Lawson Formation for Transect B-B'. Transect location is depicted in Figure 3-4.

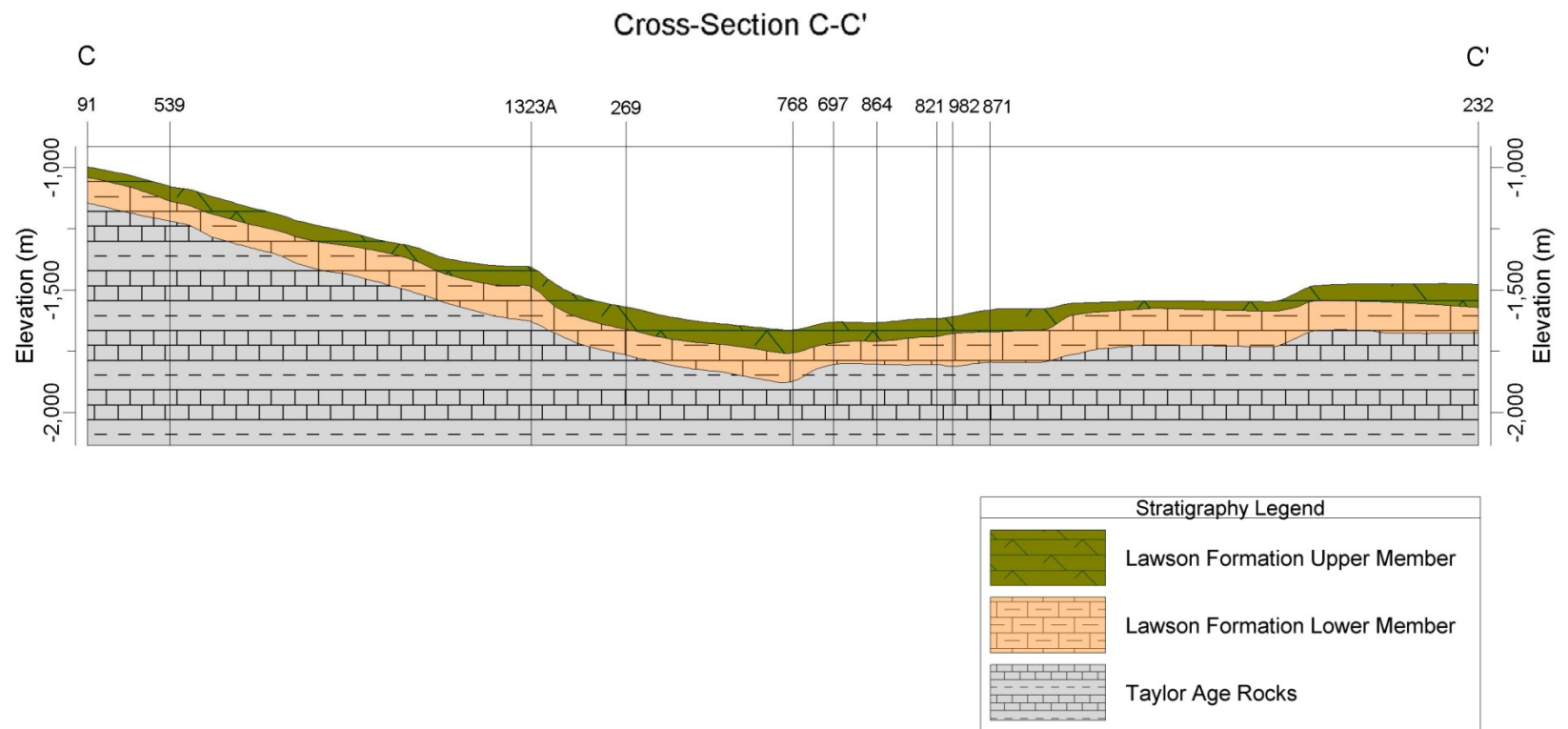


Figure 3-16: Stratigraphic cross-section displaying the Lawson Formation for Transect C-C'. Transect location is depicted in Figure 3-4.

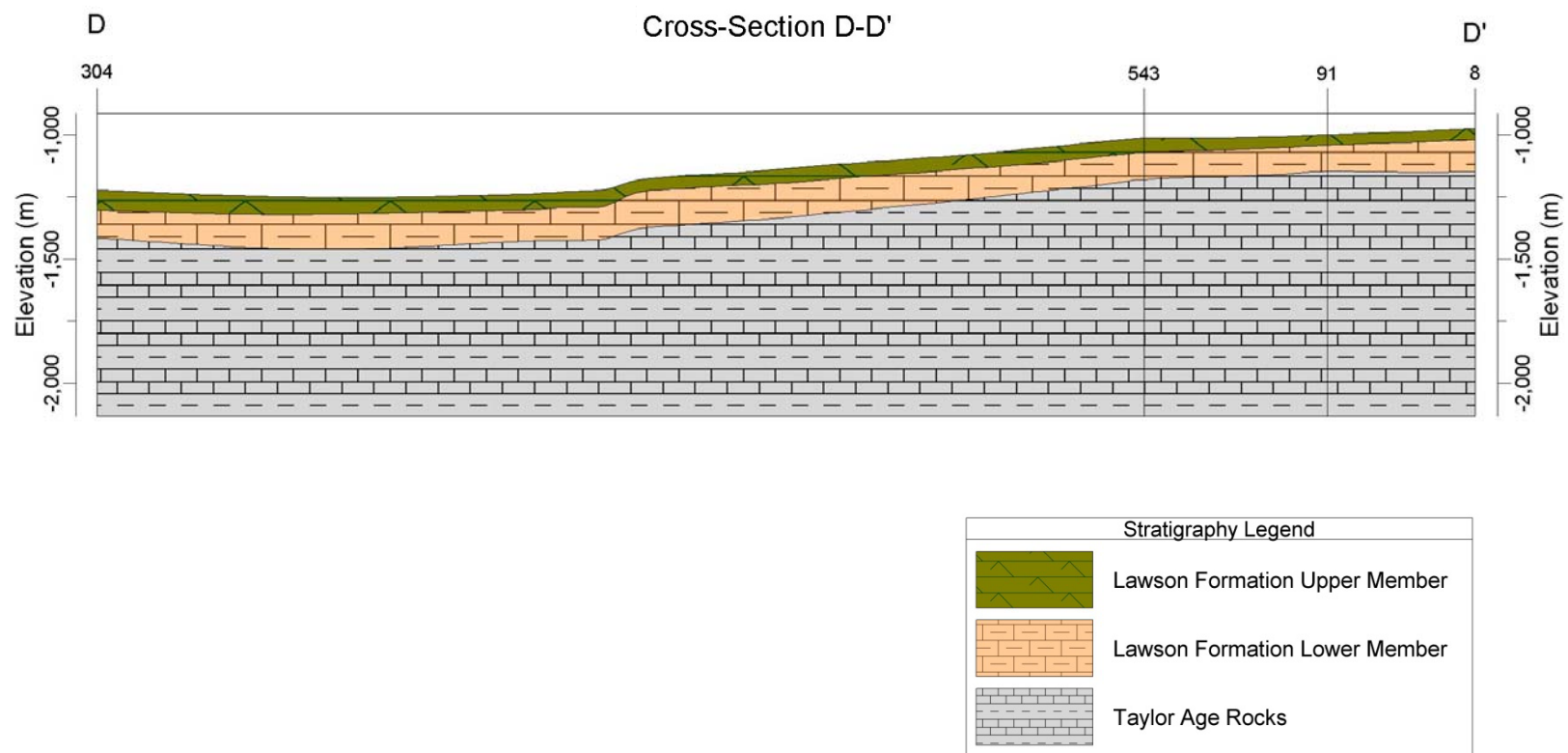


Figure 3-17: Stratigraphic cross-section displaying the Lawson Formation for Transect D-D'. Transect location is depicted in Figure 3-4.

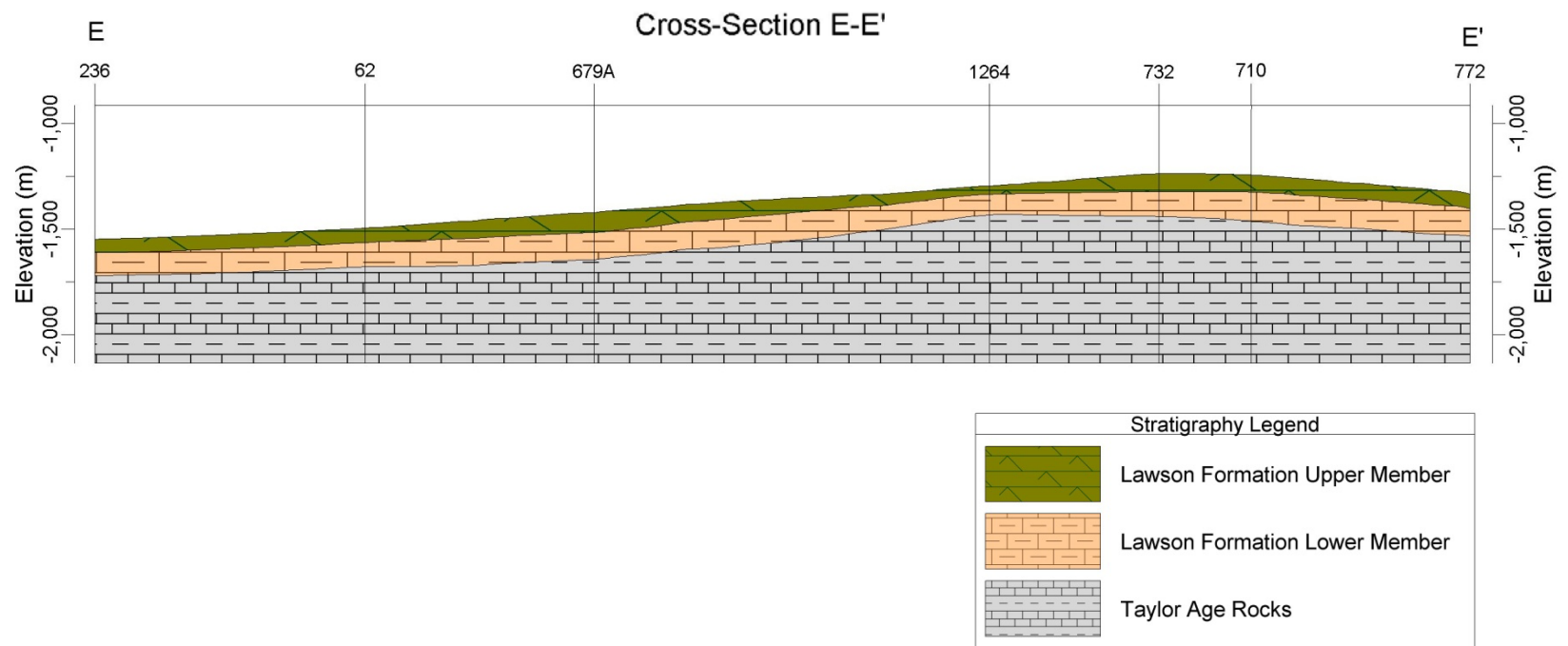


Figure 3-18: Stratigraphic cross-section displaying the Lawson Formation for Transect E-E'. Transect location is depicted in Figure 3-4.

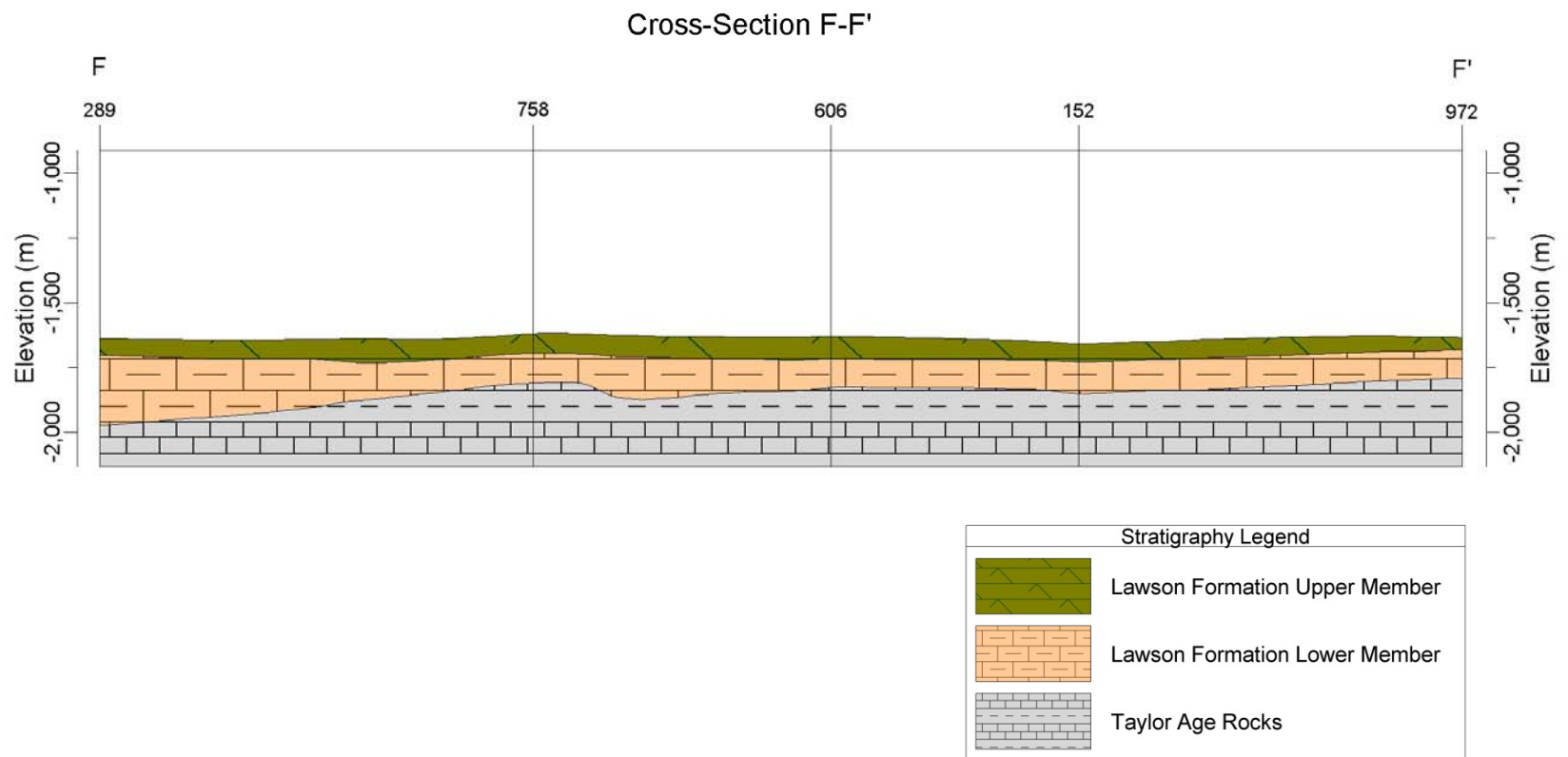


Figure 3-19: Stratigraphic cross-section displaying the Lawson Formation for Transect F-F'. Transect location is depicted in Figure 3-4.

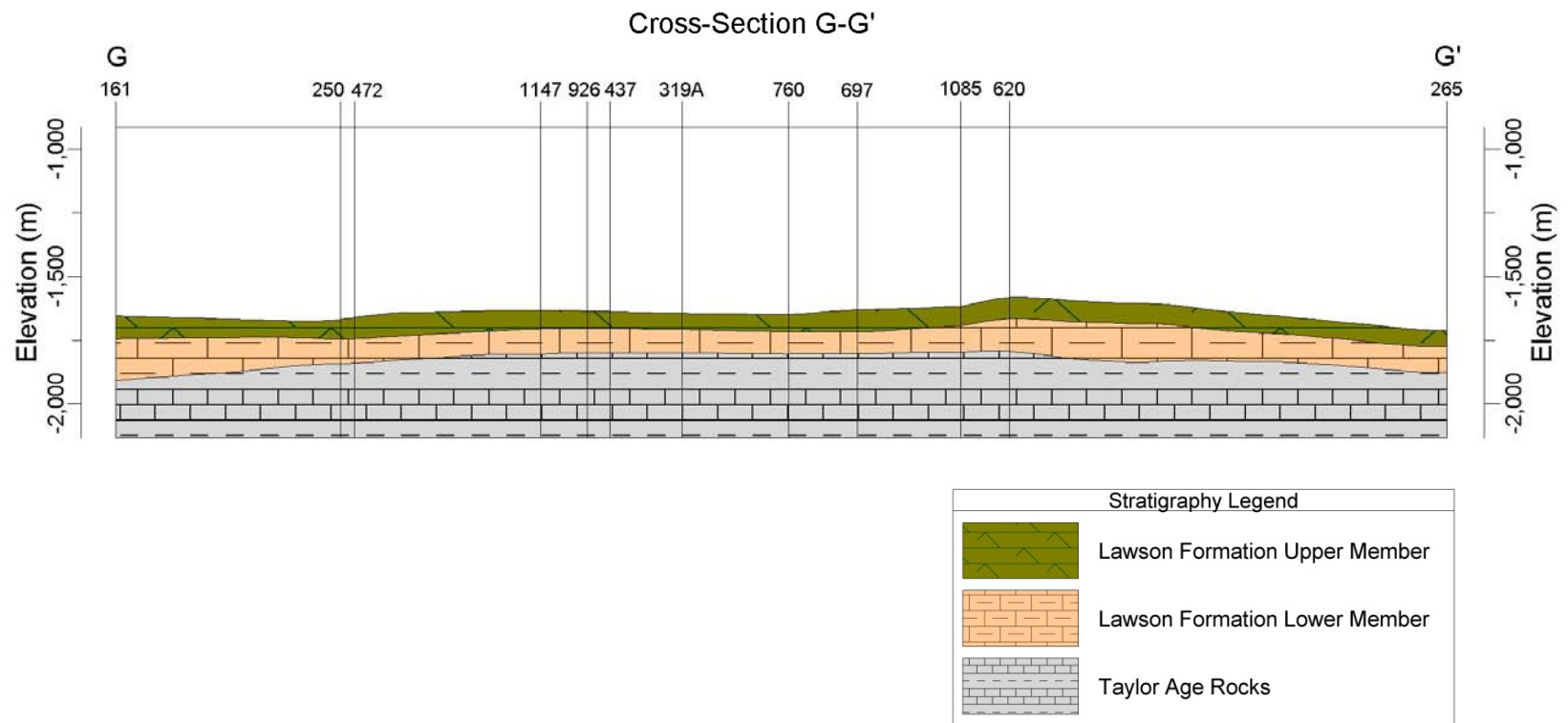


Figure 3-20: Stratigraphic cross-section displaying the Lawson Formation for Transect G-G'. Transect location is depicted in Figure 3-4.

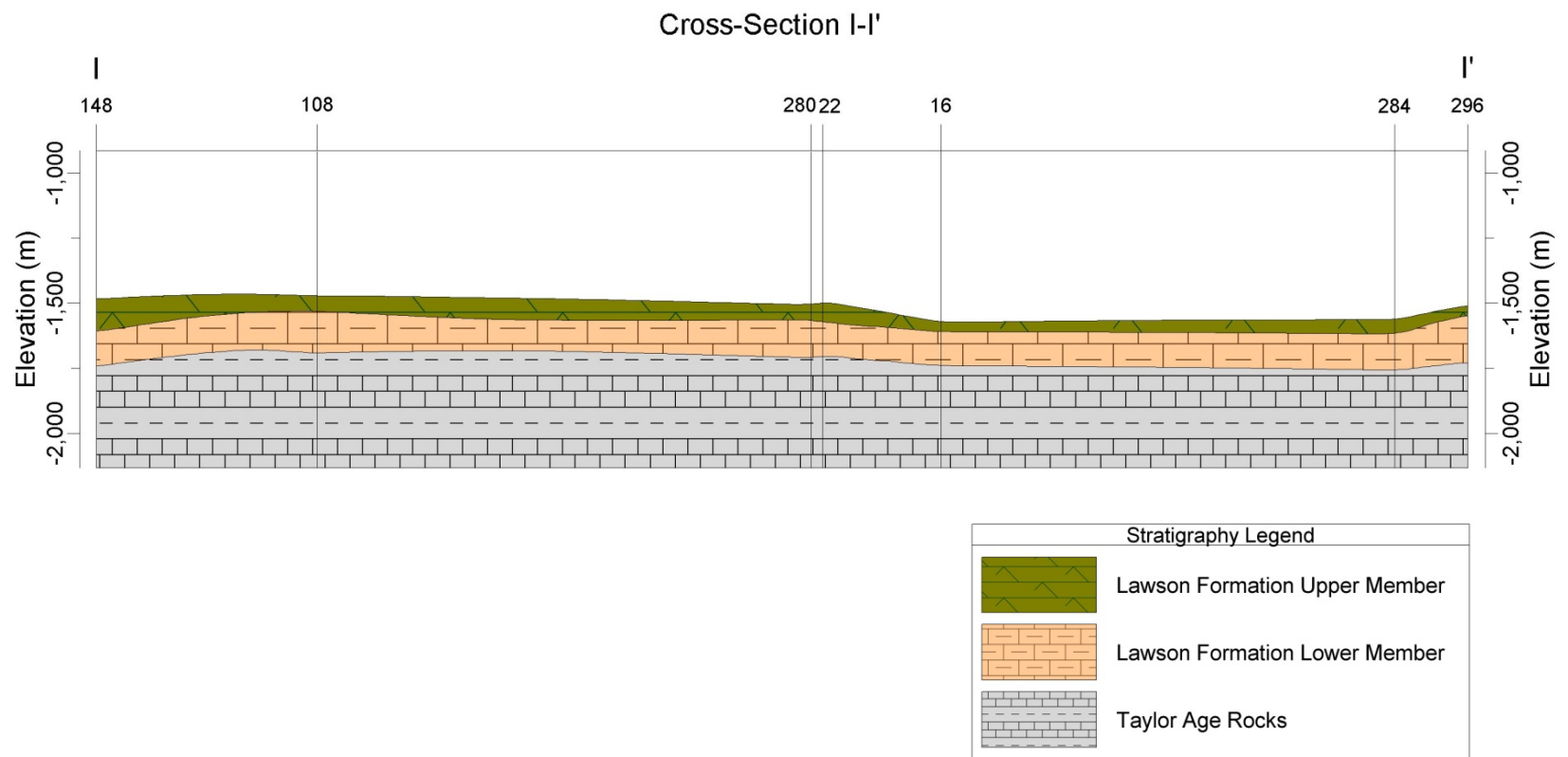


Figure 3-22: Stratigraphic cross-section displaying the Lawson Formation for Transect I-I'. Transect location is depicted in Figure 3-4.

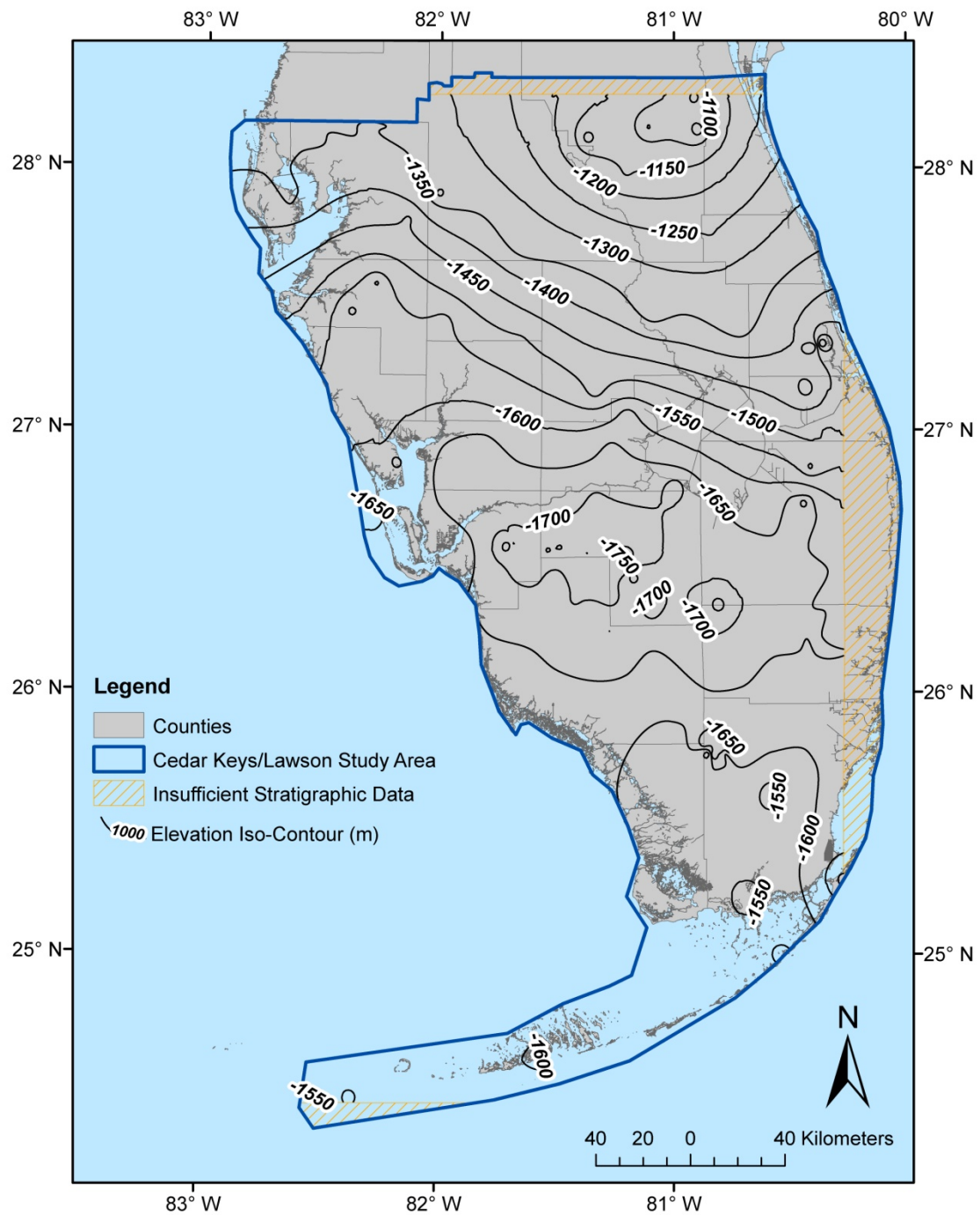


Figure 3-23: Isolith map of the top of the lower member of the Lawson Formation.

The fossil assemblage in the lower member is distinct and uniform, although lack of complete preservation can make fossil identification difficult. Microfauna characteristic of the lower member of the Lawson Formation include foraminifera such as *Lepidorbitoides* spp., brachiopods, bryozoan fragments, echinoid spines, *Saccocoma* spp., and disk- and ball-shaped algae (Applin & Applin, 1967). The highest occurrence of *Lepidorbitoides* is within the uppermost extent of the lower member, where it typically co-occurs with *Sulcoperculina cosdeni*.

At its northernmost limit adjacent to the Suwannee Saddle in southern Georgia, the lower member of the Lawson Formation pinches out and is overlain by the upper member of the Lawson Formation (Applin & Applin, 1967; Miller, 1986).

Upper Member

The upper member of the Lawson Formation is generally ~60 to ~90 m (200-300 ft) thick, although in the study area it is as thin as 30 m (100 ft) and as thick as 129 m (422 ft). The unit tends to deepen southward from around 610 m (2,000 ft) bls in north Florida (Applin & Applin, 1944) to as deep as 1,729 m (5,672 ft) bls in south Florida. Figure 3-24 is an isolith map that displays the top of the upper member of the Lawson Formation throughout the study area.

The upper member of the Lawson Formation is predominantly a cream-colored or light-tan, coarsely crystalline dolomite with interbedded lenses of gypsum and anhydrite. The unit is primarily an algal and rudistid biostrome that has been extensively altered by diagenesis, although some relic grains can be observed (Applin & Applin, 1944; Applin & Applin, 1967; Kaiser, 1971; Miller, 1986; Winston, 1994). Wave-action typical of a shallow-water marine environment probably contributed to the alteration of the upper member sediments before lithification commenced, as indicated by the abrasion and partial or complete destruction of a majority of the fundamental skeletal material (Applin & Applin, 1967). Porosity and permeability for the upper member are

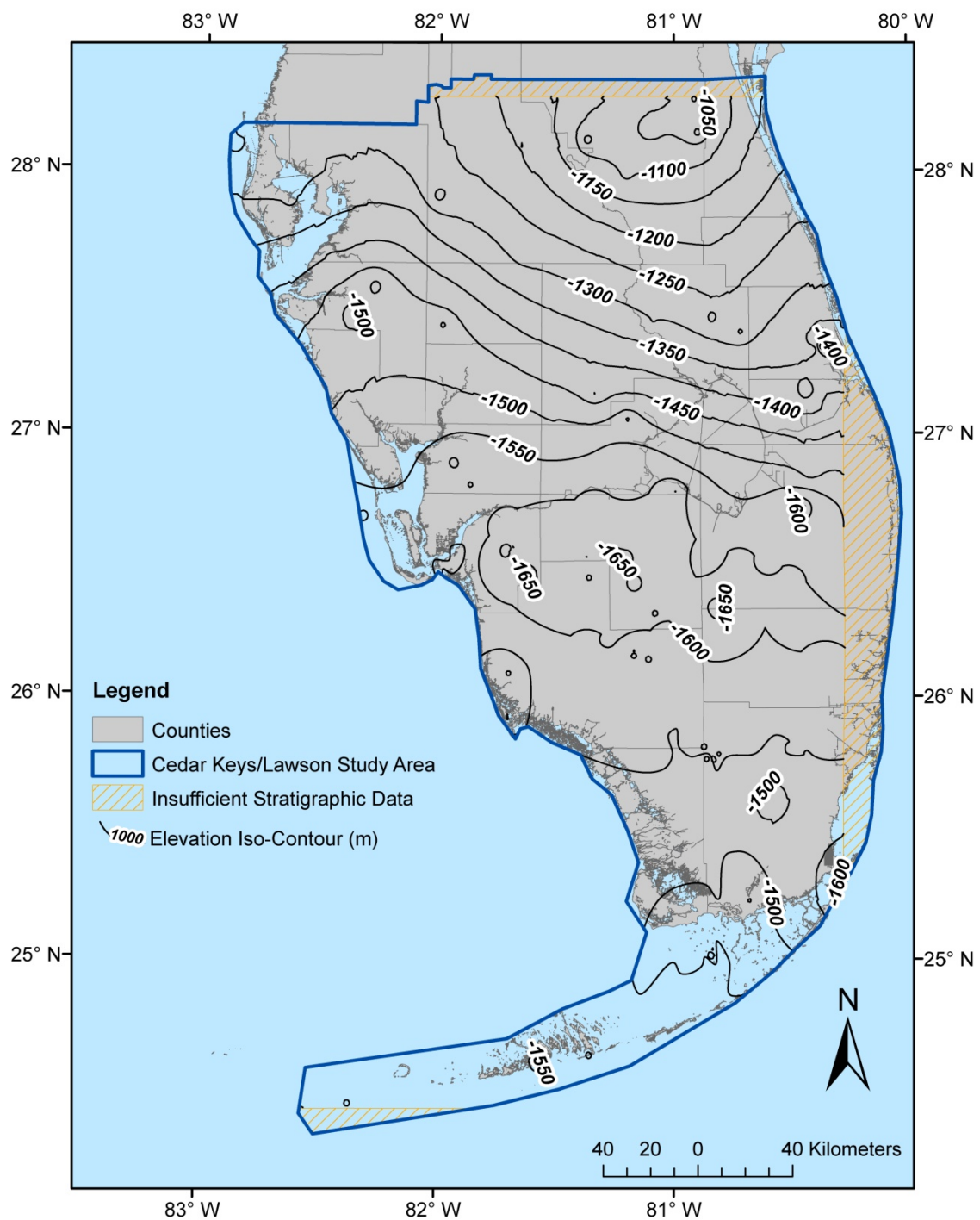


Figure 3-24: Isolith map of the top of the upper member of the Lawson Formation.

generally good; therefore, this portion of the Lawson Formation is included in the CKLIZ. Secondary porosity dominates the unit throughout its extent; however, some primary porosity is present via finely nodular, abraded, and partially dissolved relic grains that have irregular porosity (Applin & Applin, 1967).

As in the lower member of the Lawson Formation, post-depositional alteration resulted in poorly preserved fossil specimens and fragments of microfossils in the upper member; however, in addition to rudistids and algae, two species of large foraminifera, *Vaughanina cubensis* and *Orbitoides brownie*, can commonly be seen in chalky, pocket-like areas where they were probably protected from structure-altering environmental factors (Applin & Applin, 1967). In addition, rotalids are common, but are often recrystallized.

According to data presented in Applin & Applin (1967), the upper member of the Lawson Formation, at its northernmost extent adjacent to the Suwannee Saddle, onlaps onto the underlying Taylor-age rocks and pinches out in southern Georgia, approximately 35 km (~20 mi) north of where the lower member of the Lawson Formation pinches out.

3.3.1.3 Cedar Keys Formation

The Lawson Formation is overlain by the Midway age Cedar Keys Formation, a thick anhydrite and dolomite sequence that is thought to have been deposited during the Paleocene, based upon its stratigraphic position, although its deposition may have continued into the Eocene (Miller, 1986; Pollastro et al., 2001; Winston, 1995). The Cedar Keys Formation represents a lagoonal facies found in peninsular Florida that was deposited in the back-reef environment of the Rebecca Shoal reef, a 1,609-km (1,000-mi) long reef system that resembled a giant atoll during the Paleocene and Upper Cretaceous ages (Winston, 1994). The depth of occurrence and thickness of the Cedar Keys Formation is variable in the study area of south-central and southern Florida;

however, the top of the formation generally occurs at approximately 823 m (2,700 ft) bls in south-central Florida and deepens southward to approximately 1,036 m (3,400 ft) bls in southern Florida (Winston, 1994). According to Winston (1994), the contact between the Cedar Keys Formation and the Lawson Formation is sharp in northern Florida, and generally the base of the Cedar Keys Formation contains brown, finely crystalline dolomite that is distinct from the light-colored, coarsely crystalline dolomite of the upper member of the Lawson Formation. Additionally, *Borelis* sp. is only found in the Cedar Keys Formation, and can often provide for distinction between the two units. In this study for south-central and southern Florida, the contact between the Cedar Keys Formation and the upper member of the Lawson Formation is typically marked by a lens of low-permeability anhydrite or dolomite of varying thickness.

Winston (1994) divides the Cedar Keys Formation into six subunits (Units A-F), based upon varying amounts of anhydrite content. According to Winston (1994), Units A and B are predominantly relatively porous dolomites, with some thin, irregular lenses of anhydrite that occur mainly in the SFB. Some very fine to fine relic grains, such as oolites and pellets, occur in units A and B, and porosity in south-central and southern Florida is commonly granular and intercrystalline, ranging from 10 to 20%. Unit C is mostly anhydrite that occurs in numerous beds varying from a meter in thickness to 183 m (600 ft) or more. The unit contains intervening dolomite and occasional relic grains, especially in the SFB. Where porosity is present in Unit C, it is for the most part exclusively chalky, especially in the SFB; however, random and intermittent zones of intergranular, moldic, and pinpoint porosity occur in south-central Florida, with porosity values ranging from 5 to 10%. Unit D is a dolomite unit that has some relic grains and relatively thin lenses of anhydrite in south-central and southern Florida. Porosity ranges from 5 to 20% and is typically intergranular, pinpoint, and intercrystalline in south-central and southern Florida, and chalky in the southernmost extent of southern Florida. Unit E

resembles the overlying Unit D, with the exception of having fewer relic grains. According to Winston (1994), Unit E is correlative with the upper member of the Lawson Formation in northern and central peninsular Florida. Unit F is a dolomite unit with highly variable thickness and porosity, and is only present in the SFB. Anhydrite rarely occurs in Unit F, but where it is found, it exists as thin beds or nodules.

For this study, the Cedar Keys Formation was divided into three informal units: the lower Cedar Keys Formation, the middle Cedar Keys Formation, and the upper Cedar Keys Formation.

Lower Cedar Keys Formation

The lower Cedar Keys Formation is included in the CKLIZ. For this study, the geologic unit is identified as the porous interval (having porosity values of at least 10%) between the base of the middle semi-confining unit of the Cedar Keys Formation, herein known as the middle Cedar Keys Formation, and the top of the upper member of the Lawson Formation. The lower Cedar Keys Formation can be equated with units D-F of Winston (1994). Because the lower Cedar Keys Formation in this study is delineated based upon the porosity percentage, the thickness and depth of occurrence for the lower Cedar Keys Formation fluctuates due to variation in anhydrite content, which ultimately determines the porosity. In general, however, the lower Cedar Keys Formation occurs between 1,400 m (4,600 ft) and 1,500 m (4,900 ft) bls, and the thickness of the unit is approximately 122 m (400 ft) to 152 m (500 ft), but is as thin as 26 m (84 ft) and as thick as 351 m (1,152 ft).

The lower Cedar Keys Formation typically consists of light-brown to gray, finely crystalline to micro-crystalline dolomite with interbedded, thin lenses of anhydrite and nodular anhydrite. According to Miller (1986), *Borelis* sp. is abundant in this portion of the Cedar Keys Formation and can be used to distinguish the unit from the underlying upper member of the Lawson Formation; however, because the geologic units in this

study were primarily examined using geophysical logs, fossil assemblages could not be examined.

Middle Cedar Keys Formation

The middle Cedar Keys Formation, which forms the lower confining unit of the Floridan Aquifer System (FAS) and is proposed as the upper seal for the CKLIZ, consists of one or more thick, aerially extensive anhydrite beds (Miller, 1986). The middle Cedar Keys Formation presented in this study and in Miller (1986) is correlative with Unit C from Winston (1994). The top of the geologic unit is typically encountered between 1,200 m (~3,930 ft) and 1,300 m (~4,250 ft) bls within the study area. The thickness of the middle Cedar Keys Formation is generally about 200 m (~650 ft) to 300 m (~980 ft), but is as thick as 446 m (1,463 ft). Only one distinct trend can be identified in the thickness of the middle Cedar Keys Formation throughout the study area. As depicted in the stratigraphic cross-sections of figures 3-5 to 3-13 and according to the data presented in Table 3-2, the unit becomes comparatively thinner moving towards the northeast and in areas of Osceola, Okeechobee, and Palm Beach counties, where unit thickness is as thin as 22 m (72 ft). Although the middle Cedar Keys Formation in this region of Florida may not have numerous or massive anhydrite beds that often exist elsewhere in the study area, at least one significantly thick anhydrite bed exists in this region which would likely provide sufficient confinement for the underlying CKLIZ.

Upper Cedar Keys Formation

The upper Cedar Keys Formation is generally a gray to cream, coarsely crystalline dolomite that is moderately to highly porous, and is typically part of the lower FAS (Miller, 1986). The upper Cedar Keys Formation presented in this study is correlative with Unit A and Unit B, collectively, from Winston (1994). The thickness and extent of the geologic unit was not evaluated in this study; however, typically the upper Cedar Keys Formation is found around 853 m (2,800 ft) to 915 m (3,000 ft) bls and is

around 230 m (750 ft) thick (Winston, 1994). Locally within the study area, mostly in southern peninsular Florida below Lake Okeechobee, the upper Cedar Keys Formation forms the “Boulder Zone,” a thick horizon of cavernous solution-cavities that mainly developed parallel to bedding planes at numerous intervals within a vertical extent that could reach over 50 m (160 ft) (Miller, 1986). Where the Boulder Zone occurs, porosity and permeability are extremely high.

The *Borelis* sp. indicative of the Cedar Keys Formation is not present in this portion of the formation (Miller, 1986). Because of the extent of dolomitization within the upper Cedar Keys Formation, the unit cannot be dated using fossil assemblages, and has been assigned a Paleocene age based on its stratigraphic position.

3.4 Methods and Procedures

3.4.1 Well Selection

There were 103 exploratory/discovery oil wells and one waste-disposal well examined throughout the study area (Figure AIII-2 of Appendix III). All evaluated wells provide information for Cedar Keys Formation, Lawson Formation, and Taylor-Age rock picks; however, only 54 of the 104 wells could be used to derive and interpolate porosity values for the CKLIZ. For those wells used for porosity derivation, there were three major criteria for the well-selection process: 1) the well had to penetrate the entire CKLIZ, 2) the well had to have at least one geophysical log available that covered the entire storage zone from which porosity could be derived, and 3) for wells that had intentional or unintentional curves in the wellbore, the porosity log had to be reported in true vertical depth TVD. For P# 1032 (Martin County), no porosity logs could be identified that covered the entire storage zone; however, one porosity log was identified and included that covered most of the storage zone (158.5 m [520 ft]), minus about 15-30 m (50-100 ft) in the uppermost region.

Another objective in the well-selection process was to identify at least three wells for each county, which met all outlined criteria, that were arranged in such a way as to provide sufficient county-wide spatial coverage; however, several counties within the study area had little to no oil-exploration or aquifer-injection activity, and therefore lacked suitable well-coverage and provided limited geophysical data. For counties with limited well-coverage, any wells in that particular county that provided geophysical data that could be used for formation and storage-zone delineation or porosity derivation were included in the study. Five wells in this study were located offshore (P# 232, P# 284, P# 289, P# 296, and P# 304) and were included because, in addition to meeting well-selection criteria, these wells provided information on the geologic units of interest beyond the current subaerial extent of peninsular Florida, and provided some insight into how the porosity and extent of these units trends offshore.

3.4.2 Porosity Determination

Geophysical logs for exploratory/discovery oil wells and one waste-disposal well within the study area were examined in order to obtain data for the estimation of porosity for the CKLIZ, and to identify the upper and lower boundaries of the middle Cedar Keys Formation, lower Cedar Keys Formation, Lawson Formation upper member, and Lawson Formation lower member, as well as the top of the Taylor-age rocks. All geophysical porosity logs were provided by the FDEP Bureau of Mining and Minerals Regulation Oil and Gas Section. All geophysical logs reviewed in this study were created by Schlumberger and were interpolated using figures created by the company specifically for Schlumberger geophysical-log interpretation. Schlumberger (1989) provided all Schlumberger porosity-log interpretation figures for porosity determination, and copies of each figure are located in Appendix II. The types of geophysical porosity logs used in this study for the purpose of deriving porosity values included bulk density logs, BCS logs, CNLs, and CNL-FDC logs.

As discussed in Chapter 2, the measurements made during the generation of sonic, neutron, and density logs depend upon the porosity of the penetrated formation, the lithology of the formation, the type of formation fluid, and, in some instances, the geometry of the pore structure (Schlumberger, 1989). When the lithology of the formation is known, correct porosity values can be obtained using a single geophysical log; however, when the lithology is unknown, more than one geophysical log must be used or the lithology has to be confirmed using cores or well cuttings for the appropriate well, or by using mud logs and core descriptions or analyses which describe the lithology of the formation at various intervals. Rock cores and well cuttings were provided by the FGS, when necessary. For this study, every effort was made to use wells that had more than one porosity log available, so that more than one method of porosity determination could be used to ultimately derive the most accurate value of porosity for the CKLIZ. In addition, cross-plots were used when multiple porosity logs were available, which were effective tools for evaluating porosity and lithology determinations. Due to the limitations in identifying sufficient geophysical data for each county within the study area, ten wells (P#s 475, 982, 606, 864, 926, 1151, 407, 408, 758, and 304) which met the well-selection criteria, but had no available means for determining lithology, were included in the study to ensure adequate spatial coverage. For these wells, the most conservative porosity values were extrapolated. Section 2.5.2 of Chapter 2 explains how porosity values were derived from each type of porosity log used in this study.

3.4.3 Storage Capacity Calculation

Storage capacities for the CKLIZ were calculated using the volumetric equation for capacity calculation in saline formations provided by NETL (2007). The same equation was used for calculating storage capacities for the Sunniland Formation in

Chapter 2, and a detailed description of the volumetric equation and its variables is provided in Section 2.5.3.

One large polygon was created in ArcGIS™ Suite that encompassed the study area, which is depicted in Figure 3-1. ArcGIS™ Suite used this polygon to calculate A for the study area, for inclusion in the estimation of storage capacity for the CKLIZ within the boundaries of the study area.

Brennan et al. (2010) present methodologies recently developed by the USGS for evaluating geologic CO₂ storage units, and identify units with porosities of at least 8% as suitable for CO₂ sequestration. This investigation has an even more conservative approach, and identified porous zones within the CKLIZ with porosity values greater than or equal to 10% as appropriate for injection and storage of CO₂. Many exploratory/discovery oil wells, as well as the waste-disposal well, that were evaluated for porosity in this study have multiple porous zones vertically within the CKLIZ that have porosities greater than 10%, which are separated by layers of dolomite or anhydrite of low porosity (<10%) and permeability and varying thickness. This vertical heterogeneity is displayed in the striplogs created for each well, located in Appendix V.

For each well evaluated for porosity in the study area, if a low-permeability layer occurred within the confines of the CKLIZ that exceeded 5% of the total thickness of the CKLIZ for that well, then multiple, separate storage sub-zones were assigned to that well as part of the CKLIZ, which were separated by the low-permeability layer(s). Specifically, if there were two separate storage sub-zones in each well for the CKLIZ, they were termed the “upper” and “lower” storage zones, and if there were three separate storage sub-zones in each well for the CKLIZ, they were termed the “upper,” “middle,” and “lower” storage zones. The value of h_g for each evaluated well was equal to the thickness of the CKLIZ within that well. If multiple storage sub-zones were assigned to a given well, then h_g for that well was the total thickness of all the sub-zones

in that well, or the sum of all of the thicknesses estimated for each sub-zone within that well. The final value of h_g that was used in the storage capacity calculation for the entire study area was the average of each h_g value calculated for each well.

In order to calculate the value of Φ_{tot} for the CKLIZ used in the storage capacity estimation for the study area, a Φ_{tot} value was first determined for each well, and was based upon an average of all the porosity values that were derived from the well's geophysical logs throughout the vertical extent of the CKLIZ within that well. If there were multiple storage sub-zones assigned to a given well, then Φ_{avg} was first estimated for each sub-zone, and then Φ_{tot} for that well was the average of each sub-zone's estimated Φ_{avg} value. The final value of Φ_{tot} that was used in the storage capacity calculation for the study area was an average of the Φ_{tot} values that were estimated for each well.

The density of CO_2 and the p value used in the storage capacity estimation was 725 kg/m^3 , which was calculated using the hydrostatic pressure of the CKLIZ (150 bar) and the average temperature for every h_g assigned to each evaluated well (43°C). Limited temperature data are available for the CKLIZ within the study area; therefore, a plot was created with available temperature data for all study wells (Figure 3-25). From this plot, a calibration trend-line was used to estimate temperature for a given depth, specifically the depths of each h_g .

As with the Sunniland Formation, the value of E used in the storage capacity estimation for the CKLIZ was 0.03. Further explanation of E and how its value is established is provided in Section 2.5.3 of Chapter 2.

3.4.4 Data Modeling, Interpolation, and Presentation

Porosity values derived from geophysical logs for each well evaluated were recorded in 5% range-increments. This dataset is located in Table IV-2 of Appendix IV.

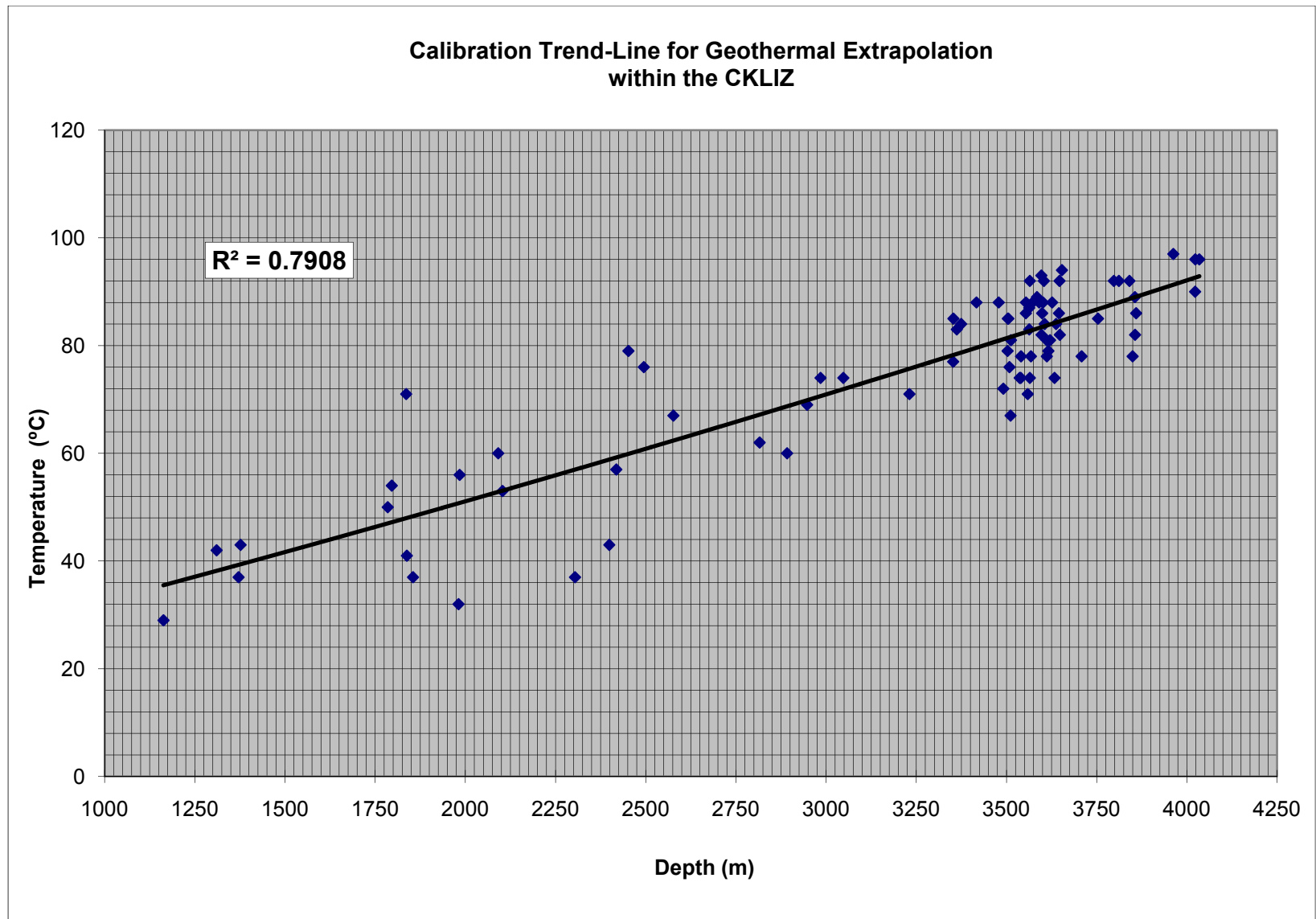


Figure 3-25: Geothermal gradient used to extrapolate temperature values for given depths within the CKLIZ.

For porosity interpolations and cross-sections in this study, porosity values in 10% range-increments were used for graphical clarity.

Similar to simulations conducted in Chapter 2, RockWorks™ and ArcGIS™ Suite were used to graphically represent geometries and lithologies for the geologic units evaluated in this study using striplogs, cross-sections, solid models, and isolith- and isopach-contour maps. RockWorks™ and ArcGIS™ Suite were also used to interpolate and model the porosity data for the CKLIZ within the study area.

ArcGIS™ Suite was used to interpolate and model the estimated CO₂ storage capacity for the CKLIZ within the region. The RBF spline methods were used for all interpolations conducted in this study using ArcGIS™. Similar to the scenario in Chapter 2, the RBF spline methods were chosen for this study due to the sparse and widespread distribution of the study wells, in addition to the large-scale of the overall CKLIZ study area, and were considered to be the most appropriate methods for modeling parameters because they have the least inherent-error of all the interpolation methods available in Geostatistical Analyst. The use of the RBF method created interpolated contour-surfaces that were bound by the outermost data points in the CKLIZ study area, which resulted in small regions within the study area that contained no predicted raster surface, and were subsequently identified in each figure as having either “Insufficient Stratigraphic Data” or “Insufficient Porosity Data.” Specifically, data-availability constraints resulted in the interpolation of 84% of the total study area for the CKLIZ. Further description of the “Horizontal Lithoblending” and RBF spline method algorithms, functions, and procedures that were utilized with these programs are provided in Section 2.5.4 of Chapter 2.

The Map Algebra and Raster Math tools in the ArcGIS™ Spatial Analyst toolbox were used to perform the CO₂ storage capacity calculation for the CKLIZ. The interpolated sequestration reservoir thickness (h_g) and average porosity (Φ_{tot}) variable

rasters were multiplied by the storage efficiency factor (E) and the CO₂ density (ρ) constants to derive a single raster output. The interpolated area (84% of the total study area) was also factored into the storage capacity equation using the Raster Math tool. The output raster layer, which contained the results of the storage capacity calculation, was reclassified into 101,432 1-km² cells in order to determine the amount of CO₂ that could potentially be sequestered in each square kilometer of the interpolated-area. The final raster was a functional display of CO₂ storage capacity in 1,000 tCO₂ per 1-km² model cell.

3.5 Results

3.5.1 Porosity

Table AIV-2 of Appendix IV provides porosity values for the CKLIZ that were derived from the 54 wells in the study area that meet the porosity derivation well-selection criteria. Appendix V provides a striplog for each of these wells, which displays porosity variation with depth for the CKLIZ.

Porosity cross-sections were created for each of the nine transects presented in Figure 3-4; however, three of these transects (A-A', B-B', and C-C') cover extensive distances which make the presentation of porosity interpolation difficult. Therefore, each of these three transects are divided into two "sub-transects." Specifically, Transect A-A' is divided into Transect A-A1 and Transect A1-A'; Transect B-B' is divided into Transect B-B1 and Transect B1-B'; and Transect C-C' is divided into Transect C-C1 and Transect C1-C', as seen in Figure 3-4. The porosity-interpolation cross-sections created for each transect within the study area are displayed in figures 3-26 to 3-37. These cross-sections show porosity variation with decreasing elevation, using sea level as the datum. Figure 3-38 is a porosity-contour map that displays average porosity variation for the CKLIZ throughout the study area.

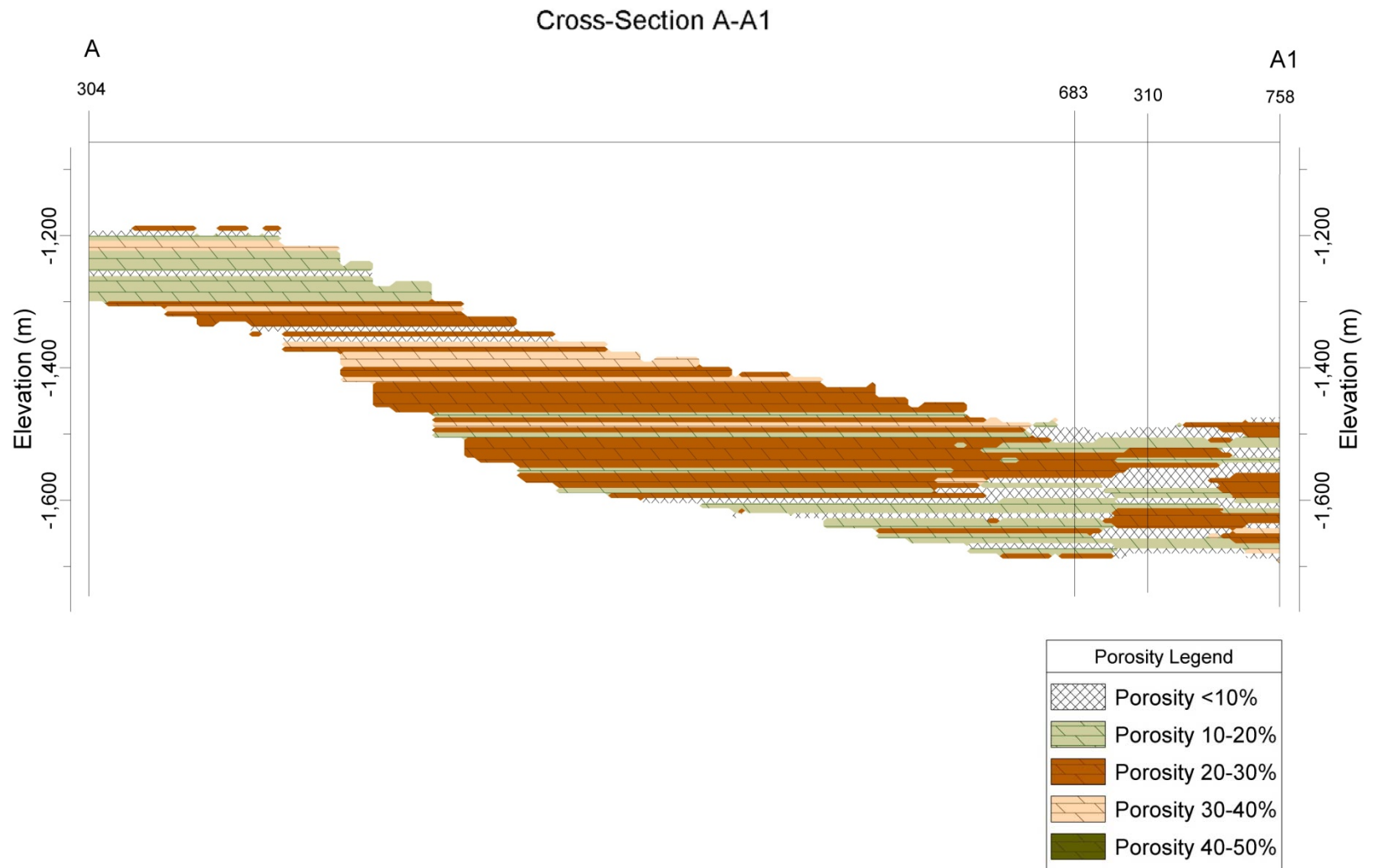


Figure 3-26: Cross-section displaying interpolated porosity for Transect A-A1. Transect location is depicted in Figure 3-4.

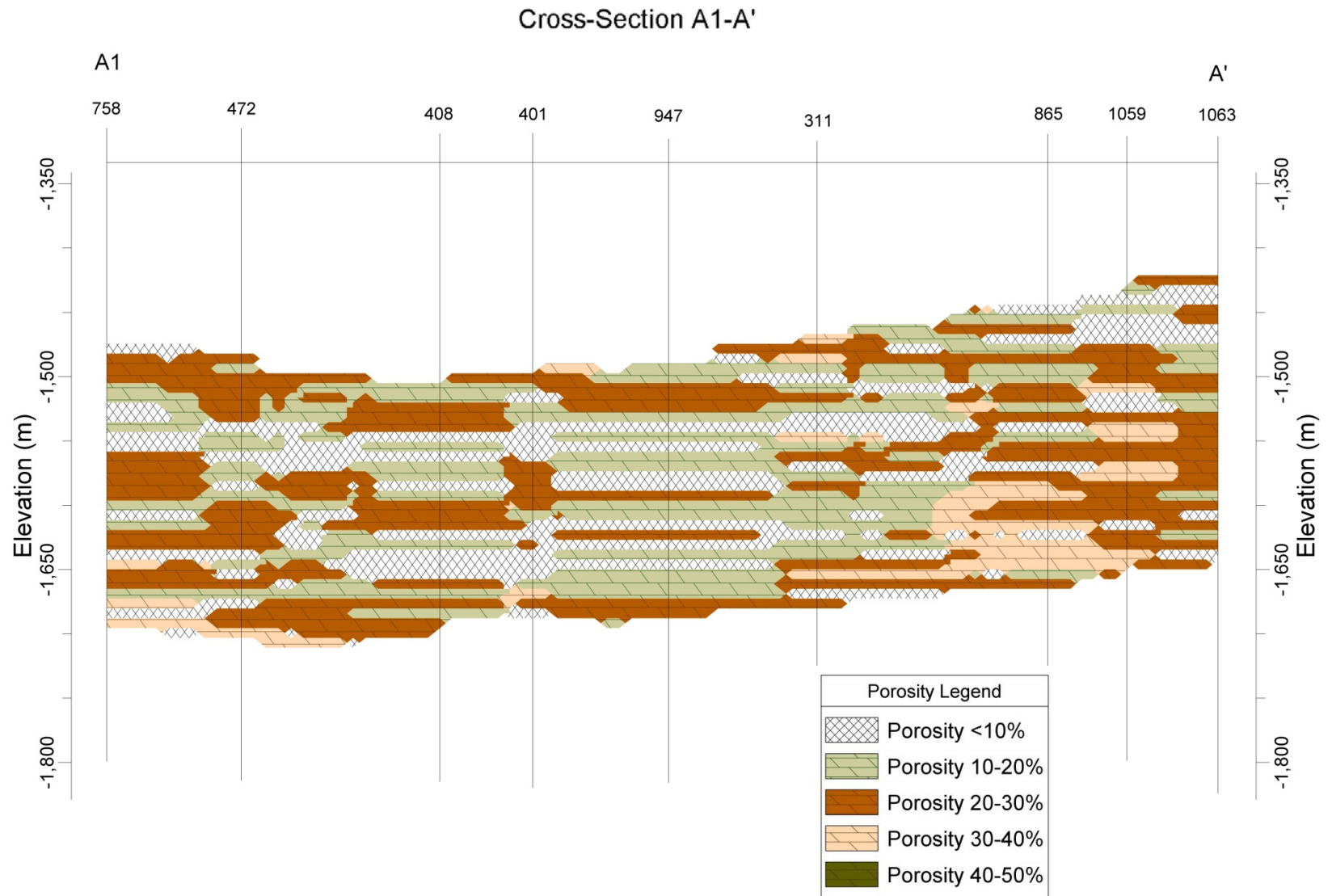


Figure 3-27: Cross-section displaying interpolated porosity for Transect A1-A'. Transect location is depicted in Figure 3-4.

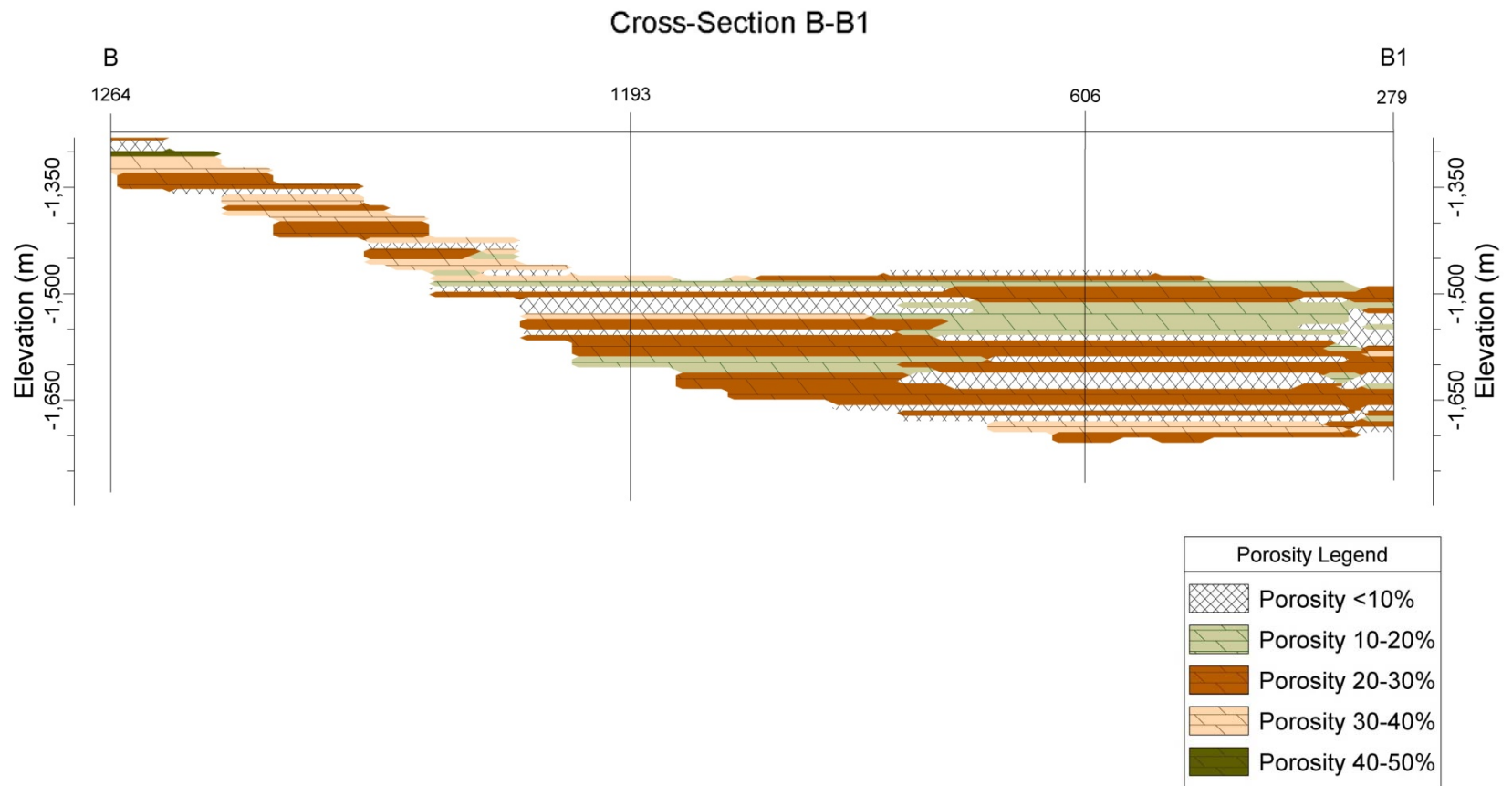


Figure 3-28: Cross-section displaying interpolated porosity for Transect B-B1. Transect location is depicted in Figure 3-4.

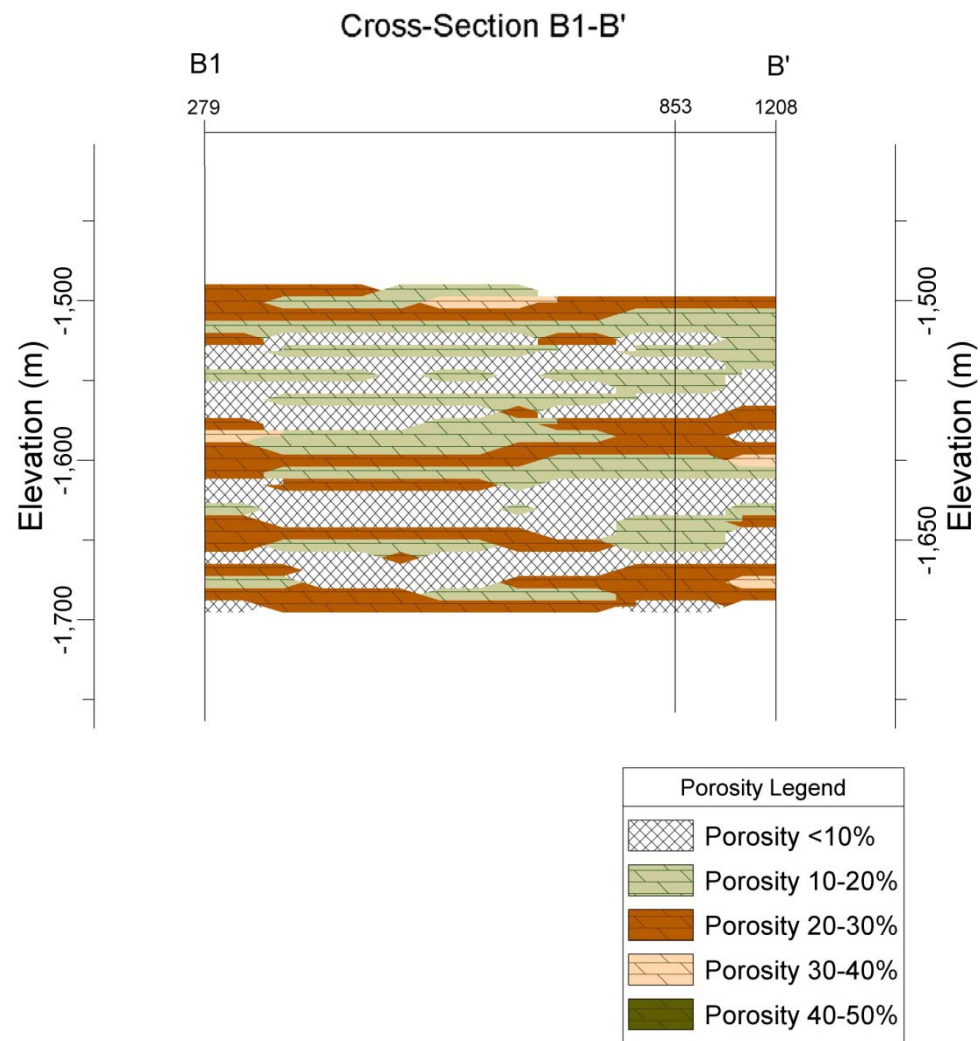


Figure 3-29: Cross-section displaying interpolated porosity for Transect B1-B'. Transect location is depicted in Figure 3-4.

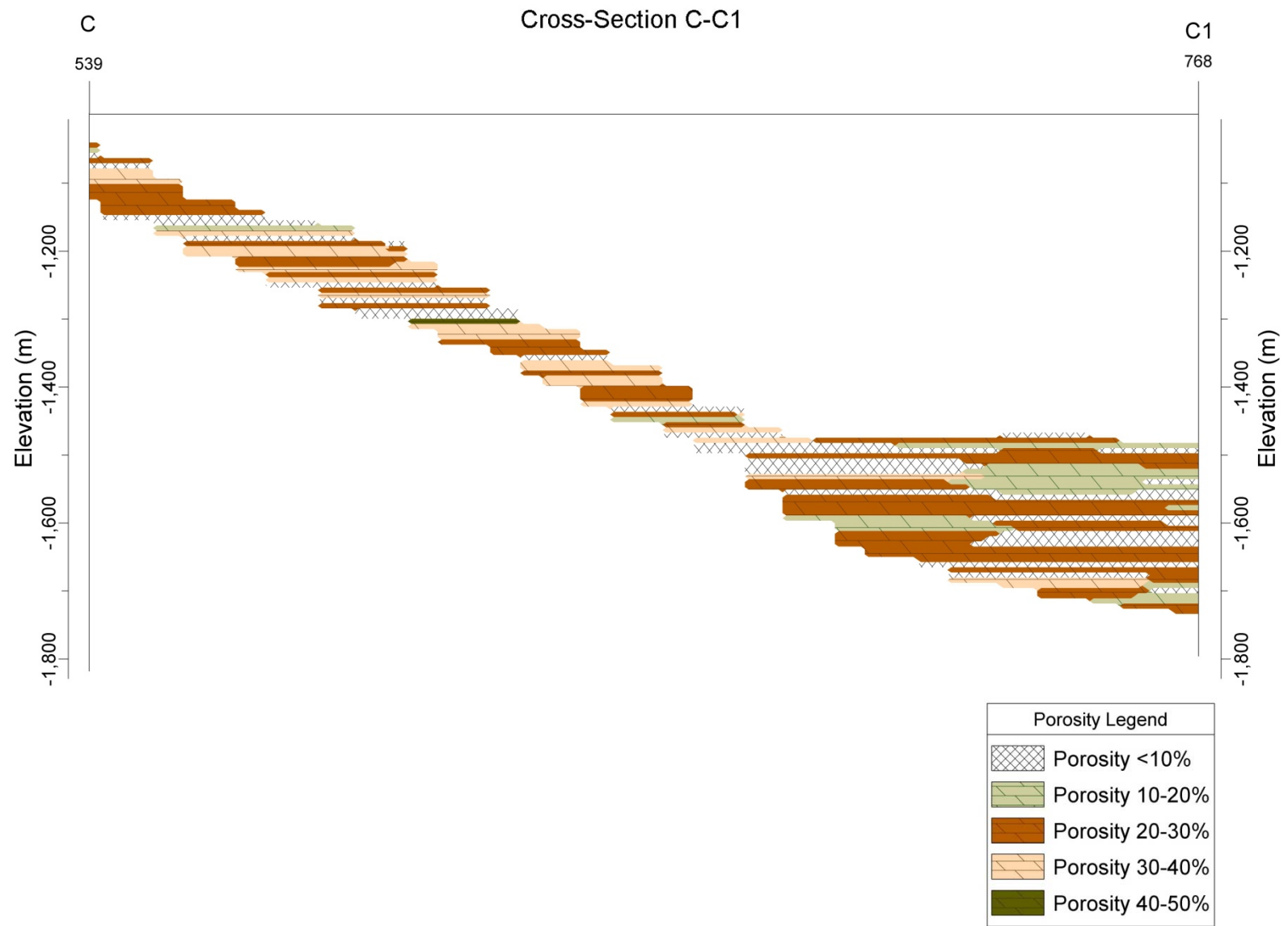


Figure 3-30: Cross-section displaying interpolated porosity for Transect C-C1. Transect location is depicted in Figure 3-4.

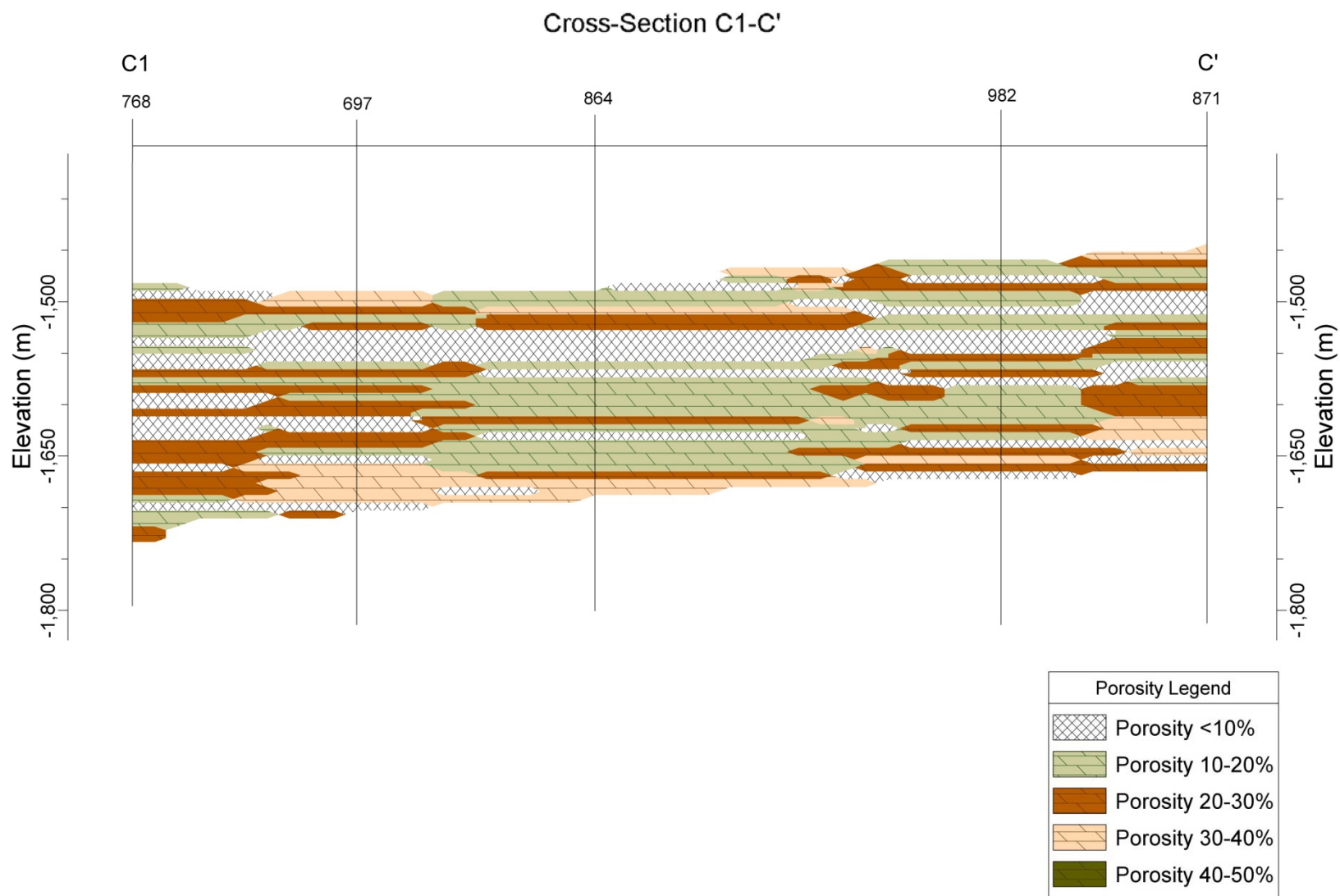


Figure 3-31: Cross-section displaying interpolated porosity for Transect C1-C'. Transect location is depicted in Figure 3-4.

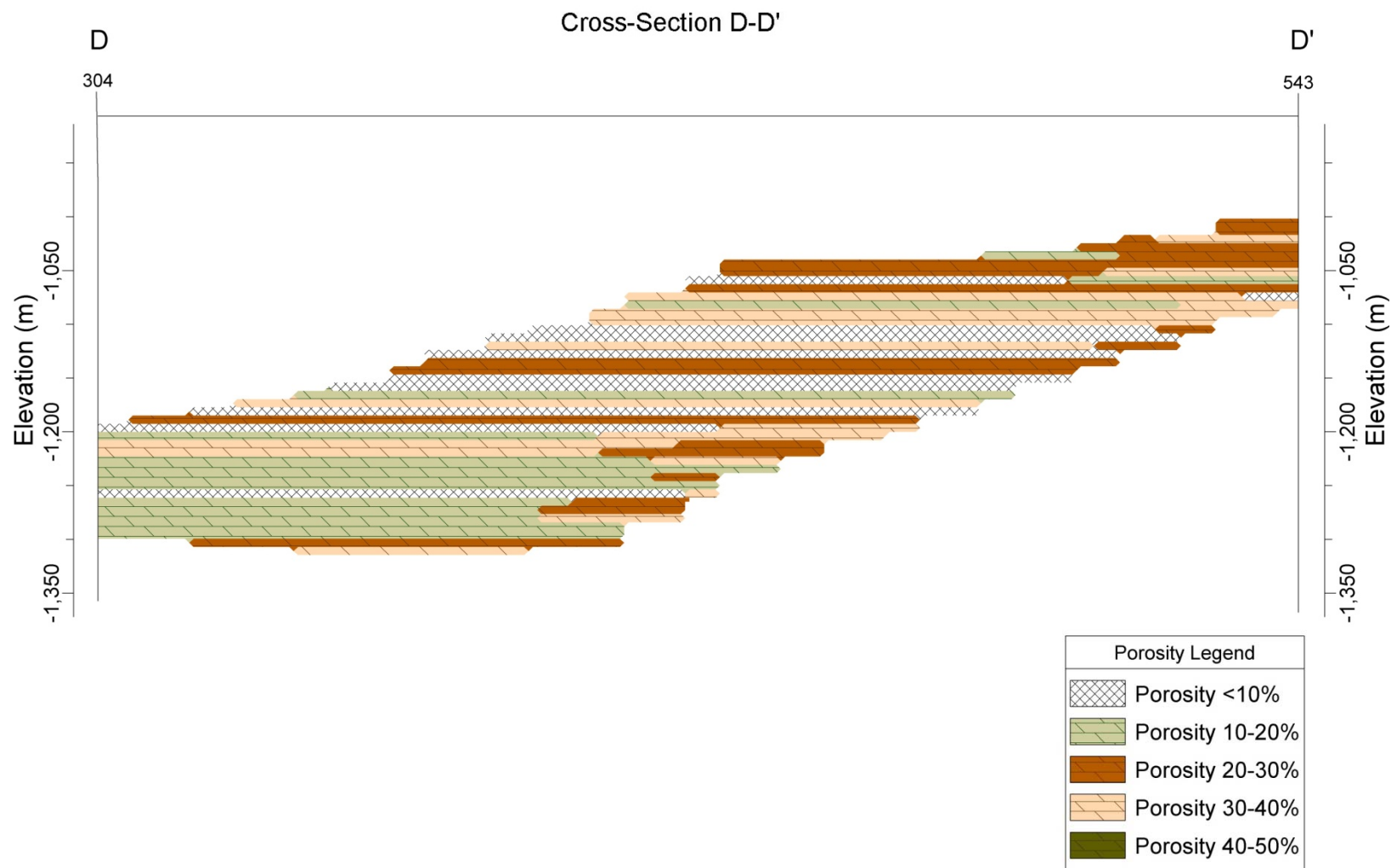


Figure 3-32: Cross-section displaying interpolated porosity for Transect D-D'. Transect location is depicted in Figure 3-4.

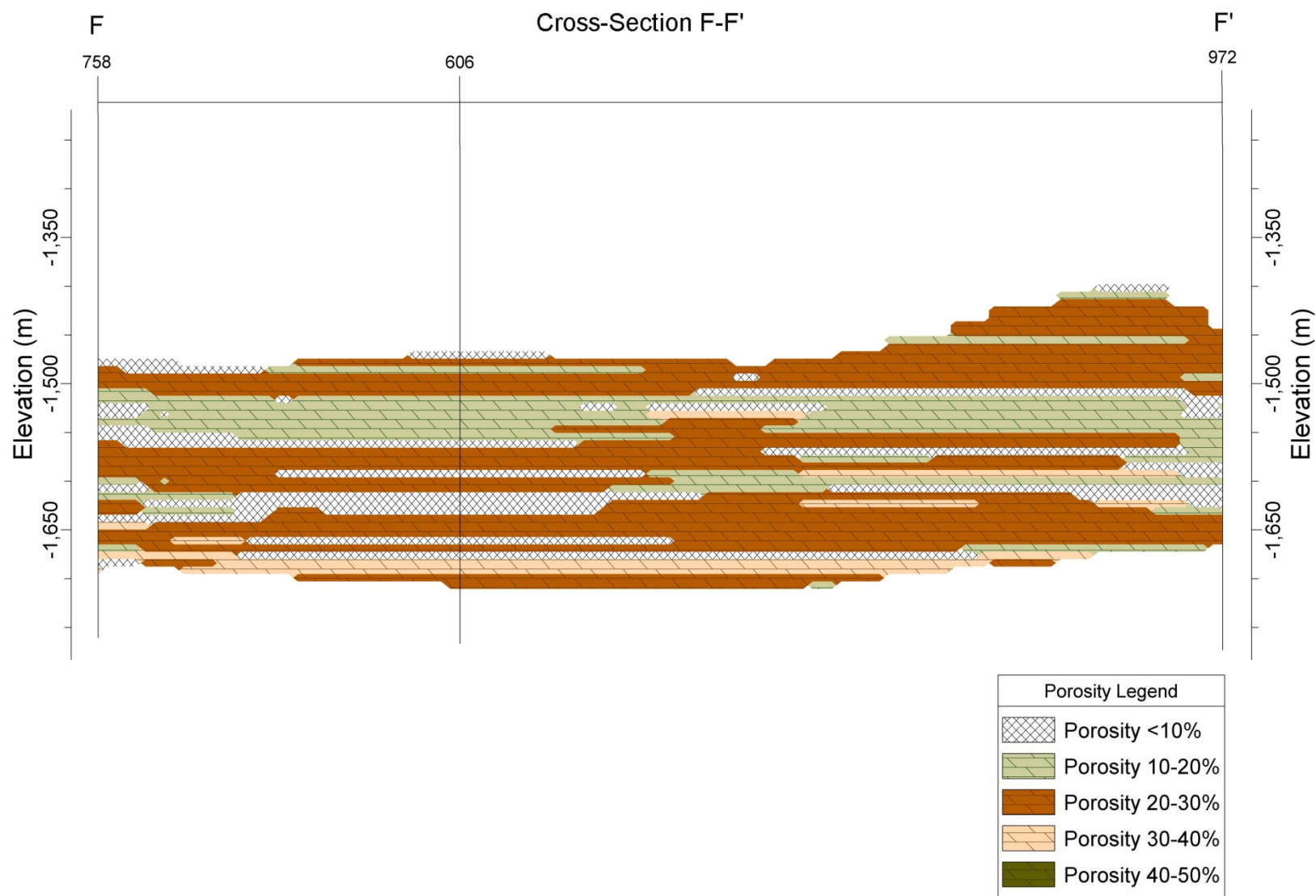


Figure 3-34: Cross-section displaying interpolated porosity for Transect F-F'. Transect location is depicted in Figure 3-4.

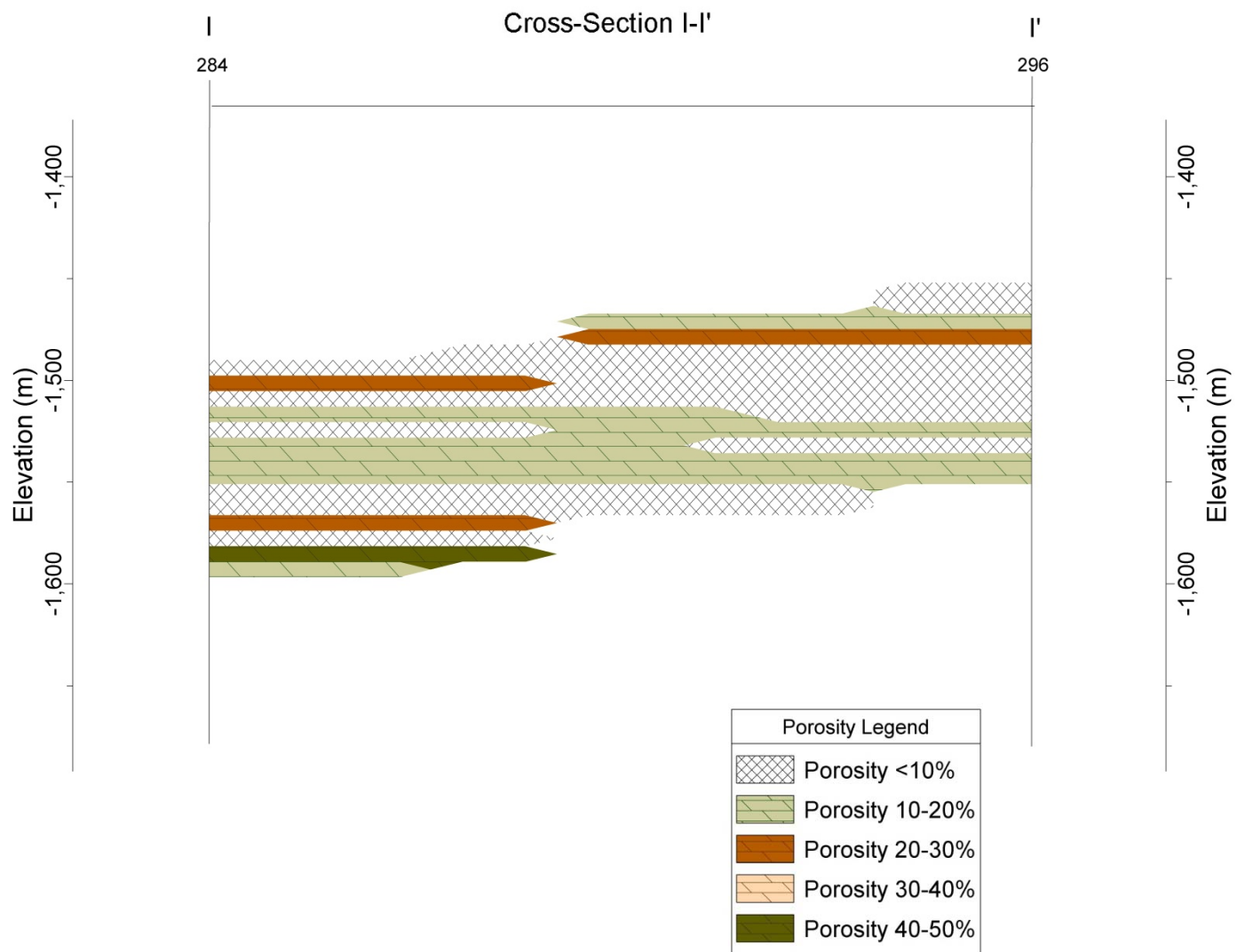


Figure 3-37: Cross-section displaying interpolated porosity for Transect I-I'. Transect location is depicted in Figure 3-4.

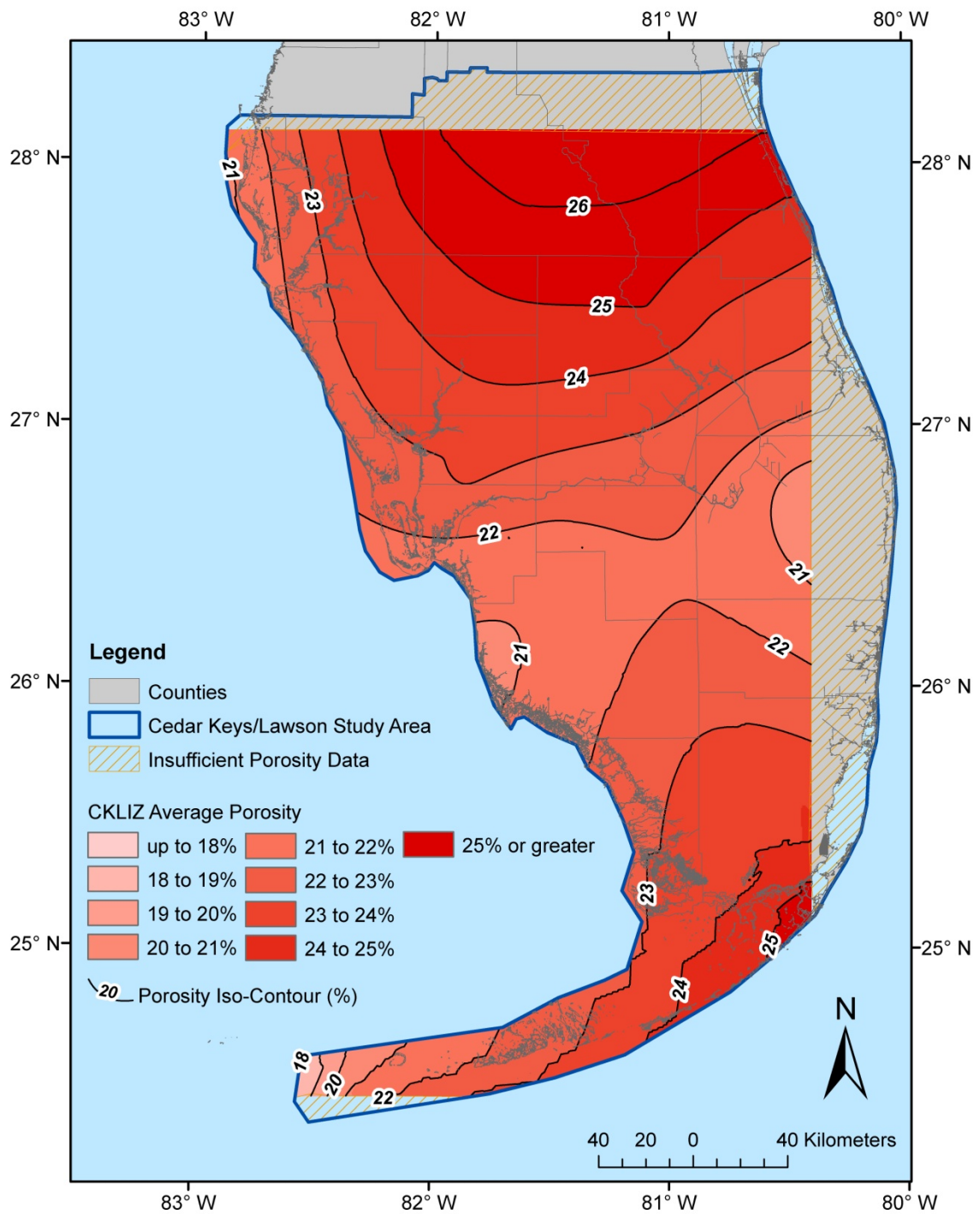


Figure 3-38: Average interpolated-porosity contours for the CKLIZ throughout the study area.

3.5.2 Storage Capacity

The total estimated CO₂ storage capacity for the CKLIZ throughout the extent of the study area is approximately 79 BtCO₂. This value was estimated using the following variables: $A = 73,559,441,205.70 \text{ m}^2$; $h_g = 198.33 \text{ m}$; $\Phi_{\text{tot}} = 0.23$; $\rho = 725 \text{ kg/m}^3$; and $E = 0.03$. Table 3-3 is a summary of data that was extrapolated from the 54 wells used for porosity derivation, which was ultimately used in the estimated storage capacity calculation. Figure 3-39, which shows variation in estimated CO₂ storage capacity by 1,000 tCO₂ km², displays how storage capacity varies throughout the study area.

3.5.3 Temperature Gradient

An average-temperature contour map was created using existing and extrapolated temperatures for all evaluated wells within the study area, and is provided in Figure 3-40.

3.5.4 Potential Leakage Points

Table 3-4 lists all of the unplugged wells in south Florida that are currently either producing oil, are used for waste disposal, or are “shut in.” Since these wells provide a conduit to the surface, they therefore serve as potential leakage points for CO₂ following CO₂ injection into the CKLIZ.

Winston (1995) discusses several suspected, small displacement (i.e., 3-15 m [10-50 ft]), normal faults within the Cedar Keys Formation, located along the coastline of the southeastern boundary of the study area within the region where no wells could be identified that met the well-selection criteria for this investigation. This region, containing insufficient data, is denoted on each figure providing interpolated data that was created for this study. The faults discussed in Winston (1995) are generally discussed for Unit A and Unit B of the formation (herein collectively known as the upper Cedar Keys Formation), and their occurrence in Unit C (herein the middle Cedar Keys Formation) is not discussed.

Table 3-3: Data used to calculate estimated storage capacity for the CKLIZ.

Well P#	h_g (m)	Total h_g (m)	Φ	Average Φ	Temperature (°C)
279	206	206	0.20	0.20	45.28
284 (Upper)	64	120	0.21	0.22	42.78
284 (Lower)	56		0.22		43.89
296 (Upper)	21	64	0.18	0.18	40.55
296 (Middle)	14		0.15		41.11
296 (Lower)	29		0.22		41.67
304	114	114	0.21	0.21	37.78
310	194	194	0.29	0.29	47.22
311	203	203	0.21	0.21	44.72
319A (Upper)	142	197	0.20	0.22	44.44
319A (Lower)	55		0.23		45.55
331	292	292	0.24	0.24	45.28
385 (Upper)	80	96	0.23	0.20	45.55
385 (Lower)	16		0.17		45.55
401 (Upper)	70	193	0.19	0.21	42.78
401 (Lower)	123		0.23		45.55
403	97	97	0.27	0.27	39.44
407	275	275	0.24	0.24	45.55
408 (Upper)	72	187	0.17	0.19	43.33
408 (Lower)	115		0.20		45.55
472	269	269	0.23	0.23	46.67
475	270	270	0.26	0.26	45.55
539	98	98	0.27	0.27	35.55
543 (Upper)	34	92	0.23	0.26	33.89
543 (Lower)	58		0.28		34.44
564 (Upper)	42	134	0.21	0.23	40.83
564 (Lower)	92		0.24		42.78
565A	248	248	0.26	0.26	44.72
596	139	139	0.24	0.24	42.78
597 (Upper)	89	238	0.23	0.26	35.00
597 (Middle)	27		0.29		35.55
597 (Lower)	122		0.26		38.33
606	265	265	0.22	0.22	45.55
609	167	167	0.24	0.24	43.33
679A	184	184	0.28	0.28	42.22
683 (Upper)	54	256	0.22	0.19	42.22
683 (Middle)	84		0.17		44.44
683 (Lower)	118		0.17		45.00
697	241	241	0.23	0.23	46.11
710	211	211	0.23	0.23	38.33
732	230	230	0.23	0.23	38.33
740	246	246	0.23	0.23	45.00
758	209	209	0.23	0.23	45.28
759	279	279	0.24	0.24	43.89
760 (Upper)	74	194	0.19	0.20	43.33
760 (Lower)	120		0.20		45.55
768 (Upper)	135	256	0.19	0.22	43.89
768 (Lower)	121		0.24		46.39

Well P#	h_g (m)	Total h_g (m)	Φ	Average Φ	Temperature (°C)
772	81	81	0.23	0.23	39.44
853 (Upper)	72	170	0.18	0.19	42.78
853 (Middle)	47		0.20		43.89
853 (Lower)	51		0.19		45.00
864	223	223	0.21	0.21	45.55
865 (Upper)	54	230	0.21	0.22	41.11
865 (Lower)	176		0.23		44.44
871	250	250	0.24	0.24	45.00
926	214	214	0.20	0.20	45.55
947 (Upper)	69	187	0.20	0.20	42.78
947 (Lower)	118		0.20		45.28
972 (Upper)	296	370	0.19	0.18	43.33
972 (Lower)	74		0.16		45.00
979 (Upper)	72	204	0.19	0.20	42.78
979 (Lower)	132		0.21		45.55
982	205	205	0.21	0.21	45.00
1014	219	219	0.22	0.22	45.55
1032 (Upper)	84	141	0.24	0.24	37.78
1032 (Lower)	57		0.24		39.44
1059 (Upper)	63	233	0.23	0.24	41.11
1059 (Lower)	170		0.24		44.17
1063	243	243	0.21	0.21	44.44
1085	234	234	0.22	0.22	45.55
1151	240	240	0.21	0.21	45.55
1169 (Upper)	45	202	0.22	0.23	41.67
1169 (Lower)	157		0.23		45.00
1193 (Upper)	20	140	0.23	0.23	41.67
1193 (Middle)	37		0.24		42.78
1193 (Lower)	83		0.22		44.44
1208	203	203	0.21	0.21	45.00
1240	207	207	0.22	0.22	45.28
1264 (Upper)	19	53	0.25	0.29	37.78
1264 (Lower)	34		0.32		38.33

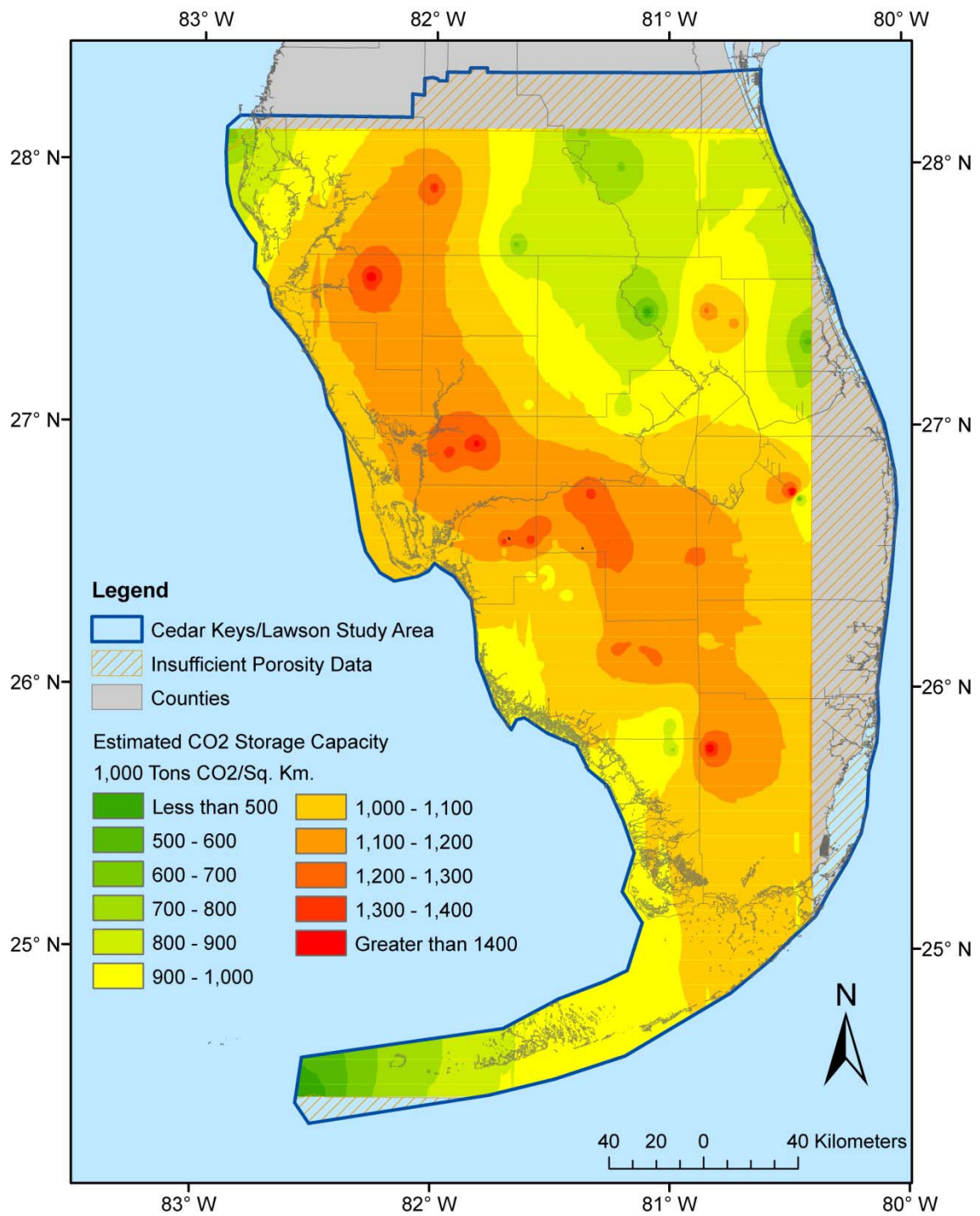


Figure 3-39: Storage-capacity contour map for the CKLIZ throughout the study area.

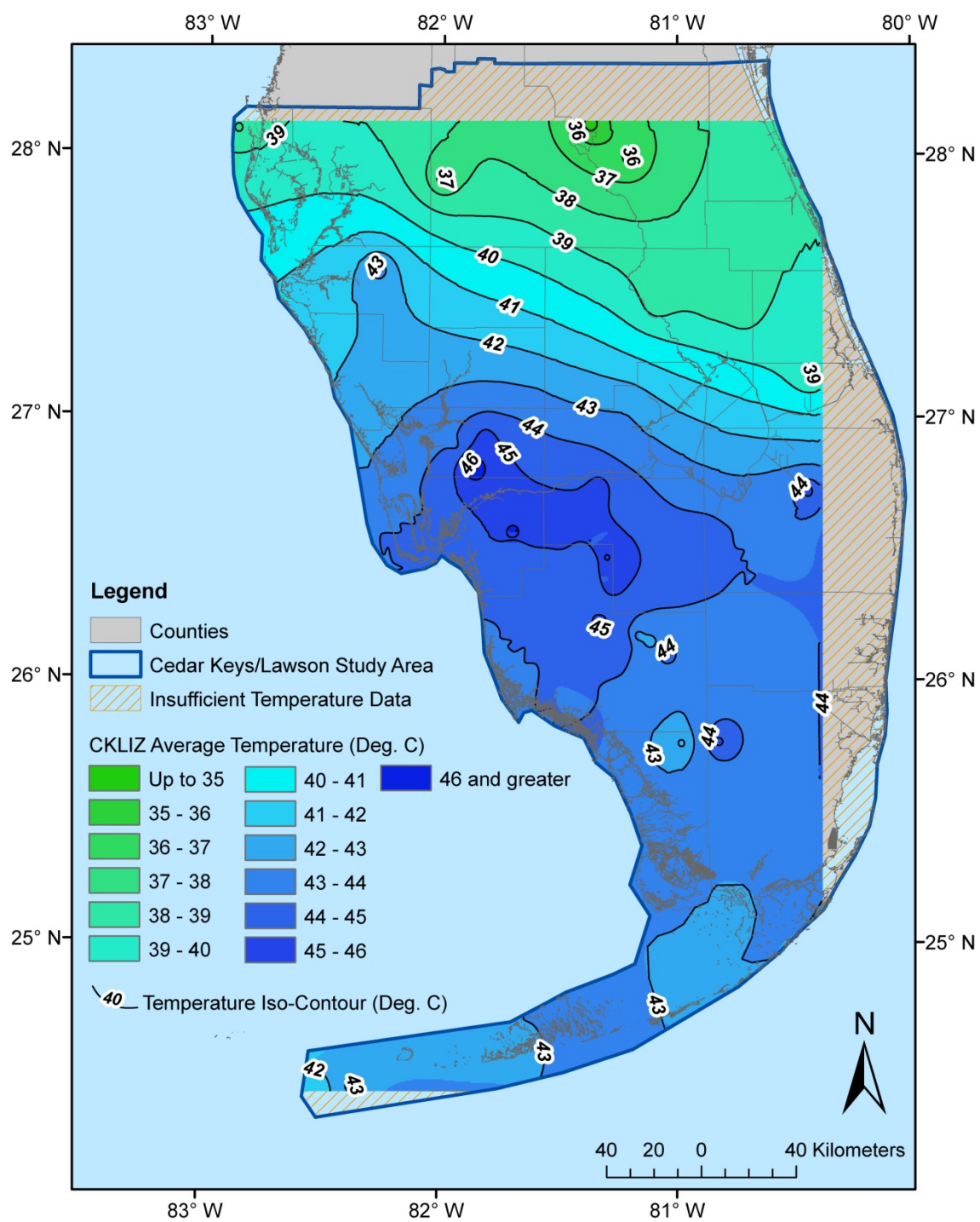


Figure 3-40: Average interpolated-temperature contours for CKLIZ within the study area.

Table 3-4: Unplugged oil/gas and waste disposal wells in south Florida.

Well P#	Oil Field Operator	Location	Well Type	Permit Status
563	BreitBurn	Bear Island Field	Oil/Gas	Expired
640	BreitBurn	Bear Island Field	Oil/Gas	Expired
733	BreitBurn	Bear Island Field	Oil/Gas	Expired
761	BreitBurn	Bear Island Field	Disposal	Operating
800	BreitBurn	Bear Island Field	Oil/Gas	Operating
856	BreitBurn	Bear Island Field	Disposal	Operating
962AH	BreitBurn	Bear Island Field	Oil/Gas	Operating
981BH	BreitBurn	Bear Island Field	Oil/Gas	Operating
1060	BreitBurn	Bear Island Field	Oil/Gas	Expired
1064	BreitBurn	Bear Island Field	Oil/Gas	Operating
1118A	BreitBurn	Bear Island Field	Oil/Gas	Expired
1119	BreitBurn	Bear Island Field	Oil/Gas	Operating
1170	Peninsular Oil Company	Corkscrew Field	Oil/Gas	Operating
1199A	Newport Oil Corporation	Corkscrew Field	Oil/Gas	Operating
1201A	BreitBurn	Corkscrew Field	Oil/Gas	Operating
1224BH	BreitBurn	Corkscrew Field	Oil/Gas	Operating
401AH	US Capital Energy, Inc	Lake Trafford Field	Oil/Gas	Operating
841	BreitBurn	Lehigh Park Field	Oil/Gas	Operating
1019	BreitBurn	Lehigh Park Field	Oil/Gas	Operating
904	BreitBurn	Mid-Sunoco Felda Field	Oil/Gas	Operating
925	Peninsular Oil Company	Mid-Sunoco Felda Field	Oil/Gas	Operating
915	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
998	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1031	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1061	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
1082AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1121	BreitBurn	Raccoon Point Field	Disposal	Operating
1130	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1141AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1149	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1167	BreitBurn	Raccoon Point Field	Oil/Gas	Expired
1190AH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1215	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1289CH	BreitBurn	Raccoon Point Field	Oil/Gas	Operating
1331AH	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
1332	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
1333	BreitBurn	Raccoon Point Field	Oil/Gas	Drilling
102	BreitBurn	Sunniland Field	Disposal	Operating
312AH	BreitBurn	Sunniland Field	Oil/Gas	Operating
323A	Oryx Energy Company	Sunoco Felda Field	Oil/Gas	Operating
416	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
442W	BreitBurn	West-Sunoco Felda Field	Disposal	Operating
645DH	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
748	BreitBurn	West-Sunoco Felda Field	Disposal	Operating
1294DH	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating
1295H	BreitBurn	West-Sunoco Felda Field	Oil/Gas	Operating

No additional leakage points, including faults or fractures in the upper seal, were apparent in the geophysical logs or core samples evaluated for the CKLIZ during this study.

3.6 Discussion

3.6.1 Study Limitations

Identifying wells that penetrated the complete CKLIZ throughout the entire extent of the study area was challenging. Hillsborough, Hardee, Highlands, and Indian River counties had wells with geophysical logs from which only formation and storage zone delineations could be made, but from which porosity could not be derived. Pinellas, Manatee, St. Lucie, Martin, Glades, Broward, and Miami-Dade counties had multiple wells available that had geophysical data for formation and storage zone delineations; however, each had only one well that provided porosity data. Similarly, Polk, Osceola, and Desoto counties had multiple wells available that provided geophysical data for formation and storage zone delineations; however, each had only two wells that provided porosity data. No geophysical logs that could be used for formation and storage zone delineation, as well as porosity derivation, were available for Brevard and Sarasota counties. Several wells had geophysical logs from which porosity could be derived; however, core/well cutting samples, mud logs, or lithological descriptions were not available for lithological confirmation, which was necessary for a more definitive porosity value determination. Notwithstanding, this porosity data was still considered useful to the study, and was therefore included using the most conservative porosity values for porosity interpolations and storage capacity estimations.

Some wells in the study area had curved wellbores that had geophysical logs only reported in measured depth, and the associated well record lacked the information needed to convert the depths to TVD for accurate representation of the depth and extent of the CKLIZ and its upper seal; as such, these wells were excluded from the study.

Evaluation of the CKLIZ within the study area was also limited to the existing well-coverage, which in some regions was dense due to the presence of past or current oil production/exploration or waste disposal injection, while in other regions well-coverage was sparse and widespread, such as the northern and eastern boundaries, as well as the southern-tip, of the study area. Well-coverage limitations affected the ability to conduct parameter-interpolations on a relatively small scale throughout the entire extent of the CKLIZ study area, using the RBF methods in ArcGIS™. As discussed in Section 2.5.4 of Chapter 2, because interpolated surfaces only go through actual data points when using the RBF methods, interpolated contour-surfaces were bound by the outermost data points in the study area. Therefore, the interpolated-surfaces for each type of parameter interpolation (i.e., isolith and isopach contours, porosity contour, storage capacity contour, and temperature contour) was consequently developed for approximately 84% of the CKLIZ study area.

3.6.2 Porosity and Permeability of the Cedar Keys/Lawson Injection Zone

Porosity within the CKLIZ primarily exists within the porous dolostone of the lower Cedar Keys Formation and the upper member of the Lawson Formation, although porous limestone also occurs locally within these geologic units, as seen in Table AIV-2. For the CKLIZ, few fractures were observed in the geophysical logs used for this study; however, additional geophysical logs, such as seismic logs, would need to be evaluated in order to better-identify fractures within the storage zone. Regardless, most of the observed porosity in the storage reservoir is intergranular, or interparticle.

Average porosity for the CKLIZ throughout the extent of the study area is 23%, and ranges from 10% to greater than 40% in the porous intervals of the storage zone. Figure 3-38 shows that porosity values within the CKLIZ tend to be greater in the northern-most extent of the study area (south-central Florida) and the southeastern-most

extent. Generally, porosity is lowest in the central portion of the SFB, and progressively increases to the north and south.

Laterally, porosity within the CKLIZ is relatively homogeneous throughout the study area, as depicted in figures 3-26 through 3-37. Vertically, however, some heterogeneity exists within the storage reservoir in the form of semi-confining anhydrite or low-permeability dolomite that occurs in thicknesses ranging from 0.3 m (1 ft) to 24 m (80 ft), as seen in Table AIV-2 and in the striplog created for each evaluated well (Appendix VI). In many instances, the relatively thick, low-permeability layers create one or more storage sub-zones within the vertical extent of the reservoir that are laterally continuous. As mentioned in Chapter 2, both of these conditions are preferable for a potential CO₂ storage zone, as the lateral homogeneity increases the storage capacity of the reservoir, while the vertical heterogeneity slows the vertical migration of injected-CO₂ and increases the CO₂ storage efficiency of the reservoir.

3.6.3 Storage Capacity of the Cedar Keys/Lawson Injection Zone

For this study, porous intervals that had porosities $\geq 10\%$ were deemed suitable for CO₂ storage, and were therefore included in the CKLIZ. Porosity values $\geq 10\%$ is a somewhat-conservative porosity delineation compared to other CCS studies that have been conducted, which use lower porosity values for storage-zone delineation, on the order of 8% (Brennan et al., 2010). The conservative porosity delineation used in this study results in a more conservative storage capacity estimate for the CKLIZ, as it affects the confines of the CKLIZ vertically, and thus affects the estimated value of h_g used in the storage capacity calculation.

The conservatively estimated total CO₂ storage capacity for the CKLIZ within the study area is approximately 79 BtCO₂. As seen when comparing Figure 3-3 with Figure 3-39, the regions within the study area that have comparatively higher storage capacities are generally located in the same areas where the CKLIZ is thicker, while the areas with

lower storage capacities are generally located in regions of the study area where the CKLIZ is comparatively thinner. Only 84% of the study area could be interpolated using ArcGIS™ in this figure.

Since most major large-scale power plants in south Florida produce 4-10 MtCO₂ per year, and have an average lifespan of about 40 years, the CKLIZ has the ability to potentially support CO₂ storage for many Florida power plants, especially those located in south-central and southern Florida. Specifically, the CKLIZ has the potential to sequester CO₂ for about 490 large-scale coal-fired power plants for the entire lifespan of each power plant, or nearly 990 coal-fired power plants for half the lifespan of each plant, depending upon the size of the power plant and the respective annual CO₂ emission.

3.6.3.1 *Effects of Study Limitations and Uncertainties on Estimated Storage Capacity*

The CO₂ storage capacity calculated for the CKLIZ throughout the study area is not a definitive calculation, but rather it is an estimation based upon the available data, which have limiting factors such as availability of wells for spatial-coverage, as well as the availability of lithologic and geophysical data at each well. Errors may exist in the storage capacity estimation as a result of uncertainties in the study area and available data, as well as uncertainties that exist in the physical and geochemical processes that occur in the system following CO₂ injection, such as factors affecting plume migration, brine displacement, and trapping mechanisms. These errors and uncertainties may increase or decrease the estimated CO₂ storage capacity calculated for the CKLIZ in this study. Given the available data, it is difficult to estimate these uncertainties.

The northern boundary of the study area for the CKLIZ is delineated from available well data in that region. Geophysical data indicate a depth of >914 m (3,000 ft) bls for the CKLIZ in Pinellas, Hillsborough, Polk, and Osceola counties, and a depth

<914 m (3,000 ft) bls, as indicated by at least one well, in the counties to the north of this region. Brevard County has no available well data; however, five wells in adjacent Osceola County, west of Brevard County, show the top of the CKLIZ to be below 914 m (3,000 ft) bls in its northernmost and easternmost extents, near the boundary with Brevard County. Therefore, it is assumed that the top of the CKLIZ continues to be below 914 m (3,000 ft) bls in adjacent Brevard County. With the exception of Osceola County, 1-2 wells were available for each county to delineate the northern extent of the CKLIZ study area. Most of the wells are located in the central and southern portions of the counties; therefore, the northernmost extent at which the top of the CKLIZ lies above 914 m (3,000 ft) bls within these counties cannot be delineated, only estimated. The area used in the estimated CO₂ storage capacity for the CKLIZ is $\sim 7.4 \times 10^{10} \text{ m}^2$; however, the lateral extent of the CKLIZ could be slightly less or slightly more than this (i.e., by $\sim 5.0 \times 10^8 \text{ m}^2$). Nevertheless, the difference in area as a result of the uncertainty in the northern boundary would likely result in a difference in storage capacity of less than 0.01%.

The porosity of the CKLIZ was derived from geophysical logs for wells within the study area, and Φ_{tot} used in the storage capacity calculation represents the average of these derived-porosity values. When more than one geophysical log was available, cross-plots were used to best-determine porosity values within the unit; however, in many instances only one geophysical log was available for porosity derivation, which often required that the lithology be determined in order to obtain the correct porosity value. Depending upon the type of geophysical log used, differences in lithology could result in a difference in porosity of 5-10% for a given porous interval of varying thickness (i.e., 0.5 or more meters). If the designated lithology chosen in this study does not match the true lithology within the unit for a given porous interval, the average porosity determination and Φ_{tot} value could be slightly less or slightly more, but probably not more

or less than 0.5-1%, which could result in a difference of ~5-10% of the estimated storage capacity. The designated, or derived, porosity throughout the CKLIZ also affects the thickness of the porous intervals and ultimately the value of h_g , as designated porous intervals in this study had to have a porosity of at least 10% to be included in the storage capacity calculation.

The amount of formation-water that is displaced as a result of CO_2 injection determines the storage efficiency of a given aquifer. Including the effects of gravity, CO_2 and formation-water displacement are dependent upon the lateral homogeneity of the storage reservoir (van der Meer, 1995). Porosity interpolations presented in this study show lateral continuity with the porous intervals of the CKLIZ, and as discussed in Section 2.5.3 of Chapter 2, simulations conducted to date at USF show significant lateral displacement of formation-brines following CO_2 injection, both of which increase storage efficiency. Additionally, the vertical heterogeneity of the CKLIZ, as presented in this study, also increases the storage efficiency in the reservoir, as it slows the vertical migration of CO_2 . For these reasons, an E value of 0.03 was selected to represent the storage efficiency of the CKLIZ; however, without knowing the residual brine saturation, which is the amount of brine remaining in the pore spaces of the unit after the CO_2 front has passed through, it is extremely difficult to determine the value of E at such a small scale. Because the value of E typically ranges from 0.01-0.04 (NETL, 2007), the estimated storage capacity for the CKLIZ potentially ranges from ~26 BtCO_2 to ~105 BtCO_2 , depending upon which value of E is used in the storage capacity calculation, which is a difference of 33-67% of the estimated storage capacity.

This study provides numerous cross-sections and interpolations that display the vertical heterogeneity and lateral continuity of porous intervals and layers of low permeability within the CKLIZ; however, these interpolations are on a regional-scale and distances between each well vary throughout the study area. The wells used in this

study are spatially dependent, as some wells occur in “clusters” in areas with extensive oil exploration, and other wells are separated by greater distances where no potential source rocks exist and little oil exploration has been conducted; therefore, a more-detailed, small-scale examination of the lithology in the CKLIZ is unavailable. As such, for this study, it is assumed that all well data are equally valid and that there is no objective basis for differentially weighting the data from individual wells.

Figure 3-39 is an interpolation of the CO₂ storage capacity within the CKLIZ throughout 84% of the study area, which was created using ArcGIS™. Essentially, ArcGIS™ was used to integrate each variable in the storage capacity equation on a cell-by-cell basis (using 101,432 cells), thereby resulting in a calculated CO₂ storage capacity for the CKLIZ. ArcGIS™ also allows for the calculation of spatial-statistics associated with a raster layer. The spatial-statistics for the storage-capacity raster layer indicate that the sum of the cells in the model equate to approximately 63 BtCO₂, which is ~80% of the manually-derived CO₂ storage capacity for the CKLIZ (~79 BtCO₂). The manually-derived CO₂ storage capacity represents an extrapolated storage capacity for the entire study area, which is approximately 16% larger than the area for which the geospatially-derived CO₂ storage capacity was calculated. Because the geospatially-derived CO₂ storage capacity was calculated for 84% of the total study area, the fact that the total storage capacity calculated using this method for the reduced study area was ~80% of the manually-derived storage capacity corroborates the general accuracy of the manually-derived CO₂ storage capacity, with a 4% difference between the two storage capacity calculation methods.

3.6.4 Cedar Keys/Lawson Injection Zone Seals

The middle Cedar Keys Formation is proposed as the upper seal or caprock for the CKLIZ during potential CO₂-injection operations, and the lower member of the Lawson Formation together with the rocks of Taylor age are proposed as the lower seal.

Within the study area, the average thickness of the middle Cedar Keys Formation is generally about 200 m (~650 ft) to 300 m (~980 ft), but it could be as thick as 446 m (1,463 ft) or as thin as 22 m (70 ft) depending upon location within the study area, as denoted in Table 3-2. The unit becomes comparatively thinner in the northeastern regions of the study area; however, at least one significantly thick anhydrite bed exists in this region which would potentially provide sufficient confinement for the underlying CKLIZ provided there were no identified leakage points.

No faults or fractures were apparent in the middle Cedar Keys Formation during the evaluation of geophysical logs and core samples for this study. Like the Lake Trafford Formation discussed in Chapter 2, if post-depositional faults and fractures ever existed within the middle Cedar Keys Formation, anhydrites within the geologic unit would likely have filled these features and reinforced the semi-confining nature of the unit. The suspected small displacement, normal faults presented in Winston (1995) occur within the upper Cedar Keys Formation, along the coastline of the southeastern boundary of the study area and within a region where no wells could be located that met the well-selection criteria for this study; therefore, no geophysical logs were examined for this “suspected-fault area” that could have confirmed or denied the presence of such faults. However, because the 3-15 m (10-50 ft) displacements of these faults are relatively small when compared to the average thickness of the middle Cedar Keys Formation, it is likely that formation anhydrites would have sealed these small displacement faults.

Based upon the core samples and geophysical logs that were evaluated in this study, and on the fact that the middle Cedar Keys Formation serves as the lower confining unit for the FAS, the geologic unit is believed to be a structurally sound and potentially effective upper seal for the CKLIZ; however, no seismic data were available

for review during this study, which would likely provide a better determination of the effectiveness and suitability of the middle Cedar Keys Formation as an upper seal.

3.6.5 Carbon Sequestration in the Cedar Keys/Lawson Injection Zone

Based upon the criteria outlined in Chapter 1 for successful CCS operations in geologic formations, the CKLIZ throughout the extent of the study area could potentially be used as a CO₂ storage zone for the following reasons:

Geographic Location

As shown in Figure 3-41, numerous electricity-generating power plants are located within the study area. Specifically, the two biggest CO₂-emitting power plants in Florida, Progress Energy's Crystal River power plant in Citrus County and TECO's Big Bend power plant in Hillsborough County, are located in south-central Florida and are either within or in very close proximity to the study area. The geographic location of the electricity-generating power plants either within or in very close proximity to the study area means that not only will the supercritical CO₂ have to travel short distances, but also less complex means of CO₂ transportation will be required, both of which result in a decrease in overall costs for CCS projects. In fact, in many cases CO₂ could potentially be injected at the power-plant site from which the CO₂ was captured, which is a significant cost reduction for CCS operations.

Depth

The depth at which the CKLIZ occurs within the study area meets the CCS depth-criteria of greater than 914 m (3,000 ft) bls. Additionally, the comparatively shallow depth of the CKLIZ is a major reason why the storage reservoir is being considered for potential CCS operations in Florida. As seen in Chapter 2, there are other geologic units and formations in Florida which could potentially serve as CO₂ sequestration reservoirs; however, the CKLIZ is the shallowest storage zone that could potentially be used for GS. Consequently, the CKLIZ is probably the least-expensive

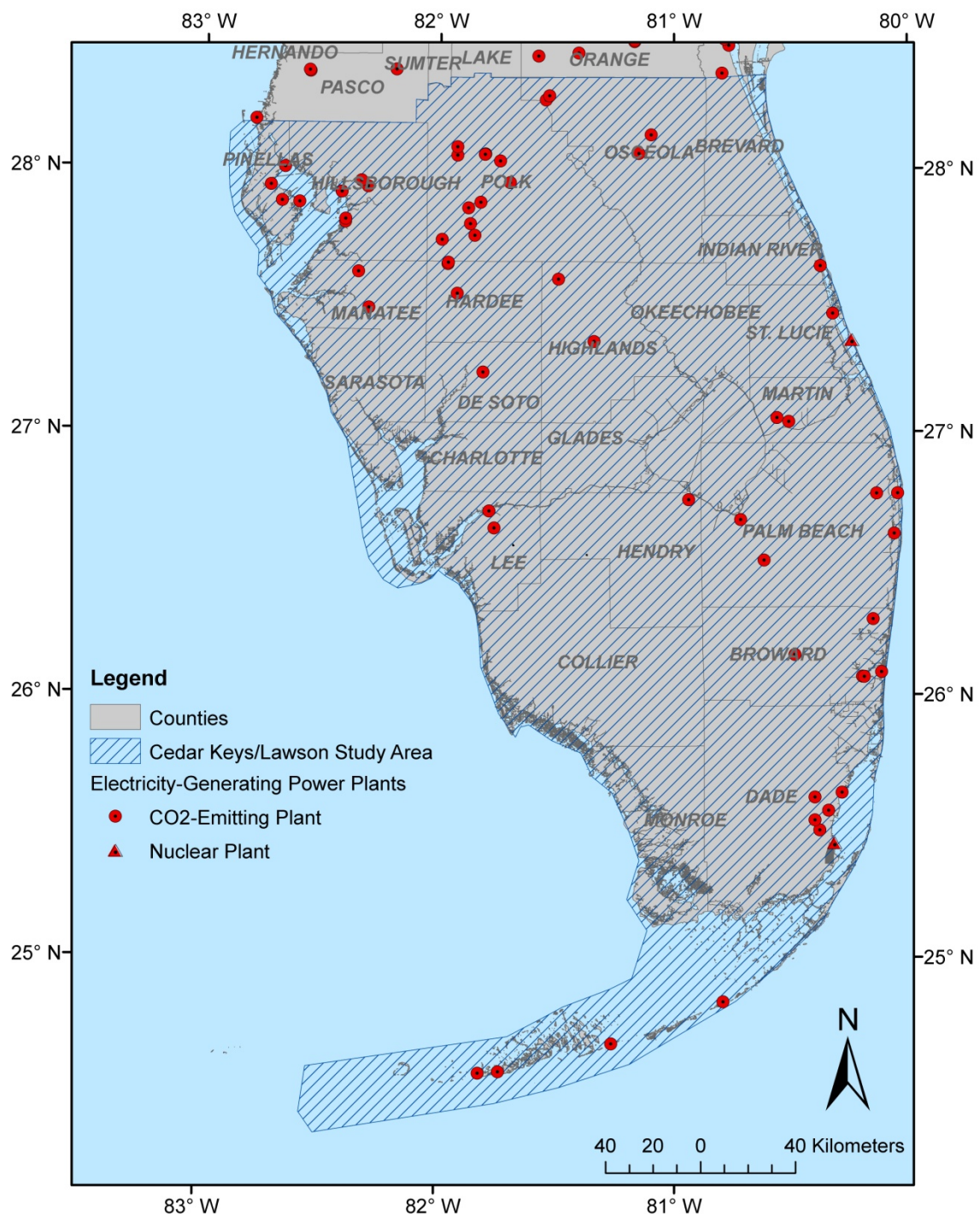


Figure 3-41: Major electricity-generating power plants within and in close proximity to the CKLIZ study area.

CO₂ storage reservoir in south-central and southern Florida that could be used in CCS operations, as the final depths of CO₂-injection wells would be significantly shallower than other units and would therefore cost less to install and operate.

Porosity and Storage Capacity

Average porosity of the CKLIZ within the study area is 23%, which suggests that the reservoir is potentially suitable for use as a geologic storage unit for CCS. Additionally, the estimated CO₂ storage capacity of the CKLIZ within the study area is about 79 BtCO₂, which means the reservoir potentially has the ability to support CCS for several hundred large-scale power plants for their entire lifespan.

Caprock

The middle Cedar Keys Formation and the lower member of the Lawson Formation, together with rocks of Taylor age, occur throughout the study area and appear to be potentially sufficient upper and lower seals for the CKLIZ for its use in CCS operations.

3.6.6 Temperature Gradient for the Cedar Keys/Lawson Injection Zone

Within the central portion of the SFB, temperatures were generally the highest, as depicted in Figure 3-40. From there, temperatures progressively decrease toward the north, northwest, and northeast into south-central Florida; however, temperatures generally remain relatively stable, or slightly decrease by a degree or two, toward the south and throughout southern Florida, including the Florida Keys.

3.6.7 Potential Leakage Points for the Cedar Keys/Lawson Injection Zone

As discussed in Section 2.7.7 of Chapter 2, if an oil exploratory well has no show of oil, it is plugged and abandoned in accordance with the rules and procedures outlined in FAC 62C-29.009, and if a producing-well ceases oil production, operators either plug and abandon the well immediately in accordance with FAC 62C-29.009, or the well is “shut in” until a decision is made by the operator to either plug and abandon the well,

deepen the well for further oil exploration, or convert the well to an injection/disposal well. In many cases, a well is often “shut in” for months or years.

Any unplugged wells in south-central and southern Florida that penetrate the upper seal of the CKLIZ, which are identified in Table 3-4, are potential leakage points for CO₂ following CO₂-injection operations. For many decades, wells were not always plugged properly, and were instead simply filled with mud-laden fluid (Metz et al., 2005); therefore, improperly plugged and abandoned wells could potentially serve as leakage points for CO₂. In addition, the condition of many plugged and abandoned wells may have deteriorated significantly over time, thereby making them a conduit for CO₂ leakage into the overlying strata. Prior to the implementation of any type of CCS operation in the CKLIZ, any unplugged wells in the vicinity of the proposed injection site should be identified and plugged in accordance with FAC 62C-29.009, and any plugged and abandoned wells in the vicinity should be identified and examined for proper and secure plugging practices. It is also imperative that the location, depth, and well-characteristics of boreholes that have penetrated the CKLIZ within the area of review for a proposed injection-site, but that reached total depth before penetrating the formation, be evaluated, as these wells could also represent potential leakage pathways.

As discussed earlier, no faults or fractures were apparent in the middle Cedar Keys Formation during the evaluation of core samples and geophysical logs conducted during this study; however, additional geophysical logs, such as seismic logs, would need to be evaluated in order to rule out the occurrence of these leakage-features within the upper seal.

3.7 Conclusion

As presented and discussed in chapters 1 and 2, Florida has been targeted by many as a potentially promising CO₂ storage reservoir within the southeast due to its multitude of highly porous and permeable, deep geologic units that are separated by

thick layers of low permeability. Specifically, the CKLIZ has been of great interest to Florida utilities due to its shallow depth and vertical and lateral expanse in south-central and southern Florida, all of which greatly affects and reduces the ultimate cost of CCS to the utilities. Until now, few studies have provided an in-depth stratigraphic and hydrogeologic examination of the Cedar Keys and Lawson formations, and more importantly to the CCS technology, few studies have evaluated these formations for their potential use as storage reservoirs. The CKLIZ would potentially be suitable for CCS operations due to its geographic location and close proximity to electricity-generating power plants, its high porosity and storage capacity, and its potentially effective seals.

The lower Cedar Keys Formation and upper member of the Lawson Formation form the CKLIZ, which, as described here, is a highly porous and permeable interval of varying thickness that is sealed by the overlying middle Cedar Keys Formation and underlying lower member of the Lawson Formation and rocks of Taylor age. From rock samples and data evaluated in this study, the middle Cedar Keys Formation appears to be a suitable upper seal; however, further geophysical evaluation, such as the examination of seismic logs, could provide a better determination of its suitability, and is recommended prior to the implementation of any CO₂ injections into the CKLIZ.

The total estimated CO₂ storage capacity of the CKLIZ within the study area is approximately 79 BtCO₂. The regions which appear to have the highest storage capacities per km² seem to correlate with the regions where the CKLIZ is thickest. Given the total estimated storage capacity, and depending upon the size of the power plant and the respective annual CO₂ emission, the CKLIZ has the potential ability to support CO₂ storage for several hundred power plants for their entire lifespan.

The average porosity of the CKLIZ is 23%. Porosity tends to be lowest in the central portion of the SFB, and gradually increases to the north and south within the study area. Laterally, porosity in the CKLIZ is relatively homogeneous, which provides

for increased storage capacity; however, vertically, some heterogeneity exists in the porosity, which could potentially slow the vertical migration of injected- CO_2 and increase the efficiency of the formation as a CO_2 storage reservoir.

Unplugged, plugged, and abandoned wells have been identified as potential CO_2 -leakage points for CO_2 injection in the CKLIZ. Prior to the commencement of any CCS operations, such wells should be identified and either plugged in accordance with FAC 62C-29.009, or inspected for proper and secure plugging and abandonment, in order to close and alleviate CO_2 -leakage conduits. Additionally and as suggested above, further examination of the middle Cedar Keys Formation via geophysical data, such as seismic logs, should be conducted prior to CCS operations in order to rule out the occurrence of faults or fractures.

Like the Sunniland Formation discussed in Chapter 2, the data provided in this study for the CKLIZ could be incorporated into preliminary mathematical models of injection, using a numerical code such as TOUGH2/ECO2N that can simulate the injection of supercritical CO_2 into brine-filled geologic units, to analyze the effects of CO_2 injection into the reservoir. This type of modeling would give an estimate of the volume of CO_2 that could be injected, examine the physical effects of CO_2 injection, such as changes in fluid pressures and brine displacement, and monitor the potential for migration of the CO_2 plume after injection had ceased.

Chapter 4: Statewide Assessment of Other Deep Geologic Units of Florida Considered for Carbon Dioxide Sequestration

4.1 Introduction

Chapters 2 and 3 provide an in-depth evaluation of the Lower Cretaceous Sunniland Formation and the Upper Cretaceous to Paleocene Lawson and Cedar Keys formations within the SFB, respectively, for their potential use as sequestration reservoirs for CCS operations in Florida. This chapter provides a more-cursory evaluation of deep geologic units throughout the state of Florida, including other rocks of Paleocene and Upper Cretaceous age through to rocks of Ordovician age. Numerous units have been identified within this interval that have adequate porosity and permeability, vertical and lateral extent, geographic location, and potential confinement that would make them potentially suitable for use as CO₂ sequestration reservoirs, not only in CCS operations, but in some cases, in CO₂-EOR operations, as well.

4.2 Potential Areas for Additional Geologic Sequestration in Florida

4.2.1 Rebecca Shoal Dolomite

According to Winston (1994), the Rebecca Shoal Dolomite, formerly termed the “deep Boulder Zone,” is a dolomitized reef-complex of Upper Cretaceous to Paleocene age. The reef system is 1,609 km (1,000 mi) long, completely surrounding the Florida peninsula, and is generally 24 km (15 mi) to 32 km (20 mi) wide, although around the Sarasota Arch in south-central Florida the reef widens to about 80 km (50 mi) (Figure 4-1; Winston, 1994). The length of the Rebecca Shoal reef can be compared to that of the

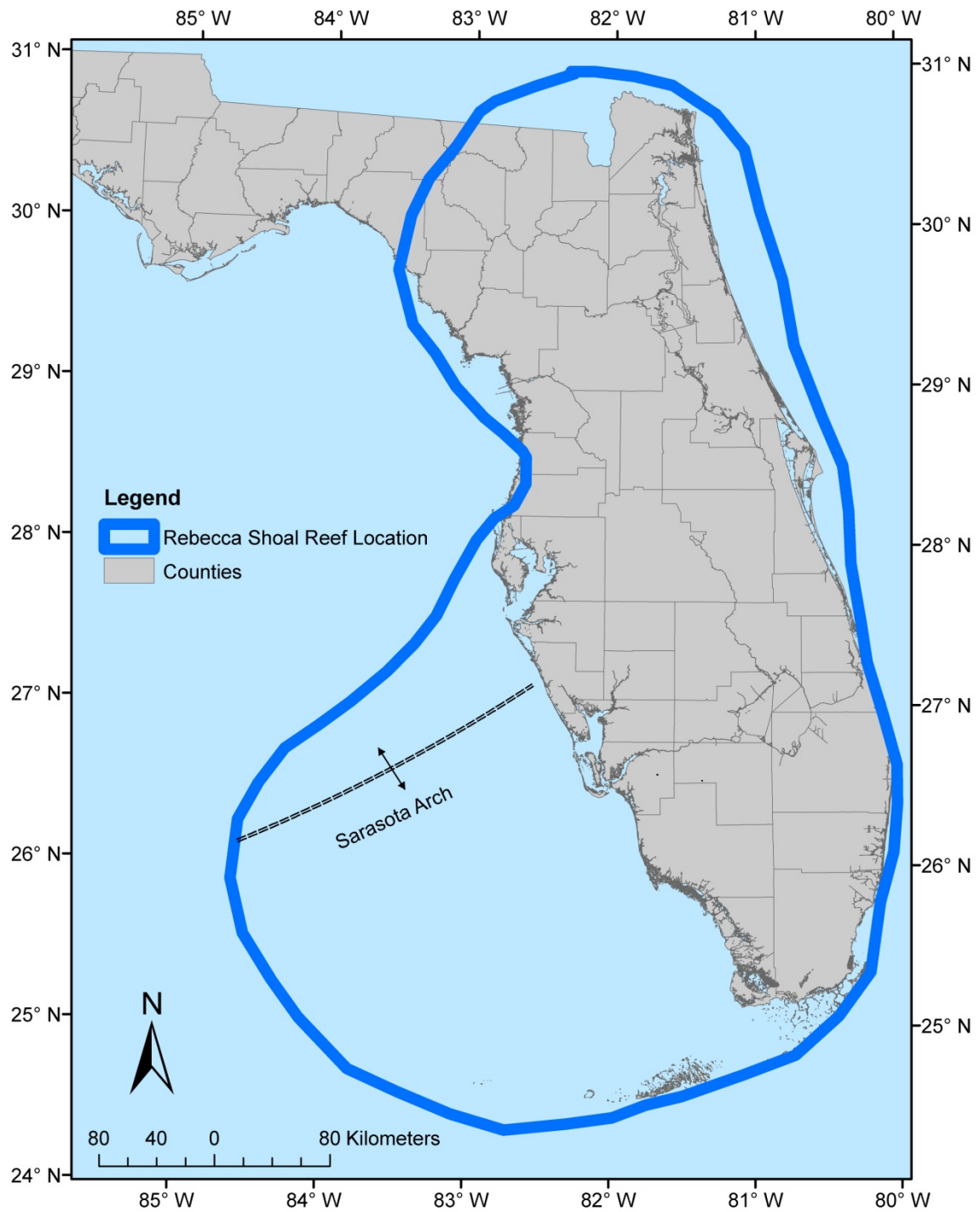


Figure 4-1: Regional structure of Rebecca Shoal reef (adapted from: Winston, 1994).

Great Barrier Reef of Australia, but the Great Barrier Reef is a linear feature, whereas the Rebecca Shoal reef essentially resembles a massive atoll. Around the Sarasota Arch, the unit reaches a maximum composite thickness of about 914 m (3,000 ft), and then progressively thins towards the north to a thickness of about 183 m (600 ft) in southeastern Georgia (Winston, 1995). The below-sea-level elevations for the Rebecca Shoal Dolomite are about -396 m (-1,300 ft) in the northwestern region of peninsular Florida to about -1067 m (-3,500 ft) in the Florida Keys (Winston, 1994). The Cedar Keys Formation discussed in Chapter 3 was deposited in the restricted, back-reef, lagoonal-environment of the Rebecca Shoal barrier reef (Winston, 1994). According to Winston (1994), the anhydrites of the middle Cedar Keys Formation, which is the proposed upper seal for the CKLIZ, was deposited in the Late Upper Cretaceous or Early Paleocene, when the rapid extension of the reef reached the point where it completely encircled the Florida peninsula.

Porosity within the Rebecca Shoal Dolomite ranges from intercrystalline to highly porous caverns and cavities that are characteristic of Florida's "Boulder Zone" (Winston, 1978). The geologic unit is inconsistent lithologically, and can contain the Upper Cretaceous Card Sound Tongue, the Upper Cretaceous to Paleocene Plantation Tongue, and/or the Paleocene Tavernier Tongue, depending upon the location within Florida. The Rebecca Shoal Dolomite may have existed into the Early Eocene; however, there is no stratigraphic evidence of this, nor is there evidence of why the reef system, which existed for roughly 40 million years, abruptly disappeared (Winston, 1995). No paleontologic data is available for the Rebecca Shoal Dolomite to more-accurately determine the age of the unit or its various Tongues; therefore, age has been assigned to the unit based upon its stratigraphic position (Figure 4-2).

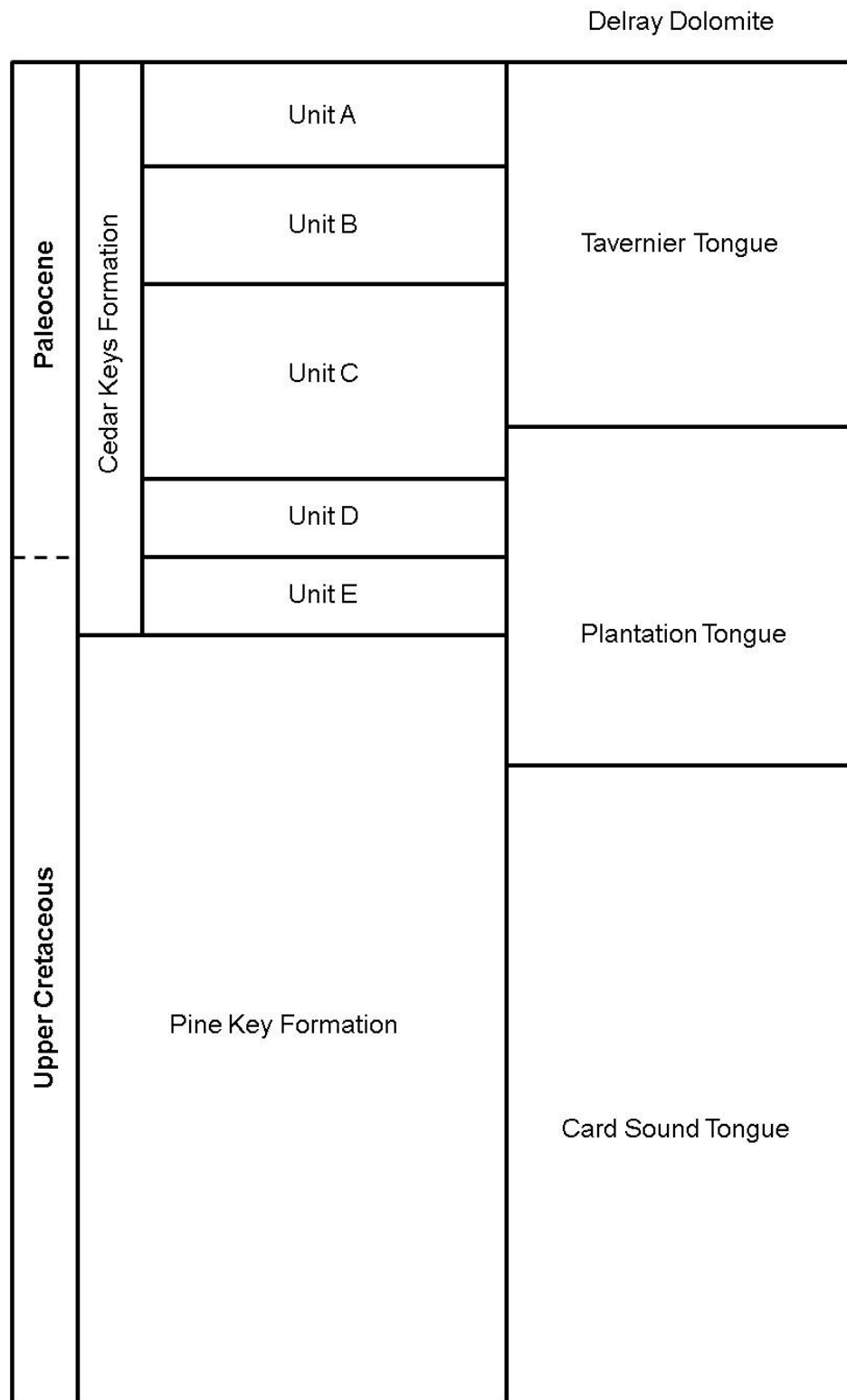


Figure 4-2: Generalized stratigraphic column for the Rebecca Shoal Dolomite (adapted from: Winston, 1994; Winston, 1995).

Around the Florida Keys, the Rebecca Shoal Dolomite is rather abundant, and contains the Card Sound Tongue, a finely crystalline dolomite with up to 10% vuggy porosity in scattered beds; the Plantation Tongue, a cryptocrystalline and fine- to medium-crystalline dolomite with vuggy and intercrystalline porosity ranging from 5-15%; and the Tavernier Tongue, a fine- to coarse-crystalline dolomite with vuggy and intercrystalline porosity ranging from 5-25% (Winston, 1978; Winston, 1994; Winston, 1995). In some areas of the Florida Keys, the Tavernier Tongue is overlain and underlain by the Cedar Keys Formation; however, in other areas it is overlain by the Delray Dolomite and underlain by the Cedar Keys Formation. The Plantation Tongue and Tavernier Tongue are inseparable in certain areas of the Florida Keys, and in this scenario, the Cedar Keys Formation is missing and the resulting Rebecca Shoal Dolomite unit overlies the Pine Key Formation (Winston, 1994). The “Boulder Zone” areas of the Rebecca Shoal Dolomite only exist in the Florida Keys, and are typically located near the basal portion of a Tongue or the continuous reef (Winston, 1995).

Little information is published for the entire vertical extent of the Rebecca Shoal Dolomite in south Florida, north of the Florida Keys, as few wells seem to penetrate the unit below the Plantation Tongue. According to Winston (1995), the Tavernier-Plantation section of the Rebecca Shoal Dolomite in St. Lucie County is mostly cryptocrystalline dolomite with occasional beds of fine- to medium-crystalline dolomite, and vuggy porosity is dominant. In St. Lucie, Martin, and northeastern Palm Beach counties, this section of the Rebecca Shoal Dolomite is predominantly a non-porous, anhedral dolomite; however, in some areas there is finely crystalline, euhedral dolomite with intercrystalline porosity that is up to 15% (Winston, 1995).

In west-central peninsular Florida, the Rebecca Shoal Dolomite is mostly composed of the Tavernier Tongue. Onshore, this unit is generally a non-porous, cryptocrystalline dolomite; however, offshore, porosity of the unit increases to about 20%

in the form of intercrystalline, vuggy, and pin-point porosity (Winston, 1994). The Card Sound Tongue does not exist in this region of Florida, and there is only a very thin section of the Plantation Tongue.

In northwest peninsular Florida, only the Tavernier Tongue represents the Rebecca Shoal Dolomite. In the core environment of the Rebecca Shoal reef, dolomite is mostly euhedral and fine- to medium-crystalline with up to 20% intercrystalline porosity, although some anhedral dolomite occurs with vuggy porosity of about 5% (Winston, 1994). In the flanks of the reef, porosity decreases and the lithology changes to a finer-crystalline, euhedral dolomite, while in the forereef/backreef environment, the unit is typically interbedded with the dolomite and anhydrite of the Cedar Keys Formation or the cherty limestone of the MADco Suite (Winston, 1994).

In its onshore portion of southeastern and southern Florida, the Rebecca Shoal Dolomite could potentially serve as a storage reservoir for CCS operations, where the porosity is highest and the unit occurs below 914 m (3,000 ft) bls; however, further detailed examination of the unit's porosity and potential storage capacity would need to be conducted. The middle Cedar Keys Formation could possibly serve as the upper seal for certain sections of the Rebecca Shoal Dolomite (i.e., Plantation Tongue and Card Sound Tongue) in specific locations; however, based upon the background literature, it is not entirely clear where this stratigraphic relationship occurs throughout the unit's entire lateral extent, and an adequate upper seal for the Rebecca Shoal Dolomite would need to be further investigated and confirmed. Additionally, as much of the Rebecca Shoal Dolomite occurs offshore, there is the potential that the geologic unit could also be used as an offshore CO₂ storage reservoir.

4.2.2 Potential, Existing, and Depleted Oil and Gas Reservoirs

Numerous oil and gas fields are located throughout Florida, either in western panhandle Florida or in southern peninsular Florida within the SFB. Although petroleum

production has slowed significantly over the past few decades since the discovery of oil in the early 1940's, Florida was once a major contributor of oil and gas to the U.S. (Lane, 1994). Oil and gas production in Florida was on a steady incline for several decades following its discovery, and peaked for many of Florida's oil fields in 1979; however, since then, production has been on a sharp, decreasing trend for existing oil fields, and many are considered depleted and therefore are "inactive." Several other geologic units in onshore and offshore portions of Florida have been studied and proposed by many as potential petroleum source rocks; however, these units have yet to be further examined and utilized for commercial oil and gas production.

Most of the oil-producing geologic units in Florida are composed of carbonate rocks, although in some cases the source rock is sandstone. For the most part, oil fields in southern peninsular Florida produce oil from traps that were created by dense rocks of low permeability which overlie the porous source rocks, while the oil traps in the Florida panhandle were created by evaporite beds, faulting, and stratigraphic traps (Lane, 1994).

Like the Sunniland Formation discussed in Chapter 2, many of the potential, existing, and depleted oil and gas reservoirs in Florida could potentially be used in CO₂-EOR operations or CCS operations.

4.2.2.1 South Florida Basin

In addition to the Sunniland Formation, several other geologic units in the SFB have exhibited signs of petroleum and reservoir potential. These units are discussed below, and their layout is presented in the stratigraphic column of Figure 2-4 in Chapter 2.

Sunniland-Dollar Bay Total Petroleum System

The Sunniland-Dollar Bay Total Petroleum System (TPS) includes all source rock, reservoir rock, seals, and accumulations of stratigraphic units between the Dollar

Bay Formation and the Sunniland Formation within the Lower Cretaceous age rocks (Figure 2-4; Pollastro et al., 2001). The lateral extent of this TPS is displayed in Figure 4-3. Primary oil and gas production for the Sunniland-Dollar Bay TPS is from the Sunniland Formation; however, additional production is expected from the Dollar Bay Formation, as well.

Dollar Bay Formation

The Lower Cretaceous Dollar Bay Formation is the youngest source rock in the SFB that is located onshore in Florida, and varies in thickness from 145 m (476 ft) to 168 m (551 ft) (Pollastro et al., 2001; Winston, 1972). Like the Sunniland Formation, which is located 457 m (1,500 ft) or more below the Dollar Bay Formation, this geologic unit contains many highly porous intervals throughout its vertical extent, and is mainly composed of sequences of evaporites and carbonates that were deposited during sea level regressions and transgressions; however, locally the Dollar Bay Formation can contain thin beds of calcareous shale, mudstones, salt, and lignitic material (Applin & Applin, 1965; Mitchell-Tapping, 1990; Pollastro et al., 2001; Winston, 1972). The Dollar Bay Formation is immediately overlain by the Lower Cretaceous Panther Camp Formation, a low-permeability sequence of limestone, dolostone, and anhydrite that is ~95 m (310 ft) thick (Pollastro et al., 2001; Winston, 1976). The Panther Camp Formation is overlain by the Lower Cretaceous Rookery Bay Formation, a 145-m (480 ft) thick, regionally extensive anhydrite unit containing numerous, low-porosity, chalky limestone and dolostone beds (Amato et al., 1986; Winston, 1976). The Panther Camp and Rookery Bay formations collectively provide a thick upper seal for the Dollar Bay Formation. Hydrocarbon shows have been observed in numerous wells of the Dollar Bay Formation, mostly confined to dolostones of the upper portion of the unit or to bioherm limestones, all of which typically have low API gravities around 15-20° (Mitchell-Tapping, 1990; Winston, 1971). Reservoir porosities range from about 9 to 33% in the

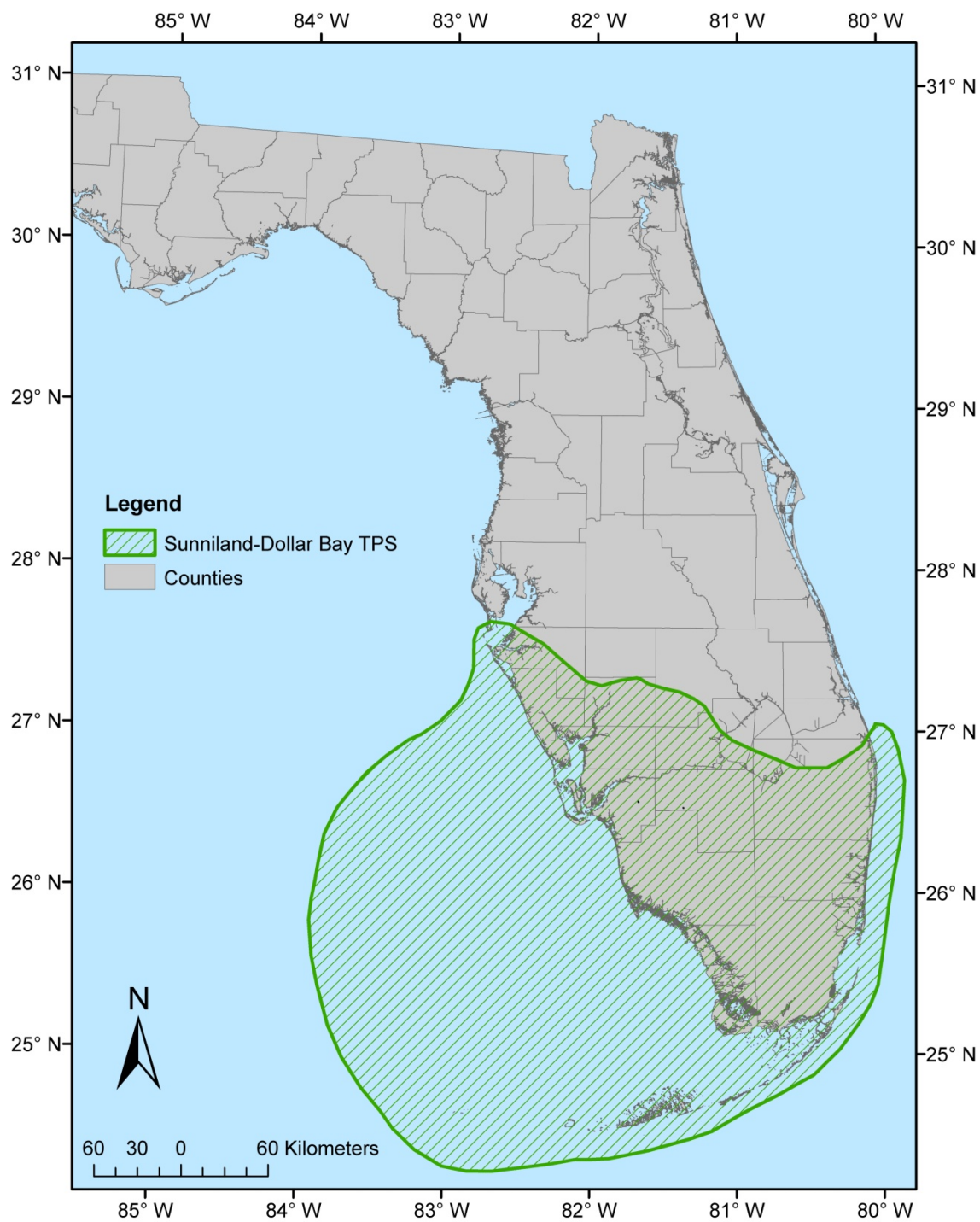


Figure 4-3: Extent of Sunniland-Dollar Bay TPS (adapted from: Pollastro et al., 2001).

limestone sections of the unit, while the dolostone sections have porosities that range from about 14 to 29% (Mitchell-Tapping, 1990). Due to low API gravities reported within the Dollar Bay Formation, some believe the reservoir may not be suitable for commercial oil production onshore, but could possibly be suitable offshore where the formation-oil is thought to be more thermally mature (Pollastro et al, 2001); however, some disagree and concede that the onshore portion of the unit should be considered a primary target for commercial oil production in the region up-dip and northeast of the Trend (Mitchell-Tapping, 1990; Winston, 1971). Notwithstanding, there is no question about the presence of a porous interval of significant thickness within the Dollar Bay Formation, as well as the presence of a low-permeability, upper seal. During the evaluation of geophysical logs for characterization of porosity within the Sunniland Formation (Chapter 2), a significantly thick, highly porous interval overlain by a thick unit with very low porosity (probably anhydrite) was observed ~400+ m (1,300+ ft) above the Sunniland Formation in many of the study wells, the identity of which is believed to be the Dollar Bay Formation.

Pre-Punta Gorda Total Petroleum System

The Pre-Punta Gorda TPS is an Upper Jurassic(?) and Lower Cretaceous system located below the Punta Gorda Anhydrite, which is expected to be a source rock and reservoir with significant petroleum production and adequate seal, based upon geochemical evidence and geologic interpretation of various lithological and geophysical data (Figure 2-4; Pollastro et al., 2001). This TPS is composed of the “brown dolomite zone” within the Twelve Mile Member of the Lehigh Acres Formation, and porous dolomite intervals within the Pumpkin Bay and Wood River formations. Numerous, thick, intraformational anhydrite beds with regional persistence, as well as local and regional, impermeable micritic carbonates, exist below the Punta Gorda Anhydrite, which could potentially serve as upper seals for units within the Pre-Punta Gorda TPS (Applegate et

al., 1981; Pollastro et al., 2001). Additionally, the Punta Gorda Anhydrite, which forms the lower seal for the Sunniland Formation as discussed in Chapter 2, has strong potential to serve as the upper seal for the entire Pre-Punta Gorda TPS. The extent of the Pre-Punta Gorda TPS is displayed in Figure 4-4, and a brief description of each of these stratigraphic units is presented below.

Brown Dolomite Zone

An area in the subsurface known as the “brown dolomite zone” is located within the Twelve Mile Member, a minimum of 15 m (50 ft) below the top of the member, of the Lower Cretaceous Lehigh Acres Formation, and is approximately 91 m (300 ft) below the base of the Punta Gorda Anhydrite, around 3,658 m bls (12,000 ft) (Applegate, 1984; Pollastro et al., 2001). The Twelve Mile Member averages about 46 m (150 ft) thick and is mostly composed of skeletal grains and miliolids (Winston, 1987), while the brown dolomite zone within this unit is typically composed of euhedral or anhedral, fine- to coarse-crystalline dolostone that typically has good porosity (10-20%) which ranges from pin-point intercrystalline to vuggy (Applegate, 1984). Generally, the brown dolomite becomes less porous with depth. The geologic unit is most developed and most porous in northern Lee, northern Hendry, Charlotte, Glades, southwest Highlands, and southeast Desoto counties of the southwestern region of peninsular Florida, although it also has significant occurrence in the western Florida Keys (Applegate, 1984). On the Florida mainland, the unit has a maximum thickness of ~30 m (100 ft); however, in the Florida Keys the unit is up to 64 m (210 ft) thick (Applegate, 1984; Winston, 1987). Offshore, the maximum thickness of the brown dolomite is around 122 m (400 ft), and occurs in the proximity of Marquesas Key (Applegate, 1984). Oil staining has been observed in the brown dolomite, and the unit is thought to contain considerable amounts of oil, especially offshore (Applegate, 1984; Pollastro et al., 2001; Winston, 1987). Because this unit is located deeper in the subsurface and below the Sunniland

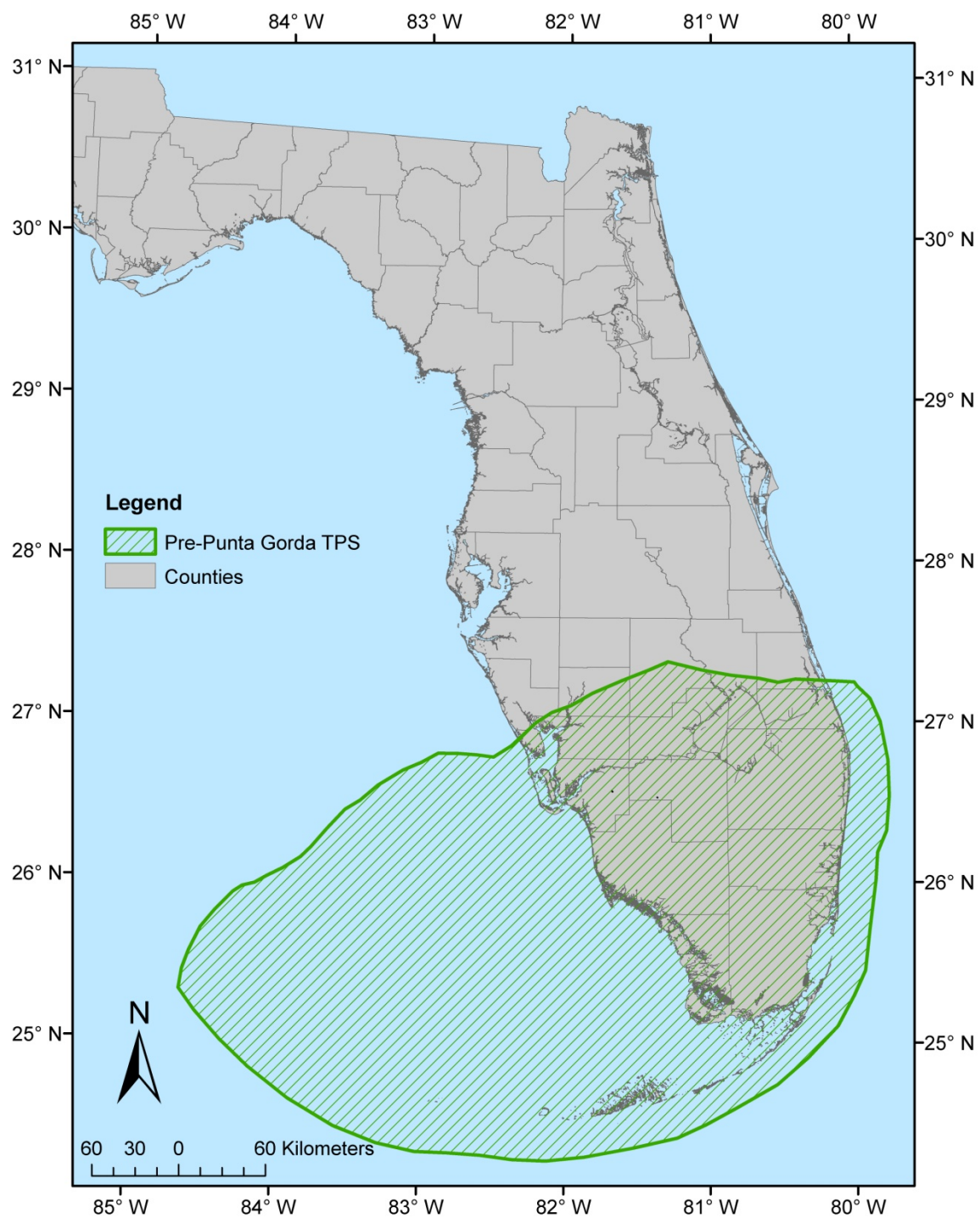


Figure 4-4: Extent of Pre-Punta Gorda TPS (adapted from: Pollastro et al., 2001).

Formation, oil gravities and gas-to-oil ratios are believed to be higher than those of the Sunniland Formation and the oil is believed to be more thermally mature (Applegate, 1984; Pollastro et al., 2001). Stratigraphic and structural traps, as well as the numerous, dense anhydrite beds that overlie the unit, provide a potentially sufficient upper seal for the brown dolomite (Applegate, 1984).

Pumpkin Bay Formation

The Lower Cretaceous Pumpkin Bay Formation is predominantly micritic limestone with intermittent beds of dolostone and anhydrite (Winston, 1987); however, at its northernmost extent around southern Highlands, southern Desoto, Charlotte, and west Glades counties, the formation is mostly a porous dolostone (Pollastro et al., 2001). The unit is typically about 274 m (900 ft) thick, and good petroleum potential is believed to exist in the upper portion of the unit (Applegate et al., 1981; Applegate, 1984; Winston, 1987). Porous intervals within the Pumpkin Bay Formation typically have pinpoint intercrystalline to vuggy porosity that can have values in excess of 20%, and the formation is typically thickest around southern Highlands, southern Desoto, Charlotte, and west Glades counties, where thickness can be up to 366 m (1,200 ft) (Applegate et al., 1981; Pollastro et al., 2001). Porosity and oil-potential are believed to be better offshore on the West Florida Shelf than onshore (Applegate et al., 1981).

Wood River Formation

The Wood River Formation is probably Upper Jurassic in age based upon its stratigraphic position, and is the lowest sedimentary unit in the SFB (Pollastro et al., 2001; Winston, 1987). Although few wells have penetrated the geologic unit, existing data show that it consists of limestone, dolostone, and anhydrite sequences with thin salt stringers, and averages ~520 m (1,700 ft) thick, although its maximum thickness is ~820 m (2,700 ft) (Pollastro et al., 2001). Relatively thick clastic units (30-46 m [100-150 ft]) composed of dark-red shale and fine- to coarse-grained arkosic sandstone and

calcareous sandstone occur in the basal portion of the formation (Pollastro et al., 2001). Dolostone within the Wood River Formation is typically euhedral and very-fine microcrystalline to microcrystalline, with abundant oolitic relic grains (Winston, 1987). Limestone is generally micritic with some oolitic beds, and overall becomes more predominant basin-ward within the formation (Winston, 1987). Recorded porosity values in the formation are as low as 8% and as high as 23%, and geophysical logs indicate the presence of multiple horizons with the potential for commercial gas production (Pollastro et al., 2001). The depositional environment of the Wood River Formation was probably reefal, especially in the southern areas of its lateral extent; therefore, a combination of source-, seal-, and reservoir-potential is believed to exist for the unit (Pollastro et al., 2001).

Estimated Storage Capacity of the Sunniland-Dollar Bay and Pre-Punta Gorda TPS

A total estimated CO₂ storage capacity of ~200 BtCO₂ was calculated for the Sunniland-Dollar Bay TPS and Pre-Punta Gorda TPS, collectively, using the combined areas of the two systems (129,607,119,102 m²); the ρ (642.57 kg/m³), Φ_{tot} (0.15), and E (0.03) values that were used to calculate the storage capacity for the Sunniland Formation; and an hg value (465 m) that was the sum of all the thicknesses calculated for each porous interval observed within the two systems, which was derived from geophysical logs for P# 472 of Charlotte County (total depth = 3,962 m [13,000 ft]). This was done in order to formulate some concept of the potential CO₂ storage capacity for these systems; however, this is a “rough estimate”, and further investigation should be conducted to better-determine the potential CO₂ storage capacity, as well as the seals, for these systems and the units that comprise them. Notwithstanding, this estimate of CO₂ storage capacity for the two systems demonstrates the massive-scale at which CO₂ sequestration could be implemented in deep geologic units of Florida, both onshore and offshore. With a potential, collective CO₂ storage capacity of ~200 BtCO₂, the deep

geologic units of the Sunniland-Dollar Bay TPS and Pre-Punta Gorda TPS potentially have the capability to support CO₂ sequestration operations for the entire 40-year lifespan of over 1,000 large-scale, coal-fired power plants.

4.2.2.2 Western Florida Panhandle

Oil production in Florida made its way north into the western Florida panhandle in June of 1970, with the discovery of Jay Field, the largest North American on-shore oil field discovered since the discovery of Prudhoe Bay Field on the Alaskan North Slope in 1968 (Lloyd et al., 1986). Currently, there are eight oil fields in Escambia and Santa Rosa counties of the Florida panhandle (Jay, Mt. Carmel, Coldwater Creek, Blackjack Creek, Bluff Springs, McLellan, Sweetwater Creek, and McDavid fields), which produce from either the Smackover Formation or Norphlet Sandstone, at depths ranging from 4,420 m (14,500 ft) bls to 5,120 m (16,800 ft) bls (Lane, 1994). The Smackover Formation and Norphlet Sandstone occur throughout the Gulf Coast, and extend into neighboring states such as Alabama, Mississippi, and Louisiana. Jay, Mt. Carmel, Coldwater Creek, and Blackjack Creek oil fields are positioned along the “Jay Trend,” a feature associated with a normal fault complex that runs alongside the Gulf Coast and potentially extends into the Gulf of Mexico, while Bluff Springs, McLellan, Sweetwater Creek, and McDavid oil fields were likely created as a result of the formation of salt structures from the underlying Louann Salt, or are associated with the stratigraphic pinch-out of the Smackover Formation (Figure 4-5; Lane, 1994). To date, no data have shown which specific trapping mechanism produced the Smackover Formation reservoir in the latter fields (Lloyd, 1991).

To demonstrate how CO₂-EOR operations might be useful in the oil and gas fields of western panhandle Florida, Jay Field, the largest oil and gas producing field in Florida, can be used as an example. According to Lawrence and others (2002), the OOIP for Jay Field is ~830 million barrels of oil, and according to the FGS Annual

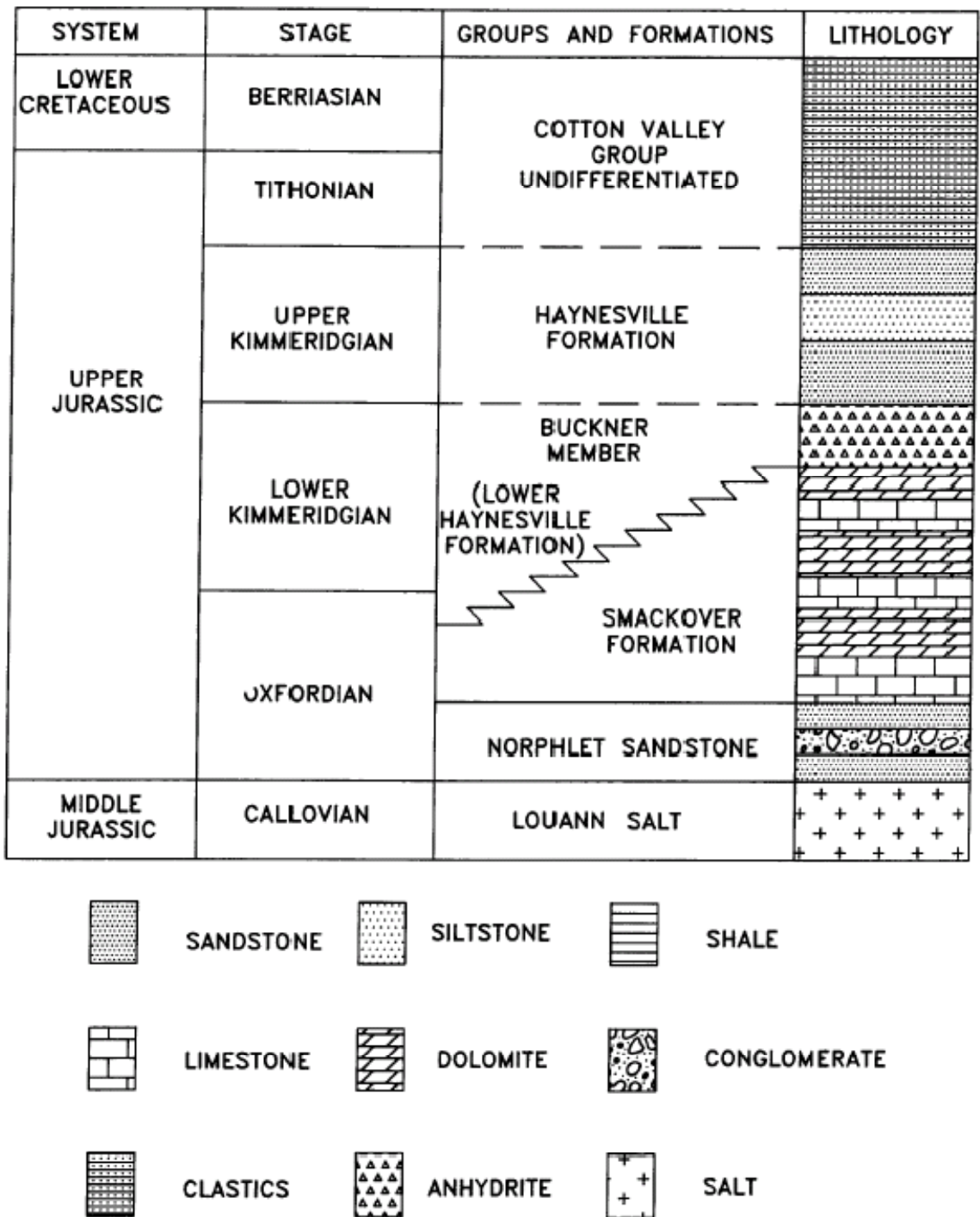


Figure 4-5: Generalized stratigraphic column displaying oil-producing units of western panhandle Florida (from: Lloyd, 1991).

Production Report (2008), 421 million barrels of oil have been produced from the field, which means the recovery rate is ~50%. If an additional 10% of the OOIP could be recovered using CO₂-EOR, then additional oil in Jay Field worth ~\$8.3 trillion USD (at \$100/barrel of oil) could potentially be recovered. During such CO₂-EOR operations, the source rock for Jay Field (Smackover Formation) could also be used by Florida utilities as a CO₂ sequestration reservoir.

Smackover Formation

Most of the oil production in the Florida panhandle comes from the Upper Jurassic Smackover Formation. In Florida, the Smackover Formation is predominantly composed of dolostone and limestone, but in some locations also contains a mixture of carbonates and clastics (Lane, 1994; Lloyd et al., 1986). Porosity in the Smackover Formation is highly variable (Applegate, 1983); however, in the porous regions of the formation, porosities can be as high as 40% (Lloyd et al., 1986). The carbonates of the Smackover Formation have both primary interparticle and secondary oomoldic and intercrystalline porosity that resulted from post-burial dolomitization, which only occurred in portions of the formation where grainstones were not deposited (Lloyd et al., 1986). The formation is underlain by the Upper Jurassic Norphlet Sandstone and Middle Jurassic Louann Salt, and overlain by the Upper Jurassic Buckner Member of the Haynesville Formation. The Buckner Member is an evaporite unit, predominantly composed of anhydrite, which forms the upper seal for much of the Smackover Formation and traps the formation-oil, along with a porosity barrier of dense, micritic limestone, as well as faulting and associated structural features and traps (Lane, 1994; Applegate & Lloyd, 1985; Lloyd, 1991).

Norphlet Sandstone

The Norphlet Sandstone in Florida is an arkosic sand unit of Upper Jurassic age, which is underlain by the Middle Jurassic Louann Salt and overlain by the Upper

Jurassic Smackover Formation (Lane, 1994). Porosity and permeability within the unit is typically very good, with interparticle porosity values generally around 20%. Mt. Carmel Field is the only oil field that produces from the Norphlet Sandstone, in addition to its oil production from the overlying Smackover Formation; however, some oil production has occurred from this unit in Blackjack Creek Field (Applegate & Lloyd, 1985).

4.2.2.3 *Apalachicola Embayment*

The pre-Cenozoic Apalachicola Embayment is located in east-central panhandle Florida, and represents a massive, shallow bay that was part of the Georgia Channel System, a basin-feature that affected sedimentation during the Paleogene (Scott, 1997). Currently, the area is not actively being drilled or explored for potential petroleum production; however, past exploratory-drilling in the Apalachicola Embayment has resulted in wells containing oil shows, as well as porous intervals of at least 27 m (90 ft) thick, in the Smackover Formation of Gulf and Franklin counties (Applegate, 1983). Furthermore, the Smackover Formation is believed to have potential hydrocarbon-production in Bay, Gulf, Franklin, and Liberty counties (Applegate, 1983). Considering what has already been presented for the Smackover Formation and its potential as a CO₂ sequestration reservoir, the Apalachicola Embayment could serve as an additional area within Florida where GS could potentially be implemented using this formation, and possibly the underlying Norphlet Sandstone.

4.2.3 Deep Saline Aquifers in the Southern Florida Peninsula

As aforementioned, during the evaluation of geophysical logs for porosity derivation in the Sunniland Formation, a highly porous rock unit of significant thickness was observed above the Sunniland Formation that is believed to be the Dollar Bay Formation. Additionally, several other intervals that were less vertically extensive, but highly porous, were observed in the Lower Cretaceous rocks that appear to have some intraformational, low-porosity rocks, as well as upper seals. The following geologic units

could potentially correlate with some of these porous intervals; however, no official correlation or in-depth examination of the intervals was conducted in this study.

Corkscrew Swamp Formation

The Lower Cretaceous Corkscrew Swamp Formation is generally ~138 m (~450 ft) thick, and in the southern peninsula is mainly composed of limestone with some interbedded, thin lenses of anhydrite and microcrystalline dolomite (Amato et al., 1986; Winston, 1976). The top of the Corkscrew Swamp Formation is 2,623 m (8,607 ft) bls, and the upper portion of the formation is typically marked by a thin bed of anhydrite, although locally it can be limestone (Winston, 1976). The Corkscrew Swamp Formation is overlain by the green shales of the basal portion of the Upper Cretaceous Pine Key Formation and is underlain by a laterally extensive anhydrite unit of the Lower Cretaceous Rookery Bay Formation (Winston, 1976), which forms part of the upper seal for the Dollar Bay Formation.

The Gordon Pass Formation, Marco Junction Formation, and Rattlesnake Hammock Formation occur between the Sunniland Formation and the Dollar Bay Formation and are thus part of the Sunniland-Dollar Bay TPS; however, these formations are not considered to be potential petroleum source rocks, and as such, few studies have been conducted which document their porosity and extent. Nevertheless, because these formations occur within the Sunniland-Dollar Bay TPS, they are subjected to the same intraformational, low-permeability rocks and upper seals, and could serve as additional sequestration reservoirs during CO₂ injection.

Gordon Pass Formation

The Lower Cretaceous Gordon Pass Formation underlies the Dollar Bay Formation, and occurs ~3,160 m (~10,360 ft) bls, averaging ~160 m (~525 ft) in thickness. The upper portion of the formation is composed of anhydrite interbedded with

dense, micritic limestone, while the basal portion of the formation is mainly a dense and chalky limestone with some thin layers of anhydrite (Amato et al., 1986; Winston, 1976).

Marco Junction Formation

The Lower Cretaceous Marco Junction Formation underlies the Gordon Pass Formation, and is mainly composed of a dense or chalky limestone with dolomite and anhydrite beds locally interbedded (Winston, 1976). In the northern regions of the SFB, the unit becomes dolostone-dominated (Amato et al, 1986; Winston, 1976). The top of the Marco Junction Formation typically occurs ~3,315 m (10,880 ft) bls and thickness is generally ~100 m (~330 ft).

Rattlesnake Hammock Formation

The Lower Cretaceous Rattlesnake Hammock Formation underlies the Marco Junction Formation, and overlies the Lake Trafford Formation, which has been identified as the upper seal for the Sunniland Formation (Chapter 2). The top of the Rattlesnake Hammock formation generally occurs at ~3,420 m (11,210 ft) bls, and is marked by a thick, laterally extensive anhydrite bed that dominates the upper portion of the unit (Winston, 1976). The basal portion of the Rattlesnake Hammock Formation typically consists of a dense limestone with some thin anhydrite beds (Winston, 1976). Around the center of the SFB, anhydrite content increases southward in the formation (Amato et al., 1986).

The Bone Island Formation occurs between the Pumpkin Bay Formation and Wood River Formation, and is thus located within the confines of the Pre-Punta Gorda TPS; therefore, the formation could be included in any CO₂ sequestration operations that took place throughout the remaining TPS. In addition to intraformational anhydrites or low-permeability dolostone within the Bone Island Formation, any intraformational or upper seals that exist for the Pumpkin Bay Formation would also serve as such for the Bone Island Formation.

Bone Island Formation

The Lower Cretaceous Bone Island Formation is overlain by the Lower Cretaceous Pumpkin Bay Formation and underlain by the Upper Jurassic (?) Wood River Formation. The average thickness of the Bone Island Formation is ~400 m (1,300 ft), and like many of the Lower Cretaceous units in Florida, lithology is mainly composed of limestone, dolostone, and anhydrite sequences (Winston, 1987). The limestone within the formation is predominantly micritic, although there are some skeletal, oolitic, and pelletal grains locally, and dolostone is typically euhedral and very-fine microcrystalline with occasional skeletal and oolitic relic grains (Winston, 1987). Oil-production is not considered likely for the formation; however, potential gas-production has been suggested (Palacas et al., 1982).

4.3 Geologic Units Considered Unsuitable for Carbon Dioxide Sequestration

Three wells drilled in Levy, Citrus, and Pinellas counties (two of which penetrated Paleozoic rock and one of which terminated in the Lower Cretaceous) showed no significant evidence of petroleum and had few intervals with considerable porosity (Lloyd, 1991). Five additional wells penetrated Paleozoic rock to the north of this area, in Taylor, Madison, Lafayette, and Dixie counties, all of which had no shows of oil (Lloyd, 1991). From geophysical logs of wells drilled in this region of Florida, Paleozoic rocks of north Florida are composed of Silurian and Devonian shales with intermittent sand stringers and, in some cases, good organic carbon content, as well as highly indurated Ordovician sandstones and orthoquartzites (Applegate, 1983). Shales are typically porous but have low permeability, and the sandstone within these units is extremely indurated with low porosity and permeability (Applegate & Lloyd, 1985); therefore, the Paleozoic rocks of Florida are not considered suitable reservoirs for CO₂ sequestration.

4.4 Conclusion

Chapters 2 through 4 have evaluated deep geologic units throughout Florida, from Paleocene age rocks of the Cenozoic era to Ordovician age rocks of the Paleozoic era. Numerous units have been identified within this interval, predominantly of the Mesozoic era, which could potentially serve as CO₂ sequestration reservoirs; however, due to low porosity and permeability, Paleozoic rocks of Florida are not likely to be suitable for CO₂ storage.

Due to the porosity, geographic location, and depth of the Upper Cretaceous to Paleocene age Rebecca Shoal Dolomite in its onshore portion of southeastern and southern Florida, the unit could potentially serve as a storage reservoir for CCS operations in this region, where the porosity is highest and the unit occurs below 914 m (3,000 ft) bls; however, further examination of the unit's porosity, potential storage capacity, and seals would need to be conducted. Additionally, as much of the Rebecca Shoal Dolomite occurs offshore, there is the potential that the geologic unit could also be used as an offshore CO₂ storage reservoir.

The high porosity and permeability, thickness, and geographic location of the Lower Cretaceous Dollar Bay Formation of the Sunniland-Dollar Bay TPS make the unit a potentially suitable reservoir for GS during CCS operations, and it could quite possibly be used for CO₂-EOR operations as well, where additional CO₂ could be sequestered with conjunctive oil production. These CO₂ sequestration techniques could likely be utilized both onshore and offshore in the formation, and the Lower Cretaceous Panther Camp and Rookery Bay formations could potentially serve as the upper seals for the reservoir. Because the Rattlesnake Hammock Formation, Marco Junction Formation, and Gordon Pass Formation are positioned between the Sunniland Formation and Dollar Bay Formation source rocks, they are thus located with the confines of the Sunniland-Dollar Bay TPS, even though they have shown no signs of petroleum production and are

not considered potential source rocks themselves. Nonetheless, CO₂ could potentially be sequestered in these non-source rocks during CO₂ injection throughout the remaining TPS, and intraformational anhydrites, as well as the Panther Camp and Rookery Bay formations, could serve as seals for these potential sequestration reservoirs.

Due to adequate porosity, vertical and lateral extent, and geographic location, the geologic units of the Pre-Punta Gorda TPS could be considered as possible CO₂ sequestration reservoirs for both CCS and CO₂-EOR operations. The intraformational anhydrite beds, as well as the local and regional, impermeable micritic carbonates, that exist below the Punta Gorda Anhydrite within this system could potentially serve as upper seals for units within the Pre-Punta Gorda TPS. Additionally, the Punta Gorda Anhydrite could serve as an upper seal for the entire TPS. Because the Bone Island Formation is located between the Pumpkin Bay and Wood River formations of the Pre-Punta Gorda TPS, potential CO₂ sequestration could occur in the Bone Island Formation during CO₂ injection throughout the remaining TPS, and rocks that serve as upper seals for units younger than the Bone Island Formation within the TPS would also confine and seal the Bone Island Formation.

The Sunniland-Dollar Bay TPS and Pre-Punta Gorda TPS collectively have the potential to support over 1,000 large-scale power plants for their entire 40-year lifespan, which is based upon a “rough estimate” of the potential CO₂ storage capacity (~200 BtCO₂) for the systems that was calculated using geophysical data from a deep well (P# 472) in Charlotte County. Although this is an estimate based upon data from a single well, it does provide some insight into the massive-scale at which CO₂ sequestration could potentially be implemented in the deep geologic units of these systems.

The Upper Jurassic Smackover Formation and Norphlet Sandstone could potentially be used for GS both in CCS operations and in CO₂-EOR operations. Such techniques could be implemented not only in western panhandle Florida, where

additional oil production could be worth trillions of USD, but could likely be implemented within the Apalachicola Embayment as well, where oil shows and significant porosity have been observed within the Smackover Formation. Notwithstanding, the Smackover Formation and Norphlet Sandstone both have areas of high porosity and permeability and potentially adequate upper seals within their extent that provide them with the potential to serve as CO₂ sequestration reservoirs.

During the evaluation of geophysical logs for characterization of porosity in the Sunniland Formation and CKLIZ (Chapter 1 and Chapter 2, respectively), several other highly porous intervals of varying thickness were observed between the Lower Cretaceous Sunniland Formation and Upper Cretaceous Lawson Formation, each separated by rock of low porosity and varying thickness. A significantly thick, highly porous interval overlain by a thick unit of low porosity was consistently observed in many of the geophysical logs around the depth interval where the Dollar Bay Formation occurs. Additionally, other intervals with significant porosity and varying thickness in the Lower Cretaceous rocks were also observed in the geophysical logs, which could potentially be the Corkscrew Swamp Formation, Rattlesnake Hammock Formation, Marco Junction Formation, Gordon Pass Formation, or Bone Island Formation. No rock units, other than those examined during the Sunniland Formation and CKLIZ evaluations, were officially identified, examined, or correlated with the porous intervals of the geophysical logs; therefore, further investigation would need to be conducted in order to identify and correlate the porous intervals, as well as to confirm any seals, for their use in CCS operations.

Chapter 5: References

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Appendix I:
Acronyms and Abbreviations

Appendix I

A	area
AAPG	American Association of Petroleum Geologists
ACESA	American Clean Energy and Security Act
API	American Petroleum Institute
BCS	borehole-compensated sonic
BHT	bottom-hole temperature
bls	below land surface
BreitBurn	BreitBurn Energy Partners L.P.
BtCO ₂	billion tons of carbon dioxide
C	Celsius
Ca ²⁺	calcium
CAA	Clean Air Act
CCS	carbon dioxide capture and sequestration
CKLIZ	Cedar Keys/Lawson Injection Zone
CO ₂	carbon dioxide
CO ₃ ²⁻	carbonate
CO ₂ -EOR	carbon dioxide-enhanced oil recovery
CNL	compensated neutron log
CNL-FDC	compensated neutron-compensated formation density
DOE	Department of Energy
E	CO ₂ Storage Efficiency Factor
EO	Executive Order
EPA	Environmental Protection Agency
F	Fahrenheit

Appendix I (Continued)

FAC	Florida Administrative Code
FAS	Floridan Aquifer System
FDEP	Florida Department of Environmental Protection
Fe^{2+}	iron
FGS	Florida Geological Survey
ft	feet
G_{CO_2}	mass estimate of CO_2 storage capacity
GCAGS	Gulf Coast Association of Geological Societies
GHG	greenhouse gas
GS	geologic sequestration
GSGI	gravity stable gas injection
GtCO_2	gigatons of carbon dioxide
h_g	gross thickness
HCO_3^-	bicarbonate
H_2CO_3	carbonic acid
I	isolated well
IDW	Inverse Distance Weighted
IEA	International Energy Agency
IEA GHG R&D Programme	International Energy Agency Greenhouse Gas Research and Development Programme
IGCC	Integrated Gasification Combined Cycle
IPCC	Intergovernmental Panel on Climate Change
IU	industrial utilization
kg	kilograms
km	kilometers

Appendix I (Continued)

km ²	square kilometers
m	meters
m ²	square meters
m ³	cubic meters
M	million
Mg ²⁺	magnesium
mi	miles
mi ²	square miles
MS	mineral sequestration
MtCO ₂	million tons of carbon dioxide
MW	megawatt
NETL	National Energy Technology Laboratory
NP	near production well
NPHI	ratio-method thermal neutron porosities
OOIP	original oil in place
OS	oceanic sequestration
P	production well
P#	permit number
ppm	parts per million
R&D	research and development
RBF	Radial Basis Function
SDWA	Safe Drinking Water Act
SFB	South Florida Basin
tCO ₂	tons of carbon dioxide
TECO	Tampa Electric Company

Appendix I (Continued)

TNPH	environmentally-corrected thermal neutron porosities
TPS	Total Petroleum System
Trend	Sunniland Trend
TS	terrestrial sequestration
TVD	true vertical depth
UF	University of Florida
UIC	Underground Injection Control
US	United States
USD	United States dollars
USDW	underground source of drinking water
USF	University of South Florida
USGS	United States Geological Survey
v_f	fluid velocity
v_{ma}	matrix velocity
WAG	water alternating gas
yr	year
°	degrees
%	percent
Φ	porosity
Φ_{avg}	average porosity
Φ_{tot}	total porosity
$\mu\text{sec/ft}$	microseconds per foot
ρ	density

Appendix I (Continued)

ρ_b	true bulk density
ρ_f	fluid density
$\rho_{\log}$	log-derived bulk density
ρ_{ma}	matrix density

Appendix II:
Porosity Derivation Figures for Geophysical Log Interpretation

Appendix II

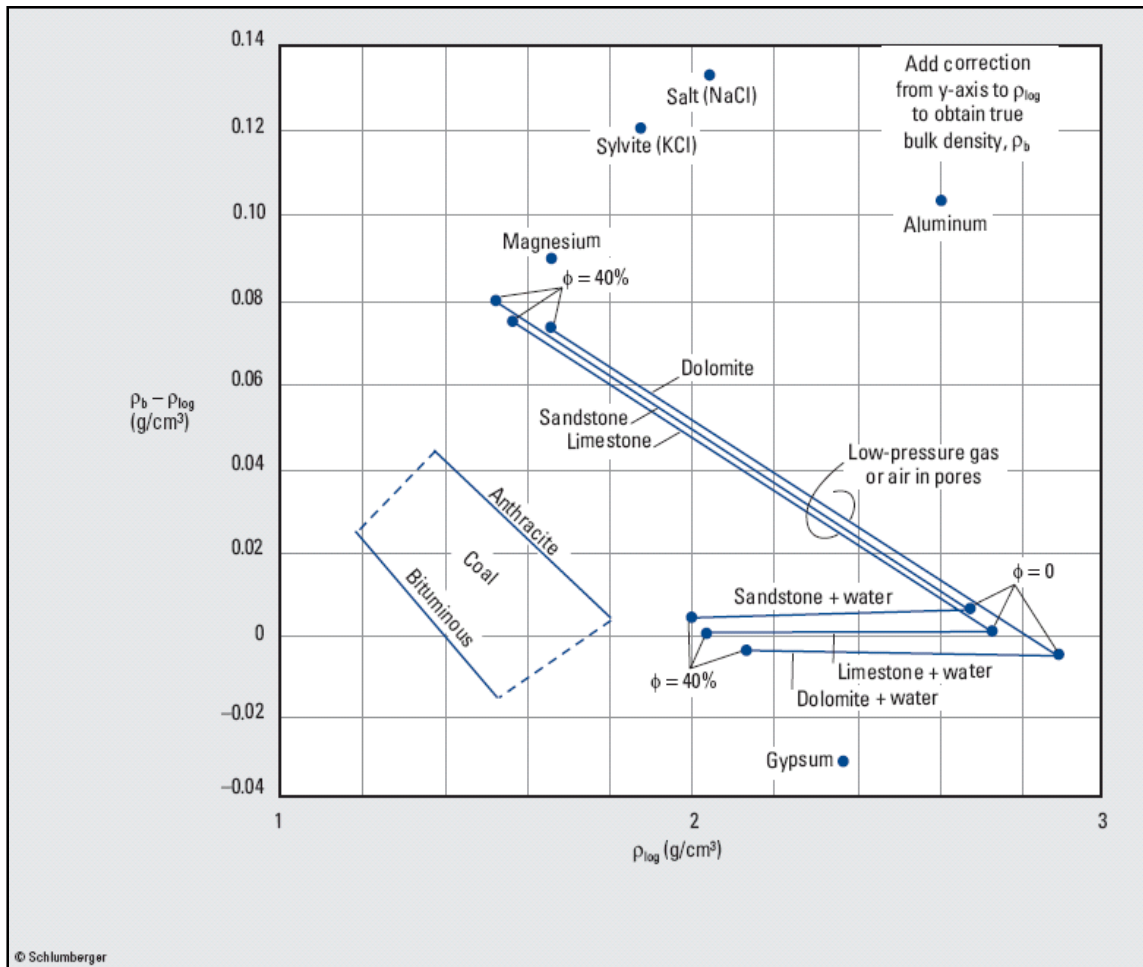


Figure All-1: Corrections to obtain true bulk density from log density (from: Schlumberger, 2009).

Appendix II (Continued)

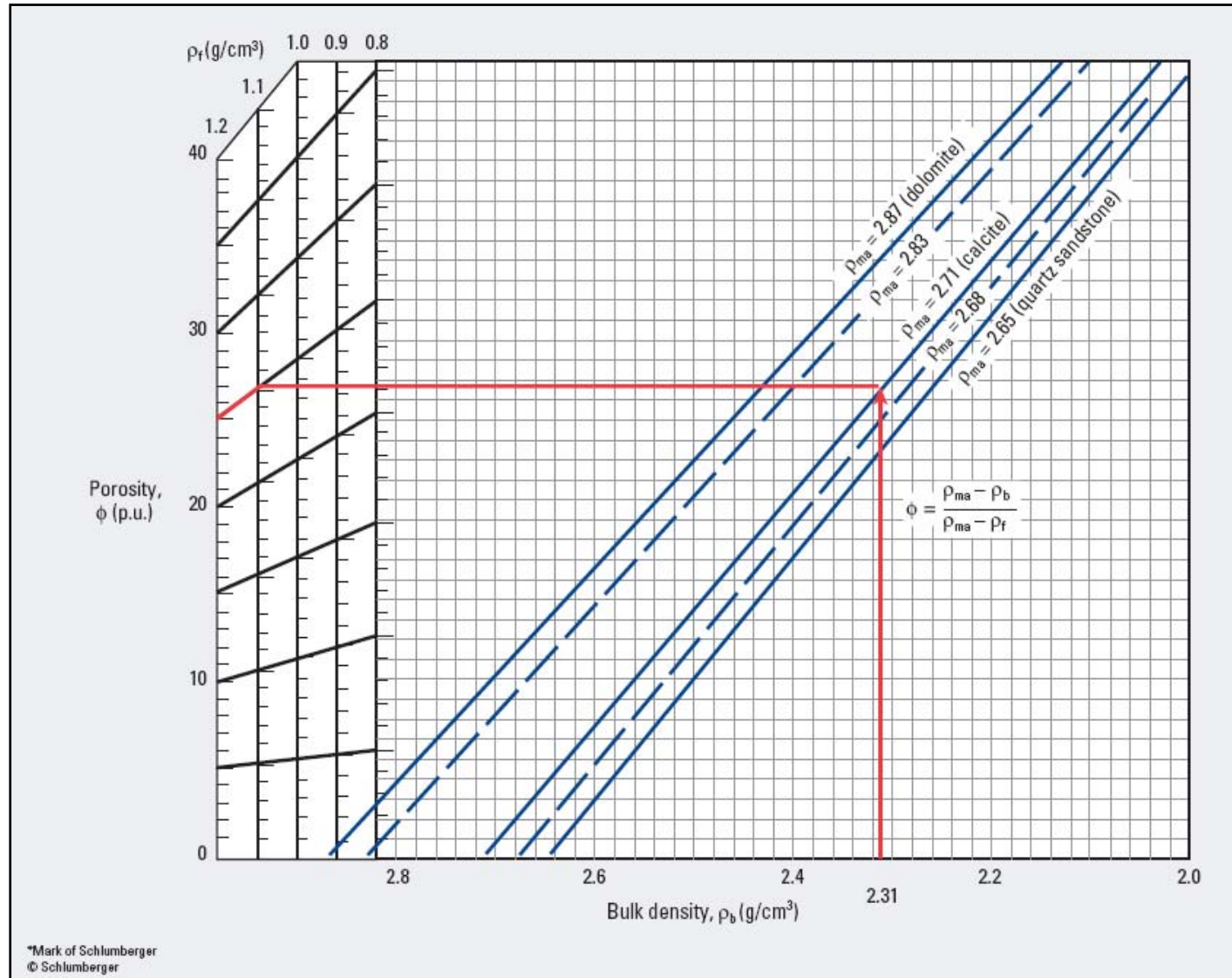


Figure All-2: Determination of porosity from true bulk density (from: Schlumberger, 2009).

Appendix II (Continued)

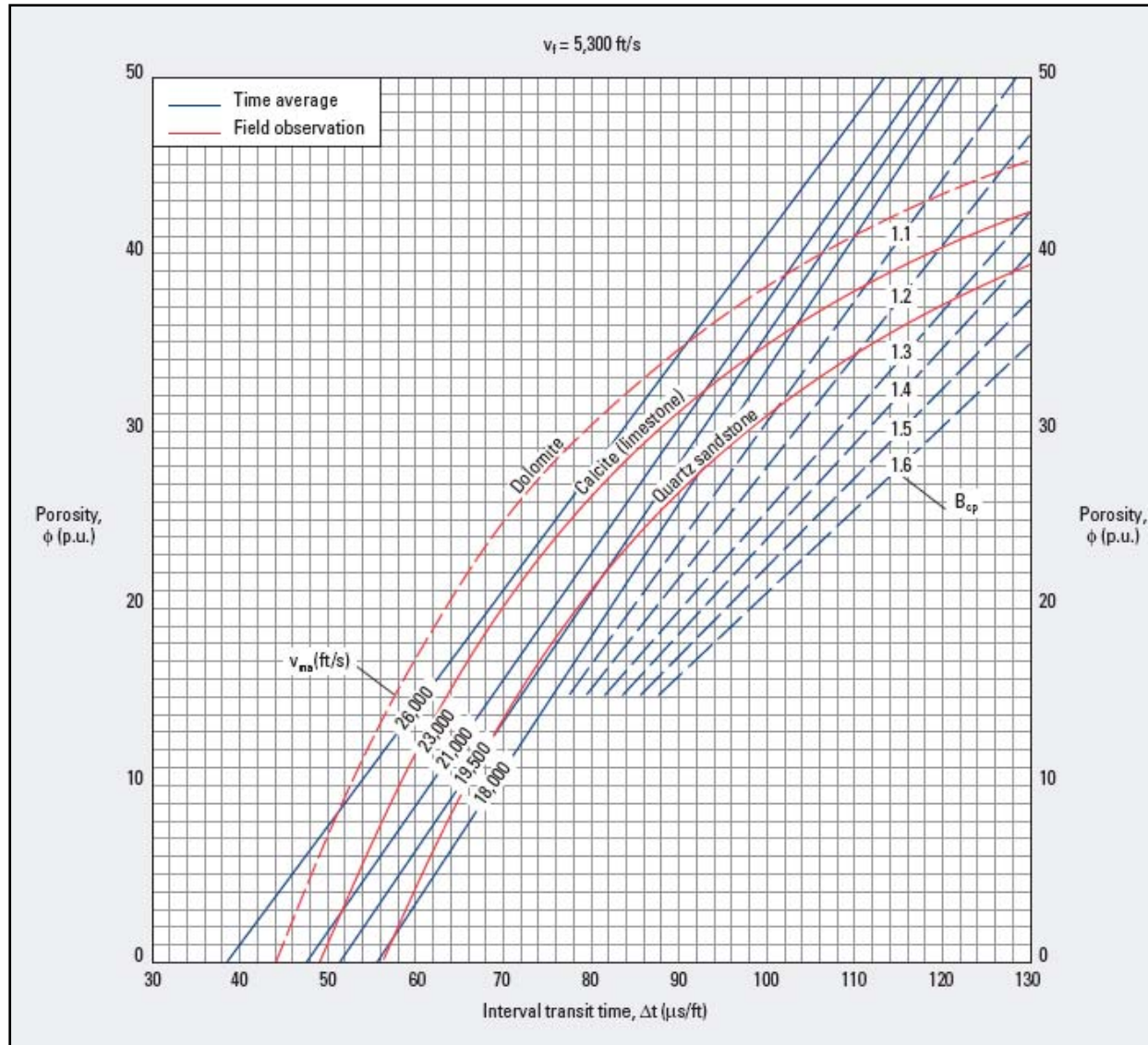


Figure All-3: Determination of porosity using interval transit time (from: Schlumberger, 2009).

Appendix II (Continued)

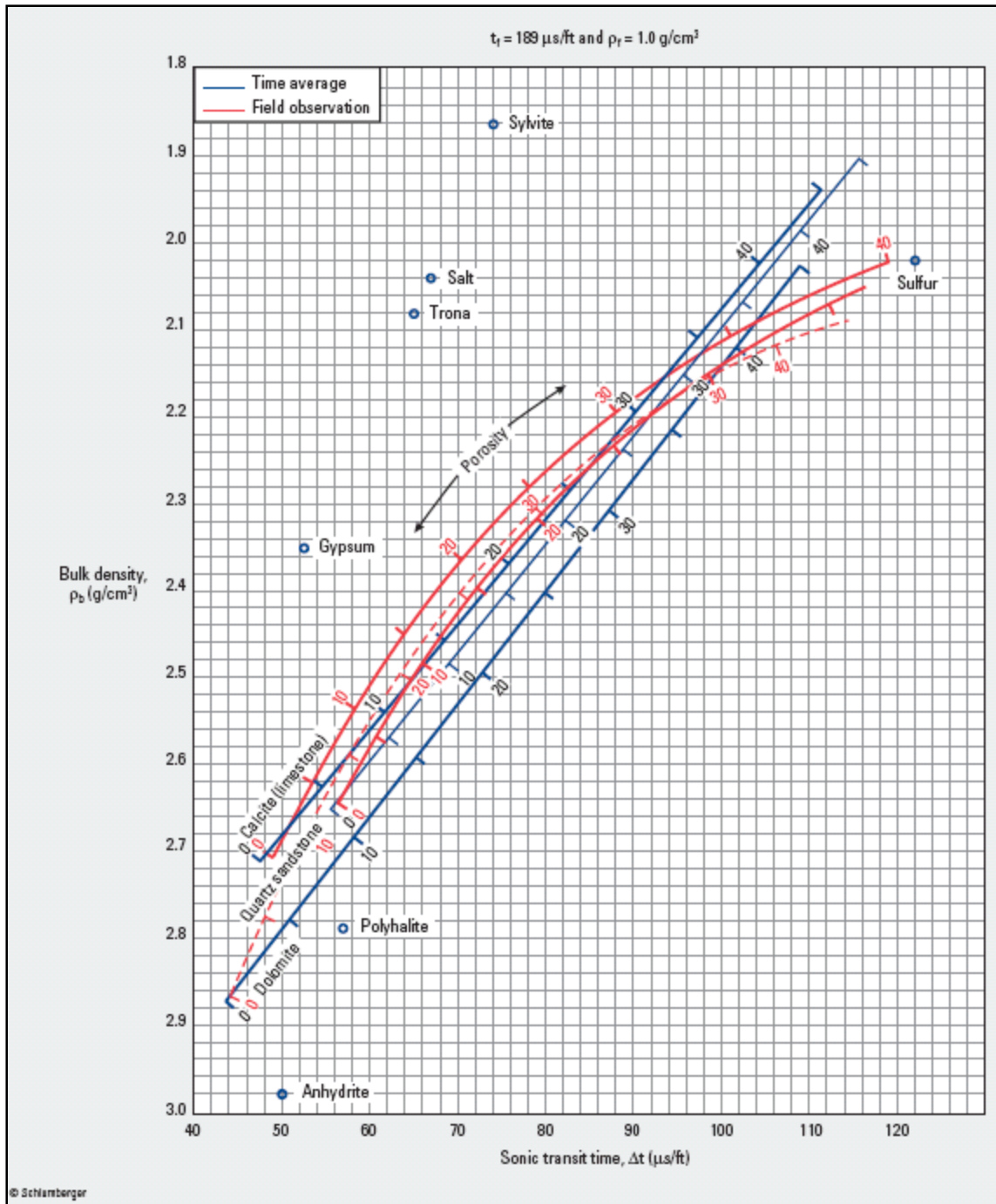


Figure All-4: Sonic-density cross-plot used to determine lithology and porosity (from: Schlumberger, 2009).

Appendix II (Continued)

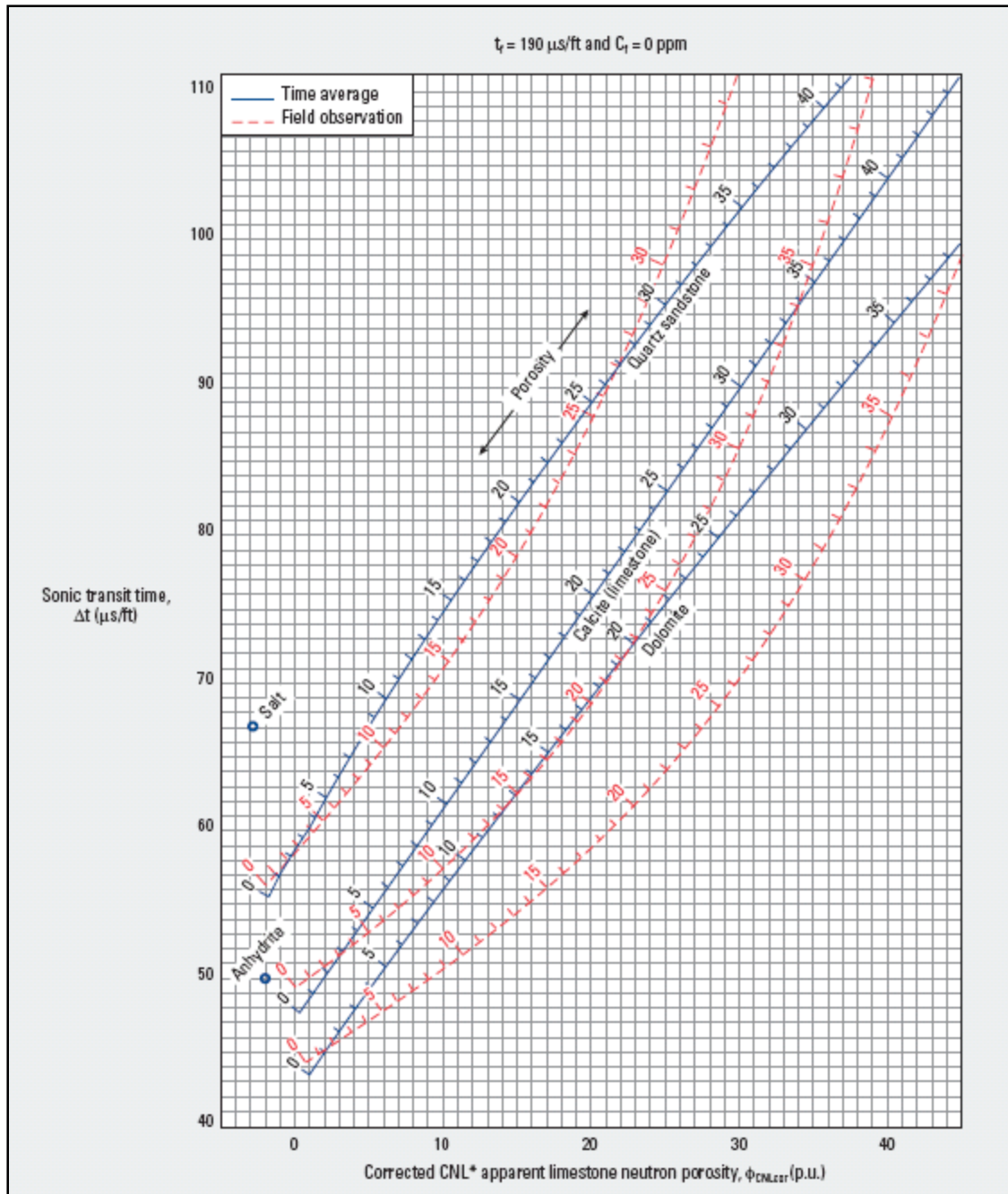


Figure All-5: Sonic-neutron cross-plot for lithology and porosity determination (from: Schlumberger, 2009).

Appendix II (Continued)

HALLIBURTON

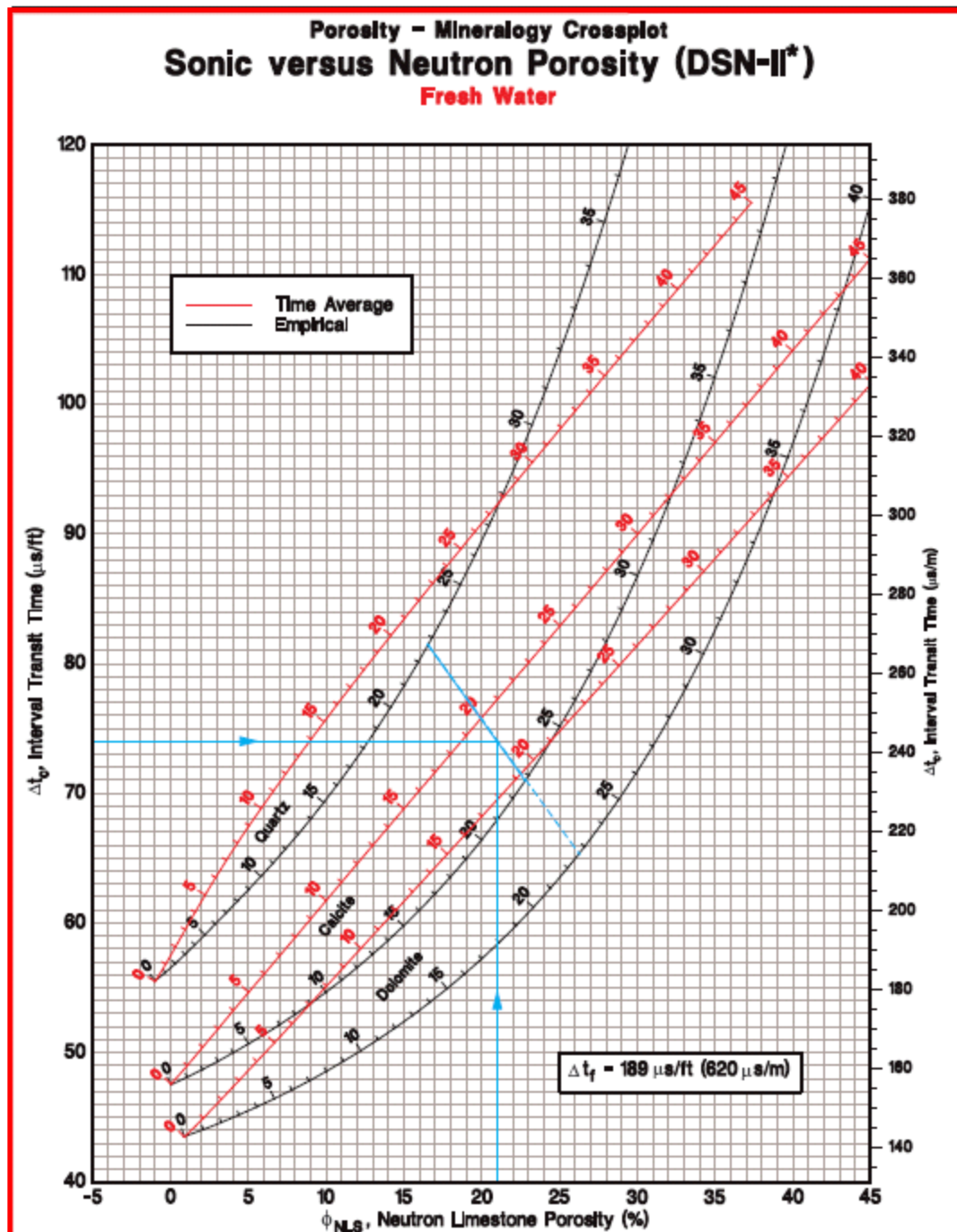


Figure AII-6: Sonic-neutron cross-plot for lithology and porosity determination (from: Halliburton, 2008).

Appendix II (Continued)

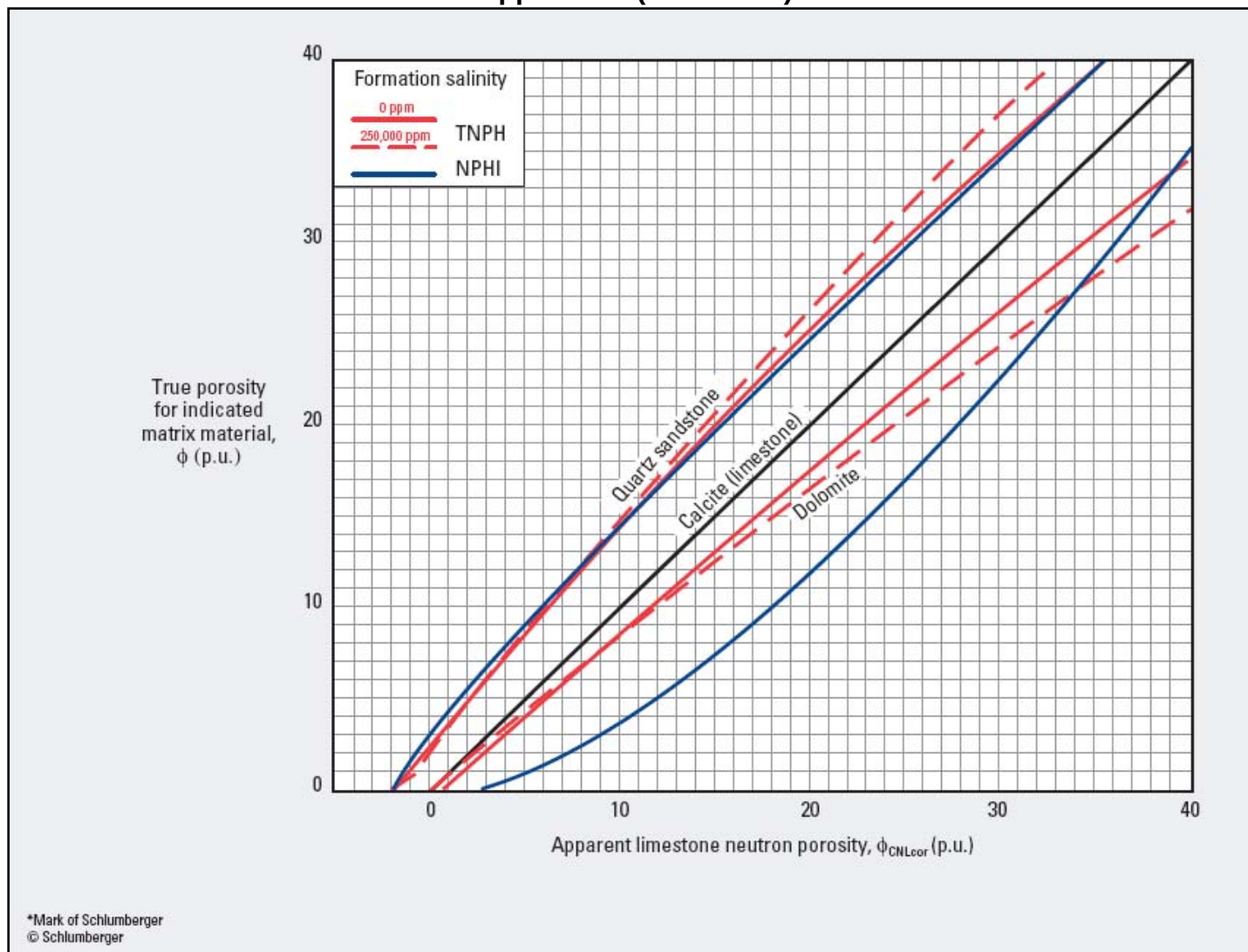


Figure AII-7: True porosity determination from apparent porosity for limestone matrix (from: Schlumberger, 2009).

Appendix II (Continued)

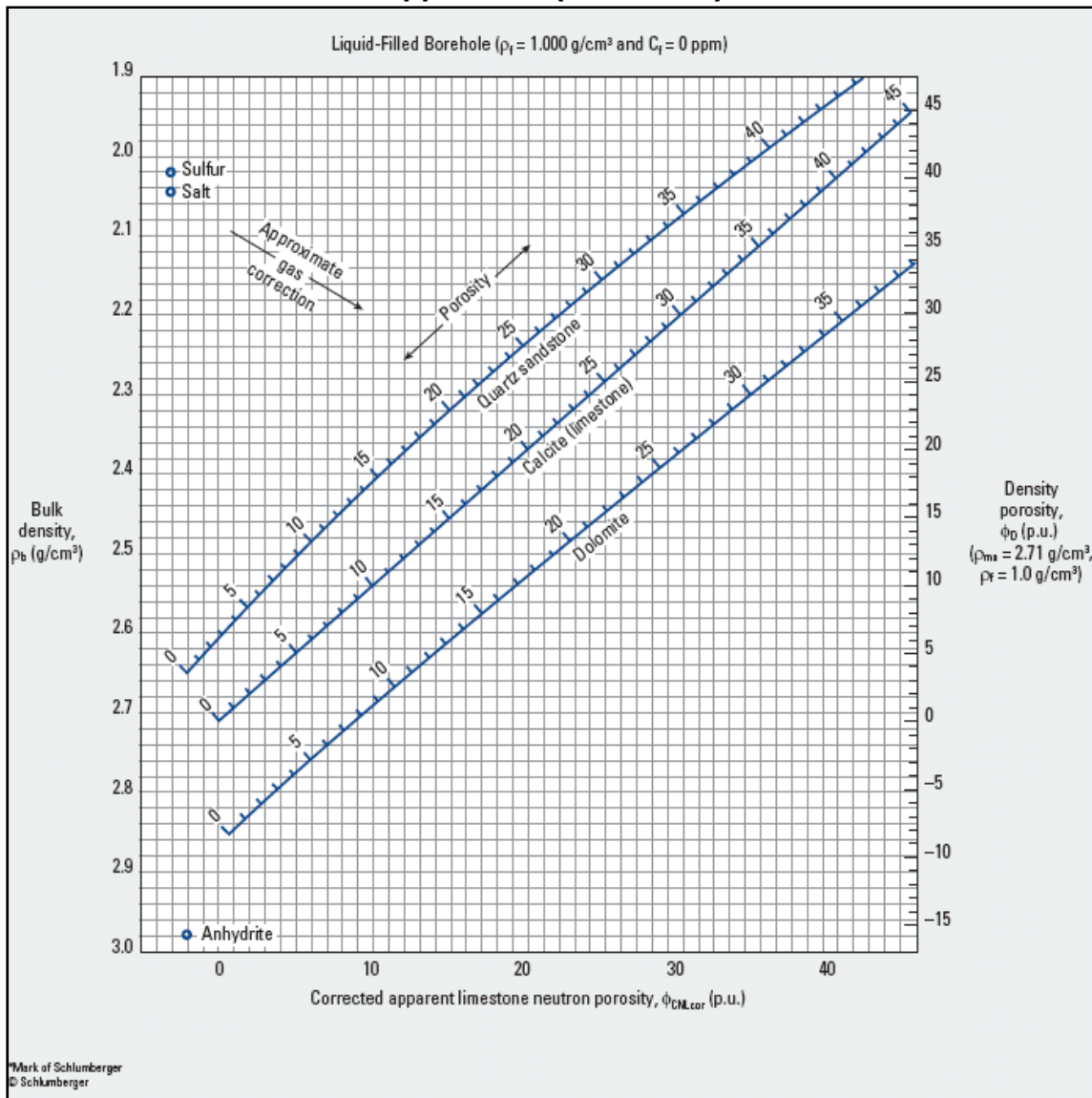


Figure AII-8: CNL-FDC cross-plot for lithology and porosity determination (from: Schlumberger, 2009).

Appendix II (Continued)

HALLIBURTON

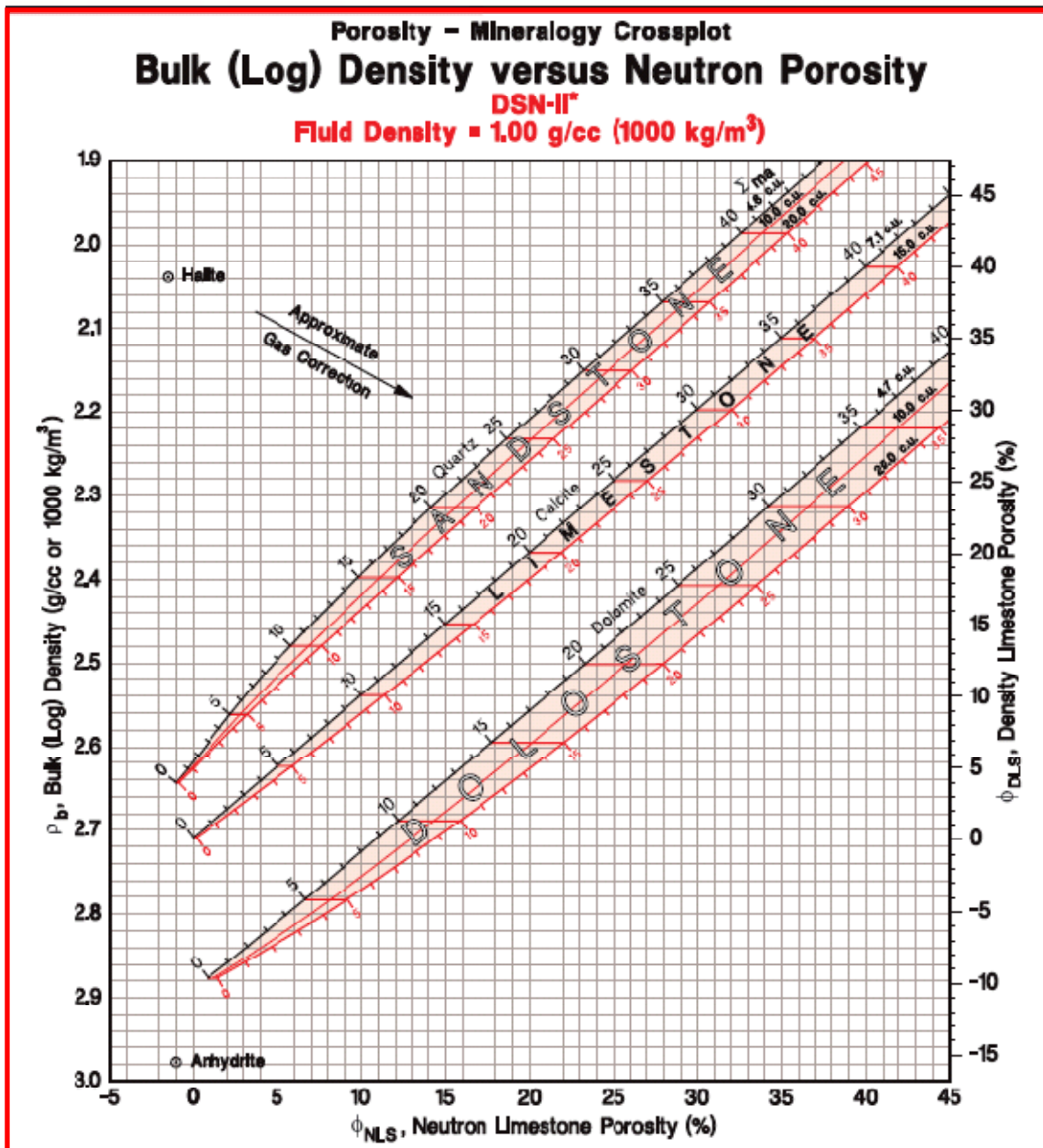


Figure AII-9: CNL-FDC cross-plot for lithology and porosity determination (from: Halliburton, 2008).

Appendix III:
Study Area Well Location Maps

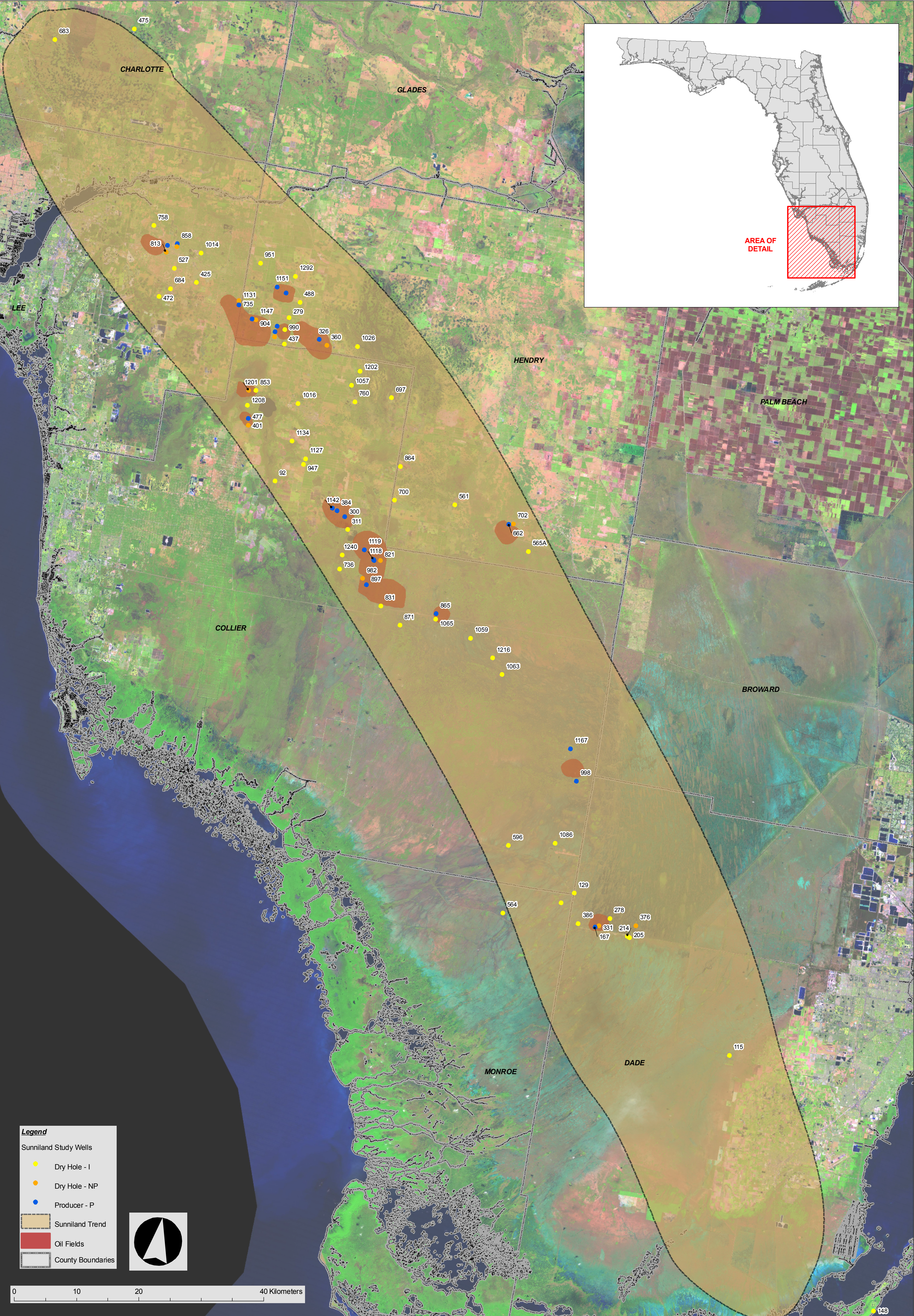


Figure All-1: Location map for Sunniland Formation study wells.

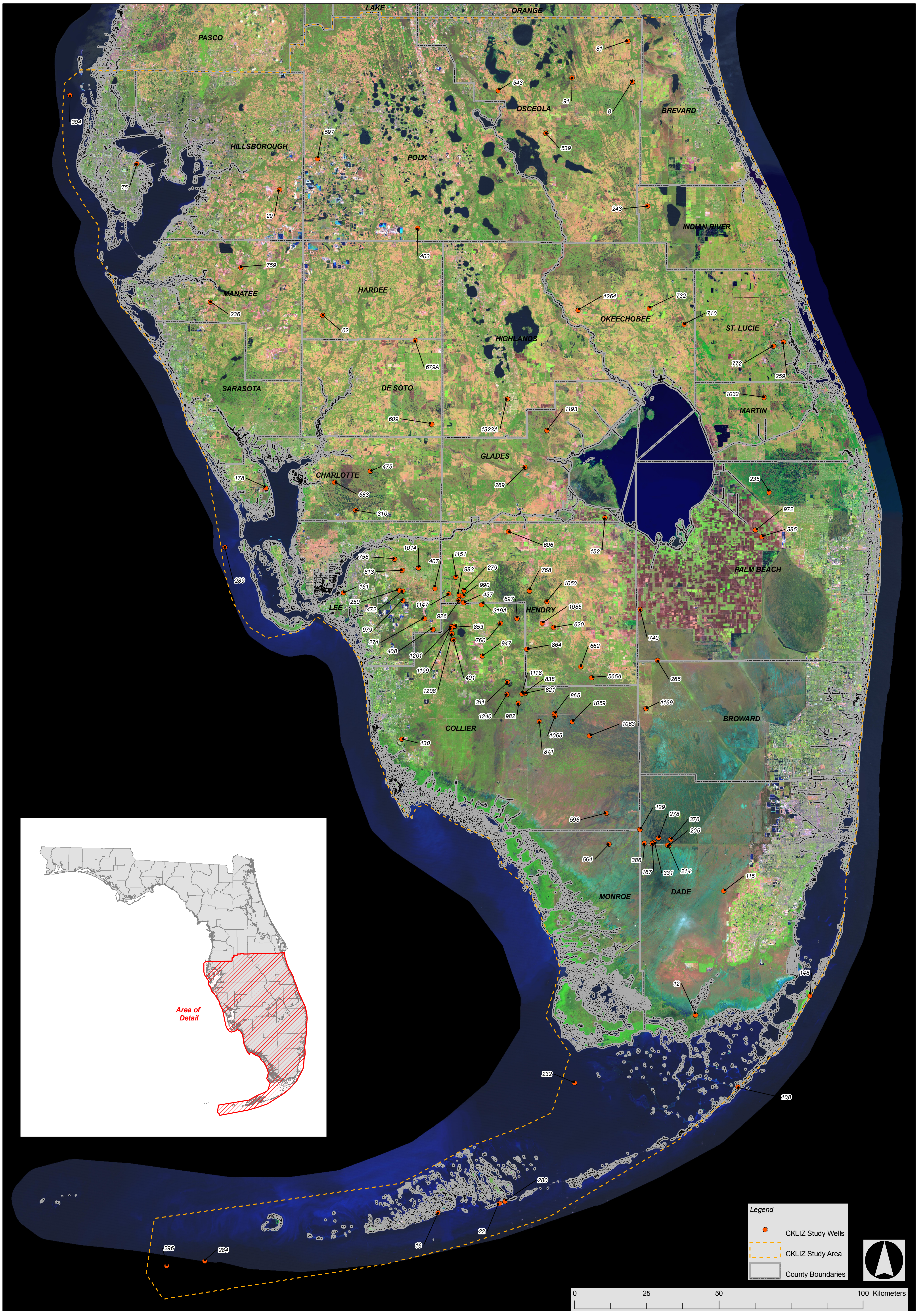


Figure AIII-2: Location map for CKLIZ study wells.

Appendix IV:
Porosity Datasets

Appendix IV

Table IV-1: Porosity data for the Sunniland Formation.

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																																													
				Estimated Porosity Value (%)										Dolostone																																			
				Limestone					Litholog					Figure AII-2					Figure AII-3					Figure AII-4					Figure AII-5					Figure AII-6					Figure AII-7					Figure AII-8					Figure AII-9
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																
683	Charlotte	25	11500	11087	11090	3	--	--	2.63	--	--	5	14-15	--	--	--	--	13	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--															
				11090	11095	5	--	--	2.46-2.47	--	--	8	--	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--													
				11095	11100	5	--	--	2.57	--	--	16	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--													
				11100	11174	74	--	--	2.6-2.65	--	--	4-6	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--													
				11193	11210	17	64-66	--	2.65-2.67	--	--	3-4	--	--	14-15	--	--	--	--	11-12	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--													
				11212	11218	6	68	--	2.42	--	--	17	--	--	17	16	--	--	--	24	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--													
				11218	11224	6	79	--	2.02	--	--	>40	--	--	25	30	--	--	--	>40	--	--	--	--	--	--	--	--	>40	--	--	--	--	--	--	--													
				11226	11230	4	68	--	2.43	--	--	17	--	--	17	17	--	--	--	23	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--													
				11234	11242	8	63	--	2.67	--	--	3	--	--	13	--	--	--	--	11	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--													
				11242	11246	4	59	--	2.75	--	--	0	--	--	9	--	--	--	--	5	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--													
				11249	11263	14	60	--	2.64-2.69	--	--	2-4	--	--	11	5-7	--	--	--	10-12	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--	--	--													
				11263	11267	4	56-57	--	2.7-2.73	--	--	0-1	--	--	7	3-4	--	--	--	5-9	--	--	--	--	--	--	--	--	5-9	--	--	--	--	--	--	--													
				11267	11275	8	71	--	2.6	--	--	6	--	--	20	--	--	--	--	14	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--													
				11286	11291	5	72	--	2.15-2.21	--	--	29-33	--	--	21	23-25	--	--	--	34-38	--	--	--	--	--	--	--	--	34-38	--	--	--	--	--	--	--													
				11291	11301	10	56	--	2.67	--	--	3	--	--	7	--	--	--	--	11	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--													
				11303	11309	6	65-66	--	2.07	--	--	37	--	--	15	25	--	--	--	>40	--	--	--	--	--	--	--	--	>40	--	--	--	--	--	--	--													
				11309	11316	7	63	--	2.55	--	--	10	--	--	13	14	--	--	--	16	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--													
				11318	11322	4	62	--	2.6	--	--	6	--	--	12	--	--	--	--	14	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--													
				11322	11332	10	67-68	--	2.49-2.52	--	--	11-13	--	--	16-17	13-14	--	--	--	19-20	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--													
				11332	11336	4	62-64	--	2.49-2.52	--	--	11-13	--	--	12-14	12	--	--	--	19-20	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--													
11336	11351	15	67-71	--	2.35-2.43	--	--	17-21	--	--	16-20	17-18	--	--	--	23-28	--	--	--	--	--	--	--	--	23-28	--	--	--	--	--	--	--																	
11351	11353	2	56	--	2.7	--	--	1	--	--	7	--	--	--	--	9	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--																	
11353	11363	10	64-66	--	2.44-2.52	--	--	11-16	--	--	14-15	12-15	--	--	--	19-23	--	--	--	--	--	--	--	--	19-23	--	--	--	--	--	--	--																	
11370	11382	12	68-71	--	2.43-2.44	--	--	16-17	--	--	17-20	16	--	--	--	23	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--																	
11382	11388	6	56-58	--	2.71	--	--	0	--	--	7-8	--	--	--	--	9	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--																	
11390	11412	22	56-59	--	2.65-2.7	--	--	1-4	--	--	7-9	--	--	--	--	9-12	--	--	--	--	--	--	--	--	9-12	--	--	--	--	--	--	--																	
11412	11427	15	60-66	--	2.64-2.71	--	--	0-4	--	--	11-15	--	--	--	--	9-12	--	--	--	--	--	--	--	--	9-12	--	--	--	--	--	--	--																	
11427	11434	7	67-68	--	2.63	--	--	5	--	--	16-17	--	--	--	--	13	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--																	
11436	11443	7	66	--	2.69	--	--	2	--	--	15	--	--	--	--	10	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--																	
11462	11466	4	60	--	2.72	--	--	0	--	--	11	--	--	--	--	8	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--																	
300	Collier	11821	11533	11536	3	59	--	--	--	--	--	9	--	--	--	--	14	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--																
			11536	11544	8	61-64	--	--	--	11-14	--	--	17-20	--	--	--	--	17-19	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--															
			11548	11554	6	60-66	--	--	--	11-15	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--															
			11554	11559	5	59	--	--	--	9	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--															
			11559	11562	3	64	--	--	--	14	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--															
			11562	11571	9	76-79	--	--	--	23-25	--	--	--	--	--	--	--	28-30	--	--	--	--	--	--	--	--	28-30	--	--	--	--	--	--	--															
			11571	11572	1	59	--	--	--	9	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--															
			11572	11574	2	62	--	--	--	12	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--															
			11574	11580	6	72-73	--	--	--	21-22	--	--	--	--	--	--	--	25-26	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--	--	--															
			11580	11582	2	55	--	--	--	6	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--															
			11582	11586	4	70	--	--	--	19	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--															
			11586	11592	6	74-77	--	--	--	22-23	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--	--															
			11592	11595	3	70	--	--	--	19	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--															
			11595	11602	7	74	--	--	--	22	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--															
			11602	11604	2	61	--	--	--	11	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--															
			11604	11608	4	73	--	--	--	22	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--															
			11608	11611	3	71	--	--	--	11	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--															
			11611	11613	2	72	--	--	--	21	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--															
			11613	11615	2	71	--	--	--	11	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--															
			11615	11622	7	73-74	--	--	--	22	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--															
11622	11625	3	70	--	--	--	19	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--																		
11625	11629	4	72	--	--	--	21	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--																		
11629	11638	9	63-66	--	--	--	13-15	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--																		
11638	11651	13	67-71	--	--	--	16-20	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--																		
11651	11663	12	63-66	--	--	--	13-15	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--																		
11663	11670	7	56-58	--	--	--	7-8	--	--	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--	--	--																		
11670	11687	17	60-66	--	--	--	11-15	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--																		
11687	11691	4	58	--	--	--	8	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--																		
11691	11699	8	68-70	--	--	--	17-19	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--	--																		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																								
				Estimated Porosity Value (%)										Dolostone														
				Limestone																								
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
311	Collier	17	11695	11699	11714	15	60-64																					
				11714	11718	4	58-59																					
				11720	11733	13	61-66																					
				11733	11736	3	55																					
				11736	11741	5	64																					
				11743	11750	7	62-64																					
				11752	11758	6	64-66																					
				11760	11770	10	54-59																					
				11770	11785	15	60-62																					
				11785	11789	4	54-59																					
				11789	11792	3	62																					
				11792	11797	5	54-59																					
				11587	11591	4	63																					
				11591	11594	3	59																					
				11594	11601	7	63-64																					
				11601	11605	4																						
				11605	11607	2	55																					
				11607	11611	4	60																					
				11611	11616	5	55																					
				11616	11619	3	62																					
				11619	11622	3	59																					
				11622	11626	4	70																					
				11626	11629	3	73																					
				11629	11632	3	70																					
				11632	11634	2	61																					
				11634	11641	7	72-76																					
11641	11651	10	74-76																									
11651	11658	7	71-73																									
11658	11663	5	68																									
11663	11668	5	63																									
11668	11676	8	65-67																									
11676	11678	2	61-66																									
11678	11695	17	61-66																									
11452	11458	6	58-60																									
11458	11466	8	75																									
11470	11474	4	62																									
11477	END	--	58																									
11566	11575	9	70																									
11575	11579	4	73																									
11583	11587	4	67																									
11587	11598	11	72-74																									
11598	11600	2	63																									
11600	11604	4	72																									
11604	11606	2	54																									
11606	11612	6	67-69																									
11612	11614	2	56																									
11614	11618	4	73																									
11618	11634	16	65-71																									
11634	11636	2	59																									
11636	11657	21	63-65																									
11657	11659	2	56																									
11659	11664	5	62-63																									
11664	11666	2	55																									
11666	11669	3	63																									
11669	11671	2	59																									
11671	11674	3	63																									
11674	11678	4	75																									
11680	11683	3	72																									
11683	11684	1	67																									
319A	Collier	38	11495																									
384	Collier	16	11705																									

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
401	Collier	24	11987	11682	11688	6	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Porous Zones																																		
Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (psec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)																							
											Limestone					Dolostone																		
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9						
697	Collier	29	13000	11836	11841	5	75	11	--	-1	--	--	--	--	6	23	0	24-26	--	15	--	--	--	--	--	--	27	--	--	--	--			
				11846	11851	5	78-80	1	--	-5	--	--	--	--	--	--	8	28	--	20	--	12-13	--	--	--	--	29-30	--	--	--	--	--		
				11864	11869	5	82	15	--	-4	--	--	--	--	--	--	--	--	12	--	20	--	14	--	--	--	31	--	--	--	--	--		
				11931	11939	8	62	24	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	16	--	--	
				11967	11971	4	72	1	--	-5	--	--	--	--	--	--	--	0	21	--	14	--	14	--	--	--	25	--	--	--	--	--		
				11971	11986	15	90-98	44-45	--	-4	--	--	--	--	--	--	--	44-45	32-34	--	--	--	--	--	--	--	--	35-38	--	--	35	--	--	
				12011	12018	7	90-98	44-45	--	-4	--	--	--	--	--	--	--	44-45	32-34	--	--	--	--	--	--	--	35-38	--	--	35	--	--		
				11489	11507	18	64-66	21-25	--	-4	--	--	--	--	--	--	--	--	14-15	--	8	--	--	--	--	--	--	19-23	19-20	16-20	--	--		
				11509	11514	5	56	11	--	9	--	--	--	--	--	--	--	10	7	--	--	--	--	--	--	--	--	12	--	--	--	--	--	
				11516	11546	30	61-66	19-24	--	-18	--	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	17-20	--	--	15-20	--	--
				11546	11557	11	67-70	26-28	--	-21	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	22-27	21-24	21-23	--	--	
				11559	11571	12	58-59	17	--	9	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	14	13	11-12	--	--	--	
11571	11576	5	63	15	--	12	--	--	--	--	--	--	--	13	13	--	12	--	12	--	--	--	--	19	--	--	--	--	--					
11578	11583	5	68	19-20	--	-12	--	--	--	--	--	--	--	17	17	--	17	--	17	--	--	--	--	22	--	--	--	--	--					
11583	11585	2	63	24	--	-22	--	--	--	--	--	--	--	23	13	--	--	--	--	--	--	--	--	--	19	--	--	17	--	--				
11587	11593	6	63	21	--	-14	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	19	15	--	--	--				
11593	11600	7	68	23-24	--	-8	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	15	22	21-22	--	--	--				
11600	11616	16	61-64	15	--	-4	--	--	--	--	--	--	--	--	10-11	11-14	--	11-13	--	--	--	--	--	--	17-19	--	--	19-20	--	--				
11618	11631	13	68-70	25-26	--	-18	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	22-24	22-24	19-20	--	--				
11631	11641	10	56-59	9	--	-6	--	--	--	--	--	--	--	8	7-9	--	7-8	--	7-8	--	--	--	--	--	12-14	--	--	--	--	--				
11644	11657	13	61-64	13-16	--	-5	--	--	--	--	--	--	--	10-12	11-14	--	10-12	--	10-12	--	--	--	--	--	--	17-19	--	--	--	--	--			
11657	11680	23	55-59	5-9	--	-5	--	--	--	--	--	--	--	5-9	6-9	--	5-9	--	5-9	--	--	--	--	--	--	11-14	--	--	--	--	--			
11680	11684	4	60	21	--	-6	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	14	16	14	--	--	--			
11700	11708	8	59	10	--	-4	--	--	--	--	--	--	--	5	9	--	9	--	9	--	--	--	--	--	--	14	--	--	14	--	--			
11648	11653	5	59	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--		
736	Collier	15	11924	11653	11664	11	61-64	--	--	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--		
				11664	11668	4	56-58	--	--	--	--	--	--	--	--	--	--	7-8	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--	
				11670	11680	10	55-58	--	--	--	--	--	--	--	--	--	--	6-8	--	--	--	--	--	--	--	--	--	11-14	--	--	--	--	--	
				11682	11687	5	59	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11689	11691	2	59	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11691	11697	6	60-61	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16-17	--	--	--	--	--
				11699	11702	3	59	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	
				11702	11731	29	60-65	--	--	--	--	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--
				11731	11733	2	56	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11733	11740	7	61	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--
				11740	11756	16	53-59	--	--	--	--	--	--	--	--	--	--	4-9	--	--	--	--	--	--	--	--	--	--	10-14	--	--	--	--	--
				11756	11760	4	63	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
11760	11762	2	59	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--				
11762	11764	2	62	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--				
11764	11766	2	55	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--				
11766	11770	4	63	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--				
11772	11776	4	55	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--				
11776	11778	2	76	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--				
11778	11779	1	63	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--				
11781	11786	5	57	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--				
11788	11789	1	54	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--				
11791	11797	6	58	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--				
11806	11813	7	54-56	--	--	--	--	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--			
11815	11822	7	60	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--			
11832	11837	5	58-59	--	--	--	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--	--			
11839	11845	6	58-59	--	--	--	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--	--			
11847	11868	21	54-55	--	--	--	--	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--			
11874	11878	4	55	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--			
11882	11885	3	55	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--			
11890	11902	12	55-57	--	--	--	--	--	--	--	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--			
11527	11535	8	66	--	23	--	-13	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	19	20	18	--	--	--			
11535	11537	2	56	--	6	--	-2	--	--	--	--	--	--	5	7	--	6	--	6	--	--	--	--	--	--	12	--	--	--	--	--			
11537	11547	10	72	--	27	--	-25	--	--	--	--	--	--	27	21	--	21	--	21	--	--	--	--	--	--	25	--	--	--	--	--			
11547	11552	5	68	--	24	--	-18	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	22	--	19	--	--	--			

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																			
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																	
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
760	Collier	29	11780	11552	11555	3	64	14	--	9	--	--	13	14	--	13	--	--	--	--	--	--	19	--	--	--	--	--	--				
				11558	11563	5	61	13	--	13	--	--	13	11	--	11	--	--	--	--	--	--	--	17	--	--	--	--	--	--			
				11570	11580	10	67	21	--	20	--	--	--	16	--	--	--	--	--	--	--	--	--	20	21	--	18	--	--	--			
				11580	11584	4	65	17	--	16	--	--	15	17	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	--			
				11586	11591	5	66	19	--	16	--	--	18	15	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	--			
				11591	11593	2	62	15	--	15	--	--	15	12	--	12	--	--	--	--	--	--	--	--	18	--	--	--	--	--			
				11593	11606	13	67-71	17-24	--	15-21	--	--	17-23	16-20	--	15-19	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--			
				11607	11611	4	64	21	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	19	--	16	--	--			
				11613	11618	5	55-56	17-18	--	7-10	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	11-12	11-12	--	11-12	--	--			
				11623	11627	4	58	11	--	10	--	--	11	8	--	9	--	--	--	--	--	--	--	--	13	--	--	--	--	--			
				11628	11633	5	65	22	--	4	--	--	--	15	--	--	--	--	--	--	--	--	--	--	14	20	--	17	--	--			
				11633	11636	3	59	23	--	11	--	--	--	9	--	--	--	--	--	--	--	--	--	--	17	14	--	14	--	--			
				11636	11641	5	64	27	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23	19	--	18	--	--			
				11643	11654	11	68	17-19	--	14-17	--	--	16-18	17	--	15-17	--	--	--	--	--	--	--	--	22	--	--	--	--	--			
				11654	11656	2	63	20	--	14	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	19	--	16	--	--			
				11656	11658	2	60	8	--	7	--	--	8	11	--	9	--	--	--	--	--	--	--	--	--	16	--	--	--	--			
				11658	11667	9	69	23	--	21	--	--	22	18	--	18	--	--	--	--	--	--	--	--	23	--	--	--	--	--			
				11667	11682	15	61-62	12-13	--	3-4	--	--	9-10	11-12	--	10	--	--	--	--	--	--	--	--	--	16-18	--	--	--	--	--		
				11684	11697	13	68	22	--	18	--	--	--	17	--	--	--	--	--	--	--	--	--	--	21	22	--	19	--	--			
				11700	11708	8	56-59	8-9	--	6-7	--	--	7-9	7-9	--	7-9	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--			
				11712	11722	10	63-65	12-13	--	6	--	--	10-11	13-15	--	11-13	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--			
				11725	11734	9	56-58	4-7	--	3-4	--	--	4-6	7-8	--	5-7	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--			
				829	Collier	11	11658	11741	11750	9	58-59	7-8	--	7-8	--	--	7-9	8-9	--	7-9	--	--	--	--	--	13-14	--	--	--	--	--	--	
								11413	11423	10	69-70	26	--	20	--	--	--	18-19	--	--	--	--	--	--	--	--	--	24	23-24	--	20	--	--
								11423	11437	14	80-84	31-34	--	22-23	--	--	27-28	26-29	--	26-28	--	--	--	--	--	--	--	30-32	--	--	--	--	--
								11437	11440	3	68	27	--	20	--	--	--	17	--	--	--	--	--	--	--	--	--	--	25	22	--	20	--
11440	11456	16	60-65					16-21	--	16-18	--	--	16-19	11-15	--	12-16	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--			
11466	11478	12	67					21	--	18	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	21	--	18	--	--			
11488	11491	3	59					10	--	4	--	--	10	9	--	10	--	--	--	--	--	--	--	--	14	--	--	--	--				
11491	11523	32	62-65					11-16	--	4-5	--	--	10-14	12-15	--	10-14	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--			
11525	11546	21	64-66					17-20	--	17-19	--	--	17-19	14-15	--	14-16	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--			
11546	11550	4	58					16	--	3	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	13	--	11	--	--			
11550	11554	4	62					18	--	16	--	--	--	12	--	--	--	--	--	--	--	--	--	--	17	18	--	15	--	--			
11554	11561	7	68					21	--	20	--	--	20	17	--	17	--	--	--	--	--	--	--	--	22	22	--	20	--	--			
11570	11578	8	64					13	--	3	--	--	11	14	--	12	--	--	--	--	--	--	--	--	19	--	--	--	--	--			
11578	11596	18	65-67					21	--	20	--	--	20	15-16	--	17	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--			
11611	11624	13	62-65					12-14	--	4-6	--	--	11-13	12-15	--	11-13	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--			
11563	11569	6	57-58					--	--	--	--	--	--	7-8	--	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--			
11572	11577	5	64					--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--			
11577	11580	3	64					--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--			
11583	11592	9	67					--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--			
11592	11597	5	60					--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--			
11597	11600	3	68					--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--			
838	Collier	18	11613					11562	11566	4	64	--	2.45	--	--	15	--	14	14	--	22	--	--	--	19	--	--	--	--	--	--		
								11566	11577	11	67	--	2.45	--	--	15	--	16	15	--	22	--	--	--	--	--	--	21	--	--	--	--	
								11580	11585	5	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	18	--	--	--	--	
								11620	11626	6	69	--	2.43	--	--	17	--	18	16	--	23	--	--	--	--	--	--	23	--	--	--	--	
								11626	11642	16	72-74	--	2.35-2.4	--	--	18-21	--	21-22	18-19	--	25-28	--	--	--	--	--	--	--	25-26	--	--	--	--
				11642	11646	4	72	--	2.35-2.4	--	--	18-21	--	21	18-19	--	25-28	--	--	--	--	--	--	25	--	--	--	--					
				11646	11649	3	64	--	2.42	--	--	17	--	14	15	--	24	--	--	--	--	--	--	19	--	--	--	--					
				11649	11659	10	69	--	2.4-2.43	--	--	17-18	--	18	16	--	23-25	--	--	--	--	--	--	23	--	--	--	--					
				11661	11664	3	60	--	2.64-2.67	--	--	3-4	--	11	--	--	11-12	--	--	--	--	--	--	16	10-12	--	--	--					
				11670	11674	4	62	--	2.5	--	--	12	--	12	12	--	20	--	--	--	--	--	--	18	--	--	--	--					
				11674	11675	1	62	--	2.47	--	--	14	--	12	13	--	21	--	--	--	--	--	--	18	--	--	--	--					
				11675	11682	7	64-65	--	2.45-2.51	--	--	12-15	--	14-15	12-14	--	19-22	--	--	--	--	--	--	19-20	--	--	--	--					
				11682	11688	6	62	--	2.55	--	--	10	--	12	10	--	--	--	--	--	--	--	--	18	--	--	--	--					
				11704	11724	20	60-64	--	2.5-2.57	--	--	--	--	11-14	11	--	16-20	--	--	--	--	--	--	16-19	--	--	--	--					

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																											
				Estimated Porosity Value (%)										Dolostone																	
				Limestone					Litholog					Figure AII-2					Figure AII-3		Figure AII-4		Figure AII-5		Figure AII-6		Figure AII-7		Figure AII-8		Figure AII-9
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
865	Collier	15	11823	11724	11728	4	64	--	2.63-2.67	--	--	--	3-5	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	--		
				11728	11735	7	67	--	2.69	--	--	2	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	
				11740	11776	36	61-64	--	2.53	--	--	11	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--
				11778	11783	5	59	--	2.68	--	--	2	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--
				11783	11790	7	62	--	2.65	--	--	4	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--
				11483	11490	7	60	20	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11493	11498	5	64	19	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11500	11506	6	59	25	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11506	11510	4	61	29	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11512	11514	2	61	33	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11514	11520	6	69	33-36	18-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11520	11525	5	66	31	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11525	11531	6	59	23	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11531	11536	5	59	17	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11536	11541	5	70	31	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11543	11547	4	81	29	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11547	11556	9	66	21	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11556	11588	32	65-67	20-25	15-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11591	11597	6	65	28	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				871	Collier	14	11920	11602	11611	9	62	17	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11611	11621	10	56-57					22	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
11623	11627	4	57-59					22	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11630	11636	6	67					22	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11647	11652	5	65					19	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11652	11657	5	55					22	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11657	11661	4	70					32	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11661	11671	10	58					28	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11672	11676	4	60					14	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11709	11725	16	62-65					16-19	13-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11625	11631	6	58					9	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11631	11642	11	60-64					10-13	9-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11645	11655	10	57-59					10-11	-1-0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11655	11665	10	61-62					11-17	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11667	11670	3	56					17	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11670	11680	10	61-63					22-25	9-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11680	11685	5	60					10	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11687	11691	4	59					12	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11691	11707	16	69-71					19-21	17-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11707	11717	10	65-66					16-17	14-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11719	11722	3	60	20	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11722	11724	2	57	11	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11724	11730	6	61	21	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11730	11737	7	58	14-17	4-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11769	11771	2	59	11	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11771	11777	6	62	15	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11777	11779	2	57	9	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11779	11784	5	59	12	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11791	11812	21	58-59	7-9	2-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11816	11822	6	63	16	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11837	11847	10	59-60	9-10	1-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11850	11856	6	59	10	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11856	11861	5	60	9	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11598	11607	9	67	20	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11607	11618	11	61	11	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11618	11628	10	67	19	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11628	11664	36	65-68	15-19	15-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11667	11683	16	65-67	16-19	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11683	11711	28	57-59	9-12	9-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11711	11731	20	56-58	10-13	4-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																							
				Estimated Porosity Value (%)																							
				Limestone						Dolostone																	
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
928	Collier	12	12991	11731	11738	7	64-65	5-6	--	5-6	--	5-6	--	10-13	--	10-13	--	--	--	--	--	19-20	--	--	--	--	
				11738	11752	14	62-66	10-13	--	2-3	--	--	--	10-13	--	10-13	--	10-13	--	--	--	--	18-20	--	--	--	--
				11754	11761	9	59	9	--	9	--	--	--	9	--	9	--	9	--	--	--	--	14	--	--	--	--
				11766	11786	20	63	9-12	--	9-12	--	--	--	9-12	--	10-11	--	10-11	--	--	--	--	19	--	--	--	--
				11867	11875	8	65-67	--	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	20-21	--	--	--	--
				11875	11891	16	62	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	18	--	--	--	--
				11891	11893	2	71	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	24	--	--	--	--
				11375	11380	5	60-62	10-11	--	1-4	--	--	--	10-11	--	10	--	10	--	--	--	--	16-18	--	--	--	--
				11393	11399	6	69-70	24	--	18	--	--	--	24	--	18-19	--	--	--	--	--	--	22	23-24	--	--	--
				11401	11407	6	63	24	--	13	--	--	--	24	--	13	--	--	--	--	--	--	20	19	--	--	--
947	Collier	26	11965	11407	11424	17	73-76	28-30	--	22-23	--	22-23	--	--	--	--	--	--	--	--	26-27	26-28	--	--	--		
				11424	11448	24	68-70	22-25	--	17-18	--	--	--	--	--	--	--	--	--	--	--	21-24	22-24	--	--	--	
				11448	11507	59	64-66	16-19	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--
				11511	11525	14	62-66	21-24	--	6-15	--	--	--	--	--	--	--	--	--	--	--	--	18-21	18-20	--	--	--
				11525	11528	3	67	23	--	16	--	--	--	--	--	16	--	--	--	--	--	--	21	21	--	--	--
				11528	11548	20	64-66	18	--	15	--	--	--	18	--	16	--	17-19	--	--	--	--	19-20	--	--	--	--
				11548	11557	9	68-70	19-21	--	3-6	--	--	--	19-21	--	14-16	--	17-19	--	--	--	--	22-24	--	--	--	--
				11561	11578	17	60-61	14-16	--	7-10	--	--	--	14-16	--	11	--	--	--	--	--	--	13-15	16-17	--	12-13	--
				11587	11593	6	64	12	--	6	--	--	--	12	--	14	--	12	--	--	--	--	19	--	--	--	--
				11595	11614	19	67-68	23-24	--	16-18	--	--	--	23-24	--	16-17	--	--	--	--	--	--	21-23	21-22	--	--	--
				11628	11640	12	62-66	6-9	--	5-6	--	5-6	--	8-12	--	8-12	--	--	--	--	18-20	--	--	--	--		
				11688	11692	4	60	9	--	9	--	--	--	9	--	11	--	9	--	--	--	--	16	--	--	--	--
				11692	11718	26	67-70	16-18	--	16-18	--	--	--	16-18	--	16-19	--	17-18	--	--	--	--	21-24	--	--	--	--
				11718	11724	6	65-66	16	--	16	--	--	--	16	--	15	--	14	--	--	--	--	20	--	--	--	--
				11724	11727	3	67	14-16	--	14-16	--	--	--	14-16	--	16	--	14-15	--	--	--	--	21	--	--	--	--
				11727	11729	2	66	17	--	15	--	--	--	17	--	15	--	15	--	--	--	--	20	--	--	--	--
				11729	11733	4	68	17	--	16	--	--	--	17	--	17	--	16	--	--	--	--	22	--	--	--	--
				11733	11737	4	64-66	15-16	--	13-14	--	--	--	15-16	--	14-15	--	13-15	--	--	--	--	19-20	--	--	--	--
				11737	11747	10	68-70	15-19	--	14-17	--	--	--	15-19	--	16-19	--	15-17	--	--	--	--	22-24	--	--	--	--
				11747	11755	8	66	16	--	15	--	--	--	16	--	16	--	16	--	--	--	--	21	--	--	--	--
				11755	11761	6	69	21	--	17	--	17	--	18	--	18	--	--	--	--	23	--	--	--	--		
				11761	11763	2	63	15	--	15	--	--	--	15	--	13	--	12	--	--	--	19	--	--	--	--	
				11763	11769	6	68	16	--	15	--	--	--	16	--	16	--	15	--	--	--	22	--	--	--	--	
				11769	11781	12	61-64	22-24	--	14-15	--	--	--	22-24	--	11-14	--	--	--	--	--	--	18-21	17-19	--	14-15	--
				11781	11786	5	68	27	--	18	--	--	--	27	--	17	--	--	--	--	--	--	24	22	--	20	--
				11786	11797	11	61-63	12-14	--	12-14	--	--	--	12-14	--	11-13	--	10-12	--	--	--	--	17-19	--	--	--	--
				11797	11803	6	57-59	16	--	10	--	--	--	16	--	7-9	--	--	--	--	--	--	14	12-14	--	11-12	--
				11803	11812	9	61-63	10-15	--	12	--	--	--	10-15	--	11-13	--	10-12	--	--	--	--	17-19	--	--	--	--
				11812	11815	3	54-55	9	--	6	--	--	--	9	--	8	--	6-7	--	--	--	--	20	--	--	--	--
				11815	11836	21	62-65	12-15	--	12-15	--	--	--	12-15	--	12-15	--	11-13	--	--	--	--	18-20	--	--	--	--
				11838	11846	8	55-59	7	--	7	--	7	--	7	--	6-8	--	--	--	--	11-14	--	--	--	--		
				11848	11862	14	55-59	6-10	--	3-10	--	--	--	6-10	--	5-10	--	5-9	--	--	--	--	11-14	--	--	--	--
				11864	11868	4	58	7	--	2	--	--	--	7	--	5	--	7	--	--	--	--	13	--	--	--	--
				11868	11873	5	63	12	--	6	--	--	--	12	--	11	--	11	--	--	--	--	19	--	--	--	--
				11873	11876	3	55	5	--	5	--	--	--	5	--	6	--	6	--	--	--	--	11	--	--	--	--
				11878	11886	8	61-65	10-12	--	3	--	--	--	10-12	--	8-10	--	10-12	--	--	--	--	17-20	--	--	--	--
				11886	11890	4	53-54	3	--	3	--	--	--	3	--	3	--	3	--	--	--	--	10	--	--	--	--
				11890	11903	13	62-65	11-12	--	1-2	--	--	--	11-12	--	7-8	--	10	--	--	--	--	18-20	--	--	--	--
				11903	11913	10	66	12-14	--	12-14	--	--	--	12-14	--	12-14	--	13	--	--	--	--	20	--	--	--	--
				11915	11932	17	54-59	6-7	--	1-4	--	--	--	6-7	--	4-7	--	6-8	--	--	--	--	10-14	--	--	--	--
				11932	11937	5	61	11	--	6	--	6	--	10	--	10	--	--	--	--	17	--	--	--	--		
				11937	11958	21	54-57	2-6	--	1-5	--	--	--	2-6	--	4-5	--	4-5	--	--	--	--	10-12	--	--	--	--
				11958	11961	3	60	10	--	3	--	--	--	10	--	7	--	9	--	--	--	--	16	--	--	--	--
				11646	11655	9	65	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	20	--	--	--	--
				11658	11667	9	66	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	20	--	--	--	--
				11670	11694	24	65-67	--	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	20-21	--	--	--	--
				11694	11699	5	70	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	24	--	--	--	--
				11699	11706	7	74-75	--	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	26-27	--	--	--	--
				11706	11711	5	82	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	31	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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982	Collier	16	11934	11711	11729	18	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																								
				Estimated Porosity Value (%)										Dolostone														
				Limestone					Litholog					Figure AII-2					Figure AII-7		Figure AII-8		Figure AII-3		Figure AII-4		Figure AII-5	
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
1063	Collier	14	11760	11643	11652	9	58-59	10	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--				
				11654	11658	4	56	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				11658	11673	15	62	12-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11673	11681	8	54	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11698	11703	5	64	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11706	11711	5	61	9-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11711	11724	13	64	11-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11725	11730	5	55	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11741	11747	6	58	8-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11756	11761	5	59	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11767	11772	5	55	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11449	11456	7	61	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11456	11461	5	56	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11463	11468	5	60	29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11470	11476	6	55	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11479	11483	4	57	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11483	11505	22	67-68	24-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11505	11510	5	62	17-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11510	11514	4	56	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11522	11526	4	53	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11533	11536	3	53	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
11536	11558	22	61-66	17-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11558	11561	3	56	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11561	11566	5	63	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11566	11571	5	67	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11571	11600	29	62-66	20-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11600	11609	9	67-69	23-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11609	11612	3	56	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11612	11618	6	60-62	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11620	11626	6	63	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11626	11634	8	56	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11634	11639	5	59	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11639	11643	4	61	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11643	11650	7	62	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11650	11661	11	60-61	13-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11661	11677	16	63-66	19-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11689	11695	6	62	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11695	11700	5	57	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11703	11710	7	56-59	9-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11504	11509	5	58	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11513	11521	8	63	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11523	11531	8	61	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11531	11537	6	55-57	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11537	11541	4	66	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11541	11548	7	62	21-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11548	11551	3	59	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11551	11573	22	61-64	13-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11573	11575	2	59	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11575	11582	7	68	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11582	11589	7	60	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11601	11614	13	67	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11614	11630	16	61-64	16-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11630	11634	4	60	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11634	11648	14	66-68	20-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11648	11654	6	57	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11661	11676	15	55-56	18-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11676	11683	7	59	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11683	11692	9	64	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
11732	11748	16	64	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone														
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
1086	Collier	10	11680	11457	11462	5	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	
				11462	11470	8	66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--
				11470	11483	13	69-70	--	--	--	--	--	--	18-19	--	--	--	--	--	--	--	--	--	--	23-24	--	--	--	--	--
				11483	11488	5	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
				11488	11495	7	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11495	11498	3	54	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--
				11498	11521	23	62-65	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--
				11521	11523	2	56	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11523	11527	4	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11527	11533	6	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
				11534	11542	8	54-57	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--
				11542	11552	10	67-69	--	--	--	--	--	--	16-18	--	--	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--
				11552	11555	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11555	11561	6	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
				11561	11575	14	56-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--
				11575	11592	17	62-66	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--
				11595	11600	5	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11603	11609	6	54-56	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--
				11611	11614	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11614	11625	11	60-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	16-18	--	--	--	--	--
				11625	11627	2	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--
				11627	11634	7	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
				11634	11640	6	56-57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
1118	Collier	17	12000	11860	11867	7	64	16-19	--	9	--	--	13-15	14	--	13-15	--	--	--	--	--	--	19	--	12	--	--	--	--	
				11872	11879	7	57	16	--	7	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	12	--	--	--	
				11880	11885	5	64	24	--	15	--	--	--	14	--	--	--	--	--	--	--	--	--	21	--	21	--	--	--	
				11887	11897	10	67	14-15	--	16-17	--	--	16-17	16	--	14	--	--	--	--	--	--	--	21	--	--	--	--	--	
				11908	11915	7	69-71	15-18	--	18	--	--	17-18	18-20	--	15-17	--	--	--	--	--	--	--	23-24	--	--	--	--	--	
				11915	11917	2	61	13	--	13	--	--	13	11	--	11	--	--	--	--	--	--	--	17	--	17	--	--	--	
				11917	11935	18	60-66	13-17	--	12-15	--	--	13-17	11-15	--	10-14	--	--	--	--	--	--	--	16-20	--	--	--	--	--	
				11937	11942	5	56-57	8	--	8	--	--	8	7	--	7	--	--	--	--	--	--	--	12	--	--	--	--	--	
				11962	11968	6	--	21	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	
				11968	11977	9	--	28-30	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--	
				11977	11979	2	--	18	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	
11979	11993	14	--	12-14	--	11-12	--	--	--	--	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--					
1119	Collier	19	12145	11982	11989	7	57-59	7	--	9-10	--	--	8-9	7-9	--	8-9	--	--	--	--	--	12-14	--	--	--	--	--			
				11991	11998	7	60-65	19-20	--	1	--	--	11	11-15	--	12-15	--	--	--	--	--	--	--	16-20	--	--	--	--	--	
				12002	12009	7	55-59	15-17	--	5-9	--	--	6-9	--	--	--	--	--	--	--	--	--	--	11-13	--	10-13	--	--	--	
				12014	12018	4	60	20	--	13	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	16	--	--	--	
				12018	12020	2	57	12	--	9	--	--	--	7	--	--	--	--	--	--	--	--	--	11	--	12	--	--	--	
				12020	12025	5	64	9-11	--	15	--	--	12-14	14	--	11-12	--	--	--	--	--	--	--	19	--	--	--	--	--	
				12025	12027	2	60	14	--	11	--	--	12	11	--	10	--	--	--	--	--	--	--	16	--	--	--	--	--	
				12027	12031	4	67	12	--	17	--	--	14	16	--	13	--	--	--	--	--	--	--	21	--	--	--	--	--	
				12031	12034	3	62	9	--	8	--	--	9	12	--	9	--	--	--	--	--	--	--	18	--	--	--	--	--	
				12057	12061	4	62	14	--	13	--	--	14	12	--	11	--	--	--	--	--	--	--	--	18	--	--	--	--	--
				12061	12066	5	64	26	--	16-18	--	--	--	14	--	--	--	--	--	--	--	--	--	20-22	--	21	--	--	--	--
				12066	12072	6	--	26-27	--	16-18	--	--	--	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--
				12072	12076	4	--	22-24	--	20	--	--	20-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				12076	12078	2	--	19	--	11	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				12078	12083	5	--	22-23	--	12-13	--	--	--	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--
				12083	12093	10	--	17-19	--	15-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12093	12100	7	--	17-18	--	8-11	--	--	--	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--				
1118	Collier	19	12145	11653	11660	7	55-56	8-11	--	2	--	--	5-6	6-7	--	6-7	--	--	--	--	--	11-12	--	--	--	--	--			
				11663	11670	7	65	22	--	4	--	--	14	15	--	15	--	--	--	--	--	--	--	20	--	--	--	--	--	
				11677	11689	12	54-59	7-15	--	6-11	--	--	8-13	4-9	--	6-10	--	--	--	--	--	--	--	10-14	--	--	--	--	--	
				11693	11712	19	67-71	18-22	--	18-22	--	--	18-22	16-20	--	15-18	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--
				11712	11724	12	64-66	18-19	--	17-18	--	--	18-19	14-15	--	14-16	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11724	11730	6	68	21	--	19	--	--	20	17	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	
				11730	11733	3	65	19	--	17	--	--	18	15	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																								
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																						
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9										
1127	Collier	23	11995	11733	11745	12	67-69	20	--	--	19	--	--	20	16-18	--	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--			
				11745	11773	28	62-66	14-19	--	--	14-17	--	--	--	--	14-17	12-15	--	11-15	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--		
				11773	11778	5	54-58	19	--	11	--	--	--	--	4-8	--	--	--	--	--	--	--	--	--	--	--	10-13	--	15	10-13	--	--	11-13	--	--	--		
				11778	11801	23	63-65	15-19	--	14-18	--	--	--	--	13-15	--	15-19	13-15	--	15-16	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--		
				11804	11813	9	55-56	12	--	6-8	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	--	--	11-12	--	10-11	11-12	--	--	9	--	--	--		
				11813	11833	20	61-64	15-18	--	12-16	--	--	--	--	--	13-17	11-14	--	11-13	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--		
				11835	11844	9	62	16	--	4	--	--	--	11	12	13	11	12	9	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--			
				11844	11849	5	56	12	--	7	--	--	--	9	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--		
				11849	11858	9	63-65	16-19	--	4	--	--	--	--	--	11-12	13-15	--	13-15	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--		
				11860	11875	15	62-64	16-17	--	3	--	--	--	--	--	10-11	12-14	--	13-14	--	--	--	--	--	--	18-19	--	--	--	--	--	--	--	--	--	--		
				11875	11887	12	67	18-22	--	15-17	--	--	--	--	--	17-19	16	--	15-17	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	
				11887	11902	15	57-58	11-13	--	4	--	--	--	--	--	8-9	7-8	--	8-9	--	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--	--	--		
				11903	11911	8	59	13	--	6	--	--	--	10	9	--	10	9	10	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	
				11911	11915	4	55	13	--	11	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	12	--	11	--	12	11	--	9	--	--	--	--	
				11915	11918	3	53	10	--	4	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	10	--	8	10	--	9-10	10-12	--	7	--	--	--	
				11920	11931	11	53-57	12-13	--	4-8	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11931	11937	6	62	16	--	12	--	--	--	14	12	13	14	12	13	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11937	11947	10	56-59	8-12	--	1-4	--	--	--	5-9	7-9	6-9	6-9	7-9	6-9	6-9	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	
1134	Collier	23	12030	11686	11694	8	56-57	7-10	--	3-4	--	--	--	7	7	6-8	6-8	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--			
				11696	11703	7	64	20	--	4	--	--	--	13	14	--	14	--	14	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--		
				11721	11725	4	64	14	--	13	--	--	--	14	14	12	14	--	12	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	
				11725	11739	14	67-68	17-19	--	14-17	--	--	--	16-19	16-17	--	16-19	16-17	--	15-16	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	--	--	
				11741	11746	5	66	16	--	15	--	--	--	16	15	--	16	15	--	16-17	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	
				11746	11754	8	68-70	19-20	--	17-18	--	--	--	18-19	17-19	--	18-19	17-19	--	16-17	--	--	--	--	--	22-24	--	--	--	--	--	--	--	--	--	--	--	
				11754	11756	2	65	17	--	15	--	--	--	16	15	--	16	15	--	14	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	
				11756	11765	9	71-72	21-23	--	20-21	--	--	--	20-22	20-21	--	20-22	20-21	--	18-19	--	--	--	--	24-25	--	--	--	--	--	--	--	--	--	--	--	--	
				11765	11767	2	69	20	--	19	--	--	--	19	18	17	19	18	--	17	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	--	
				11767	11774	7	71	22	--	20	--	--	--	21	20	--	21	20	--	18	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--	
				11774	11776	2	66	18	--	15	--	--	--	16	15	--	16	15	--	15	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	
				11776	11780	4	68	19	--	16	--	--	--	18	17	--	18	17	--	16	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	
				11780	11791	11	63-66	19	--	13	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	17	19-20	16-20	--	17	19-20	23	23	20	--	--	--	
				11791	11797	6	69	27	--	20	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	
				11797	11808	11	62-66	14	--	16	--	--	--	16	12-15	--	16	12-15	--	11-13	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	--	--	--	
				11808	11813	5	57	12	--	7	--	--	--	7	7	--	7	7	--	9	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	
				11813	11822	9	67	14	--	16-17	--	--	--	15-16	16	16	--	15-16	16	--	14	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--
				11822	11831	9	63-64	11	--	14-15	--	--	--	13-14	13-14	--	13-14	13-14	--	11	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--
11835	11845	10	54-58	8-11	--	8-9	--	--	--	8-10	4-8	--	8-10	4-8	--	6-9	--	--	--	--	10-13	--	--	--	--	--	--	--	--	--	--	--	--	--				
11845	11859	14	63-64	15-16	--	13-15	--	--	--	15-16	13-14	15-16	15-16	13-14	--	15-16	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--				
11861	11869	8	62	13	--	3	--	--	--	10	12	--	10	12	--	11	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--				
11869	11871	2	55	5	--	5	--	--	--	5	6	5	5	6	6	6	11	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--				
1142	Collier	20	11760	11871	11883	12	64-66	15-16	--	3-4	--	--	--	10-11	14-15	--	13-14	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	--			
				11886	11903	17	61-63	11-14	--	1-3	--	--	--	7-9	11-13	--	10-11	--	10-11	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	--	--	
				11904	11915	11	64-66	16	--	14-15	--	--	15	14-15	--	15	14-15	--	13-14	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	
				11917	11927	10	58-59	7-9	--	4-5	--	--	7-8	8-9	--	7-8	8-9	--	7-8	--	--	--	--	--	13-14	--	--	--	--	--	--	--	--	--	--	--	--	--
				11930	11935	5	60	11	--	6	--	--	11	11	--	10	11	--	10	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--
				11956	11960	4	60	13	--	11	--	--	12	11	--	12	11	--	10	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	
				11969	11975	6	59	11	--	3	--	--	11	11	--	10	9	--	9	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	
				11984	11989	5</																																

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																								
				Estimated Porosity Value (%)										Dolostone														
				Limestone																								
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
1201	Collier	22	11849	11682	11686	4	59	13	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11686	11692	6	57-59	16	--	13	--	--	--	7-9	--	--	10	--	--	--	--	--	--	14	--	--	--	--
				11692	11698	6	65	20	--	13	--	--	--	16	15	--	15	--	--	--	--	--	15	12-14	--	12-14	--	--
				11700	11704	4	94	34	--	39	--	--	--	35	34	--	33	--	--	--	--	--	--	37	--	--	--	--
				11704	11708	4	74	32	--	23	--	--	--	--	22	--	--	--	--	--	--	--	--	26	27	--	24	--
				11713	11731	18	61-63	16-22	--	12-20	--	--	--	--	11-13	--	--	--	--	--	--	--	--	16-20	17-19	--	13-15	--
				11731	11735	4	--	12	--	6	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11735	11744	9	--	16	--	2	--	--	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--
				11551	11557	6	--	23	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--
				11557	11564	7	--	16	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11564	11568	4	--	11	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11568	11576	8	--	10-11	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11576	11594	18	--	20-21	--	20	--	--	--	20-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11594	11596	2	--	15	--	11	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11596	11622	26	--	20-21	--	18-19	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11622	11624	2	--	18	--	15	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11624	11626	2	--	14	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11626	11630	4	--	18	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11630	11634	4	--	14	--	12	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11634	11639	5	--	17	--	16	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11639	11645	6	--	19	--	19	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11645	11663	18	--	22-24	--	21-24	--	--	--	23-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11663	11666	3	--	16	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--				
11666	11676	10	--	24	--	14	--	--	--	24	--	--	--	--	--	--	--	--	--	20	--	--	--	--				
11676	11680	4	--	14	--	13	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11680	11686	6	--	19	--	17	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11686	11693	7	--	17	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--				
11703	11708	5	--	24	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--				
11708	11712	4	--	27	--	15	--	--	--	27	--	--	--	--	--	--	--	--	--	22	--	--	--	--				
11712	11715	3	--	13	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11715	11724	9	--	18	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11724	11744	20	--	11-18	--	4-8	--	--	--	10-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
11769	11774	5	--	16	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--				
11774	11783	9	--	16	--	11	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11448	11458	10	--	2-6	--	1-3	--	--	--	2-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11460	11464	4	--	9	--	1	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11468	11477	9	--	8-9	--	3-4	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11481	11485	4	--	12	--	3	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11490	11509	19	--	16-19	--	15-18	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11511	11515	4	--	8	--	6	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11517	11522	5	--	9	--	3	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11522	11537	15	--	11-16	--	11-15	--	--	--	11-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11537	11564	27	--	19-23	--	15-19	--	--	--	17-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11564	11581	17	--	15-17	--	4-13	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11586	11593	7	59	21	--	4	--	--	--	21	--	--	--	--	--	--	--	--	--	13	14	--	14	--				
11593	11634	41	60-65	22-27	--	16	--	--	--	22-27	--	--	--	--	--	--	--	--	--	19-22	16-20	--	15-20	--				
11634	11644	10	64-65	21-28	--	9-17	--	--	--	14-15	--	--	--	--	--	--	--	--	--	16-23	19-20	--	16-20	--				
11644	11647	3	69	30	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	26	23	--	23	--				
11647	11655	8	65	20-23	--	17-12	--	--	--	15	--	--	--	--	--	--	--	--	--	18-19	20	--	16-17	--				
11659	11666	7	63	16	--	13	--	--	--	14	13	--	13	--	--	--	--	--	--	--	19	--	--	--				
11692	11696	4	58	12	--	11	--	--	--	12	8	--	9	--	--	--	--	--	--	--	13	--	--	--				
11696	11716	20	60-64	14-17	--	11-14	--	--	--	13-17	11-14	--	10-14	--	--	--	--	--	--	--	--	16-19	--	--				
11724	11734	10	57-59	19	--	8	--	--	--	--	7-9	--	--	--	--	--	--	--	--	14	12-14	--	12-13	--				
11734	11742	8	63	16	--	13	--	--	--	14	13	--	13	--	--	--	--	--	--	--	19	--	--	--				
11744	11749	5	61	13	--	2	--	--	--	8	11	--	12	--	--	--	--	--	--	--	17	--	--	--				
11751	11759	8	63-65	14-18	--	2-3	--	--	--	9-11	13-15	--	13-15	--	--	--	--	--	--	--	19-20	--	--	--				
11764	11789	25	61-63	12-14	--	1-2	--	--	--	7-9	11-13	--	10-11	--	--	--	--	--	--	--	--	17-19	--	--				
11789	11799	10	61	14	--	12	--	--	--	13	11	--	12	--	--	--	--	--	--	--	17	--	--	--				
11799	11804	5	59	9	--	2	--	--	--	6	9	--	9	--	--	--	--	--	--	--	14	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																																	
				Estimated Porosity Value (%)											Dolostone																						
				Limestone					Litholog						Figure AII-2					Figure AII-7			Figure AII-8		Figure AII-3		Figure AII-4		Figure AII-5		Figure AII-6		Figure AII-9				
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
1216	Collier	13	11755	11804	11810	6	63	13	--	--	10	--	--	--	--	--	--	--	--	--	12	13	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11822	11827	5	--	10	--	7	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11827	11832	5	--	12	--	11	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11456	11463	7	58	18	--	1	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	13	--	12	--
				11463	11469	6	65	30	--	7	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	20	--	19	--	
				11475	11479	4	57	16	--	7	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	12	--	11	--	
				11481	11486	5	59	18	--	8	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	14	--	12	--	
				11486	11490	4	60	25	--	12	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	16	--	15	--	
				11492	11502	10	61-62	28-32	--	11-12	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-22	17-18	--	17-18	--	
				11502	11509	7	53-55	15-25	--	3-5	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10-15	10-11	--	9-13	--	
				11509	11512	3	59	18	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11512	11519	7	67-68	31	--	21-22	--	--	--	16-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-26	21-22	--	21-22	--	
				11519	11524	5	60-63	15-16	--	11-12	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	
				11524	11536	12	67-70	23-24	--	16-19	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-22	21-24	--	20-22	--	
				11536	11571	35	61-66	19-29	--	12-16	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16-21	17-20	--	13-20	--	
				11571	11573	2	57	16	--	8	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	12	--	11	--	
11573	11582	9	68-71	27-28	--	19	--	--	--	17-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-25	22-24	--	20-21	--					
11582	11589	7	66	24-25	--	16	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-21	20	--	17-18	--					
11589	11596	7	56-57	22-24	--	4	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13-14	12	--	13	--					
11596	11601	5	67	24	--	16	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	21	--	17	--					
11601	11610	9	66	23	--	16	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	20	--	17	--					
11610	11614	4	68	24	--	4	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11614	11628	14	60-64	21-24	--	10-14	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17-20	16-19	--	14-17	--				
11628	11639	11	56-59	17-18	--	6-8	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13-14	12-14	--	11-12	--				
11639	11650	11	60	18	--	10-11	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15-16	16	--	13	--				
11655	11661	6	58-59	8	--	3	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	8-9	--	13-14	--				
11661	11673	12	60-63	15-17	--	14	--	--	--	15-16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10-12	11-13	--	16-19	--				
11675	11678	3	59	10	--	2	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	9	--	14	--				
11678	11684	6	60-62	11-12	--	15	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11-12	16-18	--	16-18	--				
11684	11690	6	64	19	--	4	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	19	--	15	--		
11690	11701	11	60-61	15-16	--	11-12	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12-13	16-17	--	16-17	--			
11710	11717	7	60	9	--	3	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	16	--	16	--				
11652	11658	6	64	20	--	1	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	19	--	19	--			
11663	11668	5	60	15	--	3	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	16	--	16	--			
11677	11689	12	60-62	12-18	--	8-12	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10-13	16-18	--	16-18	--			
11691	11695	4	63	22	--	4	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	19	--	19	--			
11695	11704	9	61	7-9	--	10-12	--	--	--	9-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	17	--	17	--			
11741	11748	7	63	11	--	14	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	19	--	19	--			
11748	11755	7	61	8	--	11	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	17	--	17	--			
11758	11763	5	60	8	--	8	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	16	--	16	--			
11772	11778	6	62	6	--	6	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	18	--	18	--			
11799	11805	6	62	13	--	3	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	18	--	18	--			
11824	11831	7	61	9	--	6	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	17	--	17	--			
11422	11426	4	58	--	2.29	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31	13	--	13	--			
11426	11432	6	62	--	2.35-2.37	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26-28	18	--	18	--			
11432	11437	5	59	--	2.45	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	14	--	14	--			
11437	11439	2	54	--	2.55	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	11	--	11	--			
11439	11444	5	61	--	2.55-2.59	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15-16	17	--	17	--			
11444	11446	2	54	--	2.55	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	13	--	13	--			
11446	11450	4	55-56	--	2.59	--	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	11-12	--	11-12	--			
11455	11459	4	55	--	2.51-2.53	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-19	11	--	11	--			
11459	11469	10	53-57	--	2.21	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34	10-12	--	10-12	--			
11469	11474	5	70-71	--	2.23-2.26	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32-34	24	--	24	--			
11474	11483	9	62-65	--	2.23-2.27	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-20	21-22	--	18-20	--			
11483	11500	17	66-69	--	2.23	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34	20-23	--	20-23	--			
11500	11506	6	56-57	--	2.23	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34	12	--	12	--			
11506	11510	4	67	--	2.25	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33	21	--	21	--			
11510	11524	14	66-70	--	2.23-2.45	--	--	--	--	15-19	--	--																									

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																																													
				Estimated Porosity Value (%)										Dolostone																																			
				Limestone					Litholog					Figure AII-2					Figure AII-3					Figure AII-4					Figure AII-5					Figure AII-6					Figure AII-7					Figure AII-8					Figure AII-9
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																
326	Hendry	35	11612	11529	11531	2	53	--	2.31	--	--	23	--	--	4	--	--	--	--	--	--	10	15	--	--	--	--	--	--	--	--	--	--	--															
				11531	11546	15	60-61	--	2.37-2.41	--	--	18-20	--	--	11	--	--	--	--	--	--	--	--	16-17	15-16	--	--	--	--	--	--	--	--	--	--														
				11546	11551	5	58	--	2.61	--	--	6	--	--	8	6	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--														
				11551	11557	6	60	--	2.61	--	--	6	--	--	11	6	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--														
				11557	11559	2	58	--	2.61	--	--	6	--	--	8	6	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--														
				11559	11570	11	62-63	--	2.61	--	--	6	--	--	12-13	--	--	--	--	--	--	--	--	14	14	--	--	--	--	--	--	--	--	--	--														
				11570	11577	7	58-59	--	2.61	--	--	6	--	--	8-9	6-7	--	--	--	--	--	--	--	13-14	--	--	--	--	--	--	--	--	--	--	--														
				11577	11590	13	63-66	--	2.49-2.61	--	--	6-13	--	--	13-15	12-14	--	--	--	--	--	--	--	14-20	--	--	--	--	--	--	--	--	--	--	--														
				11590	11596	6	59	--	2.61	--	--	6	--	--	9	--	--	--	--	--	--	--	--	14	13	--	--	--	--	--	--	--	--	--	--														
				11597	11611	14	60-63	--	2.49-2.55	--	--	10-13	--	--	11-13	11-12	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--														
				11611	11636	25	54-58	--	2.55-2.61	--	--	6-10	--	--	4-8	5-8	--	--	--	--	--	--	--	10-13	--	--	--	--	--	--	--	--	--	--	--														
				11449	11453	4	67	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--														
				11453	11457	4	72	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--														
				11457	11463	6	66	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--														
				11465	11470	5	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--														
11472	11485	13	72-73	--	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--	--	--	--	--	--	--																		
11485	11491	6	65-67	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	--	--	--	--	--	--																		
11491	11493	2	55	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--																		
11493	11500	7	66-70	--	--	--	--	--	--	--	15-19	--	--	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--	--	--	--	--																		
11500	11503	3	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--																		
11505	11511	6	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--																		
11516	11528	12	55-57	--	--	--	--	--	--	--	6-7	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--																		
11528	11533	5	69	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--																		
11533	11542	9	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--																		
11544	11548	4	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--																		
11548	11558	10	66-69	--	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	--	--																		
11558	11563	5	61-65	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--	--	--	--	--	--																		
11563	11565	2	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--																		
11565	11583	18	60-66	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	--																		
11583	11585	2	55	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--																		
11585	11591	6	62-63	--	--	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--	--	--	--	--	--																		
11594	11598	4	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--																		
11600	11605	5	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--																		
11605	11608	3	68	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--																		
11424	11430	6	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--																		
11430	11432	2	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--																		
11434	11437	3	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--																		
11443	11451	8	60-64	--	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--																		
11451	11454	3	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--																		
11459	11462	3	66	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--																		
11462	11467	5	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--																		
11467	11473	6	74-77	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--	--	--	--	--	--																		
11473	11475	2	67-69	--	--	--	--	--	--	--	16-18	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	--																		
11475	11477	2	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	--																		
11477	11482	5	70-71	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--																		
11484	11488	4	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--																		
11491	11495	4	89	--	--	--	--	--	--	--	31	--	--	--	--	--	--	--	--	34	--	--	--	--	--	--	--	--	--	--	--																		
11495	11501	6	83-84	--	--	--	--	--	--	--	28-29	--	--	--	--	--	--	--	--	32	--	--	--	--	--	--	--	--	--	--	--																		
11501	11507	6	67-69	--	--	--	--	--	--	--	16-18	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	--																		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																												
				Estimated Porosity Value (%)											Dolostone																	
				Limestone								Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9												
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4										Figure AII-5	Figure AII-6	Figure AII-9									
360	Hendry	34	11640	11507	11509	2	66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	--	Figure AII-6	Figure AII-9		
				11509	11511	2	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--	Figure AII-6	Figure AII-9
				11511	11512	1	69	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	Figure AII-6	Figure AII-9
				11512	11513	1	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	Figure AII-6	Figure AII-9
				11513	11515	2	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	Figure AII-6	Figure AII-9
				11515	11519	4	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	Figure AII-6	Figure AII-9
				11519	11522	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	Figure AII-6	Figure AII-9
				11522	11526	4	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	Figure AII-6	Figure AII-9
				11526	11528	2	56	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	Figure AII-6	Figure AII-9
				11531	11533	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	Figure AII-6	Figure AII-9
				11535	11537	2	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	Figure AII-6	Figure AII-9
				11539	11546	7	60-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	16-18	--	--	--	--	--	Figure AII-6	Figure AII-9
				11546	11550	4	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	Figure AII-6	Figure AII-9
				11550	11552	2	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	Figure AII-6	Figure AII-9
				11552	11557	5	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	Figure AII-6	Figure AII-9
				11557	11560	3	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	Figure AII-6	Figure AII-9
				11560	11571	11	67-71	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	Figure AII-6	Figure AII-9
				11571	11576	5	61-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--	Figure AII-6	Figure AII-9
				11576	11578	2	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	Figure AII-6	Figure AII-9
				11578	11595	17	61-65	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	Figure AII-6	Figure AII-9
11595	11597	2	54	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	Figure AII-6	Figure AII-9				
11597	11604	7	65-66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	Figure AII-6	Figure AII-9				
11606	11611	5	60-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	Figure AII-6	Figure AII-9				
11613	11620	7	60-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	Figure AII-6	Figure AII-9				
11620	11622	2	67	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	Figure AII-6	Figure AII-9				
11627	11630	3	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	Figure AII-6	Figure AII-9				
11630	11634	4	55	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	Figure AII-6	Figure AII-9				
				11451	11462	11	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	13	--	--	--	--	--	Figure AII-6	Figure AII-9			
				11462	11465	3	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11465	11467	2	55	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11467	11472	5	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11474	11479	5	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11479	11485	6	67	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11485	11490	5	61-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11490	11492	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11492	11495	3	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11495	11510	15	72-75	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11510	11512	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11512	11515	3	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11515	11521	6	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11521	11524	3	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11524	11531	7	67-70	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11531	11536	5	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11536	11538	2	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11538	11543	5	66-67	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11543	11545	2	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	Figure AII-6	Figure AII-9	
				11545	11552	7	70	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	Figure AII-6	Figure AII-9	
437	Hendry	34	11690																													

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																							
				Estimated Porosity Value (%)																							
				Limestone								Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
486	Hendry	32	11725	11552	11560	8	60-61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11560	11571	11	65-68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11571	11573	2	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11573	11579	6	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11583	11589	6	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11589	11596	7	65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11596	11620	24	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11620	11624	4	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11626	11631	5	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11633	11639	6	60-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11644	11647	3	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11647	11649	2	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11649	11652	3	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11652	11653	1	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11653	11659	6	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11659	11663	4	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11663	11670	7	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11418	11426	8	57-58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11426	11432	6	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11436	11452	16	55-56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11452	11461	9	62-63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11461	11464	3	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11464	11468	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11468	11478	10	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11480	11491	11	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11491	11495	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11495	11526	31	66-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11526	11534	8	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11534	11536	2	77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11536	11554	18	65-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11554	11556	2	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11556	11559	3	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11559	11566	7	57-58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11566	11574	8	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11574	11580	6	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11585	11612	27	60-61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11612	11622	10	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11622	11627	5	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11627	11637	10	60-63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11637	11641	4	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
				11367	11376	9	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				11376	11383	7	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11384	11388	4	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11388	11396	8	56-58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11396	11413	17	67-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11419	11423	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
11424	11435	11	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
11436	11441	5	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																																													
				Estimated Porosity Value (%)										Dolostone																																			
				Limestone					Litholog					Figure AII-2					Figure AII-3					Figure AII-4					Figure AII-5					Figure AII-6					Figure AII-7					Figure AII-8					Figure AII-9
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Figure AII-2	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Figure AII-2	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9															
488	Hendry	32	11517	11443	11451	8	64	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
				11452	11460	8	61-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--													
				11462	11466	4	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--												
				11466	11470	4	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--												
				11470	11472	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--												
				11474	11480	6	67-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
				11480	11487	7	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--												
				11487	11502	15	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--												
				11502	11504	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
				11504	11507	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
				11507	11517	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
				11435	11442	7	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
				11448	11451	3	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--											
11455	11459	4	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--															
11466	11470	4	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--															
11472	11482	10	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--															
11483	11490	7	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--															
11495	11501	6	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--															
11501	11503	2	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
11503	11517	14	72-75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
11517	11522	5	65-67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
11524	11535	11	60-66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
11535	11542	7	68-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
11544	11550	6	64-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--														
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																							
				Estimated Porosity Value (%)																							
				Limestone								Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
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				11834	11842	8	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11848	11855	7	55-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11383	11392	9	57-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11396	11401	5	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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				11430	11433	3	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11433	11436	3	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11436	11453	17	68-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11453	11466	13	58-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11469	11476	7	61-62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11476	11489	13	67-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11489	11494	5	62-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11494	11504	10	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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				11526	11536	10	64-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11536	11554	18	55-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11554	11559	5	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11559	11564	5	54-57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11564	11578	14	61-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11578	11584	6	55-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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				11609	11621	12	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11566	11574	8	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				11579	11583	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
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				11594	11598	4	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11602	11611	9	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11614	11627	13	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
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				11636	11639	3	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11640	11645	5	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11645	11649	4	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																							
				Estimated Porosity Value (%)																							
				Limestone							Dolostone																
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
864	Hendry	25	11864	11649	11651	2	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				11651	11667	16	69-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11667	11672	5	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11672	11675	3	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11675	11689	14	68-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11692	11696	4	56-58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11701	11716	15	60-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11716	11718	2	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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				11724	11726	2	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11726	11736	10	68-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11736	11738	2	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11738	11743	5	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11744	11759	15	61-62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11759	11761	2	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11761	11769	8	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11770	11789	19	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11793	11804	11	61-63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
11809	11814	5	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
11826	11834	8	57-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
904	Hendry	34	11686	11454	11460	6	--	--	2.7	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--		
				11480	11484	4	--	--	2.65	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--
				11484	11488	4	--	--	2.56-2.61	--	--	--	--	--	--	--	--	--	--	14-17	--	--	--	--	--	--	--
				11488	11497	9	--	--	2.37	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--
				11497	11502	5	--	--	2.45	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--
				11502	11508	6	--	--	2.58-2.6	--	--	--	--	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--
				11508	11510	2	--	--	2.49	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--
				11510	11517	7	--	--	2.4	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--
				11517	11522	5	--	--	2.47	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--
				11522	11526	4	--	--	2.68	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--
				11526	11529	3	--	--	2.55	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--
				11529	11533	4	--	--	2.65	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--
				11533	11540	7	--	--	2.55-2.58	--	--	--	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--
				11540	11548	8	--	--	2.57-2.61	--	--	--	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--
				11548	11552	4	--	--	2.64	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--
				11552	11557	5	--	--	2.54	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--
				11566	11573	7	--	--	2.55	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--
								11458	11465	7	--	--	2.69	--	--	--	--	--	--	--	10	--	--	--	--	--	--
11480	11481	1	--					--	2.68	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	
11481	11485	4	--					--	2.57	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	
11485	11488	3	--					--	2.64	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	
11488	11494	6	--					--	2.56-2.6	--	--	--	--	--	--	--	--	--	14-17	--	--	--	--	--	--	--	
11494	11496	2	--					--	2.63	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	
11496	11500	4	--					--	2.52	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	
11500	11505	5	--					--	2.34	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	
11505	11508	3	--					--	2.43-2.44	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	
11508	11513	5	--					--	2.38-2.39	--	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--	--	--	
11513	11515	2	--					--	2.45	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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926	Hendry	34	11705	11518	11523	5	--	--	2.56-2.63	--	--	--	5-9	--	--	--	--	--	--	--	--	13-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																			
				Estimated Porosity Value (%)										Dolostone									
				Limestone					Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9						
Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9															
1026	Hendry	30	11696	11509	11521	12	74-76	25-28	--	--	21-22												
				11521	11536	15	64	22	--	--	7												
				11536	11538	2	59	15	--	--	8												
				11538	11540	2	63-64	17-19	--	--	9												
				11540	11543	3	70	22	--	--	18												
				11543	11551	8	74	25	--	--	21												
				11551	11560	9	63-66	12-17	--	--	10-12												
				11560	11570	10	64	15	--	--	2												
				11570	11574	4	58-59	10-11	--	--	2-3												
				11574	11594	20	60-64	10-16	--	--	-1-4												
				11596	11612	16	60-65	11-19	--	--	4-12												
				11614	11625	11	61-65	13-14	--	--	2-4												
				11629	11638	9	55-57	9	--	--	3-4												
				11640	11646	6	62	13	--	--	1												
				11351	11356	5	60	14	--	--	5												
				11356	11359	3	56	12	--	--	3												
				11359	11370	11	61-63	14	--	--	5												
11380	11385	5	57	17	--	--	7																
11385	11394	9	57-59	17-18	--	--	6																
11394	11398	4	57	17	--	--	5																
11398	11402	4	61	19	--	--	9																
11402	11408	6	59	19	--	--	9																
11408	11414	6	56	11	--	--	9																
11414	11421	7	69	21	--	--	20																
11421	11428	7	64	17-18	--	--	14																
11428	11434	6	--	17	--	--	13																
11434	11443	9	--	22	--	--	18																
11443	11451	8	--	19-20	--	--	4-6																
11466	11486	20	58	--	--	--	--																
11489	11496	7	61-63	--	--	--	--																
11496	11507	11	72	--	--	--	--																
11354	11362	8	55-59	5-9	--	--	0-3																
11365	11368	3	59	11	--	--	2																
11371	11375	4	61	12	--	--	5																
11377	11382	5	57-58	8-10	--	--	3-4																
11385	11387	2	55	10	--	--	6																
11387	11393	6	56	15	--	--	2																
11402	11410	8	55-56	16	--	--	5																
11419	11422	3	64	14	--	--	14																
11422	11424	2	56	11	--	--	8																
11424	11433	9	62-63	17-18	--	--	12-13																
11433	11435	2	58	13	--	--	7																
11435	11450	15	67-69	20-22	--	--	15-19																
11454	11459	5	--	15	--	--	9																
11461	11466	5	--	17-18	--	--	4-11																
11466	11473	7	--	20-23	--	--	18-19																
11473	11486	13	--	18	--	--	11-15																
11379	11400	21	54-58	4-9	--	--	1-6																
11401	11405	4	64	21	--	--	15																
11409	11415	6	60-61	12	--	--	12																
11417	11422	5	60	12	--	--	12																
11425	11429	4	62	7	--	--	1																
11429	11436	7	60	9-12	--	--	9-11																

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones																							
				Estimated Porosity Value (%)																							
				Limestone								Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
1292	Hendry	30	11620	11436	11441	5	71	19	--	--	17	--	--	--	18	18	--	--	--	--	--	--	--	--	--		
				11441	11444	3	64	14	--	--	14	--	--	--	--	--	--	14	13	--	--	--	--	--	--	--	--
				11444	11451	7	71-72	19	--	--	18	--	--	--	--	--	--	18	18	--	--	--	--	--	--	--	--
				11451	11455	4	63	14	--	--	14	--	--	--	--	--	--	14	12	--	--	--	--	--	--	--	--
				11455	11462	7	70	24	--	--	21	--	--	--	--	--	--	21	20	--	--	--	--	--	--	--	--
				11463	11469	6	61	11	--	--	9	--	--	--	--	--	--	10	10	--	--	--	--	--	--	--	--
				11469	11474	5	65	19	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11474	11480	6	69	19	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11480	11484	4	63	13	--	--	11	--	--	--	--	--	--	13	12	--	--	--	--	--	--	--	--
				11484	11495	11	60-62	11-12	--	--	13-14	--	--	--	--	--	--	12	10-12	--	--	--	--	--	--	--	--
				11495	11502	7	66	18	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11502	11526	24	57-59	6-8	0-1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11526	11537	11	62-64	10-11	1-2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11537	11541	4	54-55	6	5	--	--	--	--	--	--	--	--	5	5	--	--	--	--	--	--	--	--
				11541	11545	4	64	11	10	--	--	--	--	--	--	--	--	11	11	--	--	--	--	--	--	--	--
				11545	11559	14	58	3	1	--	--	--	--	--	--	--	--	2	4	--	--	--	--	--	--	--	--
11570	11574	4	62	9	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
425	Lee	30	11743	11470	11475	5	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--		
				11475	11489	14	57-59	--	--	--	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	
				11489	11496	7	65	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	
				11496	11499	3	57	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	
				11507	11555	48	65-70	--	--	--	--	--	--	--	--	--	15-19	--	--	--	--	--	--	--	--	--	--
				11555	11564	9	59	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	
				11564	11570	6	61-65	--	--	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	
				11570	11591	21	64-65	--	--	--	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	
				11591	11596	5	59	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	
				11596	11616	20	58	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	
				11626	11666	40	61-64	--	--	--	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--
				11668	11672	4	59	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--
				11672	11676	4	61	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--
				11676	11681	5	56	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--
				11693	11698	5	57	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--
				11703	11707	4	57-59	--	--	--	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--
527	Lee	28	11712	11415	11421	6	57-58	--	--	--	--	--	--	7-8	--	--	--	--	--	--	--	--	--	--	--		
				11421	11426	5	68	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	
				11426	11428	2	62-64	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	
				11428	11431	3	59	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	
				11431	11444	13	60-65	--	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	
				11447	11448	1	61	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	
				11448	11450	2	79	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	
				11450	11452	2	87	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--	--	
				11452	11457	5	61-66	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--	--	
				11457	11459	2	54	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	
				11459	11472	13	67-70	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--
				11472	11483	11	60-62	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--
				11483	11485	2	56	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--
				11485	11491	6	60-62	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--
				11491	11493	2	56	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--
				11493	11498	5	63	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--
11498	11502	4	57	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--				
527	Lee	28	11712	11502	11508	6	60-61	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--		
				11508	11514	6	57-59	--	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	--	
				11514	11527	13	60-63	--	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	--	
				11534	11539	5	56	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	
				11540	11541	1	70	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	
				11542	11548	6	58-59	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	--	--	
				11556	11565	9	58-59	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	--	--	
				11565	11567	2	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	
				11567	11569	2	58	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	
				11569	11574	5	61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	
				11574	11579	5	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	
				11579	11584	5	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	
				11584	11589	5	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	
				11589	11594	5	65	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	
				11594	11599	5	66	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	
				11599	11604	5	67	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	

Appendix IV (Continued)

Porous Zones																									
Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)														
											Limestone					Dolostone									
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
684	Lee	29	11740	11569	11572	3	60	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--			
				11572	11578	6	58-59	--	--	--	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--	
				11578	11594	16	60-63	--	--	--	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--
				11596	11604	8	57-59	--	--	--	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--
				11628	11632	4	61	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--
				11472	11480	8	57-59	--	--	--	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--
				11480	11482	2	69	--	--	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--
				11482	11505	23	73-74	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--
				11505	11517	12	65-66	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--
				11517	11519	2	56	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--
				11519	11534	15	61-66	--	--	--	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--
				11534	11539	5	68	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--
				11539	11545	6	63-65	--	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--
				11545	11547	2	59	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--
				11547	11562	15	62-64	--	--	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--
				11562	11570	8	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--
				11573	11578	5	59	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--
				11580	11582	2	57	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--
				11584	11590	6	64	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--
				11590	11599	9	58	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--
				11608	11612	4	56-58	--	--	--	--	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--
11620	11656	36	62-66	--	--	--	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--				
11659	11662	3	59	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--				
11662	11666	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--				
11687	11692	5	68	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--				
735	Lee	31	12000	11703	11706	3	55	2	--	--	--	--	--	--	--	0	--	--	11	--	--	--	--		
				11706	11710	4	64	22	--	--	--	--	--	--	--	--	--	--	14	--	--	19	--	--	
				11710	11714	4	54-59	15	--	--	--	--	--	--	--	--	--	--	--	7	--	--	9-11	--	--
				11714	11724	10	67-69	16-17	--	--	--	--	--	--	--	--	--	--	--	15-16	--	--	10-14	--	--
				11724	11726	2	59	21	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	14	--
				11726	11738	12	73-74	20-21	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	26	--	--
				11740	11743	3	66	16	--	--	--	--	--	--	--	--	--	--	--	15	--	--	20	--	--
				11743	11752	9	69-71	18-21	--	--	--	--	--	--	--	--	--	--	--	18	--	--	10-13	--	--
				11752	11756	4	63	9	--	--	--	--	--	--	--	--	--	--	--	10	--	--	3	--	--
				11756	11761	5	68	17	--	--	--	--	--	--	--	--	--	--	--	17	--	--	9	--	--
				11761	11767	6	60-64	12-14	--	--	--	--	--	--	--	--	--	--	--	11-13	--	--	5-7	--	--
				11767	11774	7	72	18-20	--	--	--	--	--	--	--	--	--	--	--	16-18	--	--	10-12	--	--
				11774	11802	28	66-71	16-18	--	--	--	--	--	--	--	--	--	--	--	16-18	--	--	25	--	--
				11802	11815	13	60-66	13-17	--	--	--	--	--	--	--	--	--	--	--	14-16	--	--	20-24	--	--
				11815	11817	2	55	17	--	--	--	--	--	--	--	--	--	--	--	11-15	--	--	16-20	--	--
				11817	11821	4	63	13	--	--	--	--	--	--	--	--	--	--	--	6	--	--	11	--	--
				11821	11833	12	54-58	8-11	--	--	--	--	--	--	--	--	--	--	--	13	--	--	19	--	--
				11833	11837	4	60	11	--	--	--	--	--	--	--	--	--	--	--	4-8	--	--	10-13	--	--
				11837	11839	2	54	5	--	--	--	--	--	--	--	--	--	--	--	11	--	--	4	--	--
				11839	11845	6	64	13-14	--	--	--	--	--	--	--	--	--	--	--	5	--	--	1	--	--
				11845	11849	4	59	12	--	--	--	--	--	--	--	--	--	--	--	12	--	--	6-7	--	--
11856	11863	7	60	9	--	--	--	--	--	--	--	--	--	--	--	9	--	--	14	--	--				
11863	11868	5	58-59	8-9	--	--	--	--	--	--	--	--	--	--	--	11	--	--	3	--	--				
11868	11896	28	60-63	9-13	--	--	--	--	--	--	--	--	--	--	--	8-9	--	--	2-3	--	--				
11896	11898	2	57	11	--	--	--	--	--	--	--	--	--	--	--	9-11	--	--	3-6	--	--				
11903	11908	5	58	4-7	--	--	--	--	--	--	--	--	--	--	--	11	--	--	4	--	--				
11908	11914	6	61	10	--	--	--	--	--	--	--	--	--	--	--	7-8	--	--	12	--	--				
11914	11917	3	58	9	--	--	--	--	--	--	--	--	--	--	--	8	--	--	0.5-2	--	--				
11932	11939	7	56-57	6	--	--	--	--	--	--	--	--	--	--	--	10	--	--	13	--	--				
11384	11392	8	54	10-13	--	--	--	--	--	--	--	--	--	--	--	9-11	--	--	16-19	--	--				
11392	11400	8	56	21	--	--	--	--	--	--	--	--	--	--	--	7	--	--	12	--	--				
11400	11408	8	58	19	--	--	--	--	--	--	--	--	--	--	--	8	--	--	13	--	--				
11410	11429	19	55	17	--	--	--	--	--	--	--	--	--	--	--	16	--	--	10	--	--				
11445	11452	7	53	16	--	--	--	--	--	--	--	--	--	--	--	10	--	--	11	--	--				

Appendix IV (Continued)

Porous Zones																									
Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)														
											Limestone					Dolostone									
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
758	Lee	20	12601	11452	11456	4	53	21	--	15	--	--	--	--	--	--	19	10	--	10	--				
				11456	11461	5	72	35	--	--	--	--	--	--	--	--	--	30	25	--	24	--			
				11461	11464	3	66	21	--	--	18	15	15	--	--	--	--	--	20	20	--	--	--		
				11467	11486	19	58	9	--	--	9	8	8	--	--	--	--	--	--	13	--	--	--	--	
				11486	11492	6	53	12	--	--	4	--	--	--	--	--	--	--	--	10	10	10	--	--	
				11572	11581	9	56	17	--	--	7	--	--	--	--	--	--	--	--	12	12	12	--	--	
				11693	11703	10	56-58	--	--	--	7-8	--	--	--	--	--	--	--	--	12-13	--	--	--	--	
				11703	11707	4	61	--	--	--	11	--	--	--	--	--	--	--	--	17	--	--	--	--	
				11710	11714	4	63	--	--	--	13	--	--	--	--	--	--	--	--	--	19	--	--	--	--
				11714	11719	5	53-55	--	--	--	4-6	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--
858	Lee	19	11834	11722	11726	4	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				11728	11732	4	58	--	--	--	8	--	--	--	--	--	--	--	--	--	13	--	--	--	
				11732	11740	8	62-63	--	--	--	12-13	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--
				11740	11743	3	58	--	--	--	8	--	--	--	--	--	--	--	--	--	13	--	--	--	--
				11747	11749	2	61	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--
				11752	11758	6	66	--	--	--	15	--	--	--	--	--	--	--	--	--	20	--	--	--	--
				11758	11761	3	65	--	--	--	15	--	--	--	--	--	--	--	--	--	20	--	--	--	--
				11761	11767	6	72-73	--	--	--	21-22	--	--	--	--	--	--	--	--	--	25-26	--	--	--	--
				11767	11774	7	67-71	--	--	--	16-20	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--
				11774	11778	4	65-66	--	--	--	15	--	--	--	--	--	--	--	--	--	20	--	--	--	--
859	Lee	19	11786	11778	11783	5	67-68	--	--	--	--	--	--	--	--	--	--	--	21-22	--	--	--	--		
				11783	11785	2	66	--	--	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--	
				11785	11787	2	67	--	--	--	16	--	--	--	--	--	--	--	--	21	--	--	--	--	
				11787	11801	14	60-66	--	--	--	11-15	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--
				11801	11807	6	66-67	--	--	--	15-16	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--
				11807	11817	10	61-63	--	--	--	11-13	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--
				11828	11832	4	60	--	--	--	11	--	--	--	--	--	--	--	--	--	16	--	--	--	--
				11663	11671	8	56-58	--	--	--	7-8	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--
				11671	11675	4	61	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--
				11679	11683	4	61	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--
1014	Lee	23	11695	11683	11691	8	55-57	--	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--		
				11693	11701	8	58-59	--	--	--	8-9	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--
				11701	11705	4	54	--	--	--	4	--	--	--	--	--	--	--	--	--	10	--	--	--	--
				11705	11713	8	61	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--
				11721	11744	23	69-70	--	--	--	18-19	--	--	--	--	--	--	--	--	--	23-24	--	--	--	--
				11744	11753	9	63-65	--	--	--	13-15	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--
				11753	11759	6	67	--	--	--	16	--	--	--	--	--	--	--	--	--	21	--	--	--	--
				11759	11767	8	61-65	--	--	--	11-15	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--
				11771	11786	15	62-66	--	--	--	12-15	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--
				11425	11434	9	55-59	10	--	2-4	--	--	7-9	--	--	--	--	--	--	--	11-14	--	--	--	--
				11434	11438	4	60	11	--	4	--	--	--	--	--	--	6-8	6-9	--	10	--	16	--	--	
				11441	11444	3	62	13	--	--	11	12	11	--	--	--	--	--	--	11	--	18	--	--	--
				11444	11449	5	59	6	--	--	5	9	7	--	--	--	--	--	--	--	14	--	--	--	--
				11452	11459	7	54-56	14	--	--	--	4-7	--	--	--	--	--	--	--	--	9	10-12	9-10	--	--
				11459	11464	5	61	18	--	--	--	11	--	--	--	--	--	--	--	--	10	17	15	--	--
				11464	11483	19	69-70	19-21	--	--	18-20	18-19	16-17	--	--	--	--	--	--	--	23-24	--	--	--	--
				11487	11491	4	59	10	--	--	10	9	9	--	--	--	--	--	--	--	14	--	--	--	--
				11491	11499	8	69-70	21-22	--	--	20-22	18-19	17-18	--	--	--	--	--	--	--	23-24	--	--	--	--
				11499	11503	4	64-65	17-18	--	--	17	14-15	15-17	--	--	--	--	--	--	--	19-20	--	--	--	--
				11503	11509	6	68	18	--	--	18	17	16	--	--	--	--	--	--	--	22	--	--	--	--
				11509	11519	10	60-63	15-16	13	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--		
				11519	11522	3	59	13	--	--	11	9	10	--	--	--	--	--	--	--	14	--	--	--	--
				11522	11531	9	68-69	20-21	--	--	18-20	17-18	16-17	--	--	--	--	--	--	--	22-23	--	--	--	--
				11531	11537	6	72	23	--	--	22	21	19	--	--	--	--	--	--	--	25	--	--	--	--
				11538	11543	5	61	25	--	--	--	11	17	--	--	--	--	--	--	--	19	17	15	--	--
				11543	11546	3	58	25	--	--	--	8	--	--	--	--	--	--	--	--	18	13	17	--	--
				11546	11557	11	54-56	19-22	--	--	--	4-7	--	--	--	--	--	--	--	--	13-15	10-12	11-13	--	--
				11557	11561	4	68	25	--	--	--	17	--	--	--	--	--	--	--	--	16	22	21	--	--
				11561	11565	4	66	23	--	--	--	15	--	--	--	--	--	--	--	--	16	20	17	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																	
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone															
											Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
278	Miami-Dade	10	11675	11565	11573	8	54-59	4-13	--	4-10	--	--	4-12	4-9	--	4-8	--	--	--	--	--	--	10-14	--	--	--	--	--	--		
				11573	11591	18	62-63	15-17	--	10-14	--	--	13-16	12-13	--	12-13	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--
				11591	11609	18	59	9-11	--	2-4	--	--	6-9	9	--	8-9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11609	11614	5	60	12	--	5	--	--	10	11	--	10	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--
				11614	11616	2	59	10	--	3	--	--	8	9	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11616	11619	3	60	12	--	2	--	--	7	11	--	9	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--
				11619	11623	4	59	11	--	2	--	--	7	9	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11623	11641	18	60-63	11-17	--	1-4	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	7-11	16-19	--	11-15	--	--	--
				11643	11652	9	57	7-10	--	3-4	--	--	6-7	7	--	7-8	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
				11669	11674	5	59	10	--	2	--	--	7	9	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11387	11403	16	62-64	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--
				11403	11415	12	64-66	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--
				11415	11418	3	75	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	27	--	--	--	--	--	--
				11418	11421	3	65-66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
				11421	11424	3	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--
				11424	11426	2	70	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--
				11426	11427	1	75-78	--	--	--	--	--	--	23-24	--	--	--	--	--	--	--	--	--	--	27-29	--	--	--	--	--	--
				11427	11430	3	82	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--	--
				11430	11438	8	61-65	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--
				11438	11440	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
				11440	11464	24	61-64	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--
				11464	11466	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
				11466	11475	9	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				11475	11509	34	65-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--
				11509	11511	2	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				11511	11517	6	67	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--
				11517	11520	3	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				11520	11534	14	63-66	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--
				11534	11538	4	61-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--
				11538	11547	9	66-69	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--
				11547	11549	2	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				11549	11552	3	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
				11552	11556	4	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				11556	11568	12	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--
				11568	11570	2	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				11570	11584	14	65-67	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	--
				11584	11586	2	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11586	11589	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11589	11592	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--
				11592	11598	6	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				11598	11600	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
				11600	11601	1	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				11601	11603	2	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
				11603	11617	14	64-66	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--
				11617	11619	2	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				11619	11625	6	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
				11625	11646	21	60-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	16-18	--	--	--	--	--	--
				11333	11335	2	54	--	--	--	--	--	4	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--			
				11335	11341	6	62-63	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--	
				11341	11346	5	56-59	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	
				11346	11350	4	67	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	
				11350	11358	8	62-64	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--	
				11358	11360	2	55	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	
				11360	11364	4	67	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	
				11364	11371	7	62-66	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	
				11371	11383	12	67-70	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	
				11383	11385	2	59	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	
				11385	11394	9	60-66	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	
				11394	11397	3	55	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone														
											Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
331	Miami-Dade	9	11615	11397	11404	7	57-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	
				11407	11437	30	64-66	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11437	11440	3	55-56	--	--	--	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--
				11440	11443	3	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
				11443	11448	5	57-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--
				11448	11454	6	63-65	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11454	11461	7	54-56	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--
				11461	11466	5	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--
				11466	11470	4	65-66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--
				11470	11472	2	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--
				11472	11476	4	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
				11476	11479	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11479	11489	10	60-66	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--
				11489	11491	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--
				11491	11502	11	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
				11502	11508	6	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--
				11508	11515	7	62-64	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--
				11517	11531	14	62-66	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--
				11531	11533	2	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				11533	11535	2	55	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--
				11535	11539	4	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
				11539	11541	2	54	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--
				11541	11544	3	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
				11544	11550	6	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--
				11554	11558	4	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--
376	Miami-Dade	9	11538	11365	11367	2	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	16	--	--	--	--	--		
				11367	11386	19	63-65	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	
				11386	11403	17	72-77	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-28	--	--	--	--	--
				11403	11408	5	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	
				11408	11411	3	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	
				11419	11431	12	64-66	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11431	11436	5	67	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	
				11436	11448	12	64-65	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11448	11459	11	56-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--
				11459	11467	8	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--
				11469	11478	9	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--
				11478	11487	9	63-65	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				11489	11499	10	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
				11499	11502	3	56	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				11502	11511	9	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
				11523	11538	15	61-64	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--
				11681	11683	2	61	--	2.95	--	--	--	--	11	--	--	--	--	--	--	5	--	--	--	17	3	--	--	--	--
				11685	11687	2	58	--	2.95	--	--	--	--	8	--	--	--	--	--	--	5	--	--	--	13	2	--	--	--	--
				11694	11696	2	63	--	2.95	--	--	--	--	8	--	--	--	--	--	--	5	--	--	--	19	3	--	--	--	--
				11696	11699	3	59	--	2.95	--	--	--	--	8	--	--	--	--	--	--	5	--	--	--	14	2	--	--	--	--
				11699	11702	3	60	--	2.95	--	--	--	--	8	--	--	--	--	--	--	5	--	--	--	16	3	--	--	--	--
				11702	11705	3	81	--	2.52	--	--	--	--	27	--	--	--	--	--	--	19	--	--	--	31	22	--	--	--	--
				11705	11709	4	67	--	2.46-2.48	--	--	--	--	16	14-15	--	--	--	--	--	21-22	--	--	--	21	--	--	--	--	--
				11709	11712	3	77	--	2.52	--	--	--	--	23	22	--	--	--	--	--	19	--	--	--	28	--	--	--	--	--
				11713	11716	3	69	--	2.63	--	--	--	--	18	--	--	--	--	--	--	13	--	--	--	23	15	--	--	--	--
11716	11717	1	77	--	2.68	--	--	--	--	23	--	--	--	--	--	--	10	--	--	--	28	15	--	--	--	--				
11721	11721	4	80-81	--	2.65-2.67	--	--	--	--	26-27	--	--	--	--	--	--	11-12	--	--	--	30-31	17	--	--	--	--				
11721	11726	5	65-66	--	2.66-2.7	--	--	--	--	15	14	--	--	--	--	--	9-11	--	--	--	20	--	--	--	--	--				
11726	11728	2	75	--	2.63	--	--	--	--	18	17	--	--	--	--	--	13	--	--	--	27	13	--	--	--	--				
11728	11733	5	60-66	--	2.63-2.69	--	--	--	--	11-15	5-7	--	--	--	--	--	10-13	--	--	--	16-20	--	--	--	--	--				
11733	11736	3	59	--	2.65	--	--	--	--	9	--	--	--	--	--	--	12	--	--	--	14	12	--	--	--	--				
11736	11742	6	61-64	--	2.6-2.65	--	--	--	--	11-14	10-12	--	--	--	--	--	10-12	--	--	--	17-19	--	--	--	--	--				
11742	11745	3	55	--	2.6-2.63	--	--	--	--	4-5	5-6	--	--	--	--	--	10-13	--	--	--	11	--	--	--	--	--				
11745	11751	6	77	--	2.56	--	--	--	--	9	--	--	--	--	--	--	17	--	--	--	28	19	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zones										Estimated Porosity Value (%)																							
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	True Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																					
											Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9										
754	Monroe	5	12865	11752	11754	2	56	--	2.5	--	12	--	--	7	10	--	--	--	20	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--			
				11757	11760	3	55	--	2.55	--	10	--	--	6	8	--	--	--	--	16	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--		
				11760	11763	3	59	--	2.54-2.57	--	8-10	--	--	9	8-9	--	--	--	--	16-18	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--		
				11771	11776	5	58	--	2.64-2.68	--	2-4	--	--	8	--	--	--	--	--	10-12	--	--	--	13	11-12	--	--	--	--	--	--	--	--	--	--		
				11778	11786	8	58-59	--	2.65-2.73	--	0-4	--	--	8-9	--	--	--	--	--	8-12	--	--	--	13-14	11-12	--	--	--	--	--	--	--	--	--	--		
				11786	11788	2	71	--	2.72	--	0	--	--	20	--	--	--	--	--	8	--	--	--	24	12	--	--	--	--	--	--	--	--	--	--		
				11788	11790	2	80	--	2.72	--	0	--	--	26	--	--	--	--	--	8	--	--	--	30	15	--	--	--	--	--	--	--	--	--	--		
				11790	11794	4	60-65	--	2.55	--	10	--	--	11-15	10-12	--	--	--	--	16	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	--	--	
				11794	11798	4	67-68	--	2.37-2.44	--	16-20	--	--	16-17	16-18	--	--	--	--	24-26	--	--	--	21-22	--	--	--	--	--	--	--	--	--	--	--	--	
				11798	11802	4	63	--	2.46-2.51	--	12-15	--	--	13	12-14	--	--	--	--	19-22	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	
				11802	11810	8	56-59	--	2.49-2.57	--	8-13	--	--	7-9	8-10	--	--	--	--	16-20	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	--	--	
				11811	11814	3	63	--	2.6-2.68	--	2-6	--	--	13	--	--	--	--	--	10-14	--	--	--	19	12-14	--	--	--	--	--	--	--	--	--	--	--	
				11816	11818	2	61	--	2.85	--	0	--	--	11	--	--	--	--	--	5	--	--	--	17	5	--	--	--	--	--	--	--	--	--	--	--	
				11818	11828	10	56	--	2.65-2.73	--	0-4	--	--	7	--	--	--	--	--	5-12	--	--	--	12	8-9	--	--	--	--	--	--	--	--	--	--	--	
				11480	11499	19	--	9-14	--	2-12	--	--	12-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11501	11509	8	--	14	--	10	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11516	11542	26	--	12-14	--	1-3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				11554	11573	19	--	10-15	--	10-14	--	--	10-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				11619	11639	20	--	10-15	--	2-15	--	--	10-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Upper Porous Zone

Middle Porous Zone

Lower Porous Zone

Lithology determined using this method

Lithology determined using another method

Appendix IV (Continued)

Table IV-2: Porosity data for the CKLIZ.

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone							Dolostone														
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
4885	4893	8	68									17									22				
4899	4903	4	64									14										19			
4903	4910	7	73									22										26			
4910	4915	5	63-64									13-14										19			
4917	4921	4	58									8										13			
4921	4927	6	62-64									12-14										18-19			
4927	4951	24	66-70									15-19										20-24			
4957	4960	3	68									17										22			
4960	4967	7	74									22										26			
4967	4975	8	66-71									15-20										20-24			
4975	4989	14	73-78									22-24										26-29			
4989	4995	6	67-69									16-18										21-23			
4995	5001	6	73									22										26			
5009	5018	9	56-57									7										12			
5018	5027	9	77									23										28			
5027	5031	4	70									19										24			
5075	5087	12	58-59									8-9										13-14			
5087	5089	2	61									11										17			
5091	5099	8	61									15										20			
5099	5103	4	66									25										30			
5103	5109	6	79									26-29										30-33			
5109	5117	8	80-86									19										24			
5117	5127	10	70									13-15										19-20			
5127	5139	12	63-66									9										14			
5141	5149	8	59									21-23										25-27			
5160	5169	9	72-75									28										31			
5169	5174	5	82									20-23										24-28			
5174	5191	17	71-76									29										33			
5191	5201	10	85-86									33										36			
5201	5205	4	92									22-25										26-30			
5205	5217	12	74-79									28										31			
5217	5221	4	82									21-25										25-30			
5221	5243	22	72-79									15-18										20-23			
5243	5255	12	65-69									13										19			
5255	5261	6	63									22-23										26-27			
5261	5274	13	74-75									27										30			
5274	5277	3	81									22										26			
5277	5281	4	74									26-27										30-31			
5281	5291	10	80-81									21-23										25-28			
5296	5324	28	72-76									15										20			
5324	5327	3	66									28										31			
5327	5333	6	82									20-23										24-28			
5333	5349	16	71-77									15-16										20-21			
5349	5358	9	66-67									22										26			
5358	5365	7	73									16										21			
5367	5372	5	67									21-23										25-28			
5372	5397	25	72-77									17										22			
5397	5402	5	68									21-23										25-27			
5402	5417	15	72-75									15										20			
5417	5425	8	65									22										26			
5425	5431	6	73									16-18										21-23			
5431	5441	10	67-69									13										19			
5441	5445	4	63									12-15										18-20			
5450	5463	13	62-65									17										22			
5463	5468	5	68									11-15										16-20			
5471	5479	8	67-68									22										26			
5479	5483	4	74									9										14			
5483	5485	2	59									14										19			
5485	5492	7	64																						

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone									Dolostone												
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5492	5499	7	68-69	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--	--	--	--	22-23	--	--	--	--
5499	5501	2	61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	17	--	--	--	--
5501	5509	8	66-71	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--
5509	5515	6	74	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	26	--	--	--	--
5515	5517	2	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	--	--	--
5517	5524	7	70-71	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	24	--	--	--	--
5524	5527	3	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	26	--	--	--	--
5527	5534	7	65-70	--	--	--	--	--	--	--	15-19	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--
5534	5537	3	58-59	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--
5537	5548	11	66-69	--	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--
5548	5550	2	58	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	13	--	--	--	--
5550	5572	22	62-64	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--
5572	5577	5	76	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	28	--	--	--	--
5577	5579	2	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	16	--	--	--	--
5579	5583	4	66-67	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--
5583	5589	6	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	26	--	--	--	--
4906	4911	5	73	--	2.43	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	23	--	--	--	--
4911	4915	4	67	--	2.49	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	20	--	--	--	--
4931	4938	7	76	--	2.32	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	29	--	--	--	--
4938	4945	7	65-69	--	2.57	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	16	--	--	--	--
4945	4948	3	62-64	--	2.63	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	13	--	--	--	--
4954	4958	4	61-62	--	2.53	--	--	--	--	--	11-12	11	--	--	--	--	--	--	--	--	18	--	--	--	--
4958	4962	4	69-70	--	2.41	--	--	--	--	--	18-19	17	--	--	--	--	--	--	--	--	25	--	--	--	--
4962	4965	3	64	--	2.64	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	12	--	--	--	--
4966	4970	4	68-70	--	2.41	--	--	--	--	--	17-19	17	--	--	--	--	--	--	--	--	25	--	--	--	--
4970	4974	4	63-66	--	2.53	--	--	--	--	--	13-15	18	--	--	--	--	--	--	--	--	18	--	--	--	--
4974	4979	5	74	--	2.4	--	--	--	--	--	22	18	--	--	--	--	--	--	--	--	25	--	--	--	--
4979	4987	8	74	--	2.49	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	20	--	--	--	--
4987	4993	6	76-78	--	2.29	--	--	--	--	--	23-24	31	--	--	--	--	--	--	--	--	26	--	--	--	--
4993	4997	4	65-67	--	2.51	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	28-29	27-28	21	--	--
4997	5002	5	60-64	--	2.53	--	--	--	--	--	11-14	10-15	--	--	--	--	--	--	--	--	19	--	--	--	--
5002	5010	8	73-76	--	2.32-2.36	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	18	--	--	--	--
5010	5018	8	80-82	--	2.25	--	--	--	--	--	26-28	26	--	--	--	--	--	--	--	--	27-29	26-28	25-26	--	--
5018	5022	4	73	--	2.41	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	33	--	--	--	--
5022	5024	2	69	--	2.47	--	--	--	--	--	22	18	--	--	--	--	--	--	--	--	26	--	--	--	--
5024	5029	5	74	--	2.33	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	23	20	--	--	--
5029	5033	4	67	--	2.45	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	29	--	--	--	--
5038	5042	4	65-67	--	2.51	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	21	20	--	--	--
5042	5049	7	76-79	--	2.38	--	--	--	--	--	23-25	--	--	--	--	--	--	--	--	--	19	--	--	--	--
5049	5053	4	82	--	2.20	--	--	--	--	--	28	28	--	--	--	--	--	--	--	--	28-30	25-26	--	--	--
5053	5061	8	79	--	2.33	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	31	--	--	--	--
5061	5075	14	72-77	--	2.36-2.42	--	--	--	--	--	21-23	17-20	--	--	--	--	--	--	--	--	29	--	--	--	--
5075	5085	10	66-71	--	2.37-2.42	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	24-27	20-24	20-24	--	--
5093	5101	8	71	--	2.39	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	25	--	--	--	--
5101	5123	22	60-64	--	2.5-2.55	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	17-20	24	24	--	--
5131	5149	18	62-65	--	2.45-2.52	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	19-22	16-19	15-18	--	--
5164	5173	9	60-62	--	2.52	--	--	--	--	--	11-12	10-11	--	--	--	--	--	--	--	--	19	--	--	--	--
5181	5185	4	57	--	2.67	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	11	--	--	--
5185	5197	12	60-61	--	2.58-2.61	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	14-15	16-17	13-14	--	--
5200	5205	5	60-62	--	2.53	--	--	--	--	--	11-12	11	--	--	--	--	--	--	--	--	18	--	--	--	--
5205	5219	14	54-59	--	2.56-2.59	--	--	--	--	--	4-9	6-8	--	--	--	--	--	--	--	--	15-16	10-14	--	--	--
5219	5227	8	63	--	2.58	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	15	--	--	--
5237	5241	4	67	--	2.45	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	22	21	20	--	--
5241	5251	10	61-65	--	2.54-2.56	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	16-18	17-20	15-17	--	--
5259	5273	14	62-66	--	2.58-2.6	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	17-20	18-20	13-15	--	--
5293	5303	10	62-66	--	2.56-2.59	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	14-15	18-20	15-16	--	--
5303	5313	10	72	--	2.39-2.43	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	25	22-23	25	--	--
5313	5318	5	80	--	2.30	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	30	29	29	--	--
5318	5359	41	72-79	--	2.33-2.38	--	--	--	--	--	21-25	--	--	--	--	--	--	--	--	--	26-29	25-30	24-28	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																											
				Estimated Porosity Value (%)										Dolostone																	
				Limestone										Litholog																	
				Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9										
5359	5364	5	68-71	--	2.44	--	--	16	--	--	17-20	15-16	--	--	--	--	--	--	23	--	--	--	22-24	--	--	--	--	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9
5364	5370	6	80	--	2.33	--	--	22	--	--	26	--	--	--	--	--	--	--	29	--	--	--	30	28	--	--	--	--	--	--	--
5370	5381	11	75	--	2.34-2.36	--	--	20-21	--	--	23	--	--	--	--	--	--	--	27-28	--	--	--	27	26	--	--	--	--	--	--	--
5383	5394	11	72-76	--	2.33-2.34	--	--	21-22	--	--	21-23	20-21	--	--	--	--	--	--	28-29	--	--	--	25-28	--	--	--	--	--	--	--	--
5396	5403	7	72-76	--	2.25	--	--	27	--	--	21-23	22-24	--	--	--	--	--	--	33	--	--	--	25-28	--	--	--	--	--	--	--	--
5403	5409	6	69-71	--	2.36	--	--	20	--	--	18-20	18-19	--	--	--	--	--	--	27	--	--	--	23-24	--	--	--	--	--	--	--	--
5409	5413	4	61-64	--	2.49	--	--	13	--	--	11-14	11-12	--	--	--	--	--	--	20	--	--	--	17-19	--	--	--	--	--	--	--	--
5430	5441	11	64-66	--	2.46	--	--	15	--	--	14-15	--	--	--	--	--	--	--	22	--	--	--	19-20	19-20	--	--	--	--	--	--	--
5461	5470	9	59	--	2.63	--	--	5	--	--	9	--	--	--	--	--	--	--	13	--	--	--	14	12	--	--	--	--	--	--	--
5472	5479	7	57-58	--	2.64-2.66	--	--	4	--	--	7-8	--	--	--	--	--	--	--	12	--	--	--	12-13	11-12	--	--	--	--	--	--	--
5482	5492	10	61-66	--	2.48-2.53	--	--	11-13	--	--	11-15	11-14	--	--	--	--	--	--	18-21	--	--	--	17-20	--	--	--	--	--	--	--	--
5492	5497	5	61	--	2.66	--	--	3	--	--	11	--	--	--	--	--	--	--	11	--	--	--	17	12	--	--	--	--	--	--	--
5499	5508	9	61-65	--	2.48-2.51	--	--	12-13	--	--	11-15	11-13	--	--	--	--	--	--	19-21	--	--	--	17-20	--	--	--	--	--	--	--	--
5510	5519	9	66-70	--	2.43-2.49	--	--	13-17	--	--	15-19	--	--	--	--	--	--	--	20-23	--	--	--	20-24	19-21	--	--	--	--	--	--	--
5519	5524	5	64	--	2.49	--	--	13	--	--	14	13	--	--	--	--	--	20	--	--	--	19	--	--	--	--	--	--	--	--	--
5526	5543	17	61-64	--	2.43-2.49	--	--	13-17	--	--	11-14	11-14	--	--	--	--	--	20-23	--	--	--	17-19	--	--	--	--	--	--	--	--	--
4862	4869	7	66-67	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	--	--	--	--
4869	4872	3	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--
4872	4883	11	67-70	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--	--	--
4894	4899	5	67-70	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--	--	--
4899	4915	16	71-79	--	--	--	--	--	--	--	20-25	--	--	--	--	--	--	--	--	--	--	24-30	--	--	--	--	--	--	--	--	--
4915	4919	4	68-70	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--	--	--	--
4919	4922	3	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--
4922	4925	3	58	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--
4933	4940	7	60-66	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--
4940	4943	3	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--
4943	4946	3	65	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
4946	4953	7	74-78	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--	--	--	--
4957	4961	4	66	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
4961	4975	14	71-73	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	--	24-26	--	--	--	--	--	--	--	--	--
4975	4978	3	68	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--
4978	5001	23	71-79	--	--	--	--	--	--	--	20-25	--	--	--	--	--	--	--	--	--	--	24-30	--	--	--	--	--	--	--	--	--
5001	5007	6	63-66	--	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--
5015	5020	5	80	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--
5020	5030	10	73-79	--	--	--	--	--	--	--	22-25	--	--	--	--	--	--	--	--	--	--	26-30	--	--	--	--	--	--	--	--	--
5030	5034	4	80	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--
5034	5044	10	71-77	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	--	24-28	--	--	--	--	--	--	--	--	--
5044	5046	2	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--
5046	5058	12	71-74	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	--	24-26	--	--	--	--	--	--	--	--	--
5068	5074	6	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--
5078	5088	10	71	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--
5091	5108	17	62-66	--	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--
5119	5133	14	61-63	--	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--
5151	5158	7	61-66	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--	--	--	--
5171	5185	14	61-64	--	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--
5188	5213	25	60-66	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--
5231	5239	8	60-64	--	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--
5239	5243	4	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--
5247	5258	11	62-66	--	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--
5271	5277	6	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--
5277	5281	4	68-69	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--
5281	5285	4	65	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--
5285	5353	68	71-79	--	--	--	--	--	--	--	20-25	--	--	--	--	--	--	--	--	--	--	24-30	--	--	--	--	--	--	--	--	--
5355	5380	25	74-79	--	--	--	--	--	--	--	22-25	--	--	--	--	--	--	--	--	--	--	26-30	--	--	--	--	--	--	--	--	--
5380	5384	4	64	--	--	--	--	--																							

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												
				Estimated Porosity Value (%)												
				Limestone					Dolostone							
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)															Dolostone						
				Limestone																					
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5149	5158	9	71-77	--	2.33-2.38	--	--	19-22	--	--	20-23	--	--	--	--	--	--	26-29	--	--	--	24-28	23-27	--	--
5158	5164	6	69	--	2.42	--	--	17	--	--	18	--	--	--	--	--	--	24	--	--	--	23	22	--	--
5198	5217	19	61-63	--	2.5-2.59	--	--	7-12	--	--	11-13	--	--	--	--	--	--	15-20	--	--	--	17-19	14-17	--	--
5228	5241	13	60	--	2.54	--	--	9-10	--	--	11	--	10	--	--	--	--	18	--	--	--	16	--	--	--
5251	5264	13	61	--	2.55-2.56	--	--	9-10	--	--	11	--	9-10	--	--	--	--	16-17	--	--	--	17	--	--	--
5264	5282	18	56-59	--	2.54-2.59	--	--	7-10	--	--	7-9	--	--	--	--	--	--	15-18	--	--	--	12-14	12-15	--	--
5282	5293	11	60-63	--	2.49-2.53	--	--	11-13	--	--	11-13	--	--	--	--	--	--	18-20	--	--	--	16-19	15-17	--	--
5296	5321	25	60-62	--	2.52-2.58	--	--	8-11	--	--	11-12	8-11	--	--	--	--	--	15-19	--	--	--	16-18	--	--	--
5321	5326	5	59	--	2.6	--	--	6	--	--	9	--	--	--	--	--	--	14	--	--	--	14	13	--	--
5326	5333	7	57	--	2.58	--	--	8	--	--	7	--	--	--	--	--	--	15	--	--	--	12	13	--	--
5352	5358	6	58	--	2.64	--	--	4	--	--	8	--	--	--	--	--	--	12	--	--	--	13	11	--	--
5358	5383	25	70-72	--	2.36-2.4	--	--	18-20	--	--	19-21	17-19	--	--	--	--	--	25-27	--	--	--	24-25	--	--	--
5383	5394	11	65-66	--	2.44-2.49	--	--	13-16	--	--	15	13-15	--	--	--	--	--	20-23	--	--	--	20	--	--	--
5394	5401	7	68	--	2.39-2.4	--	--	18	--	--	17	--	17	--	--	--	--	25	--	--	--	22	--	--	--
5401	5411	10	73-74	--	2.32-2.33	--	--	22-23	--	--	22	--	--	--	--	--	--	29	--	--	--	26	25-26	--	--
5411	5415	4	68	--	2.41	--	--	18	--	--	17	--	16	--	--	--	--	25	--	--	--	22	--	--	--
5415	5419	4	73	--	2.42	--	--	17	--	--	22	--	--	--	--	--	--	24	--	--	--	26	23	--	--
5421	5438	17	71-75	--	2.33-2.41	--	--	18-22	--	--	20-23	--	--	--	--	--	--	25-29	--	--	--	24-27	22-26	--	--
5438	5450	12	66-69	--	2.43-2.46	--	--	15-17	--	--	15-18	14-16	--	--	--	--	--	22-23	--	--	--	20-23	--	--	--
5464	5469	5	59	--	2.59	--	--	7	--	--	9	--	--	--	--	--	--	15	--	--	--	14	13	--	--
5469	5475	6	65	--	2.49	--	--	13	--	--	15	--	--	--	--	--	--	20	--	--	--	20	19	--	--
5514	5519	5	62	--	2.54	--	--	10	--	--	12	10	--	--	--	--	--	18	--	--	--	18	--	--	--
5519	5525	6	68	--	2.45	--	--	15	--	--	17	15	--	--	--	--	--	22	--	--	--	22	--	--	--
5525	5527	2	61	--	2.56	--	--	9	--	--	11	--	--	--	--	--	--	16	--	--	--	17	15	--	--
5527	5533	6	63	--	2.46	--	--	15	--	--	13	--	--	--	--	--	--	22	--	--	--	19	18	--	--
5537	5546	9	62-63	--	2.5-2.56	--	--	9-12	--	--	12-13	--	--	--	--	--	--	16-20	--	--	--	18-19	15-17	--	--
5548	5585	37	60-65	--	2.49-2.58	--	--	8-13	--	--	11-15	--	--	--	--	--	--	15-20	--	--	--	16-20	14-18	--	--
4817	4825	8	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--
4827	4829	2	61	--	--	--	--	61	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--
4829	4832	3	76	--	--	--	--	76	--	--	23	--	--	--	--	--	--	--	--	--	--	28	--	--	--
4832	4840	8	80-84	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--	--	--	--	--	30-32	--	--	--
4840	4849	9	54-58	--	--	--	--	4-8	--	--	4-8	--	--	--	--	--	--	--	--	--	--	10-13	--	--	--
4849	4853	4	85	--	--	--	--	29	--	--	29	--	--	--	--	--	--	--	--	--	--	33	--	--	--
4853	4856	3	82	--	--	--	--	28	--	--	28	--	--	--	--	--	--	--	--	--	--	31	--	--	--
4856	4859	92	92	--	--	--	--	32	--	--	33	--	--	--	--	--	--	--	--	--	--	36	--	--	--
4859	4862	3	77	--	--	--	--	23	--	--	23	--	--	--	--	--	--	--	--	--	--	28	--	--	--
4862	4865	3	64	--	--	--	--	14	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--
4865	4867	2	56	--	--	--	--	7	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--
4867	4873	6	87	--	--	--	--	30	--	--	30	--	--	--	--	--	--	--	--	--	--	33	--	--	--
4873	4879	6	73-79	--	--	--	--	22-25	--	--	22-25	--	--	--	--	--	--	--	--	--	--	26-30	--	--	--
4879	4887	8	81-85	--	--	--	--	27-29	--	--	27-29	--	--	--	--	--	--	--	--	--	--	31-33	--	--	--
4887	4893	6	61-66	--	--	--	--	11-15	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--
4893	4897	4	77	--	--	--	--	23	--	--	23	--	--	--	--	--	--	--	--	--	--	28	--	--	--
4897	4900	3	83	--	--	--	--	28	--	--	28	--	--	--	--	--	--	--	--	--	--	32	--	--	--
4900	4905	5	79	--	--	--	--	25	--	--	25	--	--	--	--	--	--	--	--	--	--	30	--	--	--
4905	4912	7	67-71	--	--	--	--	16-20	--	--	16-20	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--
4912	4916	4	74	--	--	--	--	22	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--
4919	4933	14	63-65	--	--	--	--	13-15	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--
4933	4937	4	68-71	--	--	--	--	17-20	--	--	17-20	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--
4937	4939	2	65	--	--	--	--	15	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--
4939	4942	3	60	--	--	--	--	11	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--
4961	4965	4	62	--	--	--	--	12	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--
4965	4966	1	55	--	--	--	--	6	--	--	6	--	--	--	--	--	--	--	--	--	--	11	--	--	--
4972	4984	12	61-66	--	--	--	--	11-15	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--
4999	5013	14	65-70	--	--	--	--	15-19	--	--	15-19	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--
5019	5021	2	59	--	--	--	--	9	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--
5031	5031	10	61-64	--	--	--	--	11-14	--	--	11-14	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--
5031	5042	11	67-69	--	--	--	--	16-18	--	--	16-18	--	--	--	--	--	--	--	--	--	--	21-23	--	--	--
5042	5046	4	62	--	--	--	--	12	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																											
				Estimated Porosity Value (%)												Dolostone															
				Limestone																											
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9							
311	Collier	17	11695	5046	5048	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	13	--	--	--	--	--				
				5076	5080	4	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--		
				5085	5093	8	54-56	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--	
				5095	5102	7	80-81	--	--	--	--	--	--	26-27	--	--	--	--	--	--	--	--	--	--	30-31	--	--	--	--	--	
				5102	5109	7	77-79	--	--	--	--	--	--	23-25	--	--	--	--	--	--	--	--	--	--	28-30	--	--	--	--	--	
				5109	5117	8	63-65	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	
				5117	5119	2	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	
				5119	5129	10	63-66	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	
				5129	5142	13	72-74	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--	
				5142	5145	3	66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	
				5145	5158	13	73-76	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--	
				5158	5173	15	65-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	
				5187	5197	10	66-71	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--	--	
				5197	5201	4	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	
				5201	5219	18	67-71	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--
				5219	5225	6	72	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--
				5225	5231	6	67-70	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--
				5231	5236	5	61-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--
				5243	5249	6	60-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	16-18	--	--	--	--	--	--
				5249	5253	4	55-56	--	--	--	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--
				5253	5258	5	61-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--	--
				5258	5263	5	54-56	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--	--
				5271	5276	5	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				5276	5279	3	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
				5283	5285	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
				5285	5297	12	60-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--
				5297	5299	2	57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
				5299	5313	14	60-65	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--
				5313	5315	2	58	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--
				5315	5321	6	68-70	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--
				5321	5323	2	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--
				5323	5325	2	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
				5325	5328	3	74	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--
				5328	5334	6	67-71	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--
				5334	5336	2	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				5336	5339	3	69	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--	--
				5339	5341	2	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
				5359	5369	10	75-79	--	--	--	--	--	--	23-25	--	--	--	--	--	--	--	--	--	--	27-30	--	--	--	--	--	--
				5374	5377	3	54	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--
				5377	5388	11	71-74	--	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	--	24-26	--	--	--	--	--	--
				5388	5392	4	54-57	--	--	--	--	--	--	4-7	--	--	--	--	--	--	--	--	--	--	10-12	--	--	--	--	--	--
				5392	5395	3	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--
				5395	5401	6	62-64	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--
				5401	5406	5	74-75	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	26-27	--	--	--	--	--	--
				5409	5411	2	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--
				5411	5415	4	80	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--
				5415	5419	4	54-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--	--
				5421	5425	4	65	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
				5425	5432	7	84	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--	32	--	--	--	--	--	--
				5432	5437	5	76-77	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--
				5439	5441	2	72	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--
				5441	5469	28	80-90	--	--	--	--	--	--	26-32	--	--	--	--	--	--	--	--	--	--	30-35	--	--	--	--	--	--
				5469	5477	8	74-76	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--
				5477	5483	6	82	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--	--
				4938	4946	8	74-76	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--			
				4946	4951	5	56	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--		
				4951	4955	4	70	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	
				4955	4961	6	72	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	
				4963	4967	4	56	--	--	--	--	--	--	7	--	--	--	--	--	--	12	--	--	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																								
				Estimated Porosity Value (%)																								
				Limestone								Dolostone																
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
319A	Collier	38	11495	4967	4972	5	62-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	Figure AII-9		
				4972	4977	5	89	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	34	--	--	--	Figure AII-6
				4984	4994	10	72-74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-26	--	--	--	Figure AII-5
				4994	4996	2	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	Figure AII-4
				4996	5012	16	71-75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-27	--	--	--	Figure AII-3
				5015	5018	3	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	Figure AII-2
				5018	5024	6	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	Figure AII-1
				5024	5033	9	62-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	Figure AII-9
				5037	5042	5	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--	--	Figure AII-6
				5042	5045	3	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	--	--	--	Figure AII-5
				5045	5048	3	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	Figure AII-4
				5050	5054	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	Figure AII-3
				5054	5063	9	57-58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12-13	--	--	--	Figure AII-2
				5065	5071	6	58-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13-14	--	--	--	Figure AII-1
				5086	5089	3	55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11	--	--	--	Figure AII-9
				5089	5099	10	60-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	Figure AII-6
				5107	5119	12	66-67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	Figure AII-5
				5121	5123	2	95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37	--	--	--	Figure AII-4
				5125	5127	2	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	Figure AII-3
				5136	5138	2	95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37	--	--	--	Figure AII-2
				5139	5143	4	65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	Figure AII-1
				5143	5146	3	95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37	--	--	--	Figure AII-9
				5150	5155	5	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	Figure AII-6
				5164	5168	4	92	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36	--	--	--	Figure AII-5
				5170	5173	3	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	Figure AII-4
				5173	5177	4	62-63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	Figure AII-3
				5199	5207	8	87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33	--	--	--	Figure AII-2
				5223	5231	8	61-66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	Figure AII-1
				5237	5264	27	62-66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	Figure AII-9
				5264	5268	4	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	Figure AII-6
				5268	5292	24	71-76	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-28	--	--	--	Figure AII-5
5292	5295	3	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	Figure AII-4				
5295	5298	3	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	Figure AII-3				
5298	5301	3	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	Figure AII-2				
5301	5313	12	72-79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-30	--	--	--	Figure AII-1				
5313	5319	6	63-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	Figure AII-9				
5323	5333	10	94-97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37-38	--	--	--	Figure AII-6				
5333	5338	5	66-67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	Figure AII-5				
5338	5341	3	61-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	Figure AII-4				
5341	5344	3	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	Figure AII-3				
5347	5355	8	69-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23-24	--	--	--	Figure AII-2				
5355	5357	2	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	Figure AII-1				
5357	5364	7	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	Figure AII-9				
5385	5401	16	60-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	Figure AII-6				
5401	5404	3	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	Figure AII-5				
5443	5461	18	71-77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-28	--	--	--	Figure AII-4				
5461	5476	15	67-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	Figure AII-3				
5478	5484	6	67-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23-24	--	--	--	Figure AII-2				
5484	5486	2	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	Figure AII-1				
5486	5489	3	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	Figure AII-9				
5489	5501	12	79-85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29-33	--	--	--	Figure AII-6				
5501	5503	2	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	Figure AII-5				
5503	5512	9	68-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	Figure AII-4				
5512	5514	2	56	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	Figure AII-3				
5514	5519	5	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	Figure AII-2				
5527	5540	13	55-57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	Figure AII-1				
5540	5544	4	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	Figure AII-9				
5544	5554	10	76	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	Figure AII-6				
5558	5564	6	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29	--	--	--	Figure AII-5				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				Estimated Porosity Value (%)										Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
				Limestone					Litholog					Figure AII-2				Figure AII-3				Figure AII-4				Figure AII-5				Figure AII-6				Figure AII-7				Figure AII-8				Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
401	Collier	24	11987	5567	5572	5	76																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	</

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone									Dolostone												
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5369	5375	6	72	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	25	--	--	--	--
5375	5378	3	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	14	--	--	--	--
5378	5386	8	66-71	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--
5386	5390	4	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	26	--	--	--	--
5390	5394	4	62-64	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--
5394	5396	2	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	14	--	--	--	--
5396	5399	3	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	18	--	--	--	--
5402	5420	18	66-71	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--
5438	5448	10	74-77	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	26-28	--	--	--	--
5454	5461	7	81	--	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	31	--	--	--	--
5464	5469	5	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	--	--	--
5474	5477	3	56	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	--	--	--
5481	5483	2	58-59	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--
5483	5488	5	98-100	--	--	--	--	--	--	--	34-35	--	--	--	--	--	--	--	--	--	38-39	--	--	--	--
5488	5499	11	67-71	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--
5499	5511	12	90	--	--	--	--	--	--	--	32	--	--	--	--	--	--	--	--	--	35	--	--	--	--
5511	5519	8	81-84	--	--	--	--	--	--	--	27-29	--	--	--	--	--	--	--	--	--	31-32	--	--	--	--
5519	5526	7	70-71	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	24	--	--	--	--
5526	5533	7	83	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	32	--	--	--	--
5533	5537	4	57	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	--	--	--	--
5540	5545	5	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	19	--	--	--	--
4698	4705	7	66	--	30	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	23	20	--	20	--
4707	4711	4	56	--	17	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	12	--	11	--
4711	4723	12	70-71	--	42	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	32	24	--	25	--
4729	4742	13	72-75	--	48	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	36-37	25-27	--	28-29	--
4742	4757	15	68-71	--	34-43	--	--	--	--	--	17-20	--	--	--	--	--	--	--	--	--	26-32	22-24	--	22-26	--
4776	4785	9	72-73	--	41-42	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	31	25-26	--	26	--
4785	4789	4	71	--	40	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	29	24	--	25	--
4789	4809	20	73-77	--	43-48	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	32-36	26-28	--	27-31	--
4809	4813	4	69	--	37	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	28	23	--	24	--
4813	4821	8	62	--	28-31	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	21-24	18	--	17-19	--
4823	4829	6	57-59	--	23-25	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	13-15	12-14	--	13-15	--
4839	4843	4	64	--	33	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	25	19	--	20	--
4843	4851	8	72	--	40	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	30	25	--	25	--
4869	4873	4	56	--	22	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	16	12	--	12	--
4891	4903	12	72-73	--	45	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	32	25-26	--	28	--
4903	4917	14	62-66	--	32-36	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	24-27	18-20	--	19-21	--
4917	4920	3	68	--	36	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	28	22	--	23	--
4920	4931	11	80	--	45	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	35	30	--	30	--
4931	4939	8	71-74	--	32	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	25	24-26	--	22-24	--
4939	4972	33	60-66	--	31-37	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	23-26	16-20	--	18-21	--
4972	4975	3	83	--	39	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	31	32	--	30	--
4975	4983	8	77-78	--	37	--	--	--	--	--	23-24	--	--	--	--	--	--	--	--	--	27-28	28-29	--	26-27	--
4983	4984	1	82	--	37	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	28	29	--	27	--
4984	4990	6	96-100	--	45	--	--	--	--	--	34-35	--	--	--	--	--	--	--	--	--	36	38-39	--	37-39	--
4990	5001	11	79-90	--	45	--	--	--	--	--	25-32	--	--	--	--	--	--	--	--	--	35-36	30-35	--	30-35	--
5001	5011	10	71-77	--	41	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	32	24-28	--	25-28	--
5011	5020	9	92-95	--	43-44	--	--	--	--	--	33-34	--	--	--	--	--	--	--	--	--	32-34	36-37	--	35-37	--
5020	5022	2	80	--	39	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	30	30	--	29	--
5022	5026	4	67	--	34	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	27	21	--	22	--
5026	5031	5	63	--	31	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	24	19	--	19	--
5031	5035	4	68	--	31	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	24	22	--	21	--
5035	5037	2	74	--	39	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	30	26	--	26	--
5037	5049	12	65-69	--	34-35	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	27	20-23	--	21-24	--
5049	5054	5	62-63	--	22	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--	--	17	18-19	--	15	--
5054	5058	4	69	--	22	--	--	--	--	--	17	18	18	--	--	--	--	--	--	--	23	--	--	--	--
5058	5062	4	60	--	22	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	16	16	--	14	--
5062	5067	5	68	--	30	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	23	22	--	20	--
5067	5085	18	71-79	--	36-45	--	--	--	--	--	20-25	--	--	--	--	--	--	--	--	--	30-35	24-30	--	24-30	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																									
				Estimated Porosity Value (%)																									
				Limestone						Dolostone																			
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9														
697	Collier	29	13000	5085	5089	4	59	17	--	-2	--	--	--	9	--	--	--	--	--	12	14	--	--	12	--	--			
				5091	5100	9	68-71	34-36	--	12-16	--	--	--	--	17-20	--	--	--	--	--	--	25-28	22-24	--	--	22-24	--	--	
				5100	5103	3	62	27	--	6	--	--	--	--	12	--	--	--	--	--	--	19	18	--	--	17	--	--	
				5103	5107	4	59	27	--	5	--	--	--	9	--	--	--	--	--	--	--	19	14	--	--	15	--	--	
				5107	5111	4	66	34	--	14	--	--	--	15	--	--	--	--	--	--	--	25	20	--	--	21	--	--	
				5111	5115	4	74	37	--	19	--	--	--	22	--	--	--	--	--	--	--	30	26	--	--	25	--	--	
				5115	5127	12	81-84	45	--	26	--	--	--	27-29	--	--	--	--	--	--	--	36	31-32	--	--	31-32	--	--	
				5127	5135	8	73	30	--	17	--	--	--	22	--	--	--	--	--	--	--	25	26	--	--	22	--	--	
				5135	5143	8	68	25	--	13-14	--	--	--	17	--	--	--	--	--	--	--	21	22	--	--	19	--	--	
				5143	5153	10	65-66	34	--	14-16	--	--	--	15	--	--	--	--	--	--	--	26-27	20	--	--	21	--	--	
				4879	4885	6	56	17	--	2	--	--	--	7	--	--	--	--	--	--	--	13	12	--	--	11	--	--	
				4885	4891	6	67	26	--	10	--	--	--	16	--	--	--	--	--	--	--	21	21	--	--	19	--	--	
				4891	4895	4	59	12	--	1	--	--	--	10	--	--	--	9	--	--	--	--	--	--	14	--	--	--	--
				4897	4909	12	67-71	28-32	--	12-16	--	--	--	16-20	--	--	--	21	--	--	--	--	22-26	21-24	--	--	20-22	--	--
				4915	4919	4	71	29	--	13	--	--	--	23	20	--	--	24	--	--	--	--	--	--	24	--	--	--	--
				4919	4926	7	88	40	--	25	--	--	--	30	--	--	--	33	--	--	--	--	33	33	--	--	32	--	--
				4931	4940	9	75	42	--	23-24	--	--	--	23	--	--	--	34	--	--	--	--	34	27	--	--	27	--	--
				4940	4942	2	66	36	--	17	--	--	--	15	--	--	--	28	--	--	--	--	28	20	--	--	21	--	--
				4942	4945	3	72	39	--	22	--	--	--	21	--	--	--	32	--	--	--	--	32	25	--	--	25	--	--
				4945	4948	3	71	40	--	22	--	--	--	20	--	--	--	32	--	--	--	--	32	24	--	--	25	--	--
				4948	4958	10	76	48	--	28	--	--	--	23	--	--	--	38	--	--	--	--	38	28	--	--	30	--	--
				4967	4989	22	65-71	31-44	--	17-21	--	--	--	15-20	--	--	--	26-33	--	--	--	--	26-33	20-24	--	--	20-26	--	--
				4993	4999	6	67	34	--	16	--	--	--	16	--	--	--	27	--	--	--	--	27	21	--	--	22	--	--
				4999	5018	19	62-65	26-35	--	11-17	--	--	--	12-15	--	--	--	21-28	--	--	--	--	21-28	18-20	--	--	16-21	--	--
				5021	5029	8	67	36	--	19	--	--	--	16	--	--	--	29	--	--	--	--	29	21	--	--	22	--	--
				5039	5042	3	58	24-25	--	10	--	--	--	8	--	--	--	20	--	--	--	--	20	13	--	--	15	--	--
				5054	5065	11	62	32	--	14	--	--	--	12	--	--	--	25	--	--	--	--	25	18	--	--	19	--	--
				5075	5086	11	61-64	30-31	--	13-14	--	--	--	11-14	--	--	--	24-25	--	--	--	--	24-25	17-19	--	--	17-19	--	--
				5091	5098	7	58-59	22	--	10	--	--	--	8-9	--	--	--	18	--	--	--	--	18	13-14	--	--	14	--	--
				5105	5119	14	60	24-26	--	9	--	--	--	11	--	--	--	19-20	--	--	--	--	19-20	16	--	--	15	--	--
				5139	5144	5	55	13	--	0	--	--	--	6	--	--	--	10	--	--	--	--	10	11	--	--	9	--	--
				5147	5153	6	55	16	--	5	--	--	--	6	--	--	--	13	--	--	--	--	13	11	--	--	10	--	--
				5159	5167	8	67	35	--	16	--	--	--	16	--	--	--	27	--	--	--	--	27	21	--	--	22	--	--
				5172	5181	9	66-68	35-38	--	19-20	--	--	--	15-17	--	--	--	29-30	--	--	--	--	29-30	20-22	--	--	21	--	--
				5181	5185	4	66	32	--	19	--	--	--	15	--	--	--	27	--	--	--	--	27	20	--	--	20	--	--
				5185	5205	20	60-65	24-33	--	10-18	--	--	--	11-15	--	--	--	20-27	--	--	--	--	20-27	16-20	--	--	15-20	--	--
				5205	5210	5	65-70	34-43	--	16-22	--	--	--	15-19	--	--	--	27-34	--	--	--	--	27-34	20-24	--	--	21-26	--	--
				5210	5212	2	62	26	--	12	--	--	--	12	--	--	--	22	--	--	--	--	22	18	--	--	16	--	--
				5212	5243	31	60-71	35-42	--	16-22	--	--	--	15-20	--	--	--	27-33	--	--	--	--	27-33	20-24	--	--	19-25	--	--
				5243	5250	7	61-64	29	--	14	--	--	--	11-14	--	--	--	23	--	--	--	--	23	17-19	--	--	17-18	--	--
				5257	5276	19	65-70	29-43	--	15-24	--	--	--	15-19	--	--	--	24-34	--	--	--	--	24-34	20-24	--	--	19-21	--	--
				5284	5297	13	69	38-40	--	20-23	--	--	--	18	--	--	--	30-33	--	--	--	--	30-33	23	--	--	24	--	--
				5297	5313	16	74-76	40-44	--	22	--	--	--	22-23	--	--	--	33-35	--	--	--	--	33-35	26-28	--	--	24-27	--	--
				5325	5338	13	59	21	--	6	--	--	--	9	--	--	--	12	--	--	--	--	12	14	--	--	14	--	--
				5355	5362	7	59	18	--	7	--	--	--	9	--	--	--	15	--	--	--	--	15	14	--	--	12	--	--
				5367	5397	30	65-70	28-36	--	14-18	--	--	--	15-19	--	--	--	23-28	--	--	--	--	23-28	20-24	--	--	17-24	--	--
				5397	5408	11	75-76	41	--	24	--	--	--	23	--	--	--	33	--	--	--	--	33	27-28	--	--	26-27	--	--
				5408	5421	13	80-83	45	--	29	--	--	--	26-28	--	--	--	37	--	--	--	--	37	30-32	--	--	30-32	--	--
				5421	5425	4	62-63	26	--	15	--	--	--	12-13	--	--	--	22	--	--	--	--	22	18-19	--	--	16-17	--	--
				5425	5442	17	67-71	33-39	--	19-21	--	--	--	16-20	--	--	--	27-31	--	--	--	--	27-31	21-24	--	--	21-22	--	--
				5463	5475	12	83-86	45	--	32-33	--	--	--	28-29	--	--	--	38-39	--	--	--	--	38-39	32-33	--	--	32-33	--	--
				5475	5486	11	72-74	40-42	--	16-19	--	--	--	21-22	--	--	--	30-32	--	--	--	--	30-32	25-26	--	--	25-26	--	--
				5486	5497	11	76-79	45	--	26-28	--	--	--	23-25	--	--	--	36	--	--	--	--	36	28-30	--	--	28-30	--	--
				5497	5503	6	80	45	--	34	--	--	--	26	--	--	--	39	--	--	--	--	39	30	--	--	30	--	--
				5503	5507	4	77-79	45	--	26	--	--	--	23-25	--	--	--	36	--	--	--	--	36	28-30	--	--	28-30	--	--
				5507	5519	12	91-96	45	--	33-39	--	--	--	32-34	--	--	--	38-42	--	--	--	--	38-42	36-38	--	--	35-37	--	--
				5519	5531	12	89-90	45	--	31-34	--	--	--	31-32	--	--	--	38-39	--	--	--	--	38-39	34-35	--	--	35	--	--
				5531	5537	6	96	45	--	37	--	--	--	34	--	--	--	40	--	--	--	--	40	38	--	--	37	--	--
				5537	5567	30	84-88	45	--	32-36	--	--	--	29-30	--	--	--	38-40	--	--	--	--	38-40	32-33	--	--	32-34	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																									
				Estimated Porosity Value (%)																									
				Limestone							Dolostone																		
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
760	Collier	29	11780	5571	5591	20	82-89	43-45	--	--	26-34	--	--	--	--	--	--	--	--	--	35-39	31-34	--	31-35	--	--			
				5594	5598	4	60	12	--	--	1	--	--	10	11	--	10	--	--	--	--	--	--	16	--	--	--		
				5600	5607	7	61	15	--	--	2	--	--	12	11	--	12	--	--	--	--	--	--	17	--	--	--		
				5611	5633	22	77-79	44-45	--	--	24-26	--	--	12	23-25	--	--	--	--	--	--	--	--	35-36	28-30	--	29-30	--	
				5633	5635	2	60	17	--	--	7	--	--	--	11	--	12	--	--	--	--	--	--	16	--	--	--	--	
				5635	5637	2	59	17	--	--	7	--	--	--	9	--	--	--	--	--	--	--	--	14	14	--	12	--	
				5637	5671	34	80-90	40-45	--	--	27-36	--	--	--	26-32	--	--	--	--	--	--	--	--	35-40	30-35	--	29-35	--	
				4965	4968	3	57	16	--	--	4	--	--	--	7	--	--	--	--	--	--	--	--	13	12	--	11	--	
				4968	4976	8	75	35	--	--	20	--	--	--	23	--	--	--	--	--	--	--	--	29	27	--	25	--	
				4982	4995	13	72	34	--	--	20	--	--	--	21	--	--	--	--	--	--	--	--	29	25	--	23	--	
				5001	5005	4	66	24-27	--	--	17	--	--	--	15	--	--	--	--	--	--	--	--	22-24	20	--	18-19	--	
				5005	5009	4	93	36	--	--	22	--	--	--	30	33	--	33	--	--	--	--	--	--	36	--	--	--	
				5009	5014	5	68	25	--	--	15	--	--	--	17	--	--	--	--	--	--	--	--	22	22	--	19	--	
				5019	5039	20	72-77	33-39	--	--	19-23	--	--	--	21-23	--	--	--	--	--	--	--	--	27-32	25-28	--	23-27	--	
				5051	5061	10	68-69	31-32	--	--	18-19	--	--	--	17-18	--	--	--	--	--	--	--	--	26-27	22-23	--	21	--	
				5061	5067	6	62	29	--	--	13	--	--	--	12	--	--	--	--	--	--	--	--	23	18	--	17	--	
				5069	5073	4	61	24	--	--	11	--	--	--	11	--	--	--	--	--	--	--	--	20	17	--	15	--	
				5073	5076	3	55	15	--	--	3	--	--	--	6	--	--	--	--	--	--	--	--	12	11	--	10	--	
				5076	5093	17	60-63	18-29	--	--	13-16	--	--	--	11-13	--	--	--	--	--	--	--	--	18-24	16-19	--	13-18	--	
				5095	5101	6	62	23	--	--	13	--	--	--	12	--	--	--	--	--	--	--	--	20	18	--	15	--	
				5115	5121	6	59	23	--	--	10	--	--	--	9	--	--	--	--	--	--	--	--	19	14	--	14	--	
				5121	5131	10	65	25-27	--	--	14	--	--	--	15	--	--	--	--	--	--	--	--	21-22	20	--	18	--	
				5137	5151	14	65-66	29-30	--	--	16-19	--	--	--	15	--	--	--	--	--	--	--	--	24-26	20	--	19-20	--	
				5163	5175	12	63-66	27-30	--	--	16-17	--	--	--	13-15	--	--	--	--	--	--	--	--	23-25	19-20	--	17-20	--	
				5179	5187	8	61	24	--	--	12	--	--	--	11	--	--	--	--	--	--	--	--	20	17	--	15	--	
				5192	5198	6	58	22	--	--	8	--	--	--	8	--	--	--	--	--	--	--	--	17	13	--	14	--	
				5199	5209	10	56-59	25	--	--	11-12	--	--	--	7-9	--	--	--	--	--	--	--	--	21	12-14	--	13-14	--	
				5258	5267	9	62	27	--	--	12	--	--	--	12	--	--	--	--	--	--	--	--	22	18	--	15	--	
				5272	5280	8	65-67	32-34	--	--	15-16	--	--	--	15-16	--	--	--	--	--	--	--	--	25-27	20-21	--	20-22	--	
				5280	5315	35	62-65	26-29	--	--	9-16	--	--	--	12-15	--	--	--	--	--	--	--	--	22-24	18-20	--	16-19	--	
				5315	5344	29	65-71	31-35	--	--	14-19	--	--	--	15-20	--	--	--	--	--	--	--	--	25-29	20-24	--	20-24	--	
				5344	5351	7	60-61	23-24	--	--	7-8	--	--	--	11	--	--	--	--	--	--	--	--	18-19	16-17	--	15	--	
				5359	5387	28	65-68	30-35	--	--	12-16	--	--	--	15-17	--	--	--	--	--	--	--	--	25-28	20-22	--	19-23	--	
				5387	5391	4	63	29	--	--	14	--	--	--	13	--	--	--	--	--	--	--	--	23	19	--	18	--	
				5391	5396	5	56	21	--	--	7	--	--	--	7	--	--	--	--	--	--	--	--	17	12	--	12	--	
				5413	5421	8	58-59	13-15	--	--	3-1	--	--	--	8-9	--	--	--	--	--	--	--	--	10-11	13-14	--	10-11	--	
				5421	5432	11	62-63	15-22	--	--	0-9	--	--	--	11-18	12-13	13-15	--	--	--	--	--	--	--	18-19	--	--	--	--
				5459	5465	6	59	19	--	--	5	--	--	--	9	--	--	--	--	--	--	--	--	15	14	--	13	--	
				5471	5477	6	62	24	--	--	8	--	--	--	12	--	--	--	--	--	--	--	--	18	18	--	16	--	
				5477	5488	11	65-67	28-32	--	--	14-15	--	--	--	15-16	--	--	--	--	--	--	--	--	23-25	20-21	--	18-20	--	
				5488	5496	8	61-62	25-27	--	--	7	--	--	--	11-12	--	--	--	--	--	--	--	--	19-20	17-18	--	15-17	--	
				5496	5501	5	56-58	20	--	--	4-5	--	--	--	7-8	--	--	--	--	--	--	--	--	15-16	12-13	--	12-13	--	
				5501	5512	11	61-63	27-31	--	--	12-13	--	--	--	11-13	--	--	--	--	--	--	--	--	22-24	17-19	--	16-19	--	
				5512	5517	5	71	31	--	--	18	--	--	--	20	--	--	--	--	--	--	--	--	26	24	--	22	--	
				5517	5526	9	79	45	--	--	24	--	--	--	25	--	--	--	--	--	--	--	--	30	30	--	30	--	
				5526	5545	19	65-70	25-30	--	--	13-16	--	--	--	15-19	--	--	--	--	--	--	--	--	21-25	20-24	--	18-21	--	
				5569	5576	7	75	33	--	--	15	--	--	--	23	--	--	--	--	--	--	--	--	26	27	--	25	--	
				5583	5589	6	82	37	--	--	22	--	--	--	28	--	--	--	--	--	--	--	--	31	31	--	30	--	
				5605	5625	20	68-71	25-26	--	--	16-17	--	--	--	17-20	--	--	--	--	--	--	--	--	22-23	22-24	--	19-20	--	
				5625	5631	6	80	45	--	--	23	--	--	--	26	--	--	--	--	--	--	--	--	35	30	--	30	--	
				5631	5638	7	73-76	26-34	--	--	19-20	--	--	--	22-23	--	--	--	--	--	--	--	--	24-28	26-28	--	21-25	--	
				5638	5651	13	65-70	22-26	--	--	15-19	--	--	--	15-19	--	--	--	--	--	--	--	--	20-24	20-24	--	16-20	--	
				4894	4906	12	67	--	--	--	248-253	--	--	--	--	--	--	--	--	--	--	--	21	17-19	--				
				4912	4915	3	65	--	--	249	--	--	13	--	--	--	--	--	--	--	--	--	--	20	18	--			
				4915	4921	6	86	--	--	238	--	--	19	--	--	--	--	--	--	--	--	--	--	33	27	--			
				4921	4927	6	68	--	--	253	--	--	11	--	--	--	--	--	--	--	--	--	--	22	17	--			
				4929	4944	15	74-79	--	--	235-241	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	26-30	23-26	--		
				4944	4958	14	71-74	--	--	238-239	--	--	--	18-19	--	--	--	--	--	--	--	--	--	--	24-26	23-25	--		
				4958	4961	3	64	--	--	26	--	--	--	6	--	--	--	--	--	--	--	--	--	--	19	14	--		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																									
				Estimated Porosity Value (%)																									
				Limestone								Dolostone																	
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
853	Collier	22	11815	4961	4966	5	68	--	2.49	--	--	--	13	--	--	--	--	--	--	--	--	22	19	--	--	--			
				4966	4972	6	75	--	2.37-2.41	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	27	24-25	--	--	--	
				4972	4978	6	68	--	2.56	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	22	17	--	--	--
				4978	4986	8	64	--	2.53	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	19	17	--	--	--
				4988	4993	5	68	--	2.47	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	22	20	--	--	--
				4993	4997	4	62	--	2.54	--	--	--	--	10	--	10	--	--	--	--	--	--	--	--	18	--	--	--	--
				4997	5001	4	69	--	2.53	--	--	--	--	11	--	18	--	--	--	--	--	--	--	--	23	18	--	--	--
				5025	5032	7	57-59	--	2.55	--	--	--	--	10	--	7-9	--	--	--	--	--	--	--	--	12-14	12-14	--	--	--
				5032	5036	4	64	--	2.56	--	--	--	--	9	--	14	--	--	--	--	--	--	--	--	19	16	--	--	--
				5046	5061	15	60-62	--	2.54	--	--	--	--	10	--	11-12	10-11	--	--	--	--	--	--	--	16-18	--	--	--	--
				5071	5076	5	59	--	2.58	--	--	--	--	8	--	9	7	--	--	--	--	--	--	--	14	--	--	--	--
				5076	5078	2	76	--	2.53	--	--	--	--	11	--	23	--	--	--	--	--	--	--	--	28	20	--	--	--
				5078	5087	9	61-62	--	2.56-2.58	--	--	--	--	8-9	--	11-12	8-9	--	--	--	--	--	--	--	17-18	--	--	--	--
				5097	5104	7	62	--	2.56-2.6	--	--	--	--	6-9	--	12	--	--	--	--	--	--	--	--	18	13-15	--	--	--
				5108	5116	8	61	--	2.61	--	--	--	--	6	--	11	--	--	--	--	--	--	--	--	17	14	--	--	--
				5116	5130	14	60-66	--	2.51-2.53	--	--	--	--	11-12	--	11-15	10-12	--	--	--	--	--	--	--	16-20	--	--	--	--
				5182	5187	5	69	--	2.42	--	--	--	--	17	--	18	17	--	--	--	--	--	--	--	23	--	--	--	--
				5187	5189	2	79	--	2.42	--	--	--	--	17	--	25	--	--	--	--	--	--	--	--	30	24	--	--	--
				5189	5191	2	65	--	2.46	--	--	--	--	15	--	15	14	--	--	--	--	--	--	--	20	--	--	--	--
				5191	5195	4	71-73	--	2.46-2.48	--	--	--	--	13-15	--	20-22	--	--	--	--	--	--	--	--	24-26	21-22	--	--	--
				5195	5197	2	63	--	2.53	--	--	--	--	11	--	13	11	--	--	--	--	--	--	--	19	--	--	--	--
				5197	5199	2	79	--	2.48	--	--	--	--	13	--	25	--	--	--	--	--	--	--	--	30	22	--	--	--
				5199	5203	4	65-68	--	2.48-2.5	--	--	--	--	12-13	--	15-17	--	--	--	--	--	--	--	--	20-22	18-20	--	--	--
				5203	5205	2	79	--	2.44	--	--	--	--	16	--	25	--	--	--	--	--	--	--	--	20-21	--	--	--	--
				5205	5207	2	68	--	2.43	--	--	--	--	17	--	17	16	--	--	--	--	--	--	--	22	--	--	--	--
				5207	5210	3	72	--	2.4	--	--	--	--	18	--	21	--	--	--	--	--	--	--	--	25	23	--	--	--
				5210	5213	3	69-71	--	2.38	--	--	--	--	19	--	18-20	17-18	--	--	--	--	--	--	--	23-24	--	--	--	--
				5213	5219	6	73-79	--	2.43	--	--	--	--	17	--	22-25	17-19	--	--	--	--	--	--	--	26-30	--	--	--	--
				5219	5221	2	65	--	2.48	--	--	--	--	13	--	15	13	--	--	--	--	--	--	--	20	--	--	--	--
				5221	5230	9	73	--	2.39-2.46	--	--	--	--	15-18	--	22	--	--	--	--	--	--	--	--	26	22-24	--	--	--
				5230	5233	3	82	--	2.42	--	--	--	--	17	--	28	--	--	--	--	--	--	--	--	31	25	--	--	--
				5233	5235	2	67	--	2.44	--	--	--	--	16	--	16	15	--	--	--	--	--	--	--	21	--	--	--	--
				5235	5239	4	84	--	2.39-2.4	--	--	--	--	18	--	29	--	--	--	--	--	--	--	--	32	22	--	--	--
				5239	5256	17	71-78	--	2.43-2.49	--	--	--	--	13-17	--	20-24	--	--	--	--	--	--	--	--	24-29	20-23	--	--	--
				5256	5264	8	73	--	2.53	--	--	--	--	11	--	22	--	--	--	--	--	--	--	--	26	19	--	--	--
				5270	5282	12	76-79	--	2.44-2.47	--	--	--	--	14-16	--	23-25	--	--	--	--	--	--	--	--	28-30	22-24	--	--	--
				5282	5289	7	92-93	--	2.51	--	--	--	--	12	--	33	--	--	--	--	--	--	--	--	36	25	--	--	--
				5289	5291	2	68	--	2.49	--	--	--	--	13	--	17	13	--	--	--	--	--	--	--	22	--	--	--	--
				5291	5297	6	75-79	--	2.49	--	--	--	--	13	--	23-25	--	--	--	--	--	--	--	--	27-30	21-22	--	--	--
				5297	5300	3	65-67	--	2.51-2.53	--	--	--	--	11-12	--	15-16	11-13	--	--	--	--	--	--	--	20-21	--	--	--	--
				5300	5302	2	71	--	2.54	--	--	--	--	10	--	20	--	--	--	--	--	--	--	--	24	18	--	--	--
				5302	5315	13	76-80	--	2.33-2.34	--	--	--	--	21-22	--	23-26	21-23	--	--	--	--	--	--	--	28-30	--	--	--	--
				5328	5337	9	60-63	--	2.61	--	--	--	--	6	--	11-13	--	--	--	--	--	--	--	--	16-19	13-14	--	--	--
				5390	5414	24	64-67	--	2.53-2.57	--	--	--	--	8-11	--	14-16	--	--	--	--	--	--	--	--	19-21	15-17	--	--	--
				5414	5427	13	65-70	--	2.41-2.46	--	--	--	--	15-18	--	15-19	14-17	--	--	--	--	--	--	--	20-24	--	--	--	--
				5427	5434	7	64	--	2.57	--	--	--	--	8	--	14	--	--	--	--	--	--	--	--	19	15	--	--	--
				5436	5442	6	62-64	--	2.57	--	--	--	--	8	--	12-14	--	--	--	--	--	--	--	--	18-19	14-15	--	--	--
				5442	5452	10	71-75	--	2.45-2.55	--	--	--	--	10-15	--	20-23	--	--	--	--	--	--	--	--	24-27	17-22	--	--	--
				5452	5454	2	64	--	2.65	--	--	--	--	4	--	14	--	--	--	--	--	--	--	--	19	13	--	--	--
				5477	5486	9	68	--	2.49	--	--	--	--	13	--	17	14	--	--	--	--	--	--	--	22	--	--	--	--
				5492	5501	9	79	--	2.39	--	--	--	--	18	--	25	--	--	--	--	--	--	--	--	30	25	--	--	--
				5516	5557	41	71-79	--	2.29-2.38	--	--	--	--	19-24	--	20-25	--	--	--	--	--	--	--	--	24-30	23-28	--	--	--
				4647	4652	5	72	32	--	--	17	--	--	--	--	--	--	--	--	--	--	26	23	--	--	--			
				4652	4656	4	68	22	--	11	--	--	--	17	--	--	--	--	--	--	--	--	--	22	--	--	--	--	
				4659	4673	14	65-71	28-30	--	14-15	--	--	--	15-20	--	--	--	--	--	--	--	--	--	23-25	20-24	--	--	--	
				4677	4686	9	72-77	36-37	--	22-24	--	--	--	21-23	--	--	--	--	--	--	--	--	--	30-31	25-28	--	--	--	
				4686	4689	3	80	39	--	26	--	--	--	26	--	--	--	--	--	--	--	--	--	33	30	--	--	--	
				4689	4699	10	73-77	35-38	--	18-25	--	--	--	--	22-23	--	--	--	--	--	--	--	--	28-32	26-28	--	--	--	
				4702	4706	4	64	25	--	10	--	--	--	14	--	--	--	--	--	--	--	--	--	20	17	--	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone						Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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Appendix IV (Continued)

Permit No.	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																						
			Estimated Porosity Value (%)																						
			Limestone									Dolostone													
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5012	5016	4	77-79	26	--	16	--	--	--	--	23	23-25	--	23-24	--	--	--	--	--	--	28-30	--	--	--	--
5016	5028	12	74-76	31-32	--	21-23	--	--	--	--	22-23	23-25	--	--	--	--	--	--	--	--	27-28	26-28	--	23-25	--
5028	5038	10	67-69	24-28	--	13-15	--	--	--	--	16-18	16-18	--	--	--	--	--	--	--	21-23	21-23	--	18-20	--	
5038	5058	20	63-66	22-25	--	13-15	--	--	--	--	13-15	13-15	--	--	--	--	--	--	--	19-22	19-20	--	15-18	--	
5058	5062	4	69	27	--	16	--	--	--	--	18	18	--	--	--	--	--	--	--	23	23	--	20	--	
5087	5100	13	60-65	21-25	--	9-11	--	--	--	--	11-15	11-15	--	--	--	--	--	--	--	17-21	16-20	--	14-18	--	
5108	5115	7	68	26	--	10	--	--	--	--	17	9	--	--	--	--	--	--	--	21	22	--	19	--	
5115	5119	4	59	17	--	3	--	--	--	--	9	9	--	--	--	--	--	--	--	13	14	--	12	--	
5130	5142	12	62-63	22-23	--	11-12	--	--	--	--	12-13	12-13	--	--	--	--	--	--	--	19-20	18-19	--	15-16	--	
5148	5156	8	60-65	27	--	3-10	--	--	--	--	11-15	11-15	--	--	--	--	--	--	--	19-21	16-20	--	16-18	--	
5159	5165	6	58	15	--	0	--	--	--	--	8	8	--	--	--	--	--	--	--	11	13	--	11	--	
5169	5179	10	53-59	19	--	6	--	--	--	--	4-9	4-9	--	--	--	--	--	--	--	15	10-14	--	10-13	--	
5226	5233	7	60-61	25	--	7	--	--	--	--	11	11	--	--	--	--	--	--	--	19	16-17	--	15	--	
5237	5255	18	65-67	25-26	--	13-15	--	--	--	--	15-16	15-16	--	--	--	--	--	--	--	21-22	20-21	--	18-19	--	
5255	5293	38	61-66	24-27	--	12-16	--	--	--	--	11-15	11-15	--	--	--	--	--	--	--	20-23	17-20	--	15-18	--	
5293	5297	4	68	28	--	19	--	--	--	--	17	17	--	--	--	--	--	--	--	25	22	--	20	--	
5297	5305	8	64-66	25-26	--	10-12	--	--	--	--	14-15	14-15	--	--	--	--	--	--	--	20-21	19-20	--	17-18	--	
5305	5308	3	59	20	--	7	--	--	--	--	9	9	--	--	--	--	--	--	--	16	14	--	13	--	
5308	5318	10	61-64	19-22	--	4-9	--	--	--	--	11-14	11-14	--	--	--	--	--	--	--	15-18	17-19	--	13-16	--	
5325	5331	6	74	28	--	17	--	--	--	--	24	22	--	--	22	--	--	--	--	--	26	--	--	--	
5331	5341	10	62-66	21-27	--	8-15	--	--	--	--	12-15	12-15	--	--	--	--	--	--	--	17-23	18-20	--	15-19	--	
5341	5363	22	67-71	28-31	--	16-18	--	--	--	--	16-20	16-20	--	--	--	--	--	--	--	24-26	21-24	--	20-22	--	
5363	5371	8	75	33	--	20	--	--	--	--	23	23	--	--	--	--	--	--	--	28	27	--	25	--	
5376	5383	7	57	13	--	2	--	--	--	--	7	7	--	--	--	--	--	--	--	11	12	--	10	--	
5390	5401	11	60-61	15-16	--	1	--	--	--	--	11-12	11-12	--	--	11-12	--	--	--	--	--	17-18	--	--	--	
5432	5447	15	60	18	--	2-4	--	--	--	--	13-14	11	--	--	11	--	--	--	--	--	17	--	--	--	
5447	5449	2	59	17	--	6	--	--	--	--	9	9	--	--	--	--	--	--	--	14	14	--	12	--	
5449	5477	28	61-66	19-26	--	7-13	--	--	--	--	11-15	11-15	--	--	--	--	--	--	--	16-22	17-20	--	13-18	--	
5481	5491	10	62-64	20-23	--	8-11	--	--	--	--	12-14	12-14	--	--	--	--	--	--	--	18-19	18-19	--	15-16	--	
5491	5497	6	77	33	--	17	--	--	--	--	23	23	--	--	--	--	--	--	--	27	28	--	25	--	
5497	5502	5	66	22	--	9	--	--	--	--	15	15	--	--	--	--	--	--	--	18	20	--	17	--	
5522	5529	7	82	33	--	24	--	--	--	--	28	28	--	--	27	--	--	--	--	--	31	--	--	--	
5529	5535	6	78	35	--	23	--	--	--	--	24	24	--	--	--	--	--	--	--	30	29	--	26	--	
5541	5550	9	74-76	25-27	--	15-16	--	--	--	--	22-23	22-23	--	--	22-23	--	--	--	--	--	26-28	--	--	--	
5567	5585	18	61-66	21-29	--	12-13	--	--	--	--	11-15	11-15	--	--	--	--	--	--	--	19-23	17-20	--	14-20	--	
5585	5592	7	78	21	--	19	--	--	--	--	24	24	--	--	21	--	--	--	--	34	32	--	31	--	
5592	5597	5	84	40	--	27	--	--	--	--	29	29	--	--	--	--	--	--	--	24-25	29	--	--	--	
5597	5608	11	71-72	21-22	--	16-18	--	--	--	--	19-20	20-21	--	--	18-19	--	--	--	--	--	23	23	--	20	--
5608	5613	5	69	28	--	14	--	--	--	--	18	18	--	--	--	--	--	--	--	--	18	--	--	--	
4823	4834	11	62	--	--	--	--	--	--	--	12	12	--	--	--	--	--	--	--	--	12	--	--	--	
4836	4839	3	57	--	--	--	--	--	--	--	7	7	--	--	--	--	--	--	--	--	33	--	--	--	
4839	4849	10	85	--	--	--	--	--	--	--	29	29	--	--	--	--	--	--	--	--	20	--	--	--	
4849	4851	2	65	--	--	--	--	--	--	--	15	15	--	--	--	--	--	--	--	--	20	--	--	--	
4851	4855	4	79	--	--	--	--	--	--	--	25	25	--	--	--	--	--	--	--	--	30	--	--	--	
4859	4865	6	75	--	--	--	--	--	--	--	23	23	--	--	--	--	--	--	--	--	27	--	--	--	
4865	4872	7	101	--	--	--	--	--	--	--	35	35	--	--	--	--	--	--	--	--	40	--	--	--	
4878	4893	15	74-75	--	--	--	--	--	--	--	22-23	22-23	--	--	--	--	--	--	--	--	26-27	--	--	--	
4893	4899	6	80	--	--	--	--	--	--	--	26	26	--	--	--	--	--	--	--	--	30	--	--	--	
4899	4903	4	71	--	--	--	--	--	--	--	20	20	--	--	--	--	--	--	--	--	24	--	--	--	
4905	4909	4	55	--	--	--	--	--	--	--	6	6	--	--	--	--	--	--	--	--	11	--	--	--	
4909	4915	6	70-71	--	--	--	--	--	--	--	19-20	19-20	--	--	--	--	--	--	--	--	24	--	--	--	
4915	4920	5	74	--	--	--	--	--	--	--	22	22	--	--	--	--	--	--	--	--	26	--	--	--	
4920	4925	5	65-66	--	--	--	--	--	--	--	15	15	--	--	--	--	--	--	--	--	20	--	--	--	
4925	4933	8	72-74	--	--	--	--	--	--	--	21-22	21-22	--	--	--	--	--	--	--	--	25-26	--	--	--	
4937	4942	5	66	--	--	--	--	--	--	--	15	15	--	--	--	--	--	--	--	--	20	--	--	--	
4942	4947	5	56	--	--	--	--	--	--	--	7	7	--	--	--	--	--	--	--	--	12	--	--	--	
4947	4962	15	64-66	--	--	--	--	--	--	--	14-15	14-15	--	--	--	--	--	--	--	--	19-20	--	--	--	
4979	4988	9	59	--	--	--	--	--	--	--	9	9	--	--	--	--	--	--	--	--	14	--	--	--	
4991	4996	5	59	--	--	--	--	--	--	--	9	9	--	--	--	--	--	--	--	--	14	--	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)														
											Limestone					Dolostone									
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
982	Collier	16	11934	4996	5003	7	63-64											19							
				5012	5028	16	63-66													19-20					
				5041	5048	7	64														19				
				5051	5061	10	66														20				
				5065	5070	5	62														18				
				5070	5074	4	58														13				
				5101	5105	4	56														12				
				5119	5123	4	67														21				
				5123	5133	10	74														26				
				5135	5147	12	64-66														19-20				
				5147	5153	6	69														23				
				5153	5155	2	63														19				
				5155	5185	30	66-71														20-24				
				5185	5189	4	64-65														19-20				
				5189	5194	5	71														24				
				5194	5197	3	61														17				
				5213	5220	7	65-68														20-22				
				5220	5228	8	63-66														19-20				
				5228	5232	4	71														24				
				5235	5255	20	65-68														20-22				
				5255	5257	2	62														18				
				5271	5278	7	62														18				
				5282	5285	3	57														12				
				5296	5301	5	57														12				
				5313	5341	28	61-66														17-20				
				5341	5353	12	68														22				
				5353	5357	4	74														26				
				5357	5360	3	68														22				
				5360	5379	19	61-66														17-20				
				5390	5396	6	59														14				
				5401	5414	13	71-74														24-26				
				5418	5421	3	56														12				
				5421	5431	10	76-78														28-29				
				5431	5439	8	65-68														20-22				
				5442	5458	16	89-100														34-39				
				5458	5461	3	85														33				
				5461	5468	7	77														28				
				5468	5479	11	67-71														21-24				
				5479	5484	5	79														30				
				5484	5495	11	71														24				
				4593	4601	8	59														14				
				4603	4610	7	70														24				
				4610	4615	5	64														19				
				4618	4629	11	69-71														23-24				
				4636	4649	13	73-76														26-28				
				4649	4657	8	82														31				
				4657	4663	6	74														26				
				4666	4687	21	72-77														25-28				
				4687	4699	12	61-66														17-20				
				4699	4705	6	67-68														21-22				
				4705	4711	6	65														20				
				4719	4733	14	60														16				
				4735	4745	10	66														20				
				4750	4763	13	66-71														20-24				
				4768	4775	7	64														19				
				4778	4799	21	68-69														22-23				
				4853	4859	6	74														26				
				4859	4863	4	70														24				
				4869	4874	5	72														25				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																											
				Estimated Porosity Value (%)																											
				Limestone								Dolostone																			
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9							
1059	Collier	15	11830	4874	4876	2	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--						
				4876	4884	8	69-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
				4886	4899	13	63-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
				4899	4929	30	65-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
				4935	4954	19	72-75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				4957	4973	16	78-79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				4973	4982	9	82-83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				4982	4989	7	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5005	5011	6	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5016	5023	7	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5030	5041	11	53-54	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5047	5051	4	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5051	5055	4	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5057	5070	13	66-67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5070	5077	7	83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5077	5081	4	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				5081	5099	18	77-78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5099	5111	12	95-100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5111	5114	3	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5118	5140	22	71-75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5144	5152	8	71-73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5160	5164	4	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5164	5171	7	73-74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5171	5178	7	79-81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5178	5182	4	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5182	5185	3	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5185	5190	5	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5190	5192	2	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5192	5196	4	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5196	5200	4	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5200	5205	5	68-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5205	5216	11	71-73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5216	5223	7	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5223	5229	6	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5229	5234	5	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5238	5245	7	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5247	5257	10	68-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5260	5264	4	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5264	5272	8	63-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5272	5286	14	67-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5286	5301	15	73-78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5301	5305	4	69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5316	5321	5	69-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5328	5339	11	81-83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5343	5350	7	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5350	5357	7	60-66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5357	5374	17	65-68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5374	5378	4	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5380	5388	8	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				5390	5404	14	83-85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
								5407	5410	3	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
								4602	4609	7	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
								4609	4612	3	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
								4616	4626	10	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4633	4653	20	68-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4653	4659	6	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4659	4674	15	65-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4674	4679	5	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4679	4687	8	66-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
								4602	4609	7	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		
				4609	4612	3	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4616	4626	10	62-65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4633	4653	20	68-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4653	4659	6	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4659	4674	15	65-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4674	4679	5	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4679	4687	8	66-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4687	4694	7	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					
				4694	4701	7	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--					

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																							
				Estimated Porosity Value (%)																							
				Limestone								Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
1063	Collier	14	11760	4689	4699	10	60-65																				
				4699	4716	17	65-66																				
				4728	4737	9	60																				
				4754	4768	14	65-69																				
				4773	4781	8	65																				
				4787	4806	19	67-71																				
				4828	4832	4	55																				
				4851	4862	11	68																				
				4869	4874	5	68																				
				4874	4879	5	73																				
				4879	4885	6	71																				
				4892	4916	24	62-66																				
				4916	4925	9	57-59																				
				4939	4943	4	63																				
				4943	4975	32	72-78																				
				4975	4983	8	65-71																				
				4983	4988	5	73																				
				4993	5001	8	60																				
				5009	5015	6	61																				
				5020	5025	5	55																				
				5030	5039	9	54-57																				
				5045	5051	6	70																				
				5051	5055	4	64																				
				5055	5060	5	59																				
				5060	5089	29	65-71																				
				5089	5094	5	74																				
				5094	5098	4	82																				
				5098	5101	3	76																				
				5101	5107	6	85																				
				5107	5111	4	75																				
				5111	5127	16	68-70																				
				5127	5131	4	55																				
				5133	5141	8	83																				
				5147	5161	14	72-79																				
				5161	5165	4	81																				
				5165	5168	3	79																				
				5168	5173	5	68																				
				5173	5195	22	72-79																				
				5195	5211	16	65-71																				
				5211	5220	9	72-74																				
				5220	5234	14	65-70																				
				5234	5241	7	61-62																				
				5241	5248	7	72-75																				
				5248	5250	2	59																				
				5250	5283	33	66-71																				
				5304	5329	25	72-78																				
				5329	5334	5	66																				
				5334	5343	9	55-58																				
				5343	5352	9	62-63																				
				5352	5355	3	57																				
				5355	5373	18	60-66																				
				5373	5383	10	75																				
				5383	5390	7	67-68																				
				5390	5398	8	76																				
				4861	4865	4	54																				
				4865	4871	6	61																				
				4874	4881	7	68																				
				4881	4885	4	61																				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																								
				Estimated Porosity Value (%)																								
				Limestone								Dolostone																
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
4892	4897	5	63								13											19						
4897	4899	2	54								4											10						
4899	4903	4	73								22											26						
4903	4906	3	65								15											20						
4909	4913	4	69								18											23						
4913	4923	10	77								23											28						
4923	4939	16	70-71								19-20											24						
4939	4943	4	64								14											19						
4943	4952	9	70-71								19-20											24						
4952	4978	26	62-66								12-15											18-20						
4999	5007	8	59								9											14						
5013	5027	14	60-62								11-12											16-18						
5040	5055	15	57-59								7-9											12-14						
5058	5062	4	54								4											10						
5062	5070	8	61-64								11-14											17-19						
5072	5084	12	57-59								7-9											12-14						
5084	5087	3	62								12											18						
5087	5091	4	57								7											12						
5116	5121	5	56								7											12						
5129	5138	9	60-62								11-12											16-18						
5143	5158	15	65-68								15-17											20-22						
5158	5162	4	64								14											19						
5162	5172	10	68-70								17-19											22-24						
5172	5185	13	71-74								20-22											24-26						
5185	5213	28	65-71								15-20											20-24						
5213	5218	5	64								14											19						
5229	5235	6	72								21											25						
5235	5239	4	64								14											19						
5239	5254	15	72-77								21-23											25-28						
5254	5260	6	63-65								13-15											19-20						
5260	5268	8	75-76								23											27-28						
5268	5275	7	82								28											31						
5292	5302	10	62								12											18						
5304	5307	3	58								8											13						
5307	5314	7	62								12											18						
5342	5348	6	60								11											16						
5353	5365	12	61-64								11-14											17-19						
5365	5372	7	68								17											22						
5372	5379	7	63-66								13-15											19-20						
5379	5389	10	67-70								16-19											21-24						
5389	5396	7	61-62								11-12											17-18						
5399	5405	6	68								17											22						
5405	5410	5	64								14											19						
5410	5412	2	57								7											12						
5412	5417	5	65								15											20						
5436	5446	10	71								20											24						
5453	5461	8	71-74								20-22											24-26						
5481	5495	14	71-73								20-22											24-26						
5495	5500	5	91								32											36						
5500	5512	12	85-86								29											33						
5512	5519	7	71-72								20-21											24-25						
5519	5527	8	83								28											32						
				4815	4825	10	61-66																					
				4827	4842	15	72-76																					
				4845	4849	4	55																					
				4849	4861	12	65-69																					
				4861	4887	26	72-77																					
				4887	4894	7	80-81																					
				4894	4903	9	72-76																					

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																								
				Estimated Porosity Value (%)																								
				Limestone							Dolostone																	
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
1240	Collier	16	11879	4903	4905	2	68																					
				4905	4909	4	77																					
				4909	4914	5	76-78																					
				4914	4917	3	71																					
				4917	4927	10	65-68																					
				4929	4934	5	70																					
				4939	4945	6	54-56																					
				4947	4964	17	66-69																					
				4980	4991	11	54-58																					
				4994	5005	11	61-66																					
				5016	5029	13	63-65																					
				5038	5047	9	61-68																					
				5049	5056	7	66-67																					
				5059	5067	8	61-62																					
				5097	5102	5	56																					
				5120	5128	8	77-78																					
				5128	5131	3	82																					
				5131	5135	4	78																					
				5135	5148	13	68-71																					
				5148	5171	23	72-79																					
				5171	5174	3	84																					
				5174	5179	5	78																					
				5179	5186	7	80-84																					
				5186	5197	11	66-71																					
				5197	5201	4	61																					
				5215	5236	21	72-77																					
				5238	5244	6	65-69																					
				5244	5258	14	72-73																					
				5258	5264	6	66-67																					
				5273	5279	6	63																					
				5279	5283	4	57																					
				5288	5292	4	60																					
				5302	5320	18	55-58																					
				5320	5330	10	63-66																					
				5330	5333	3	59																					
				5333	5341	8	60-61																					
				5341	5347	6	65-69																					
				5347	5350	3	60																					
				5350	5357	7	74																					
				5357	5368	11	62-65																					
				5368	5373	5	70																					
				5373	5376	3	62																					
				5376	5381	5	56-58																					
				5381	5383	2	61																					
				5383	5386	3	57																					
				5401	5407	6	58																					
				5413	5422	9	69-71																					
				5422	5431	9	72-77																					
				5435	5441	6	72																					
				5441	5445	4	57																					
				5445	5451	6	66																					
				5453	5469	16	82-85																					
				5469	5477	8	73-79																					
				5477	5487	10	69-71																					
				5487	5495	8	75-78																					
				4694	4699	5	72	31		18																		
				4699	4705	6	70	32-33		14-17																		
				4705	4711	6	73	32		18																		
				4711	4719	8	70	27		12																		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																	
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone						Dolostone																
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
609	Desoto	60	13000	4719	4724	5	77	34	--	--	21	--	--	--	23	--	--	--	--	--	--	28	28	28	--	25	--	--					
				4724	4729	5	82	36	--	--	24	--	--	--	28	--	--	--	--	--	--	--	31	31	31	--	29	--	--				
				4729	4731	2	67	26	--	--	12	--	--	--	16	--	--	--	--	--	--	--	21	21	21	--	19	--	--				
				4731	4736	5	76	34	--	--	22	--	--	--	23	--	--	--	--	--	--	--	28	28	28	--	25	--	--				
				4736	4738	2	70	28	--	--	17	--	--	--	19	--	--	--	--	--	--	--	24	24	24	--	21	--	--				
				4738	4745	7	82	39	--	--	24	--	--	--	28	--	--	--	--	--	--	--	32	31	30	--	30	--	--				
				4767	4775	8	85	42	--	--	28	--	--	--	29	--	--	--	--	--	--	--	35	33	32	--	32	--	--				
				4775	4788	13	75-76	33-34	--	--	20-21	--	--	--	23	--	--	--	--	--	--	--	28-29	27-28	--	23-25	--	--	--				
				4798	4803	5	67	22	--	--	12	--	--	--	16	--	--	--	--	--	--	--	19	21	--	18	--	--	--				
				4803	4808	5	65	16	--	--	8	--	--	14	15	--	15	--	--	--	--	--	--	20	--	--	--	--	--	--			
				4808	4813	5	77-78	36-37	--	--	20	--	--	--	23-24	--	--	--	--	--	--	--	30	28-29	--	26-27	--	--	--				
				4813	4817	4	71	20	--	--	10	--	--	17	20	--	19	--	--	--	--	--	--	24	--	--	--	--	--	--			
				4822	4841	19	79-86	34-45	--	--	22-29	--	--	--	25-29	--	--	--	--	--	--	--	29-37	30-33	--	26-33	--	--	--	--			
				4841	4844	3	77	36	--	--	18	--	--	--	23	--	--	--	--	--	--	--	29	28	--	26	--	--	--	--			
				4844	4864	20	83-86	41-43	--	--	27-29	--	--	--	28-29	--	--	--	--	--	--	--	35-36	32-33	--	31-33	--	--	--	--			
				4864	4867	3	63	22	--	--	10	--	--	--	13	--	--	--	--	--	--	--	18	19	--	15	--	--	--	--			
				4867	4873	6	79	33	--	--	20	--	--	28	25	--	26	--	--	--	--	--	--	30	--	--	--	--	--	--	--		
				4878	4885	7	95	45	--	--	33	--	--	--	34	--	--	--	--	--	--	--	39	37	--	37	--	--	--	--			
				4885	4905	20	79-86	32-39	--	--	21-25	--	--	--	25-29	--	--	--	--	--	--	--	28-33	30-33	--	26-31	--	--	--	--	--		
				4913	4921	8	60-64	17-18	--	--	3-6	--	--	13-15	11-14	--	11-14	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--		
				4926	4935	9	77-79	39	--	--	21	--	--	--	23-25	--	23-25	--	--	--	--	--	31	28-30	--	27-28	--	--	--	--	--		
				4935	4945	10	83-87	41-42	--	--	25	--	--	--	28-30	--	--	--	--	--	--	--	34-35	32-33	--	31-32	--	--	--	--	--		
				4945	4951	6	66	22	--	--	12	--	--	--	15	--	--	--	--	--	--	--	19	20	--	17	--	--	--	--	--		
				4953	4968	15	80-87	42-45	--	--	22-27	--	--	--	26-30	--	--	--	--	--	--	--	33-37	30-33	--	30-34	--	--	--	--	--		
				4968	4977	9	65-71	27	--	--	16	--	--	23	15-20	--	18-20	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--		
				4977	4985	8	84	46	--	--	25	--	--	--	29	--	--	--	--	--	--	--	37	32	--	33	--	--	--	--	--		
				4985	4991	6	78	41	--	--	24	--	--	--	24	--	--	--	--	--	--	--	33	29	--	28	--	--	--	--	--		
				4997	5000	3	66	27	--	--	13	--	--	--	15	--	--	--	--	--	--	--	22	20	--	19	--	--	--	--	--		
				5000	5025	25	75-79	37-41	--	--	24-28	--	--	--	23-25	--	--	--	--	--	--	--	31-35	27-30	--	28-29	--	--	--	--	--		
				5025	5033	8	81-85	40-48	--	--	29-32	--	--	--	27-29	--	--	--	--	--	--	--	35-39	31-33	--	30-34	--	--	--	--	--		
				5033	5039	6	77	40	--	--	24	--	--	--	23	--	--	--	--	--	--	--	33	28	--	28	--	--	--	--	--		
				5042	5089	47	71-77	31-36	--	--	17-23	--	--	--	20-23	--	--	--	--	--	--	--	26-30	24-28	--	22-26	--	--	--	--	--		
				5089	5096	7	65-71	27-34	--	--	14-18	--	--	22-28	15-20	--	15-21	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--		
				5096	5129	33	74-79	34-43	--	--	21-26	--	--	--	22-25	--	--	--	--	--	--	--	29-35	26-30	--	24-30	--	--	--	--	--		
				5129	5151	22	66-71	25-30	--	--	11-17	--	--	21-25	15-20	--	15-20	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--		
				5151	5156	5	73	32	--	--	21	--	--	--	22	--	--	--	--	--	--	--	28	26	--	23	--	--	--	--	--		
				5156	5176	20	61-66	27-29	--	--	13-16	--	--	--	11-15	--	--	--	--	--	--	--	22-24	17-20	--	16-20	--	--	--	--	--		
				5185	5197	12	67-71	30-31	--	--	16-19	--	--	--	16-20	--	--	--	--	--	--	--	25-26	21-24	--	20-22	--	--	--	--	--		
				5197	5204	7	63-65	22-24	--	--	10-12	--	--	--	13-15	--	--	--	--	--	--	--	18-20	19-20	--	15-17	--	--	--	--	--		
				5204	5210	6	80	34	--	--	22	--	--	--	26	--	--	--	--	--	--	--	29	30	--	27	--	--	--	--	--		
				5217	5228	11	72-73	32	--	--	16-19	--	--	--	21-22	--	--	--	--	--	--	--	25-27	25-26	--	23	--	--	--	--	--		
				5228	5231	3	65	25	--	--	10	--	--	--	15	--	--	--	--	--	--	--	20	20	--	18	--	--	--	--	--		
				5237	5241	4	66	16	--	--	5	--	--	14	15	--	14	--	--	--	--	--	--	20	--	--	--	--	--	--	--		
								4469	4501	32	72-78	31-34	--	--	16-21	--	--	--	25-28	21-24	--	21-25	--	--	25-29	--	--	--	--	--	--	--	
								4521	4529	8	72-76	34	--	--	22	--	--	28	--	--	--	21-23	--	--	--	25-28	--	--	--	--	--	--	
								4529	4535	6	81-84	44	--	--	28	--	--	--	--	--	--	27-29	--	--	--	36	31-32	--	30-32	--	--	--	
								4535	4543	8	74-79	35-37	--	--	22-23	--	--	--	--	--	--	22-25	--	--	--	30-31	26-30	--	25-28	--	--	--	
								4555	4569	14	67-71	28-29	--	--	17-19	--	--	--	--	--	--	16-20	--	--	--	24-25	21-24	--	20-21	--	--	--	
								4569	4571	2	73	37	--	--	22	--	--	31	22	--	24	--	--	--	--	31	26	--	24	--	--	--	
								4571	4577	6	83	39	--	--	24	--	--	31	28	--	30	--	--	--	--	29-32	26-27	--	24-26	--	--	--	
								4582	4597	15	73-75	34-37	--	--	21-25	--	--	--	22-23	--	34	--	--	--	--	--	36	--	--	--	--	--	--
								4597	4602	5	91	40	--	--	31	--	--	35	32	--	34	--	--	--	--	--	35	31	--	30	--	--	--
								4602	4606	4	81	41	--	--	28	--	--	--	27	--	--	--	--	--	--	39	37	--	36	--	--	--	--
								4606	4614	8	94	43	--	--	34	--	--	--	34	--	--	--	--	--	--	--	39	37	--	36	--	--	--
								4614	4619	5	76	34-36	--	--	19-20	--	--	--	23	--	--	--	--	--	--	28-29	28	--	25-26	--	--	--	--
				4619	4622	3	67	32	--	--	15	--	--	--	16	--	--	--	--	--	--	25	21	--	20	--	--	--	--				
				4622	4625	3	76	40	--	--	27	--	--	--	23	--	--	--	--	--	--	34	28	--	27	--	--	--	--				
				4625	4629	4	109	43	--	--	31	--	--	--	>35	--	--	--	--	--	--	--	37	>40	--	44	--	--	--	--			
4629	4633	4	76	34	--	--	24	--	--	--	23	--																					

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																												
				Estimated Porosity Value (%)										Dolostone																		
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (usec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
4636	4660	24	81-88	43	--	31-34	--	--	--	--	27-30	--	--	--	--	--	--	--	--	37-38	31-33	--	31-34	--	--	Figure AII-6	Figure AII-9					
679A	Desoto	96	11660	4660	4662	2	75	39	--	26	--	23	--	--	--	--	--	--	--	--	33	27	--	26	--	--	--	--	--			
				4662	4667	5	86	40	--	27	--	--	--	29	--	--	--	--	--	--	--	34	33	--	31	--	--	--	--	--		
				4667	4669	2	58	23	--	8	--	--	--	8	--	--	--	--	--	--	--	18	13	--	14	--	--	--	--	--		
				4669	4679	10	85-86	45	--	33	--	--	--	29	--	--	--	--	--	--	--	39	33	--	32-33	--	--	--	--	--		
				4679	4684	5	76	35	--	19	--	--	--	23	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--
				4684	4689	5	64	26	--	11	--	--	--	14	--	--	--	--	--	--	--	--	21	19	--	18	--	--	--	--	--	
				4685	4703	8	68-71	27-30	--	18-19	--	--	--	17-20	--	--	--	--	--	--	--	--	24-26	22-24	--	20-22	--	--	--	--	--	
				4703	4711	8	61-62	16	--	8	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	
				4711	4722	11	82-85	42-43	--	29-30	--	--	--	28-29	--	--	--	--	--	--	--	--	36-37	31-33	--	31-33	--	--	--	--	--	
				4722	4730	8	72-78	37	--	26	--	--	--	21-24	--	--	--	--	--	--	--	--	32	25-29	--	24-27	--	--	--	--	--	
				4730	4734	4	64	34	--	20	--	--	--	14	--	--	--	--	--	--	--	--	28	19	--	20	--	--	--	--	--	
				4746	4751	5	76	37	--	24	--	--	--	23	--	--	--	--	--	--	--	--	31	28	--	26	--	--	--	--	--	
				4751	4755	4	84	43	--	28	--	--	--	29	--	--	--	--	--	--	--	--	36	32	--	32	--	--	--	--	--	
				4755	4760	5	78	43	--	26	--	--	--	24	--	--	--	--	--	--	--	--	35	29	--	29	--	--	--	--	--	
				4760	4775	15	79-85	40-41	--	24-28	--	--	--	25-29	--	--	--	--	--	--	--	--	33-34	30-33	--	29-31	--	--	--	--	--	
				4777	4796	19	74-79	36-39	--	23-26	--	--	--	22-25	--	--	--	--	--	--	--	--	31-33	26-30	--	25-28	--	--	--	--	--	
				4804	4809	5	70-71	34	--	20	--	--	--	19-20	--	--	--	--	--	--	--	--	29	24	--	23-24	--	--	--	--	--	
				4809	4835	26	75-79	37-41	--	22-26	--	--	--	23-25	--	--	--	--	--	--	--	--	31-34	27-30	--	26-29	--	--	--	--	--	
				4835	4840	5	80	42	--	27	--	--	--	26	--	--	--	--	--	--	--	--	34	30	--	30	--	--	--	--	--	
				4840	4852	12	74-76	36-39	--	22-25	--	--	--	22-23	--	--	--	--	--	--	--	--	30-33	26-28	--	25-27	--	--	--	--	--	
				4852	4857	5	70-71	33-34	--	19	--	--	--	19-20	--	--	--	--	--	--	--	--	27-28	24	--	22-23	--	--	--	--	--	
				4857	4914	57	72-79	36-40	--	21-26	--	--	--	--	--	--	--	--	--	--	--	--	30-34	25-30	--	24-29	--	--	--	--	--	
				4914	4931	17	65-71	27-30	--	13-17	--	--	--	21-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4931	4934	3	73	35	--	21	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				4934	4941	7	61-66	25-29	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	21-23	17-20	--	15-20	--	--	--	--	--	
				4941	4955	14	66-71	30-33	--	13-18	--	--	--	--	--	--	--	--	--	--	--	--	24-27	20-24	--	20-23	--	--	--	--	--	
				4955	4957	2	57	23	--	11	--	--	--	--	--	--	--	--	--	--	--	--	19	12	--	13	--	--	--	--	--	
				4957	4963	6	63-65	29-30	--	15-16	--	--	--	--	--	--	--	--	--	--	--	--	24-25	19-20	--	18-19	--	--	--	--	--	
				4963	4967	4	71	33	--	18	--	--	--	--	--	--	--	--	--	--	--	--	27	24	--	23	--	--	--	--	--	
				4967	4970	3	63	29	--	14	--	--	--	--	--	--	--	--	--	--	--	--	24	19	--	18	--	--	--	--	--	
				4970	4977	7	65-69	28-30	--	15-20	--	--	--	22-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4977	4984	7	61-65	27	--	12-13	--	--	--	--	--	--	--	--	--	--	--	--	22	17-20	--	16-18	--	--	--	--	--	
				4984	5000	16	72-79	36-39	--	22-25	--	--	--	--	--	--	--	--	--	--	--	--	30-33	25-30	--	24-28	--	--	--	--	--	
				5000	5004	4	66	29	--	21	--	--	--	--	--	--	--	--	--	--	--	--	25	20	--	20	--	--	--	--	--	
				5004	5019	15	75-76	39	--	24-25	--	--	--	--	--	--	--	--	--	--	--	--	32-33	27-28	--	26-27	--	--	--	--	--	
				5021	5024	3	61	19	--	4	--	--	--	14	--	--	--	--	--	--	--	--	31	26	--	25	--	--	--	--	--	
				5036	5041	5	73	38	--	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				5041	5049	8	68-71	27-31	--	15-18	--	--	--	--	--	--	--	--	--	--	--	--	23-26	22-24	--	20-22	--	--	--	--	--	
				5049	5053	4	60-62	23	--	10	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				5053	5059	6	63	22	--	11	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				5059	5073	14	72-79	33-38	--	19-23	--	--	--	--	--	--	--	--	--	--	--	--	28-32	25-30	--	23-28	--	--	--	--	--	
								4905	4912	7	68	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4915	4919	4	61					--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
4931	4938	7	65					--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
4938	4957	19	73-78					--	--	--	--	22-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
4957	4965	8	66-68					--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
4965	4971	6	75					--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5002	5010	8	68-70					--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5010	5015	5	63					--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5015	5021	6	56					--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5025	5029	4	66					--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5029	5033	4	59					--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5035	5041	6	73					--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5041	5047	6	70					--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5047	5051	4	83					--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5051	5087	36	76-77					--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5087	5090	3	69					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
5090	5107	17	72-75					--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																						
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone						Dolostone																					
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9										
1193	Glades	32	9238	5107	5112	5	70	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--				
				5112	5119	7	72-75	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	--	--	--	--	--	--			
				5119	5123	4	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--		
				5149	5163	14	74-75	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	26-27	--	--	--	--	--	--	--	--	--	--	--		
				5163	5168	5	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--		
				5168	5180	12	72-75	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	--	--	--	--	--	--	--		
				5180	5186	6	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--		
				5188	5196	8	68-69	--	--	--	--	--	--	17-18	--	--	--	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	--		
				5198	5207	9	71	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--		
				5210	5229	19	65-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	--	--	--	
				5237	5248	11	67-68	--	--	--	--	--	--	16-17	--	--	--	--	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	--	--	--	
				5248	5255	7	63	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	
				5255	5271	16	66-67	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	--	--	--	--	--	--	--	
				5271	5280	9	62-64	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--	--	--	--	--	--	--	--	
				5284	5288	4	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	
				5297	5303	6	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	
				5303	5309	6	65-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--	--	--	--	--	--	--	--
				5309	5313	4	72	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--	--	
				5313	5317	4	81	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	
				5317	5353	36	72-78	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--	--	--	--	25-29	--	--	--	--	--	--	--	--	--	--	--	--	--
5353	5368	15	68-70	--	--	--	--	--	--	17-19	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--	--	--	--	--	--	--	--	--				
5368	5382	14	72-75	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	--	--	--	--	--	--	--	--	--				
5382	5389	7	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--				
5389	5391	2	60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--				
5391	5405	14	65-69	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	--	--	--	--				
5405	5413	8	59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--				
5413	5421	8	64	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--				
279	Hendry	38	11646	4911	4917	6	64	--	2.23	--	--	--	--	14	--	--	--	--	--	--	--	19	20	--	--	--	--	--	--	--	--	--	--	--	--			
				4921	4931	10	67-68	--	2.27-2.30	--	--	--	--	16-17	--	--	--	--	--	--	--	--	--	21-22	20-21	--	--	--	--	--	--	--	--	--	--	--	--	
				4936	4941	5	66	--	2.30	--	--	--	--	15	--	--	--	--	--	--	--	--	--	20	19	--	--	--	--	--	--	--	--	--	--	--	--	
				4941	4951	10	76-77	--	2.28	--	--	--	--	23	23	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4955	4975	20	72-76	--	2.17-2.18	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	25-28	28-30	--	--	--	--	--	--	--	--	--	--	--	--	--
				4975	5011	36	65-71	--	2.26-2.35	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	28-32	20-24	23-25	--	--	--	--	--	--	--	--	--	--	--	--
				5011	5041	30	60-64	--	2.35-2.39	--	--	--	--	11-14	15-16	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	
				5043	5050	7	63	--	2.4	--	--	--	--	13	--	--	--	--	--	--	--	--	--	19	20	--	--	--	--	--	--	--	--	--	--	--	--	
				5061	5071	10	65	--	2.32	--	--	--	--	15	19	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	
				5079	5089	10	64-65	--	2.30-2.31	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	29-30	19-20	24	--	--	--	--	--	--	--	--	--	--	--	--
				5101	5114	13	63-64	--	2.27	--	--	--	--	13-14	--	--	--	--	--	--	--	--	--	31	--	25	--	--	--	--	--	--	--	--	--	--	--	--
				5117	5125	8	62	--	2.38	--	--	--	--	12	15	--	--	--	--	--	--	--	--	26	--	18	--	--	--	--	--	--	--	--	--	--	--	--
				5129	5135	6	59	--	2.50	--	--	--	--	9	10	--	--	--	--	--	--	--	--	14	--	14	--	--	--	--	--	--	--	--	--	--	--	--
				5138	5145	7	64	--	2.37	--	--	--	--	14	--	--	--	--	--	--	--	--	--	19	21	--	--	--	--	--	--	--	--	--	--	--	--	
				5167	5172	5	56	--	2.65	--	--	--	--	7	--	--	--	--	--	--	--	--	--	12	11	--	--	--	--	--	--	--	--	--	--	--	--	--
				5187	5193	6	63	--	2.44	--	--	--	--	13	--	--	--	--	--	--	--	--	--	23	19	20	--	--	--	--	--	--	--	--	--	--	--	--
				5202	5211	9	67	--	2.36	--	--	--	--	16	18	--	--	--	--	--	--	--	--	27	--	21	--	--	--	--	--	--	--	--	--	--	--	--
				5215	5244	29	65-71	--	2.31-2.34	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	28-29	20-24	23-25	--	--	--	--	--	--	--	--	--	--	--	--
				5244	5254	10	76-77	--	2.13-2.16	--	--	--	--	23	--	--	--	--	--	--	--	--	--	38-39	28	32-34	--	--	--	--	--	--	--	--	--	--	--	--
				5254	5261	7	69-71	--	2.2	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	35	23-24	25-26	--	--	--	--	--	--	--	--	--	--	--	--
5261	5300	39	72-76	--	2.2-2.25	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	33-35	23-24	25-26	--	--	--	--	--	--	--	--	--	--	--	--	--			
5305	5317	12	74-76	--	2.19-2.25	--	--	--	--	22-23	24-25	--	--	--	--	--	--	--	--	33-36	26-28	27-30	--	--	--	--	--	--	--	--	--	--	--	--	--			
5317	5321	4	66-68	--	2.29	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	31	20-22	24	--	--	--	--	--	--	--	--	--	--	--	--	--			
5321	5326	5	69	--	2.28	--	--	--	--	18	--	--	--	--	--	--	--	--	--	23	26	--	--	--	--	--	--	--	--	--	--	--	--	--				
5328	5338	10	66-71	--	2.25-2.28	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	31-33	20-24	20-25	--	--	--	--	--	--	--	--	--	--	--	--	--			
5338	5344	6	61	--	2.46	--	--	--	--	11	--	--	--	--	--	--	--	--	--	22	17	17	--	--	--	--	--	--	--	--	--	--	--	--				
5354	5373	19	62-64	--	2.34																																	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																						
				Estimated Porosity Value (%)											Dolostone											
				Limestone																						
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
5504	5509	5	57	--	2.67	--	--	3	--	--	7	--	--	--	--	--	--	11	--	--	--	12	10	--	--	Figure AII-9
5509	5517	8	69-71	--	2.37	--	--	20	--	--	18-20	--	--	--	--	--	--	26	--	--	--	23-24	23	--	--	Figure AII-6
5523	5529	6	72	--	2.36	--	--	20	--	--	21	19	--	--	--	--	--	27	--	--	--	25	--	--	--	Figure AII-6
5531	5537	6	69	--	2.46	--	--	15	--	--	18	--	--	--	--	--	--	22	--	--	--	23	20	--	--	Figure AII-6
5541	5544	3	58	--	2.61	--	--	6	--	--	8	--	--	--	--	--	--	14	--	--	--	13	13	--	--	Figure AII-6
5546	5555	9	60	--	2.36	--	--	20	--	--	11	15	--	--	--	--	--	27	--	--	--	16	--	--	--	Figure AII-6
5555	5561	6	81-82	--	2.21	--	--	29	--	--	27-28	--	--	--	--	--	--	34	--	--	--	31	31	--	--	Figure AII-6
5561	5564	3	64	--	2.36	--	--	20	--	--	14	16	--	--	--	--	--	27	--	--	--	19	--	--	--	Figure AII-6
5564	5569	5	72	--	2.26	--	--	26	--	--	21	--	--	--	--	--	--	32	--	--	--	25	27	--	--	Figure AII-6
5569	5579	10	61-65	--	2.34-2.36	--	--	20-21	--	--	11-15	--	--	--	--	--	--	27-28	--	--	--	17-20	20-22	--	--	Figure AII-6
5579	5587	8	75-76	--	2.23	--	--	28	--	--	23	--	--	--	--	--	--	34	--	--	--	27-28	28	--	--	Figure AII-6
4639	4665	26	--	26-30	--	9-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--	Figure AII-6
4667	4689	22	--	39-43	--	23-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32-35	--	--	--	--	Figure AII-6
4689	4695	6	--	35-36	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29	--	--	--	--	Figure AII-6
4695	4711	16	--	>45	--	24-26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	38	--	--	--	--	Figure AII-6
4711	4719	8	--	36	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	Figure AII-6
4719	4725	6	--	43	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33	--	--	--	--	Figure AII-6
4725	4743	18	--	31-33	--	13-17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	Figure AII-6
4743	4749	6	--	35-37	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29-30	--	--	--	--	Figure AII-6
4749	4752	3	--	41	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32	--	--	--	--	Figure AII-6
4752	4755	3	--	35	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	Figure AII-6
4755	4759	4	--	23	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	Figure AII-6
4772	4780	8	--	31-32	--	12-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-25	--	--	--	--	Figure AII-6
4780	4783	3	--	17	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	Figure AII-6
4783	4801	18	--	35-36	--	18-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28-29	--	--	--	--	Figure AII-6
4805	4822	17	--	36-38	--	16-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	Figure AII-6
4822	4830	8	--	32	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	Figure AII-6
4833	4839	6	--	31	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	Figure AII-6
4839	4842	3	--	22	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	Figure AII-6
4842	4846	4	--	31	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	Figure AII-6
4846	4852	6	--	40	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	Figure AII-6
4872	4876	4	--	24	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	Figure AII-6
4911	4920	9	--	39	--	20-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30-31	--	--	--	--	Figure AII-6
4920	4924	4	--	33	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	27	--	--	--	--	Figure AII-6
4924	4934	10	--	26	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	Figure AII-6
4934	4971	37	--	32-37	--	14-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-30	--	--	--	--	Figure AII-6
4971	4984	13	--	27-32	--	14-15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22-25	--	--	--	--	Figure AII-6
4991	5003	12	--	37-40	--	20-22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30-32	--	--	--	--	Figure AII-6
5003	5005	2	--	31	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	Figure AII-6
5005	5015	10	--	45	--	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	35	--	--	--	--	Figure AII-6
5015	5017	2	--	32	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	Figure AII-6
5017	5027	10	--	40	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32	--	--	--	--	Figure AII-6
5027	5035	8	--	26	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	Figure AII-6
5051	5060	9	--	24	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	Figure AII-6
5060	5070	10	--	30	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	Figure AII-6
5101	5123	22	--	30-35	--	16-22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25-29	--	--	--	--	Figure AII-6
5123	5132	9	--	26-27	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21-22	--	--	--	--	Figure AII-6
5132	5141	9	--	35-36	--	18-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29-30	--	--	--	--	Figure AII-6
5141	5148	7	--	38-42	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31-33	--	--	--	--	Figure AII-6
5148	5151	3	--	35	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29	--	--	--	--	Figure AII-6

565A

Hendry

17025

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone								Dolostone													
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5151	5173	22	--	42-43	--	28-30	--	--	--	--	--	--	--	--	--	--	--	--	35-36	--	--	--	--	--	--
5173	5178	5	--	23	--	10	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--
5178	5191	13	--	35-37	--	21-24	--	--	--	--	--	--	--	--	--	--	--	--	29-31	--	--	--	--	--	--
5191	5195	4	--	22	--	13	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--
5202	5213	11	--	37-39	--	24-25	--	--	--	--	--	--	--	--	--	--	--	--	31-33	--	--	--	--	--	--
5221	5225	4	--	15	--	2	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
5225	5248	23	--	39-42	--	19-26	--	--	--	--	--	--	--	--	--	--	--	--	31-34	--	--	--	--	--	--
5248	5253	5	--	32	--	16	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--
5253	5331	78	--	35-42	--	18-23	--	--	--	--	--	--	--	--	--	--	--	--	30-34	--	--	--	--	--	--
5331	5345	14	--	30-33	--	15-18	--	--	--	--	--	--	--	--	--	--	--	--	24-27	--	--	--	--	--	--
5345	5351	6	--	25-27	--	11-12	--	--	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--	--	--
5351	5357	6	--	33-36	--	16-20	--	--	--	--	--	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--
5357	5361	4	--	20	--	9	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
5361	5371	10	--	39-40	--	18-19	--	--	--	--	--	--	--	--	--	--	--	--	30-31	--	--	--	--	--	--
5371	5401	30	--	31-37	--	16-20	--	--	--	--	--	--	--	--	--	--	--	--	25-30	--	--	--	--	--	--
5401	5403	2	--	22	--	8	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--
5403	5413	10	--	34-36	--	18-19	--	--	--	--	--	--	--	--	--	--	--	--	27-29	--	--	--	--	--	--
5413	5415	2	--	23	--	7	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--
5415	5426	11	--	26-29	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--
5426	5442	16	--	21-25	--	8-12	--	--	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--
5442	5452	10	--	31-32	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4790	4795	5	69-71	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	--	23-24	--	--	--
4795	4813	18	72-75	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--
4813	4816	3	66	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--
4816	4840	24	76-79	--	--	--	--	--	--	--	23-25	--	--	--	--	--	--	--	--	--	--	28-30	--	--	--
4841	4845	4	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--
4868	4882	14	69-71	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	--	23-24	--	--	--
4897	4901	4	65	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--
4901	4909	8	75	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	27	--	--	--
4918	4920	2	61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--
4920	4927	7	72	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	25	--	--	--
4932	4936	4	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	19	--	--	--
4936	4942	6	80	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	30	--	--	--
4947	4957	10	72-74	--	--	--	--	--	--	--	21-22	--	--	--	--	--	--	--	--	--	--	25-26	--	--	--
4957	4961	4	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16	--	--	--
4961	4980	19	66-71	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--
4980	4990	10	60-61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16-17	--	--	--
4997	5012	15	63-66	--	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--
5019	5041	22	60-65	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--
5044	5052	8	60-63	--	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--
5061	5077	16	60-62	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	16-18	--	--	--
5090	5094	4	60-61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	16-17	--	--	--
5096	5102	6	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--
5122	5125	3	61	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--
5138	5145	7	68-69	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--	--	--	--	--	22-23	--	--	--
5157	5165	8	72-75	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--
5169	5224	55	65-71	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--
5224	5231	7	73-75	--	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	26-27	--	--	--
5231	5234	3	68	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	22	--	--	--
5234	5237	3	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--
5237	5244	7	65-69	--	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--
5251	5260	9	70	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	24	--	--	--
5260	5264	4	62	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--
5272	5295	23	80-86	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--	--	--	--	--	30-33	--	--	--
606	Hendry	24	11424																						

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone									Dolostone												
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5295	5310	15	73								22											26			
5310	5323	13	60-66								11-15											16-20			
5363	5369	6	65								15											20			
5386	5406	20	74-79								22-25											26-30			
5406	5428	22	65-70								15-19											20-24			
5428	5440	12	72-77								21-23											25-28			
5440	5450	10	82								28											31			
5450	5455	5	65								15											20			
5462	5467	5	75								23											27			
5467	5472	5	68								17											22			
5477	5479	2	61								11											17			
5479	5483	4	77								23											28			
5483	5489	6	66-68								15-17											20-22			
5489	5507	18	72-77								21-23											25-28			
5507	5514	7	65-68								15-17											20-22			
5514	5520	6	75								23											27			
5520	5524	4	66								15											20			
5527	5590	63	82-90								28-32											31-35			
5590	5594	4	72								21											25			
5597	5609	12	72								21											25			
5616	5628	12	72-73								21-22											25-26			
5628	5638	10	86								29											33			
5638	5647	9	70								19											24			
5647	5658	11	63-66								13-15											19-20			
4895	4903	8	63-65	19		10					13-15											17	19-20	15-16	
4911	4915	4	68	29-31		12					17											23-24	22	20-21	
4915	4918	3	73	29-31		12					22			22-23								26			
4918	4922	4	68	29-31		12					17											22			
4929	4933	4	65	23		8					15											20			
4933	4936	3	81	23		9					19	27		23								31			
4936	4939	3	57	13		-4					7											12			
4943	4969	26	74-78	37-42		19-25					22-24											29-33	26-29	25-29	
4969	4974	5	62-64	28-29		11					12-14											22-23	18-19	17-18	
4974	4984	10	66-70	28-32		14-17					15-19											23-25	20-24	19-22	
4987	5015	28	66-71	27-35		12-19					15-20											22-29	20-24	19-24	
5019	5029	10	59	20		6					9											16	14	13	
5033	5038	5	60	25		11					11											21	16	15	
5038	5043	5	57	19		4					7											15	12	12	
5045	5053	8	62	24		11					12											20	18	16	
5059	5073	14	60-62	23-25		9					11-12											19-20	16-18	15-16	
5075	5077	2	56	18		1					7											13	12	11	
5077	5084	7	66	29		13					15											23	20	20	
5087	5103	16	64-65	26-27		12-13					14-15											22	19-20	18	
5103	5107	4	57	14		7					7											13	12	10	
5133	5139	6	60	13		4					10	11		10											
5141	5149	8	56-57	13		-2					7											10	12	9-10	
5158	5164	6	68	32		14					17											25	22	21	
5169	5185	16	73-75	38-45		20-24					22-23											30-36	26-27	25-28	
5185	5205	20	62-64	25-28		10-12					12-14											20-22	18-19	16-18	
5205	5237	32	65-69	26-34		12-18					15-18											21-27	20-23	18-22	
5237	5247	10	62	23		9					12											18	18	15	
5255	5273	18	61-66	21-27		10-14					11-15											18-22	16-20	14-19	
5286	5303	17	72-75	35-36		20-21					21-23											29-30	25-27	24-26	
5303	5305	2	60	25		10					11											20	16	15	
5305	5311	6	70	27		14					19											23	24	20	
5327	5330	3	57	16		-2					7											11	12	11	
5330	5339	9	64-66	23		8-9					14-15											18-19	19-20	16-17	
5385	5391	6	66-68	24		7					18	15-17		17-18									20-22		
5391	5395	4	74	29		14					22											24	26	23	

15000

70

Unorder

760

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone															
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)								
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9
700	Henry	29	10000	5395 5411 5420 5426 5426 5439 5446 5446 5446 5457 5464 5485 5509 5514 5529 5539 5551 5558 5558 5562 5565 5584 5584 5595 5602 5617 5617 5622 5627 5639 5639 5660 5663 5675 5680 5677 5680 5693 5693 5699 5699 5703 5706 5715 5706 5706 5715 5715 5736 5739 5747 5751 5759 5759 5769 5769 5781	5411 5420 5426 5439 5446 5446 5457 5474 5509 5514 5529 5539 5551 5558 5562 5565 5584 5584 5595 5617 5622 5627 5639 5655 5663 5675 5680 5693 5699 5703 5706 5715 5715 5736 5747 5759 5769 5781	16 9 6 13 7 11 10 24 5 15 10 12 7 4 3 19 11 74 15 5 5 5 12 7 3 3 12 3 13 13 46 6 4 3 8 8 10 12	74-79 66-67 75 86-87 77 66-68 65-67 72-79 63 67-68 74-77 66-71 62-64 75 67 62-66 74 78-79 69 64 66-68 62-65 59 67-68 65 80-81 62-65 68 64 67-68 61-66 72 80-84 67-69 80-81	36-46 32 34 41-47 36 26-28 25-27 37-41 25 30-33 34-36 29-33 23-25 34 31 25-27 32 41-45 29 26 21-24 23-25 21 24-31 30 46 21-24 18 25 18-22 34 44 21-24 44	-- --										

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																				
				Estimated Porosity Value (%)											Dolostone																																									
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																			
864	Hendry	25	11864	5104	5119	15		63-66	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9															
				5121	5125	4		57	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9								
				5125	5133	8		61-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5137	5155	18		60-63	--	--	--	--	--	--	11-13	--	--	--	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5173	5180	7		53-55	--	--	--	--	--	--	4-6	--	--	--	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5183	5187	4		56	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
				5193	5200	7		63-64	--	--	--	--	--	--	13-14	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5204	5220	16		67-70	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	--	--	21-24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
				5220	5236	16		57-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
				5236	5283	47		60-66	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
				5293	5298	5		67	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
				5298	5323	25		60-66	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5323	5331	8		71	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5347	5366	19		59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5370	5375	5		57	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9
				5386	5392	6		60	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5399	5412	13		63-66	--	--	--	--	--	--	13-15	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5412	5415	3		68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5415	5423	8		61-65	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5423	5426	3		59	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
				5426	5433	7		61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5433	5437	4		70	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5437	5442	5		77	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5442	5447	5		81	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5447	5457	10		62-65	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5470	5474	4		62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5474	5485	11		65-69	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5485	5495	10		61-65	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
				5495	5499	4		68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
				5499	5507	8		74-77	--	--	--	--	--	--	22-23	--	--	--	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
				5507	5512	5		80	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
				5512	5514	2		77	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
				5514	5541	27		83-90	--	--	--	--	--	--	28-32	--	--	--	--	--	--	--	--	--	--	--	32-35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
				5541	5551	10		92	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	--	--	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5551	5558	7		71-75	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	--	--	24-27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5558	5583	25		83-87	--	--	--	--	--	--	28-30	--	--	--	--	--	--	--	--	--	--	--	32-33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
				5583	5586	3		77	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9						
				5586	5594	8		80-81	--	--	--	--	--	--	26-27	--	--	--	--	--	--	--	--	--	--	--	30-31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9						
				5594	5600	6		78-79	--	--	--	--	--	--	24-25	--	--	--	--	--	--	--	--	--	--	--	29-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3										

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																								
				Estimated Porosity Value (%)										Dolostone														
				Limestone																								
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
926	Hendry	34	11705	4953	4968	15	--	--	2.4-2.45	--	--	--	--	--	--	--	--	15-18	--	--	--	--	--	--	--	--		
				4968	4971	3	--	--	2.33	--	--	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--
				4971	4985	14	--	--	2.37-2.46	--	--	--	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--
				4985	4993	8	--	--	2.49-2.51	--	--	--	--	--	--	--	--	--	--	12-13	--	--	--	--	--	--	--	--
				4997	5001	4	--	--	2.5	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--
				5001	5011	10	--	--	2.36-2.41	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--	--	--	--
				5011	5019	8	--	--	2.45-2.5	--	--	--	--	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--
				5021	5037	16	--	--	2.6-2.66	--	--	--	--	--	--	--	--	--	--	3-6	--	--	--	--	--	--	--	--
				5037	5047	10	--	--	2.5-2.53	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--
				5049	5057	8	--	--	2.56	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--
				5070	5080	10	--	--	2.57-2.63	--	--	--	--	--	--	--	--	--	--	5-8	--	--	--	--	--	--	--	--
				5090	5093	3	--	--	2.61	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--
				5093	5100	7	--	--	2.55-2.57	--	--	--	--	--	--	--	--	--	--	8-10	--	--	--	--	--	--	--	--
				5111	5123	12	--	--	2.55-2.58	--	--	--	--	--	--	--	--	--	--	8-10	--	--	--	--	--	--	--	--
				5129	5137	8	--	--	2.53-2.54	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	--	--	--	--
				5137	5143	6	--	--	2.67	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--
				5148	5156	8	--	--	2.52	--	--	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--
				5187	5195	8	--	--	2.55-2.57	--	--	--	--	--	--	--	--	--	--	8-10	--	--	--	--	--	--	--	--
				5205	5214	9	--	--	2.57	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--
				5221	5226	5	--	--	2.46	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
				5226	5241	15	--	--	2.49-2.55	--	--	--	--	--	--	--	--	--	--	10-13	--	--	--	--	--	--	--	--
				5241	5252	11	--	--	2.43-2.5	--	--	--	--	--	--	--	--	--	--	12-17	--	--	--	--	--	--	--	--
				5252	5261	9	--	--	2.35-2.37	--	--	--	--	--	--	--	--	--	--	20-21	--	--	--	--	--	--	--	--
				5261	5266	5	--	--	2.43-2.49	--	--	--	--	--	--	--	--	--	--	13-17	--	--	--	--	--	--	--	--
				5266	5270	4	--	--	2.36	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--
				5270	5279	9	--	--	2.39-2.49	--	--	--	--	--	--	--	--	--	--	13-18	--	--	--	--	--	--	--	--
				5279	5288	9	--	--	2.5-2.52	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--
				5288	5296	8	--	--	2.4-2.47	--	--	--	--	--	--	--	--	--	--	14-18	--	--	--	--	--	--	--	--
				5296	5298	2	--	--	2.54	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--
				5298	5303	5	--	--	2.47	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--
				5311	5325	14	--	--	2.4-2.49	--	--	--	--	--	--	--	--	--	--	13-18	--	--	--	--	--	--	--	--
				5325	5327	2	--	--	2.57	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--
				5327	5343	16	--	--	2.5-2.52	--	--	--	--	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--
				5355	5370	15	--	--	2.6	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--
				5398	5404	6	--	--	2.64	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--
				5409	5439	30	--	--	2.39-2.49	--	--	--	--	--	--	--	--	--	--	13-18	--	--	--	--	--	--	--	--
				5439	5450	11	--	--	2.5-2.58	--	--	--	--	--	--	--	--	--	--	8-12	--	--	--	--	--	--	--	--
				5452	5471	19	--	--	2.39-2.5	--	--	--	--	--	--	--	--	--	--	12-18	--	--	--	--	--	--	--	--
				5489	5499	10	--	--	2.44-2.45	--	--	--	--	--	--	--	--	--	--	15-16	--	--	--	--	--	--	--	--
				5504	5513	9	--	--	2.37	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--
				5528	5537	9	--	--	2.57-2.59	--	--	--	--	--	--	--	--	--	--	7-8	--	--	--	--	--	--	--	--
				5537	5545	8	--	--	2.43-2.49	--	--	--	--	--	--	--	--	--	--	13-17	--	--	--	--	--	--	--	--
				5545	5557	12	--	--	2.27-2.32	--	--	--	--	--	--	--	--	--	--	23-25	--	--	--	--	--	--	--	--
				5557	5560	3	--	--	2.6	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--
				5564	5567	3	--	--	2.45	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--
				5567	5575	8	--	--	2.25-2.3	--	--	--	--	--	--	--	--	--	--	24-27	--	--	--	--	--	--	--	--
				5575	5632	57	--	--	2.39-2.49	--	--	--	--	--	--	--	--	--	--	13-18	--	--	--	--	--	--	--	--
				4852	4860	8	58-59	--	--	--	--	--	--	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)														
											Limestone					Dolostone									
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
1085	Hendry	30	11676	4862	4866	4	62	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--			
				4866	4871	5	71	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	
				4871	4877	6	63	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	
				4880	4885	5	54-55	--	--	--	--	--	--	--	--	--	--	--	--	10-11	--	--	--	--	
				4885	4897	12	72	--	--	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	
				4901	4911	10	72-75	--	--	--	--	--	--	--	--	--	--	--	--	25-27	--	--	--	--	--
				4911	4914	3	62	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
				4914	4921	7	81	--	--	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--
				4921	4938	17	77-79	--	--	--	--	--	--	--	--	--	--	--	--	28-30	--	--	--	--	--
				4938	4941	3	70	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--
				4941	4953	12	62-65	--	--	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--
				4955	4962	7	65	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--
				4962	4965	3	58	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--
				4965	4969	4	64	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
				4969	4990	21	67-69	--	--	--	--	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--
				4999	5010	11	61-64	--	--	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--
				5017	5027	10	61-63	--	--	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--
				5035	5047	12	63-65	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				5053	5060	7	61-62	--	--	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--	--
				5062	5083	21	63-66	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				5098	5107	9	62-63	--	--	--	--	--	--	--	--	--	--	--	--	18-19	--	--	--	--	--
				5110	5115	5	56	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				5125	5133	8	68-69	--	--	--	--	--	--	--	--	--	--	--	--	22-23	--	--	--	--	--
				5139	5153	14	72-74	--	--	--	--	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--
				5153	5174	21	60-66	--	--	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--
				5174	5203	29	65-69	--	--	--	--	--	--	--	--	--	--	--	--	20-23	--	--	--	--	--
				5203	5205	2	59	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				5205	5215	10	61-64	--	--	--	--	--	--	--	--	--	--	--	--	17-19	--	--	--	--	--
				5221	5234	13	60-65	--	--	--	--	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--
				5234	5239	5	72	--	--	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--
				5243	5251	8	72-74	--	--	--	--	--	--	--	--	--	--	--	--	25-26	--	--	--	--	--
				5251	5257	6	70-71	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--
				5257	5262	5	73	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--
				5262	5269	7	81	--	--	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--
				5274	5281	7	63	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
				5295	5303	8	59	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				5303	5314	11	61-66	--	--	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--	--
				5322	5325	3	59	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				5333	5339	6	56	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--
				5345	5349	4	69	--	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--
				5349	5362	13	63-65	--	--	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--	--
				5362	5371	9	77	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--
				5371	5375	4	71	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--
				5375	5381	6	75-76	--	--	--	--	--	--	--	--	--	--	--	--	27-28	--	--	--	--	--
				5381	5397	16	81-84	--	--	--	--	--	--	--	--	--	--	--	--	31-32	--	--	--	--	--
				5397	5400	3	71	--	--	--	--	--	--	--	--	--	--	--	--	24	--	--	--	--	--
				5400	5403	3	81	--	--	--	--	--	--	--	--	--	--	--	--	31	--	--	--	--	--
				5403	5408	5	74-75	--	--	--	--	--	--	--	--	--	--	--	--	26-27	--	--	--	--	--
				5408	5413	5	69	--	--	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--
				5415	5418	3	58	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	--	--	--
				5418	5427	9	68-71	--	--	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--	--
				5429	5433	4	59	--	--	--	--	--	--	--	--	--	--	--	--	14	--	--	--	--	--
				5433	5442	9	74	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--	--
				5442	5447	5	62-66	--	--	--	--	--	--	--	--	--	--	--	--	18-20	--	--	--	--	--
				5447	5461	14	74-77	--	--	--	--	--	--	--	--	--	--	--	--	26-28	--	--	--	--	--
				5461	5467	6	66	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--	--
				5467	5471	4	78	--	--	--	--	--	--	--	--	--	--	--	--	29	--	--	--	--	--
				5471	5479	8	89	--	--	--	--	--	--	--	--	--	--	--	--	34	--	--	--	--	--
				5479	5486	7	80-89	--	--	--	--	--	--	--	--	--	--	--	--	30-34	--	--	--	--	--

Appendix IV (Continued)

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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone											
				Estimated Porosity Value (%)						Dolostone					
				Limestone						Litholog					
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-9
												Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-9
407	Lee	31	15710	5118	5124	6	56-57	--	--	--	--	--	--	--	--
				5130	5132	2	69	--	--	--	--	--	--	--	--
				5162	5168	6	56-58	--	--	--	--	--	--	--	--
				5175	5177	2	58	--	--	--	--	--	--	--	--
				5181	5186	5	67	--	--	--	--	--	--	--	--
				5186	5189	3	61-62	--	--	--	--	--	--	--	--
				5189	5199	10	63-66	--	--	--	--	--	--	--	--
				5199	5208	9	67-70	--	--	--	--	--	--	--	--
				5208	5209	1	66	--	--	--	--	--	--	--	--
				5209	5232	23	72-78	--	--	--	--	--	--	--	--
				5232	5236	4	70-71	--	--	--	--	--	--	--	--
				5236	5241	5	77	--	--	--	--	--	--	--	--
				5241	5247	6	67-69	--	--	--	--	--	--	--	--
				5247	5252	5	72-73	--	--	--	--	--	--	--	--
				5252	5254	2	68	--	--	--	--	--	--	--	--
				5254	5256	2	115	--	--	--	--	--	--	--	--
				5256	5258	2	72	--	--	--	--	--	--	--	--
				5258	5273	15	67-71	--	--	--	--	--	--	--	--
				5273	5275	2	62	--	--	--	--	--	--	--	--
				5281	5286	5	73	--	--	--	--	--	--	--	--
				5286	5289	3	69	--	--	--	--	--	--	--	--
				5289	5298	9	73-76	--	--	--	--	--	--	--	--
				5302	5317	15	72-76	--	--	--	--	--	--	--	--
				5336	5341	5	56	--	--	--	--	--	--	--	--
				5341	5345	4	59	--	--	--	--	--	--	--	--
				5345	5350	5	61-65	--	--	--	--	--	--	--	--
				5350	5354	4	59	--	--	--	--	--	--	--	--
				5388	5407	19	65-70	--	--	--	--	--	--	--	--
				5407	5412	5	57	--	--	--	--	--	--	--	--
				5412	5415	3	66	--	--	--	--	--	--	--	--
				5415	5417	2	110	--	--	--	--	--	--	--	--
				5417	5432	15	73-76	--	--	--	--	--	--	--	--
				5432	5436	4	79	--	--	--	--	--	--	--	--
				5442	5446	4	77	--	--	--	--	--	--	--	--
				5446	5452	6	82	--	--	--	--	--	--	--	--
				5452	5455	3	71-73	--	--	--	--	--	--	--	--
				5458	5461	3	55-57	--	--	--	--	--	--	--	--
				5461	5463	2	71	--	--	--	--	--	--	--	--
				5463	5466	3	86	--	--	--	--	--	--	--	--
				5472	5474	2	57	--	--	--	--	--	--	--	--
				5474	5476	2	67	--	--	--	--	--	--	--	--
				5478	5485	7	80-85	--	--	--	--	--	--	--	--
				5485	5491	6	63-64	--	--	--	--	--	--	--	--
				5491	5495	4	59	--	--	--	--	--	--	--	--
				5495	5507	12	67-69	--	--	--	--	--	--	--	--
				5507	5510	3	76	--	--	--	--	--	--	--	--
				5510	5527	17	67-71	--	--	--	--	--	--	--	--
				5527	5549	22	72-79	--	--	--	--	--	--	--	--
				5549	5555	6	68-70	--	--	--	--	--	--	--	--
				5555	5559	4	75-76	--	--	--	--	--	--	--	--
				5559	5562	3	84	--	--	--	--	--	--	--	--
				5562	5564	2	76	--	--	--	--	--	--	--	--
				5564	5582	18	81-88	--	--	--	--	--	--	--	--
				5582	5586	4	68-69	--	--	--	--	--	--	--	--
				5586	5591	5	78	--	--	--	--	--	--	--	--
				5591	5607	16	81-84	--	--	--	--	--	--	--	--
				5607	5609	2	66	--	--	--	--	--	--	--	--
				5609	5612	3	72	--	--	--	--	--	--	--	--
				5621	5624	3	76	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																									
				Estimated Porosity Value (%)																									
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone									Dolostone									
								Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
408	Lee	26	11960	5624	5625	1	112																						
				5625	5638	13	72-77																						
				5638	5641	3	70																						
				5641	5648	7	80-82																						
				5648	5659	11	76-79																						
				5659	5666	7	82																						
				5666	5669	3	68																						
				5669	5673	4	62-66																						
				5673	5678	5	66-68																						
				5678	5685	7	84																						
				4967	4971	4	56																						
				4971	4975	4	60																						
				4975	4978	3	54																						
				4978	4987	9	65-70																						
				4990	5000	10	62-66																						
				5000	5003	3	57																						
				5005	5012	7	67-68																						
				5012	5019	7	72-74																						
				5019	5035	16	65-71																						
				5044	5076	32	68-71																						
5076	5098	22	60-63																										
5117	5127	10	57-58																										
5131	5142	11	60-62																										
5154	5163	9	63																										
5163	5167	4	59																										
5171	5174	3	54																										
5174	5181	7	58-59																										
5183	5189	6	55																										
5193	5199	6	61-62																										
5199	5204	5	57																										
5244	5251	7	58-59																										
5259	5280	21	68-71																										
5280	5295	15	75-78																										
5295	5331	36	67-71																										
5356	5361	5	61																										
5379	5393	14	60-62																										
5395	5405	10	55-57																										
5435	5441	6	61																										
5451	5457	6	58																										
5461	5476	15	70-71																										
5476	5483	7	62																										
5483	5503	20	66-68																										
5520	5531	11	74-76																										
5537	5546	9	82																										

Appendix IV (Continued)

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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																								
				Estimated Porosity Value (%)																								
				Limestone									Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9				
1014	Lee	23	11695	4948	4953	5	65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			
				4958	4968	10	73-74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4968	4971	3	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4971	4977	6	72-75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
				4977	4988	11	70-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				4988	5016	28	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5023	5038	15	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5045	5059	14	60-61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5063	5075	12	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5075	5077	2	59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5079	5086	7	54-55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5089	5095	6	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5097	5107	10	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5141	5146	5	66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5160	5164	4	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5167	5182	15	67-68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5182	5193	11	73-77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5193	5197	4	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5197	5203	72	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5203	5211	8	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5211	5213	2	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5213	5219	6	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5219	5223	4	62-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5223	5227	4	68	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5227	5243	16	75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5245	5249	4	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5249	5257	8	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5257	5259	2	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5259	5263	4	57	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5269	5275	6	77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5275	5279	4	71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5279	5293	14	74-79	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5293	5299	6	67-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5299	5307	8	74	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5317	5332	15	56-59	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5352	5359	7	61-63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5359	5363	4	58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5363	5376	13	63-66	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5376	5385	9	67-69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
				5389	5393	4	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5393	5399	6	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5401	5405	4	72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5405	5409	4	63-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5409	5414	5	80	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5414	5433	19	66-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5433	5439	6	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5447	5457	10	71-72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5457	5461	4	63-64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5461	5463	2	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5463	5469	6	74-76	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5469	5475	6	81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5475	5488	13	66-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5488	5490	2	63	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5490	5501	11	65-71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5501	5503	2	62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5503	5510	7	71-73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5510	5517	7	69-70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5517	5519	2	64	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				
5519	5524	5	65-67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
1032	Martin	29	13198	5086	5089	3	60	17	--	6	--	--	--	13	11	--	12	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												
				Estimated Porosity Value (%)												
				Limestone					Dolostone							
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
4228	4237	9	67-69									16-18				
4237	4240	3	72									21			25	
4240	4245	5	100									>35			>40	
4305	4327	22	54-57									4-7			10-12	
4331	4340	9	66-71									15-20			20-24	
4340	4345	5	77									23			28	
4345	4365	20	65-71									15-20			20-24	
4365	4368	3	80-84									26-29			30-32	
4368	4374	6	72-79									21-25			25-30	
4374	4381	7	80									26			30	
4381	4420	39	72-78									21-24			25-29	
4420	4465	45	80-87									26-30			30-33	
4465	4471	6	72-74									21-22			25-26	
4471	4474	3	69									18			23	
4474	4480	6	63									13			19	
4480	4491	11	56-59									7-9			12-14	
4532	4541	9	57-59									7-9			12-14	
4546	4555	9	62									12			18	
4562	4565	3	57									7			12	
4565	4567	2	62									12			18	
4567	4579	12	70-71									19-20			24	
4579	4585	6	71-72									20-21			24-25	
4585	4588	3	64									14			19	
4588	4593	5	55-59									6-9			11-14	
4593	4632	39	60-66									11-15			16-20	
4632	4634	2	55									6			11	
4634	4639	5	60									11			16	
4639	4643	4	56									7			12	
4655	4661	6	56-57									7			12	
4689	4700	11	60-62									11-12			16-18	
4700	4715	15	55-58									6-8			11-13	
4715	4722	7	61-62									11-12			17-18	
4722	4733	11	75-77									23			27-28	
4733	4741	8	55									6			11	
4756	4780	24	62-63									12-13			18-19	
4780	4786	6	59									9			14	
4786	4790	4	64									14			19	
4790	4799	9	66-68									15-17			20-22	
4799	4807	8	60-62									11-12			16-18	
4809	4815	6	62									12			18	
4815	4819	4	56-59									7-9			12-14	
4819	4830	11	60-63									11-13			16-19	
4830	4839	9	56-57									7			12	
4845	4855	10	55-59									6-9			11-14	
4857	4863	6	54-56									4-7			10-12	
4865	4868	3	55									6			11	
4875	4890	15	55-59									6-9			11-14	
4890	4897	7	62									12			18	
4897	4907	10	57-58									7-8			12-13	
4907	4910	3	60									11			16	
4910	4935	25	55-57									6-7			11-12	
4938	4949	11	54-56									4-7			10-12	
4949	4961	12	70-71									19-20			24	
4961	4977	16	80-83									26-28			30-32	
4977	4980	3	77									23			28	
4980	4990	10	79-82									25-28			30-31	
4990	4993	3	75									23			27	
4993	5001	8	70-71									19-20			24	
5001	5029	28	74-78									22-24			26-29	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone						Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
331	Miami-Dade	9	11615	5029	5034	5	68	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																									
				Estimated Porosity Value (%)												Dolostone													
				Limestone						Litholog																			
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Litholog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9					
284	Monroe	Sea Level	15294	5464	5467	3	69-70																						
				5467	5470	3	72-79																						
				5470	5476	6	80-83																						
				5476	5481	5	72-75																						
				5481	5487	6	84-87																						
				5487	5491	4	73-76																						
				4900	4921	21	65-71																						
				4921	4923	2	64																						
				4923	4949	26	67-70																						
				4951	4967	16	60-66																						
				4967	4972	5	58-59																						
				4972	4981	9	62-64																						
				4985	4993	8	60																						
				5009	5012	3	66																						
				5012	5014	2	74																						
				5021	5031	10	53-55																						
				5047	5050	3	53																						
				5055	5058	3	53																						
				5058	5062	4	75-76																						
				5062	5065	3	69																						
				5065	5076	11	54-56																						
				5076	5079	3	79																						
				5079	5082	3	84																						
				5082	5083	1	72																						
				5094	5099	5	73-76																						
				5101	5111	10	80-88																						
				5132	5137	5	72-78																						
				5137	5141	4	54																						
				5141	5150	9	66-68																						
				5150	5153	3	55-56																						
				5153	5156	3	71																						
				5156	5158	2	58																						
				5162	5165	3	67																						
				5167	5171	4	85																						
				5171	5173	2	57																						
				5175	5180	5	87																						
				5180	5190	10	72-76																						
				5190	5209	19	98-126																						
				5209	5211	2	80																						
				5211	5213	2	55																						
				5221	5229	8	54-59																						
				5237	5243	6	56																						
				5243	5245	2	66																						
				5245	5247	2	86																						
				5247	5251	4	107																						
				5251	5253	2	86-88																						
				5253	5257	4	60-66																						
				5257	5259	2	53-54																						
				5259	5261	2	63																						
				5261	5265	4	87																						
				5265	5266	1	77																						
				5266	5268	2	67-71																						
				5268	5270	2	60-62																						
				5270	5272	2	68																						
				5272	5274	2	56																						
				5274	5277	3	63-64																						
				5277	5283	6	72-78																						
				5283	5285	2	55																						
				5285	5290	5	72-77																						

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																						
				Estimated Porosity Value (%)																						
				Limestone							Dolostone															
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9		
																						</				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																													
				Estimated Porosity Value (%)																													
				Limestone									Dolostone																				
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9									
564	Monroe	9	12662	4895	4915	20	71-77	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24-28	--	--	--	--							
				4915	4924	9	66-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	21-22	--	--	--	--					
				4937	4965	28	71-76	--	--	--	--	--	--	20-23	--	--	--	--	--	--	--	--	--	24-28	--	--	--	--					
				4965	4969	4	69	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	23	--	--	--	--					
				4969	4995	26	74-79	--	--	--	--	--	--	22-25	--	--	--	--	--	--	--	--	--	--	26-30	--	--	--	--				
				4995	5011	16	66-70	--	--	--	--	--	--	15-19	--	--	--	--	--	--	--	--	--	--	20-24	--	--	--	--				
				5011	5017	6	62	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--				
				5017	5029	12	60-64	--	--	--	--	--	--	11-14	--	--	--	--	--	--	--	--	--	--	16-19	--	--	--	--				
				5029	5037	8	65-68	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	20-22	--	--	--	--				
				5037	5042	5	73	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	26	--	--	--	--				
				5045	5064	19	61-66	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	17-20	--	--	--	--				
				5071	5089	18	84-90	--	--	--	--	--	--	29-32	--	--	--	--	--	--	--	--	--	--	32-35	--	--	--	--				
				5089	5100	11	71-78	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--	--	--	--	24-29	--	--	--	--				
				5100	5105	5	69	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--				
				5105	5108	3	72	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--				
				5108	5111	3	69	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--				
				5111	5114	3	61-62	--	--	--	--	--	--	11-12	--	--	--	--	--	--	--	--	--	--	17-18	--	--	--	--				
				5114	5121	7	58-59	--	--	--	--	--	--	8-9	--	--	--	--	--	--	--	--	--	--	13-14	--	--	--	--				
				5121	5132	11	64-66	--	--	--	--	--	--	14-15	--	--	--	--	--	--	--	--	--	--	19-20	--	--	--	--				
				5135	5140	5	66	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	20	--	--	--	--				
				5140	5152	12	71-78	--	--	--	--	--	--	20-24	--	--	--	--	--	--	--	--	--	--	24-29	--	--	--	--				
				5152	5156	4	61	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--				
				5156	5164	8	57-59	--	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	12-14	--	--	--	--				
								3668	3685	17	76-79	37-40	--	--	21-25	--	--	--	--	--	--	--	--	--	--	30-33	28-30	--	26-29	--	--		
								3685	3689	4	82	45	--	30	--	--	28	--	--	--	--	--	--	--	--	--	38	31	--	31	--	--	
								3689	3706	17	75-79	39-43	--	24-27	--	--	23-25	--	--	--	--	--	--	--	--	--	--	32-35	27-30	--	26-30	--	--
								3706	3709	3	66	37	--	18	--	--	15	--	--	--	--	--	--	--	--	--	--	29	20	--	21	--	--
								3709	3717	8	73	39	--	20	--	--	22	--	--	--	--	--	--	--	--	--	--	31	26	--	26	--	--
								3717	3725	8	65-68	32-34	--	16-20	--	--	15-17	--	--	--	--	--	--	--	--	--	--	26-28	20-22	--	20-22	--	--
								3725	3728	3	60	23	--	8	--	--	11	--	--	--	--	--	--	--	--	--	--	18	16	--	15	--	--
								3734	3751	17	65-69	32-36	--	16-21	--	--	15-18	--	--	--	--	--	--	--	--	--	--	26-30	20-23	--	20-24	--	--
								3756	3762	6	62-64	28	--	15	--	--	12-14	--	--	--	--	--	--	--	--	--	--	23	18-19	--	17-18	--	--
								3762	3769	7	73	37	--	22	--	--	22	--	--	--	--	--	--	--	--	--	--	31	26	--	24	--	--
								3769	3774	5	66	29	--	13	--	--	15	--	--	--	--	--	--	--	--	--	--	23	20	--	20	--	--
								3774	3783	9	54-56	16	--	6	--	--	4-7	--	--	--	--	--	--	--	--	--	--	13	10-12	--	10-11	--	--
								3783	3795	12	74-77	39-40	--	22	--	--	22-23	--	--	--	--	--	--	--	--	--	--	32	26-28	--	26-28	--	--
								3805	3814	9	80-82	38-40	--	24-28	--	--	26-28	--	--	--	--	--	--	--	--	--	--	32-34	30-31	--	28-30	--	--
								3814	3818	4	76	30	--	17	--	--	23	--	--	--	--	--	--	--	--	--	--	25	28	--	24	--	--
								3822	3827	5	62	22	--	9	--	--	12	--	--	--	--	--	--	--	--	--	--	18	18	--	15	--	--
								3831	3838	7	74	37	--	22	--	--	22	--	--	--	--	--	--	--	--	--	--	31	26	--	25	--	--
								3838	3843	5	69	31	--	16	--	--	18	--	--	--	--	--	--	--	--	--	--	25	23	--	21	--	--
								3848	3855	7	80	43	--	25	--	--	26	--	--	--	--	--	--	--	--	--	--	35	30	--	30	--	--
								3859	3875	16	66-71	28-36	--	15-19	--	--	15-20	--	--	--	--	--	--	--	--	--	--	23-29	20-24	--	19-24	--	--
								3883	3886	3	58	13	--	2	--	--	9	8	--	10	--	--	--	--	--	--	--	--	13	--	--	--	--
								3886	3890	4	62	11	--	2	--	--	10	12	--	10	--	--	--	--	--	--	--	--	18	--	--	--	--
								3893	3900	7	71	33	--	19	--	--	20	--	--	20	--	--	--	--	--	--	--	27	24	--	23	--	--
								3900	3904	4	59	12	--	2	--	--	9	9	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--
								3904	3912	8	66-69	28-35	--	12-13	--	--	15-18	--	--	--	--	--	--	--	--	--	--	22-26	20-23	--	19-24	--	--
								3912	3919	7	83	44	--	28	--	--	28	--	--	28	--	--	--	--	--	--	--	36	32	--	32	--	--
								3919	3927	8	66	23-27	--	11-16	--	--	15	--	--	15	--	--	--	--	--	--	--	19-23	20	--	17-19	--	--
								3927	3949	22	72-79	38-40	--	21-25	--	--	21-25	--	--	21-25	--	--	--	--	--	--	--	31-34	25-30	--	25-29	--	--
								3949	3956	7	68-71	28-32	--	18	--	--	17-20	--	--	17-20	--	--	--	--	--	--	--	25-26	21-24	--	20-22	--	--
								3964	3969	5	64	19	--	5	--	--	13	14	--	14	--	--	--	--	--	--	--	--	19	--	--	--	--
								3973	3978	5	68-71	26	--	13	--	--	20	17-20	--	18-19	--	--	--	--	--	--	--	--	21-24	--	--	--	--
								3978	3983	5	85	43-44	--	28-29	--	--	29	--	--	29	--	--	--	--	--	--	--	36	33	--	32	--	--
								3983	3993	10	77	34-39	--	19-24	--	--	23	--	--	23	--	--	--	--	--	--	--	28-32	28	--	25-27	--	--
								3993	3999	6	86	43	--	26	--	--	29	--	--	29	--	--	--	--	--	--	--	35	33	--	33	--	--
								3999	4004	5	70	24	--	8	--	--	18	19	--	18	--	--	--	--	--	--	--	--	24	--	--	--	--
								4008	4018	10	85-89	40-44	--	30-31	--	--	29-31	--	--	29-31	--	--	--	--	--	--	--	35-37	33-34	--	31-34	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																							
				Estimated Porosity Value (%)																							
				Limestone									Dolostone														
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
710	Okeechobee	43	11300	4018	4025	7	74-79	33-37	--	22-24	--	--	--	22-25	--	--	--	--	--	--	28-31	26-30	--	24-28	--	--	
				4032	4041	9	74-79	32-35	--	19-23	--	--	--	22-25	--	--	--	--	--	--	--	27-30	26-30	--	24-27	--	--
				4041	4051	10	80-83	37-42	--	22-27	--	--	--	26-28	--	--	--	--	--	--	--	31-35	30-32	--	28-31	--	--
				4051	4059	8	96-99	>45	--	37	--	--	--	34-35	--	--	--	--	--	--	--	>40	38-39	--	>40	--	--
				4059	4065	6	81	39	--	26	--	--	--	27	--	--	--	--	--	--	--	33	31	--	30	--	--
				4067	4069	2	68	15	--	14	--	--	--	17	--	15	--	--	--	--	--	--	22	--	--	--	--
				4069	4080	11	84-85	43-44	--	30-31	--	--	--	29	--	--	--	--	--	--	--	37	32-33	--	32	--	--
				4084	4091	7	86	44	--	28	--	--	--	29	--	--	--	--	--	--	--	36	33	--	33	--	--
				4091	4094	3	77	36	--	25	--	--	--	23	--	--	--	--	--	--	--	31	28	--	26	--	--
				4094	4101	7	81	34	--	27	--	--	--	27	--	26	--	--	--	--	--	--	31	--	--	--	--
				4105	4122	17	77-79	36-40	--	24-25	--	--	--	23-25	--	--	--	--	--	--	--	31-38	28-30	--	26-29	--	--
				4122	4125	3	70	32	--	18	--	--	--	19	--	--	--	--	--	--	--	26	24	--	22	--	--
				4125	4129	4	73	34	--	19	--	--	--	22	--	--	--	--	--	--	--	28	26	--	24	--	--
				4129	4151	22	81-86	42-45	--	26-31	--	--	--	27-29	--	--	--	--	--	--	--	35-38	31-33	--	30-33	--	--
				4151	4171	20	74-77	34-41	--	21-26	--	--	--	22-23	--	--	--	--	--	--	--	29-34	26-28	--	24-28	--	--
				4171	4182	11	85-89	43-45	--	30-35	--	--	--	29-31	--	--	--	--	--	--	--	36-40	33-34	--	32-35	--	--
				4182	4187	5	75-76	34	--	21	--	--	--	23	--	--	--	--	--	--	--	29	27-28	--	25	--	--
				4187	4193	6	89	46	--	32	--	--	--	31	--	--	--	--	--	--	--	39	34	--	35	--	--
				4193	4200	7	75-79	33-39	--	25-27	--	--	--	23-25	--	--	--	--	--	--	--	30-34	27-30	--	25-28	--	--
				4200	4211	11	87-88	43-44	--	30-32	--	--	--	30	--	--	--	--	--	--	--	36-38	33	--	33-34	--	--
4211	4213	2	70	27	--	19	--	--	--	23	--	19	--	19	--	--	--	--	24	--	--	--	--				
4213	4217	4	86	37	--	28	--	--	--	29	--	--	--	--	--	--	--	33	33	--	31	--	--				
4217	4221	4	76	35	--	19	--	--	--	23	--	--	--	--	--	--	--	28	28	--	25	--	--				
4221	4225	4	70	27	--	16	--	--	--	22	--	19	--	19	--	--	--	--	24	--	--	--	--				
4225	4246	21	72-78	35-42	--	19-24	--	--	--	21-24	--	--	--	--	--	--	--	28-34	25-29	--	24-29	--	--				
4246	4253	7	80	42-44	--	26	--	--	--	26	--	--	--	--	--	--	--	36-37	30	--	30	--	--				
4253	4255	2	65	28	--	15	--	--	--	15	--	--	--	--	--	--	--	24	20	--	18	--	--				
4255	4262	7	72-73	37	--	20-23	--	--	--	21-22	--	--	--	--	--	--	--	30-31	25-26	--	24	--	--				
4262	4266	4	65-68	27-30	--	14-18	--	--	--	21-25	--	15-17	--	17-19	--	--	--	20-22	--	--	--	--	--				
4266	4282	16	74-79	33-45	--	22-26	--	--	--	22-25	--	--	--	--	--	--	--	28-36	26-30	--	24-30	--	--				
4282	4291	9	81	33	--	29	--	--	--	31	--	27	--	26	--	--	--	--	31	--	--	--	--				
4291	4294	3	58	19	--	8	--	--	--	8	--	--	--	--	--	--	--	16	13	--	13	--	--				
4294	4305	11	80	33-35	--	25	--	--	--	29	--	26	--	26	--	--	--	--	30	--	--	--	--				
4305	4318	13	65-71	26-30	--	14-17	--	--	--	21-24	--	15-20	--	17-20	--	--	--	--	20-24	--	--	--	--				
4318	4324	6	57-59	15	--	5	--	--	--	12	--	7-9	--	9-10	--	--	--	--	12-14	--	--	--	--				
4324	4329	5	63	27	--	19	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--				
4329	4334	5	69	35	--	25	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--				
4334	4340	6	62	18	--	8	--	--	--	15	--	12	--	14	--	--	--	--	--	--	--	--	--				
4340	4344	4	55	16	--	7	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--				
4352	4355	3	60	20	--	5	--	--	--	14	--	11	--	13	--	--	--	--	--	--	--	--	--				
4355	4360	5	56-59	17	--	8	--	--	--	--	--	7-9	--	--	--	--	--	--	--	--	--	--	--				
3639	3648	9	61-66	--	--	--	--	--	--	--	--	11-15	--	--	--	--	--	--	--	--	--	--	--				
3652	3672	20	66-71	--	--	--	--	--	--	--	--	15-20	--	--	--	--	--	--	--	--	--	--	--				
3672	3681	9	83	--	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--				
3681	3688	7	72	--	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--				
3688	3692	4	66-68	--	--	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	--				
3697	3705	8	66-68	--	--	--	--	--	--	--	--	15-17	--	--	--	--	--	--	--	--	--	--	--				
3705	3709	4	59	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--				
3711	3716	5	74	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--				
3716	3728	12	67-71	--	--	--	--	--	--	--	--	16-20	--	--	--	--	--	--	--	--	--	--	--				
3737	3754	17	62-66	--	--	--	--	--	--	--	--	12-15	--	--	--	--	--	--	--	--	--	--	--				
3766	3774	8	78	--	--	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--				
3774	3778	4	66	--	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--				
3785	3793	8	69	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--				
3801	3805	4	64	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--				
3809	3823	14	72-75	--	--	--	--	--	--	--	--	21-23	--	--	--	--	--	--	--	--	--	--	--				
3823	3827	4	63	--	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--				
3827	3833	6	73	--	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--				
3833	3835	2	55	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone												Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone						Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
732	Okeechobee	68	10774	3845	3855	10	74-77							22-23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																										
				Estimated Porosity Value (%)												Dolostone														
				Limestone																										
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9						
1264	Okeechobee	53	8185	4242	4248	6	--	41	--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-9				
				4248	4252	4	--	33	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-6			
				4252	4255	3	--	37	--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-5			
				4255	4258	3	--	28	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-4			
				4258	4268	10	--	31-33	--	21-22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-3		
				4268	4273	5	--	27	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2		
				4302	4314	12	--	33-35	--	22-25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-1		
				4322	4327	5	--	45	--	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-9		
				4327	4335	8	--	35-36	--	23-29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-6		
				4335	4342	7	--	33	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-5		
				4342	4358	16	--	34-39	--	27-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-4		
				4358	4361	3	--	31	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-3		
				4361	4364	3	--	38	--	29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-2		
				4364	4368	4	--	29-30	--	18-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-1		
				4368	4372	4	--	37-42	--	30-33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-9		
				4372	4380	8	--	39-42	--	30-33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-6		
				4380	4386	6	--	36-41	--	29-30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-5		
				4388	4403	15	--	37-40	--	27-35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-4		
				4403	4414	11	--	32-34	--	27-28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Figure AII-3		
539	Osceola	67	7935	3482	3490	8	78	--	--	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	29	--	--		
				3490	3495	5	85	--	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--	--	33	--	--	
				3495	3500	5	69	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	23	--	--	
				3500	3503	3	55	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	11	--	--	
				3508	3520	12	80-84	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--	--	--	--	--	--	--	30-32	--	--
				3520	3539	19	55-56	--	--	--	--	--	--	--	6-7	--	--	--	--	--	--	--	--	--	--	--	--	11-12	--	--
				3539	3546	7	64	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	19	--	--	
				3552	3557	5	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	26	--	--	
				3557	3561	4	67-70	--	--	--	--	--	--	--	16-19	--	--	--	--	--	--	--	--	--	--	--	21-24	--	--	
				3561	3568	7	73	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	26	--	--	
				3568	3571	3	60	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	16	--	--	
				3571	3578	7	67	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	21	--	--	
				3578	3585	7	75-77	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	27-28	--	--	
				3585	3594	9	67-69	--	--	--	--	--	--	--	16-18	--	--	--	--	--	--	--	--	--	--	--	21-23	--	--	
				3594	3598	4	63	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	19	--	--	
				3612	3621	9	93	--	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	--	--	36	--	--	
				3621	3627	6	80-83	--	--	--	--	--	--	--	26-28	--	--	--	--	--	--	--	--	--	--	--	30-32	--	--	
				3627	3629	2	79	--	--	--	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--	30	--	--	
				3629	3635	6	95	--	--	--	--	--	--	--	34	--	--	--	--	--	--	--	--	--	--	--	37	--	--	
				3635	3639	4	67	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	21	--	--	
				3639	3642	3	59	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	14	--	--	
				3642	3647	5	84	--	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--	--	32	--	--	
				3647	3652	5	93	--	--	--	--	--	--	--	33	--	--	--	--	--	--	--	--	--	--	--	36	--	--	
				3652	3656	4	76	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	28	--	--	
				3656	3662	6	83	--	--	--	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	32	--	--	
				3662	3668	6	91	--	--	--	--	--	--	--	32	--	--	--	--	--	--	--	--	--	--	--	36	--	--	
				3668	3673	5	76	--	--	--	--	--	--	--	23	--	--	--	--	--	--	--	--	--	--	--	28	--	--	
				3673	3683	10	82-84	--	--	--	--	--	--	--	28-29	--	--	--	--	--	--	--	--	--	--	--	31-32	--	--	
				3683	3687	4	94	--	--	--	--	--	--	--	34	--	--	--	--	--	--	--	--	--	--	--	37	--	--	
				3687	3698	11	84-85	--	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--	--	32-33	--	--	
				3698	3701	3	74	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	26	--	--	
				3701	3705	4	70	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	24	--	--	
				3705	3707	2	90	--	--	--	--	--	--	--	32	--	--	--	--	--	--	--	--	--	--	--	35	--	--	
				3707	3711	4	86	--	--	--	--	--	--	--	29	--	--	--	--	--	--	--	--	--	--	--	33	--	--	
				3711	3721	10	80-84	--	--	--	--	--	--	--	26-29	--	--	--	--	--	--	--	--	--	--	--	30-32	--	--	
				3721	3725	4	74	--	--	--	--	--	--	--	22	--	--	--	--	--	--	--	--	--	--	--	26	--	--	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
				Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Lithlog	Figure AII-2	Figure AII-7	Figure AII-8								Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																					
				Estimated Porosity Value (%)																					
				Limestone									Dolostone												
Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	
5273	5281	8	68-69	26-28	--	9-11	--	--	--	19-21	17-18	--	18-20	--	--	--	--	--	--	--	22-23	--	--	--	--
5288	5296	8	74	29	--	14	--	--	--	22	22	--	22	--	--	--	--	--	--	--	26	--	--	--	--
5303	5308	5	79	41	--	22	--	--	--	22	25	--	--	--	--	--	--	--	--	--	30	--	--	29	--
5308	5334	26	72-75	35-42	--	17-20	--	--	--	22	21-23	--	--	--	--	--	--	--	--	--	28-32	25-27	24-27	24-27	--
5334	5341	7	70	35	--	17	--	--	--	17	19	--	--	--	--	--	--	--	--	--	28	24	--	24	--
5341	5357	16	82-86	40-41	--	22-27	--	--	--	22-27	28-29	--	--	--	--	--	--	--	--	--	32-34	31-33	--	30-32	--
5357	5360	3	77	33	--	19	--	--	--	19	23	--	--	--	--	--	--	--	--	--	27	28	--	25	--
5360	5371	11	68-71	28-30	--	12-13	--	--	--	12-13	17-20	--	--	--	--	--	--	--	--	--	22-24	22-24	--	20-22	--
5371	5376	5	72	36	--	14	--	--	--	14	21	--	--	--	--	--	--	--	--	--	27	25	--	24	--
5376	5396	20	74-79	35-39	--	19-21	--	--	--	19-21	22-25	--	--	--	--	--	--	--	--	--	29-31	26-30	--	25-28	--
5396	5405	9	66-71	27-31	--	9-13	--	--	--	9-13	15-20	--	--	--	--	--	--	--	--	--	21-24	20-24	--	19-22	--
5405	5412	7	72-74	34-38	--	19-20	--	--	--	19-20	21-22	--	--	--	--	--	--	--	--	--	28-30	25-26	--	23-25	--
5413	5425	12	67-69	30	--	13-14	--	--	--	13-14	16-18	--	--	--	--	--	--	--	--	--	24	21-23	--	20	--
5425	5441	16	73-77	37-39	--	18-22	--	--	--	18-22	22-23	--	--	--	--	--	--	--	--	--	30-32	26-28	--	24-27	--
5441	5446	5	68	31	--	13	--	--	--	13	17	--	--	--	--	--	--	--	--	--	24	22	--	21	--
5446	5463	17	77-79	37-43	--	22-23	--	--	--	22-23	23-25	--	--	--	--	--	--	--	--	--	31-34	28-30	--	26-30	--
5463	5477	14	65-70	26-31	--	8-12	--	--	--	8-12	15-19	--	--	--	--	--	--	--	--	--	20-24	20-24	--	18-22	--
5477	5481	4	73	35	--	15	--	--	--	15	22	--	--	--	--	--	--	--	--	--	27	26	--	24	--
5481	5483	2	71	32	--	12	--	--	--	12	19	--	--	--	--	--	--	--	--	--	25	24	--	22	--
5483	5494	11	74-75	35-38	--	16-20	--	--	--	16-20	22-23	--	--	--	--	--	--	--	--	--	28-31	26-27	--	25-26	--
4233	4243	10	75-77	37-45	--	22	--	--	--	22	23	--	--	--	--	--	--	--	--	--	31-35	27-28	--	26-29	--
4243	4246	3	63	29	--	5	--	--	--	5	13	--	--	--	--	--	--	--	--	--	21	19	--	18	--
4246	4250	4	81	44	--	26	--	--	--	26	27	--	--	--	--	--	--	--	--	--	36	31	--	31	--
4250	4254	4	77	40	--	20	--	--	--	20	23	--	--	--	--	--	--	--	--	--	31	28	--	28	--
4259	4273	14	83-90	50	--	26-30	--	--	--	26-30	28-32	--	--	--	--	--	--	--	--	--	>40	32-35	--	35-36	--
4273	4279	6	72-75	39-40	--	16-19	--	--	--	16-19	21-23	--	--	--	--	--	--	--	--	--	30-31	25-27	--	25-27	--
4279	4285	6	66	32	--	3	--	--	--	3	15	--	--	--	--	--	--	--	--	--	21	20	--	20	--
4295	4298	3	57	23	--	0	--	--	--	0	7	--	--	--	--	--	--	--	--	--	16	12	--	13	--
4298	4303	5	76	35	--	17	--	--	--	17	23	--	--	--	--	--	--	--	--	--	28	28	--	25	--
4303	4313	10	66-67	33-35	--	11-14	--	--	--	11-14	15-16	--	--	--	--	--	--	--	--	--	25-27	20-21	--	20-22	--
4321	4351	30	72-78	37-45	--	20-25	--	--	--	20-25	21-24	--	--	--	--	--	--	--	--	--	30-35	24-29	--	24-29	--
4351	4355	4	65-69	36	--	13-14	--	--	--	13-14	15-18	--	--	--	--	--	--	--	--	--	27	20-23	--	21-24	--
4355	4372	17	75-77	40-46	--	21-25	--	--	--	21-25	23	--	--	--	--	--	--	--	--	--	32-36	27-28	--	27-30	--
4372	4381	9	68	33-36	--	7	--	--	--	7	17	--	--	--	--	--	--	--	--	--	23-25	22	--	21-23	--
4381	4386	5	78	43	--	22	--	--	--	22	24	--	--	--	--	--	--	--	--	--	33	29	--	29	--
4386	4390	4	63	22	--	1	--	--	--	1	14	--	--	--	--	--	--	--	--	--	--	19	--	--	--
4390	4407	17	69-71	37-39	--	16-20	--	--	--	16-20	18-20	--	--	--	--	--	--	--	--	--	28-31	23-24	--	24	--
4407	4415	8	73	40	--	21	--	--	--	21	22	--	--	--	--	--	--	--	--	--	32	26	--	26	--
4421	4433	12	76-79	40-45	--	25-28	--	--	--	25-28	23-25	--	--	--	--	--	--	--	--	--	33-37	28-30	--	27-30	--
4433	4445	12	62-66	28-33	--	10-12	--	--	--	10-12	12-15	--	--	--	--	--	--	--	--	--	22-25	18-20	--	17-20	--
4445	4451	6	67	42	--	17	--	--	--	17	16	--	--	--	--	--	--	--	--	--	31	21	--	24	--
4451	4456	5	56	20	--	-1	--	--	--	-1	7	--	--	--	--	--	--	--	--	--	14	12	--	12	--
4456	4462	6	60	29	--	10	--	--	--	10	11	--	--	--	--	--	--	--	--	--	22	16	--	17	--
4462	4469	7	69	38	--	16	--	--	--	16	18	--	--	--	--	--	--	--	--	--	--	23	--	24	--
4475	4501	26	67-68	35-37	--	14-18	--	--	--	14-18	16-17	--	--	--	--	--	--	--	--	--	26-30	21-22	--	22-23	--
4501	4505	4	60	21	--	4	--	--	--	4	11	--	--	--	--	--	--	--	--	--	16	16	--	14	--
4505	4516	11	61-66	33-38	--	11-16	--	--	--	11-16	11-15	--	--	--	--	--	--	--	--	--	24-29	17-20	--	18-22	--
4527	4535	8	74-75	42-43	--	14	--	--	--	14	22-23	--	--	--	--	--	--	--	--	--	35	26-27	--	26-27	--
4535	4538	3	68	35	--	14	--	--	--	14	17	--	--	--	--	--	--	--	--	--	26	22	--	23	--
4545	4560	15	70-72	36-39	--	18-19	--	--	--	18-19	19-21	--	--	--	--	--	--	--	--	--	29-30	24-25	--	24-25	--
4560	4566	6	59	29	--	7	--	--	--	7	9	--	--	--	--	--	--	--	--	--	21	14	--	16	--
4571	4577	6	57-58	32-35	--	8-10	--	--	--	8-10	7-8	--	--	--	--	--	--	--	--	--	23-25	12-13	--	16-17	--
4577	4585	8	66	43	--	17	--	--	--	17	15	--	--	--	--	--	--	--	--	--	32	20	--	24	--
4585	4597	12	55-59	34-35	--	9-11	--	--	--	9-11	6-9	--	--	--	--	--	--	--	--	--	25	11-14	--	15-17	--
4601	4605	4	53	32	--	8	--	--	--	8	4	--	--	--	--	--	--	--	--	--	--	10	--	13	--
4605	4615	10	66-69	38-42	--	17-20	--	--	--	17-20	15-18	--	--	--	--	--	--	--	--	--	29-33	20-23	--	22-24	--
4615	4633	18	53-55	28-33	--	4-6	--	--	--	4-6	4-6	--	--	--	--	--	--	--	--	--	18-23	10-11	--	13-15	--
4638	4645	7	60-61	34-37	--	12-13	--	--	--	12-13	11	--	--	--	--	--	--	--	--	--	26-27	16-17	--	18-19	--
4645	4675	30	66-71	38-43	--	16-21	--	--	--	16-21	15-20	--	--	--	--	--	--	--	--	--	29-33	20-24	--	22-26	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
972	Palm Beach	12	11000	4875	4684	9	60-63	--	--	11-14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone																				
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Estimated Porosity Value (%)													
											Limestone					Dolostone								
				Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9			
304	Pinellas	Sea Level	10600	3890	3893	3	61	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--		
				3893	3898	5	68-71	--	--	--	--	--	--	--	--	--	--	--	--	22-24	--	--	--	--
				3898	3900	2	77	--	--	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--
				3900	3904	4	80-84	--	--	--	26-29	--	--	--	--	--	--	--	--	30-32	--	--	--	--
				3904	3919	15	93-114	--	--	--	>35	--	--	--	--	--	--	--	--	>40	--	--	--	--
				3919	3921	2	85	--	--	--	29	--	--	--	--	--	--	--	--	33	--	--	--	--
				3921	3923	2	93	--	--	--	33	--	--	--	--	--	--	--	--	36	--	--	--	--
				3925	3926	1	76	--	--	--	23	--	--	--	--	--	--	--	--	28	--	--	--	--
				3926	3933	7	98-108	--	--	--	>35	--	--	--	--	--	--	--	--	>40	--	--	--	--
				3933	3938	5	81-87	--	--	--	27-30	--	--	--	--	--	--	--	--	31-33	--	--	--	--
				3938	3941	3	72	--	--	--	21	--	--	--	--	--	--	--	--	25	--	--	--	--
				3941	3949	8	81-85	--	--	--	27-29	--	--	--	--	--	--	--	--	31-33	--	--	--	--
				3949	3953	4	67-69	--	--	--	16-18	--	--	--	--	--	--	--	--	21-23	--	--	--	--
				3953	3958	5	80-84	--	--	--	26-29	--	--	--	--	--	--	--	--	30-32	--	--	--	--
				3958	3961	3	123	--	--	--	>35	--	--	--	--	--	--	--	--	>40	--	--	--	--
				3961	3971	10	71-74	--	--	--	20-22	--	--	--	--	--	--	--	--	24-26	--	--	--	--
				3971	3979	8	82-83	--	--	--	28	--	--	--	--	--	--	--	--	31-32	--	--	--	--
				3979	3985	6	70-73	--	--	--	19-22	--	--	--	--	--	--	--	--	24-26	--	--	--	--
				3985	3989	4	83-85	--	--	--	28-29	--	--	--	--	--	--	--	--	32-33	--	--	--	--
				3989	3991	2	78	--	--	--	24	--	--	--	--	--	--	--	--	29	--	--	--	--
				3991	4001	10	80-90	--	--	--	26-32	--	--	--	--	--	--	--	--	30-35	--	--	--	--
				4001	4006	5	72	--	--	--	21	--	--	--	--	--	--	--	--	25	--	--	--	--
				4006	4027	21	65-68	--	--	--	15-17	--	--	--	--	--	--	--	--	20-22	--	--	--	--
				4027	4043	16	62-66	--	--	--	12-15	--	--	--	--	--	--	--	--	18-20	--	--	--	--
				4043	4059	16	54-56	--	--	--	4-7	--	--	--	--	--	--	--	--	10-12	--	--	--	--
				4059	4061	2	61	--	--	--	11	--	--	--	--	--	--	--	--	17	--	--	--	--
				4061	4063	2	57	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--
				4065	4067	2	59	--	--	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--
				4067	4073	6	60-61	--	--	--	11	--	--	--	--	--	--	--	--	16-17	--	--	--	--
				4073	4077	4	58	--	--	--	8	--	--	--	--	--	--	--	--	13	--	--	--	--
				4077	4082	5	63	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--
				4082	4089	7	66-67	--	--	--	15-16	--	--	--	--	--	--	--	--	20-21	--	--	--	--
				4089	4094	5	60-61	--	--	--	11	--	--	--	--	--	--	--	--	16-17	--	--	--	--
				4096	4101	5	59	--	--	--	9	--	--	--	--	--	--	--	--	14	--	--	--	--
				4101	4107	6	69	--	--	--	18	--	--	--	--	--	--	--	--	23	--	--	--	--
				4107	4110	3	63	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--
				4110	4111	1	58	--	--	--	8	--	--	--	--	--	--	--	--	13	--	--	--	--
				4127	4134	7	65-66	--	--	--	15	--	--	--	--	--	--	--	--	20	--	--	--	--
				4134	4137	3	57-58	--	--	--	7-8	--	--	--	--	--	--	--	--	12-13	--	--	--	--
				4137	4146	9	60-61	--	--	--	11	--	--	--	--	--	--	--	--	16-17	--	--	--	--
				4146	4150	4	55-57	--	--	--	6-7	--	--	--	--	--	--	--	--	11-12	--	--	--	--
				4157	4160	3	63	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--
4167	4178	11	62-64	--	--	--	12-14	--	--	--	--	--	--	--	--	18-19	--	--	--	--				
4178	4182	4	67	--	--	--	16	--	--	--	--	--	--	--	--	21	--	--	--	--				
4182	4190	8	63-66	--	--	--	13-15	--	--	--	--	--	--	--	--	19-20	--	--	--	--				
4190	4198	8	56-59	--	--	--	7-9	--	--	--	--	--	--	--	--	12-14	--	--	--	--				
4198	4204	6	62-63	--	--	--	12-13	--	--	--	--	--	--	--	--	18-19	--	--	--	--				
4204	4207	3	55-58	--	--	--	6-8	--	--	--	--	--	--	--	--	11-13	--	--	--	--				
4207	4215	8	72-77	--	--	--	21-23	--	--	--	--	--	--	--	--	25-28	--	--	--	--				
4215	4216	1	61	--	--	--	11	--	--	--	--	--	--	--	--	17	--	--	--	--				
4216	4217	1	56	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--				
4217	4226	9	60-64	--	--	--	11-14	--	--	--	--	--	--	--	--	16-19	--	--	--	--				
4226	4227	1	56	--	--	--	7	--	--	--	--	--	--	--	--	12	--	--	--	--				
4231	4239	8	58-59	--	--	--	8-9	--	--	--	--	--	--	--	--	13-14	--	--	--	--				
4239	4242	3	63	--	--	--	13	--	--	--	--	--	--	--	--	19	--	--	--	--				
4242	4247	5	55-57	--	--	--	6-7	--	--	--	--	--	--	--	--	11-12	--	--	--	--				
4247	4248	1	73	--	--	--	22	--	--	--	--	--	--	--	--	26	--	--	--	--				
4248	4252	4	62	--	--	--	12	--	--	--	--	--	--	--	--	18	--	--	--	--				
4252	4259	7	55-57	--	--	--	6-7	--	--	--	--	--	--	--	--	11-12	--	--	--	--				

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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403	Polk	151	9670	4259	4265	6	61-63																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	

Appendix IV (Continued)

Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Porous Zone										Estimated Porosity Value (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone					Dolostone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
597	Polk	120	5000	3623	3631	8	81	--	2.24	--	--	27	--	--	27	26	--	--	--	--	33	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix IV (Continued)

Porous Zone																										
Permit No.	County	Ground Elevation (ft)	Total Depth (ft)	Estimated Porosity Value (%)																						
				Top (ft)	Bottom (ft)	Total Thickness (ft)	Interval Travel Time (μsec/ft)	Neutron Porosity (Φ _n)	Bulk Density	Density Porosity (Φ _d)	Limestone									Dolostone						
											Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5	Figure AII-6	Figure AII-9	Lithlog	Figure AII-2	Figure AII-7	Figure AII-8	Figure AII-3	Figure AII-4	Figure AII-5
772	St Lucie	95	12652	4324	4326	2	74																			
				4326	4329	3	115-125																			
				4329	4332	3	62																			
				4332	4334	2	84																			
				4334	4335	1	65																			
				4340	4347	7	80																			
				4347	4367	20	72-76																			
				4367	4374	7	66-70																			
				4374	4376	2	73																			
				4376	4383	7	138-140																			
				4383	4392	9	75-76																			
				4392	4395	3	56																			
				4399	4404	5	54-55																			
				4404	4409	5	60																			
				4411	4431	20	67-70																			
				4434	4440	6	63																			
				4440	4449	9	57-59																			
				4449	4472	23	61-65																			
				4480	4485	5	64																			
				4485	4502	17	67-71																			
				4502	4522	20	72-76																			
				4522	4526	4	65																			
				4526	4530	4	59																			
				4530	4540	10	66-67																			
				4542	4554	12	69-70																			

Upper Porous Zone

Middle Porous Zone

Lower Porous Zone

Upper Porous Zone

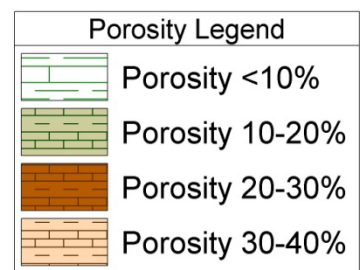
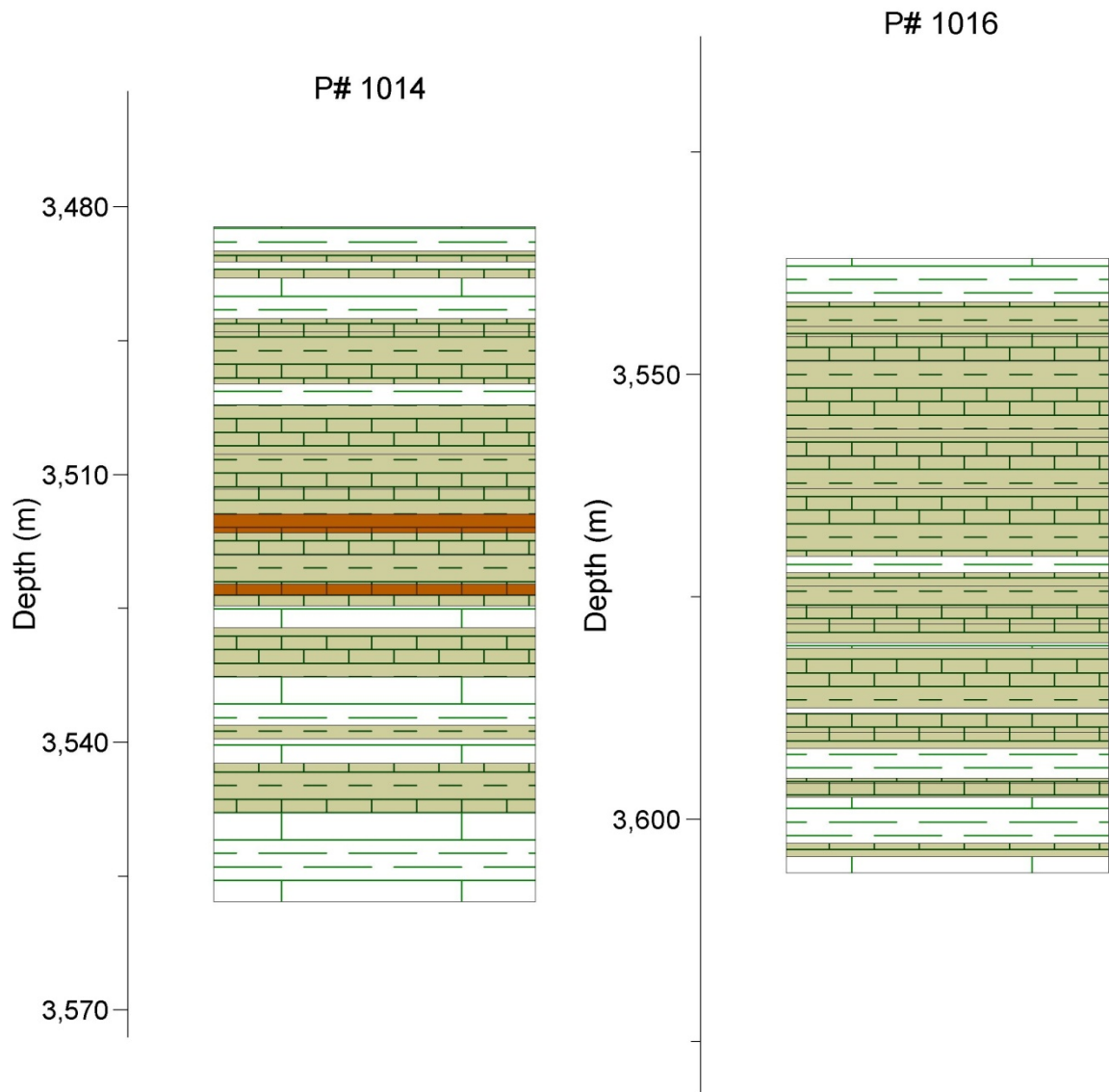
Middle Porous Zone

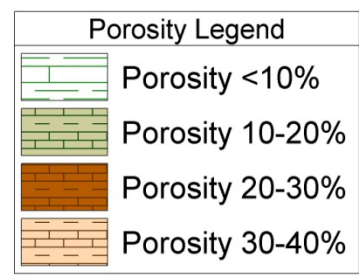
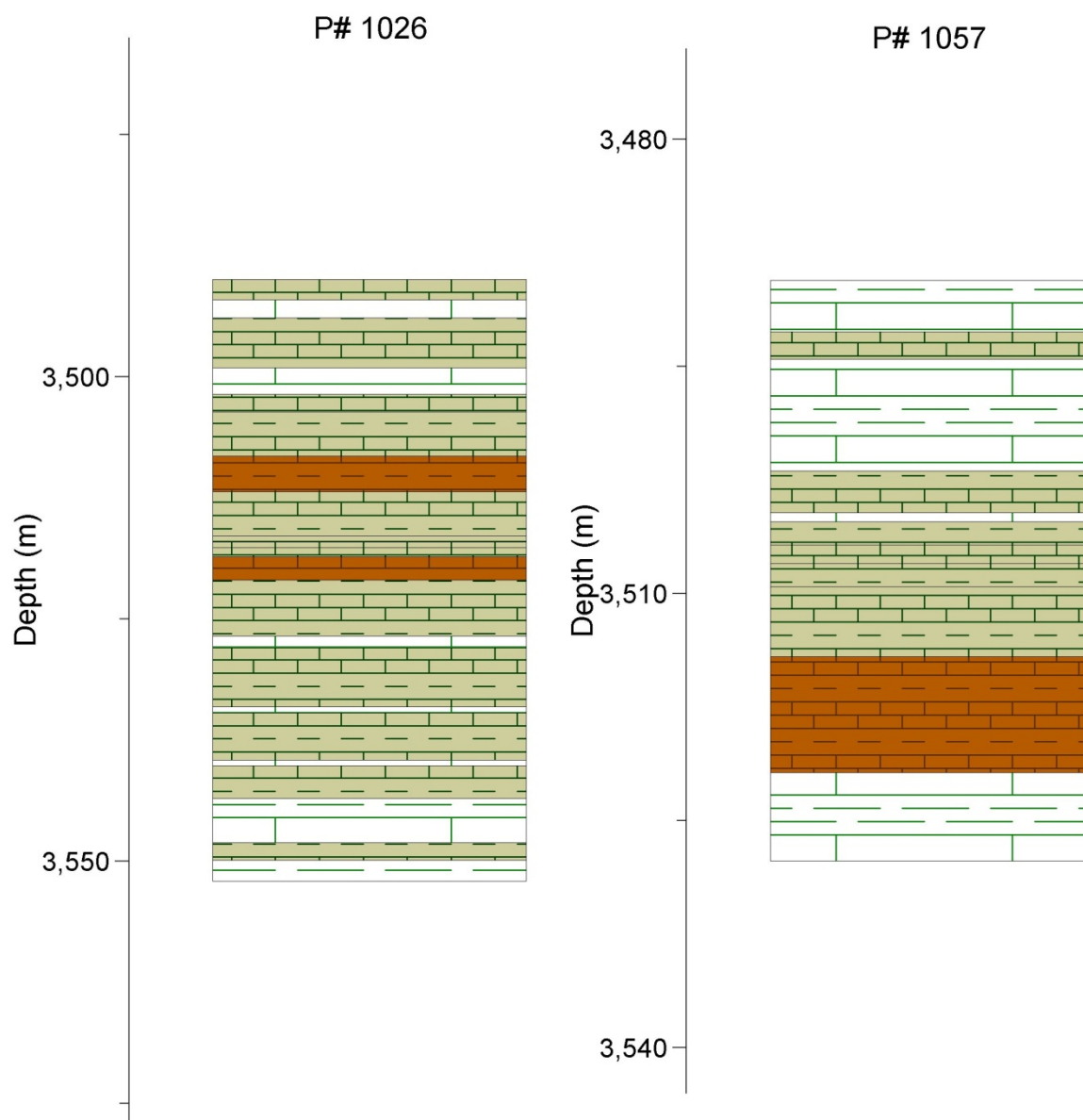
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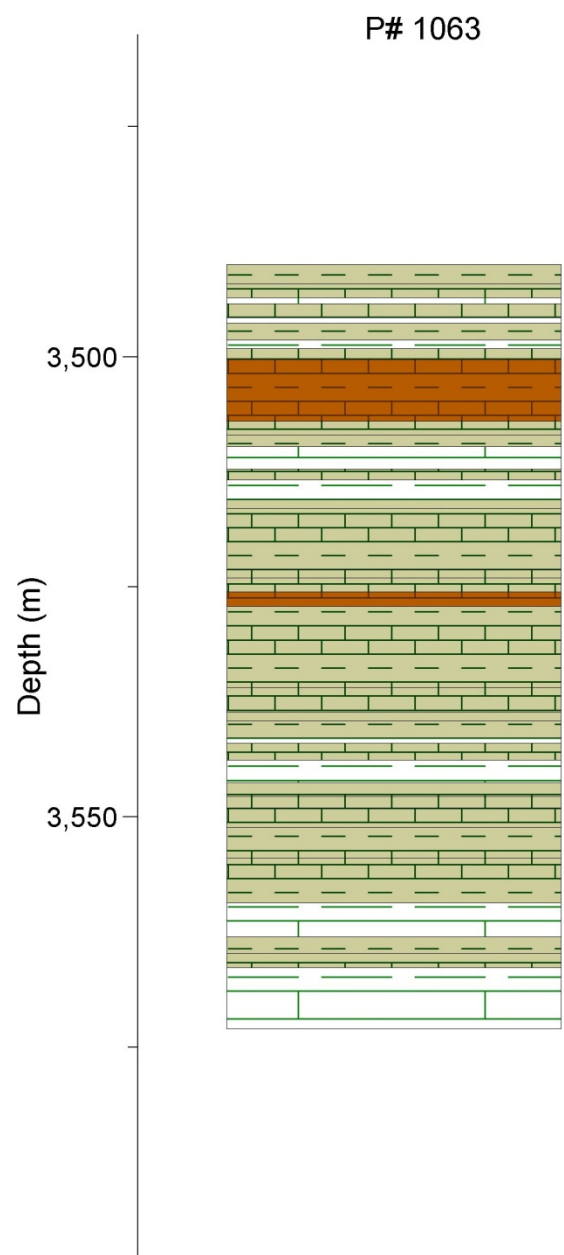
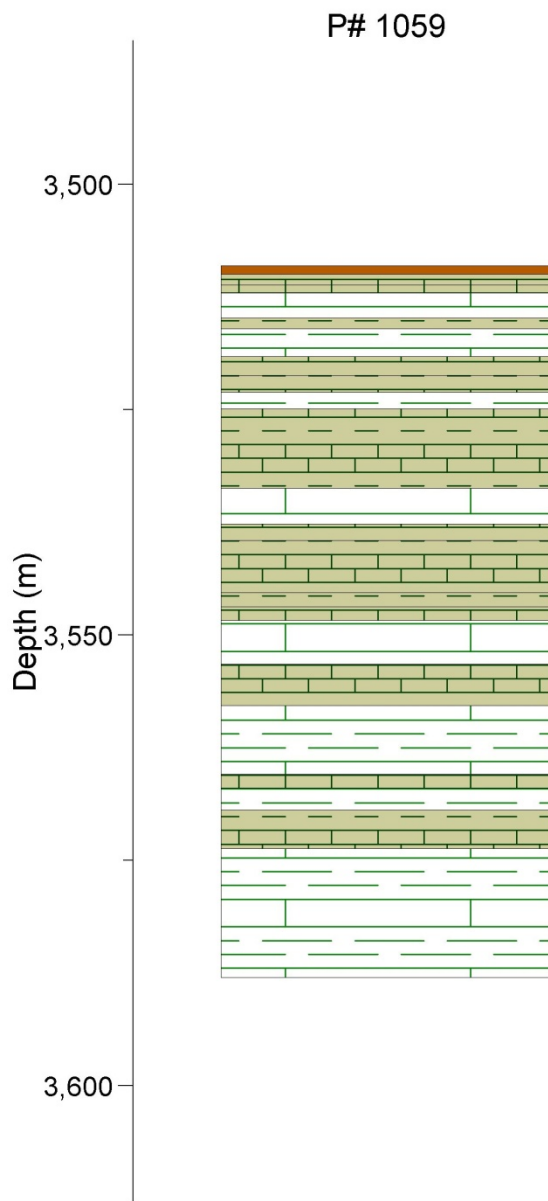
Lithology determined using this method

Lithology determined using another method

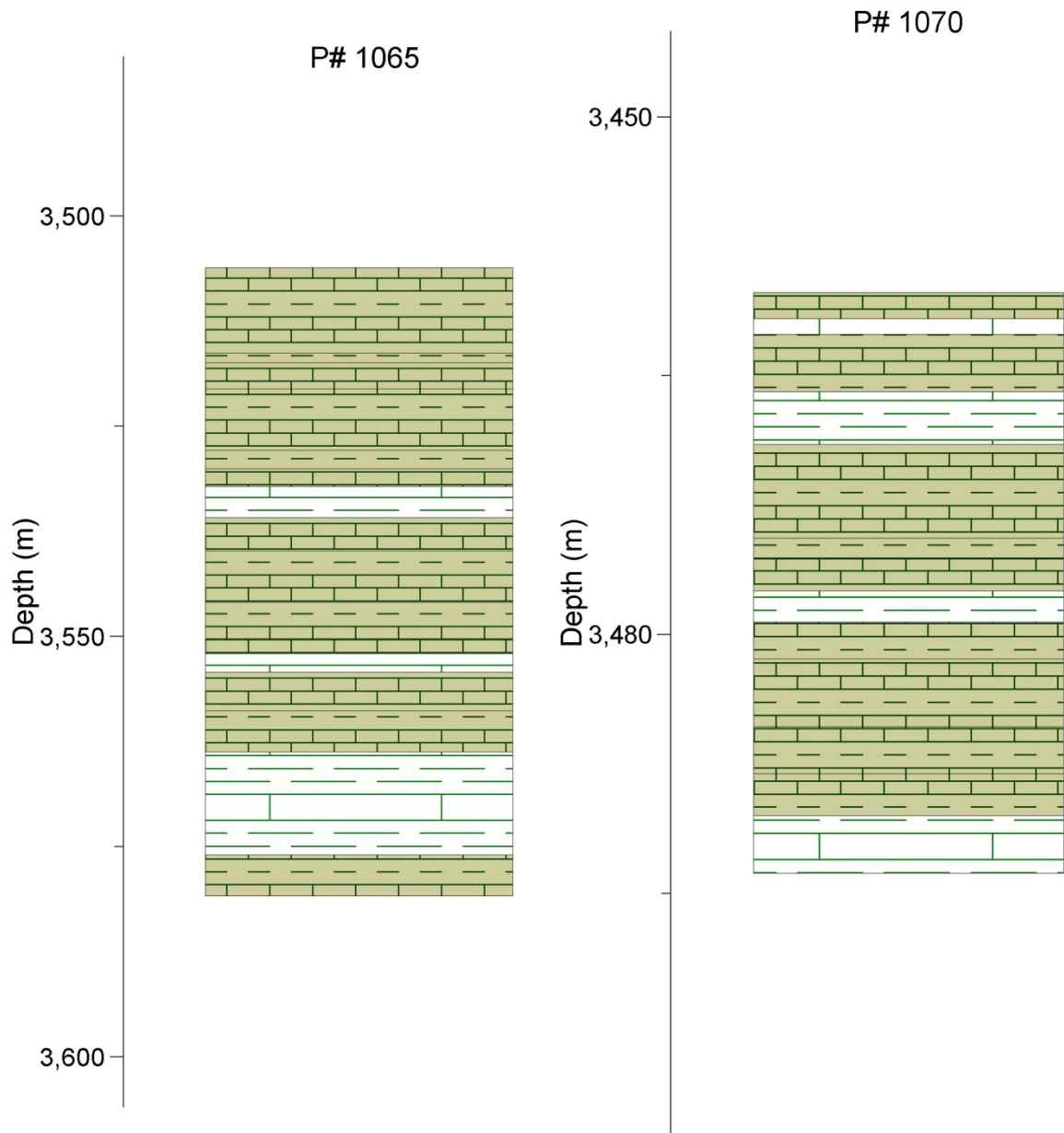
Appendix V:
Striplogs Displaying Porosity for Sunniland Formation Study Wells





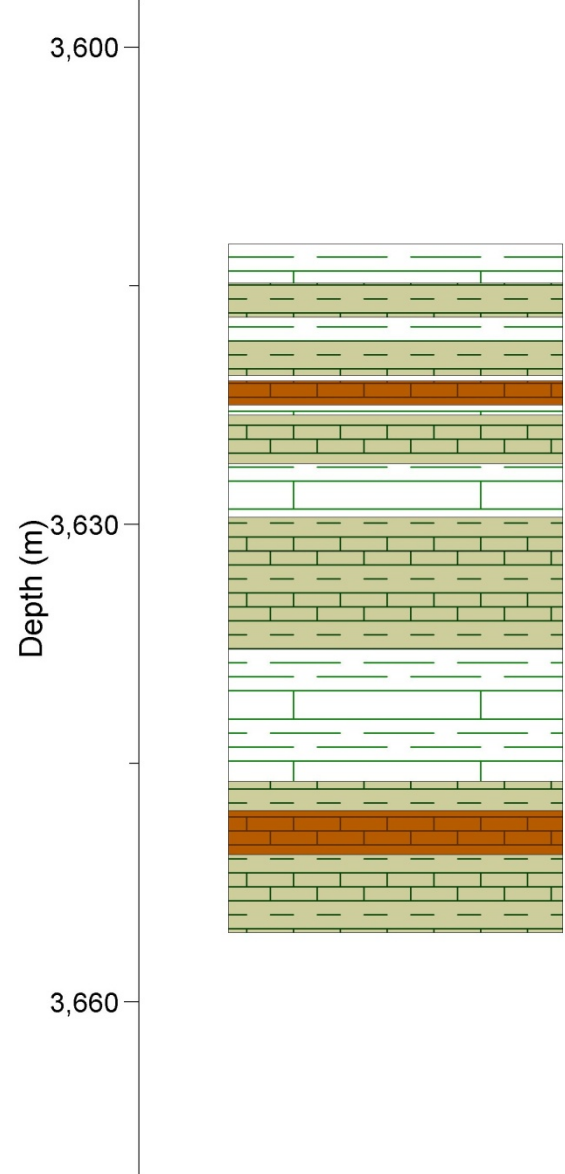
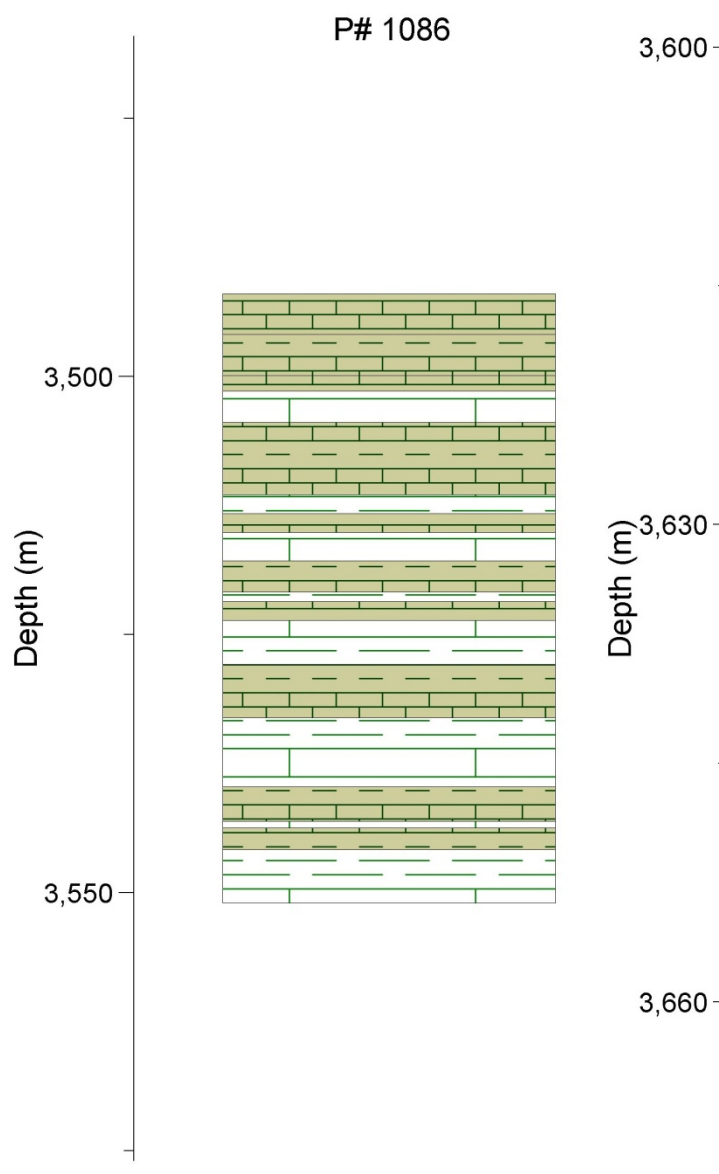


Porosity Legend	
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	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

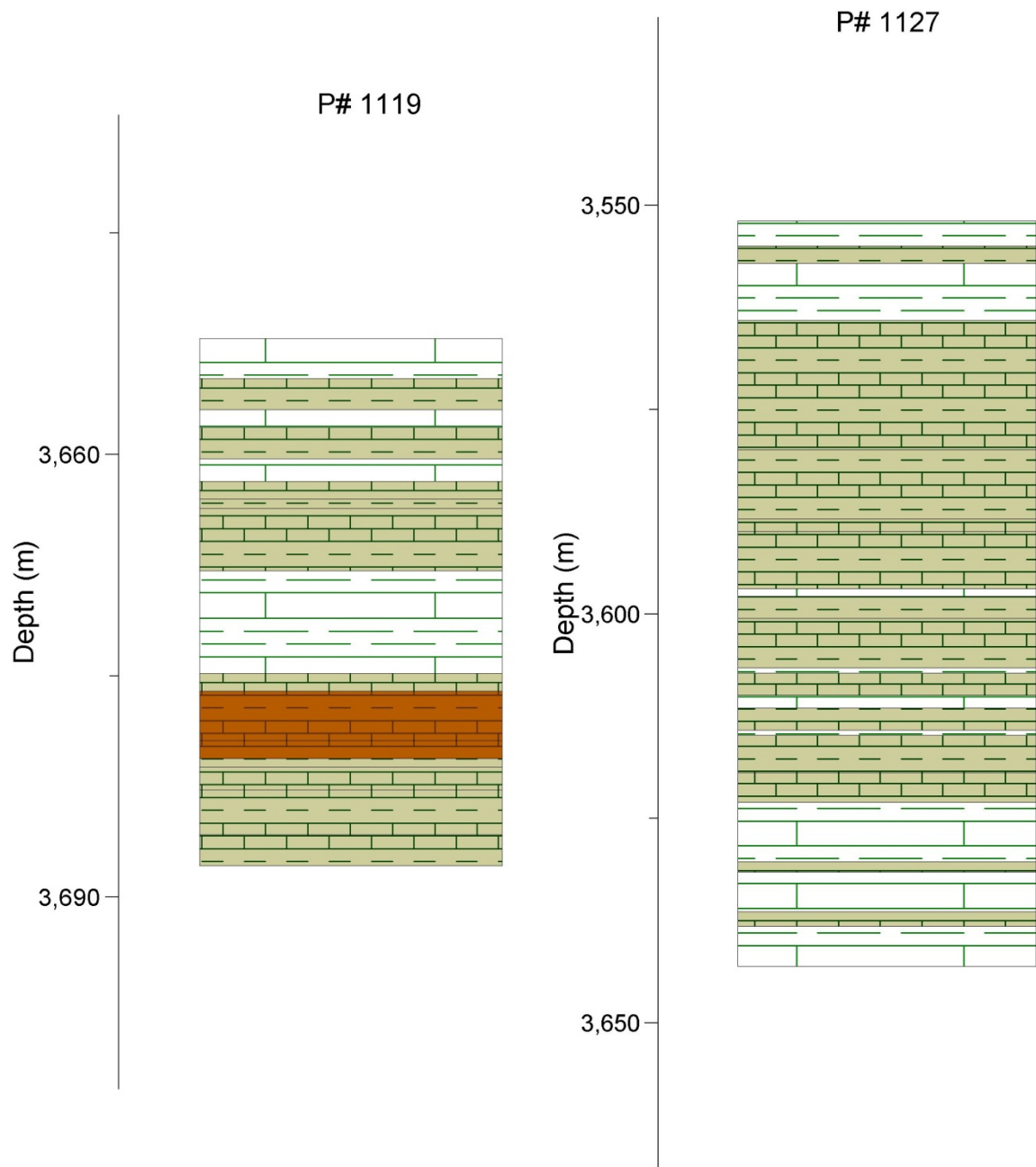


Porosity Legend	
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	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

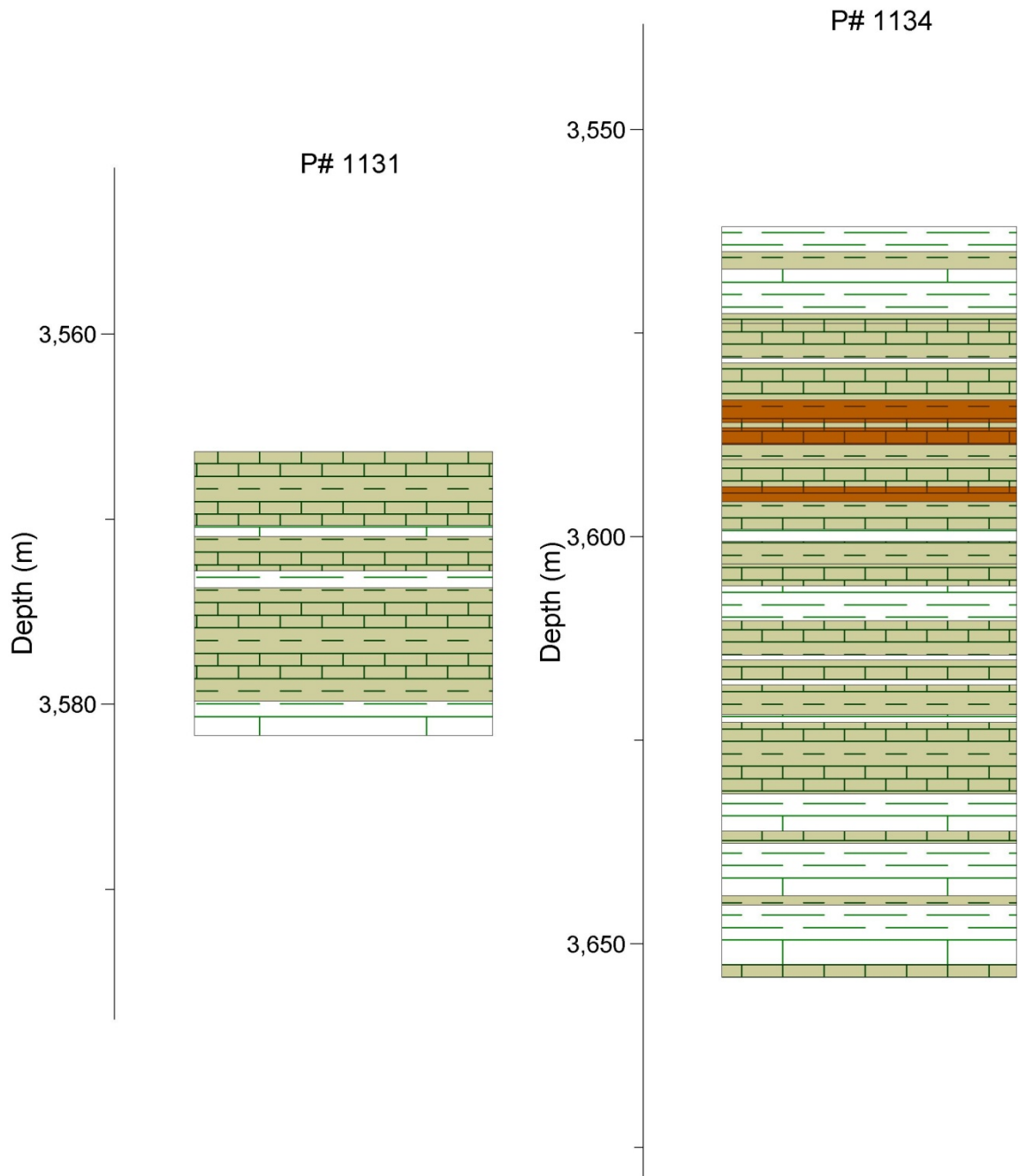
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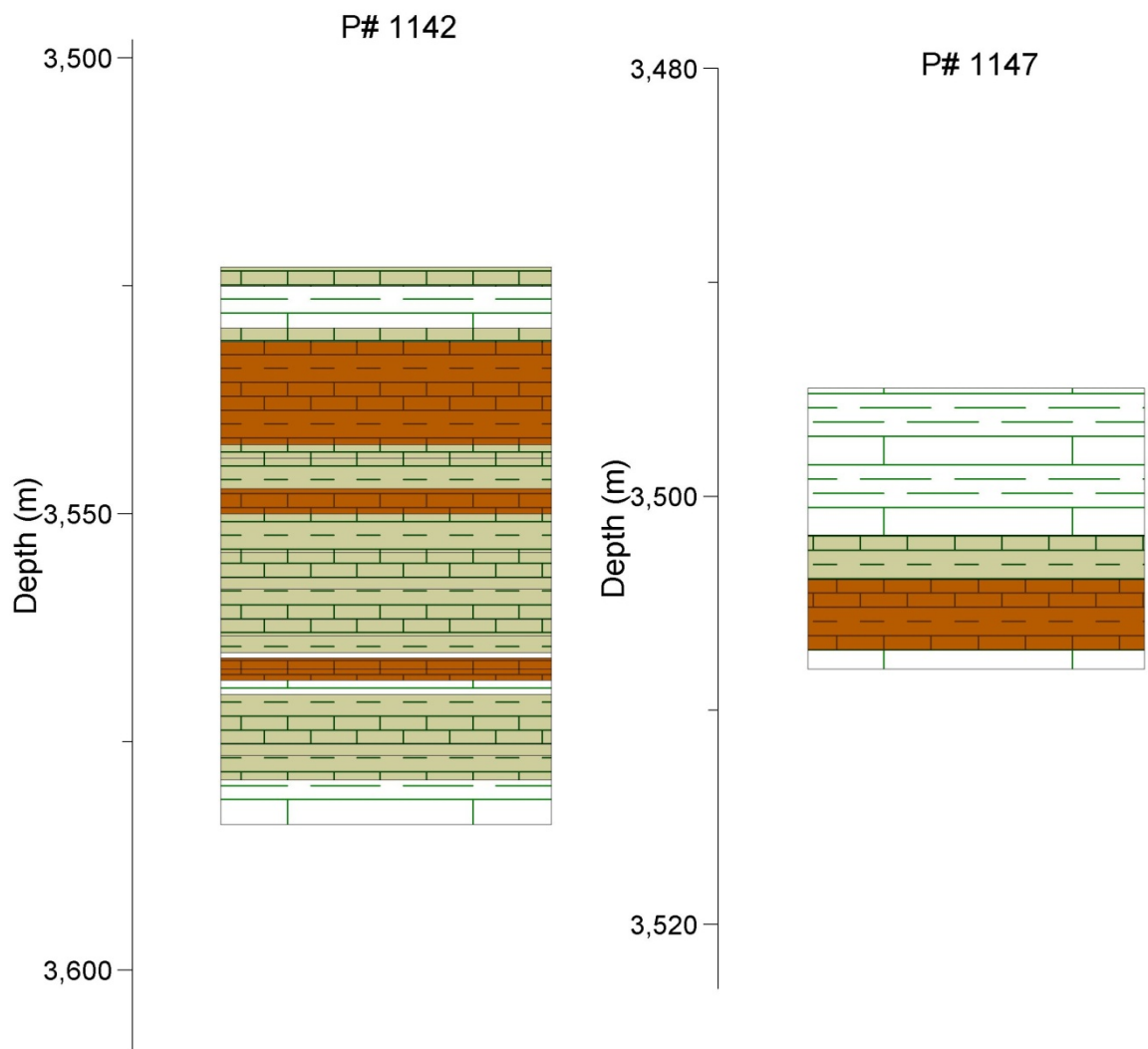
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



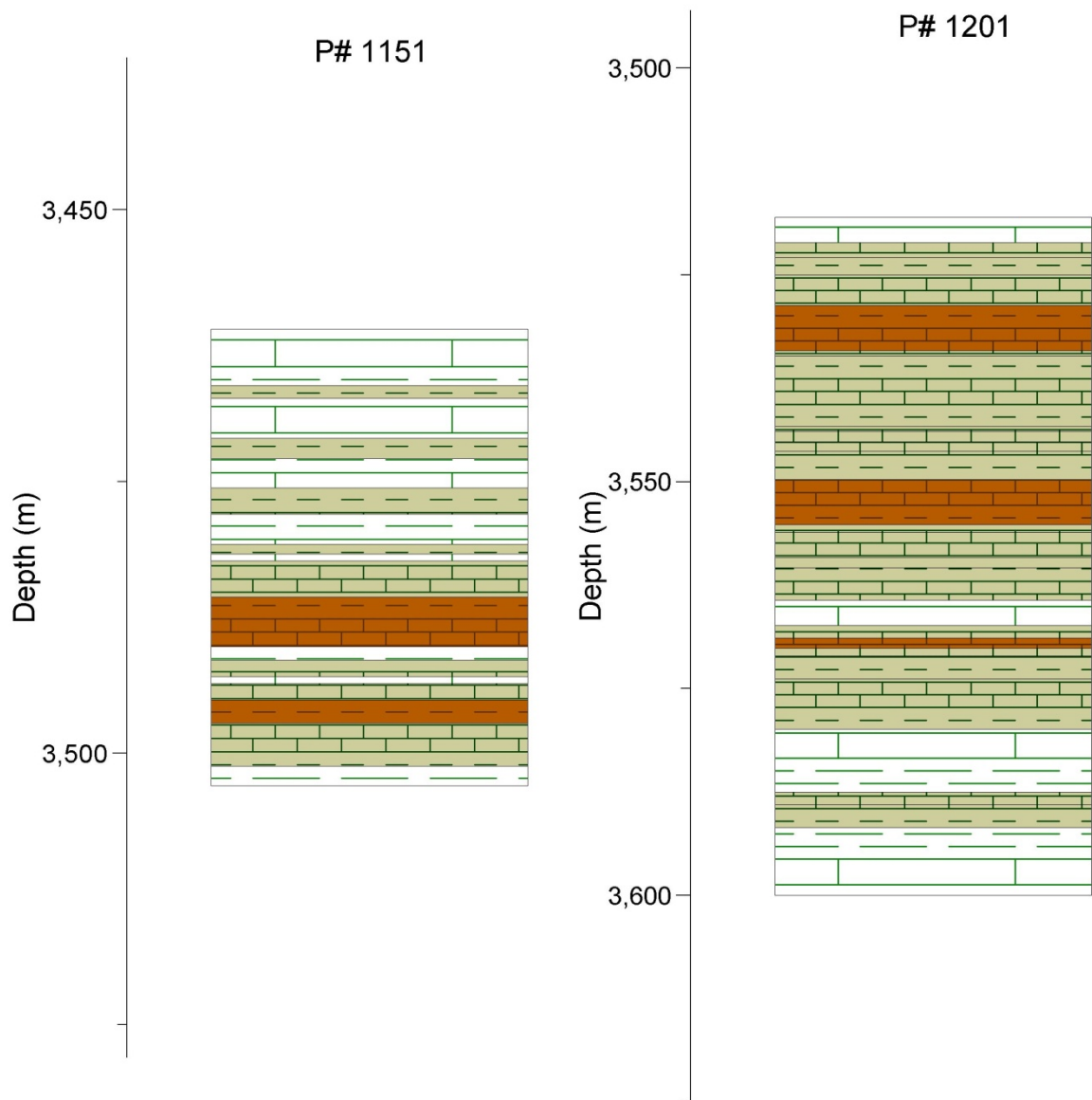
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



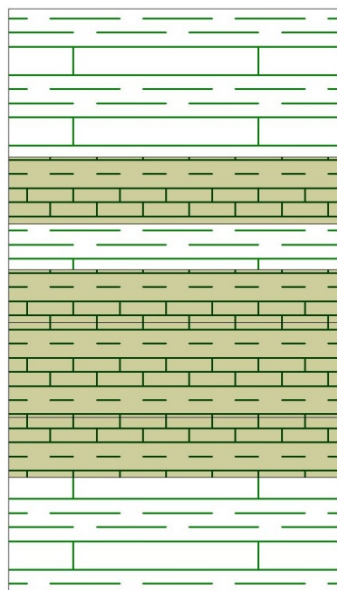
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



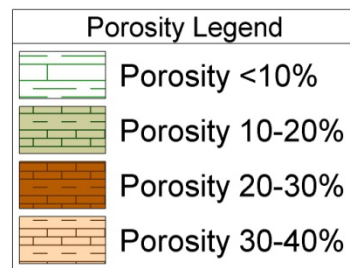
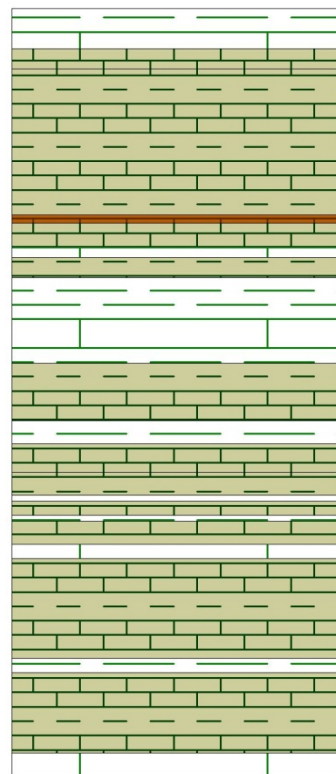
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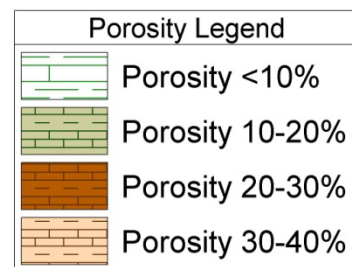
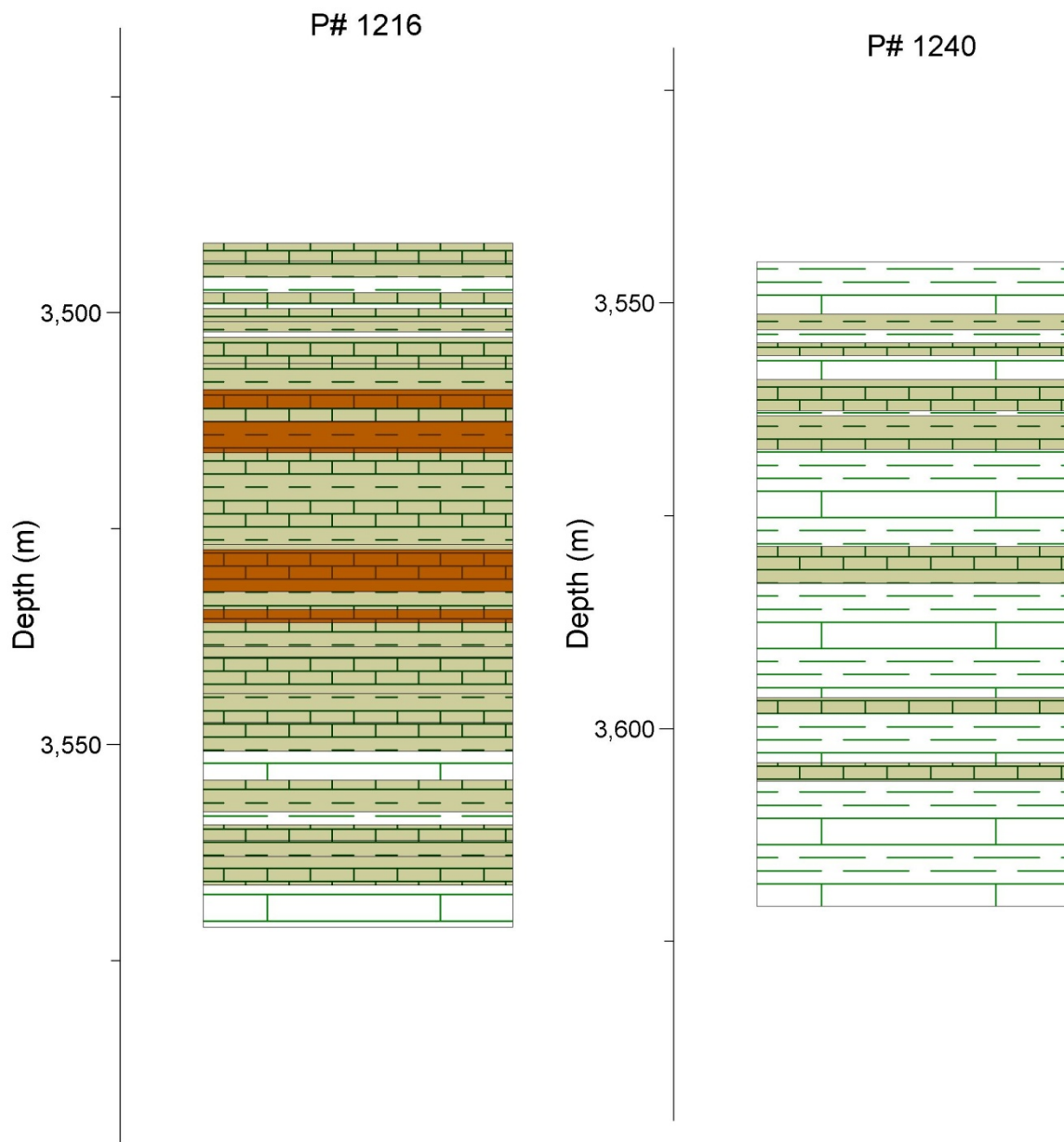


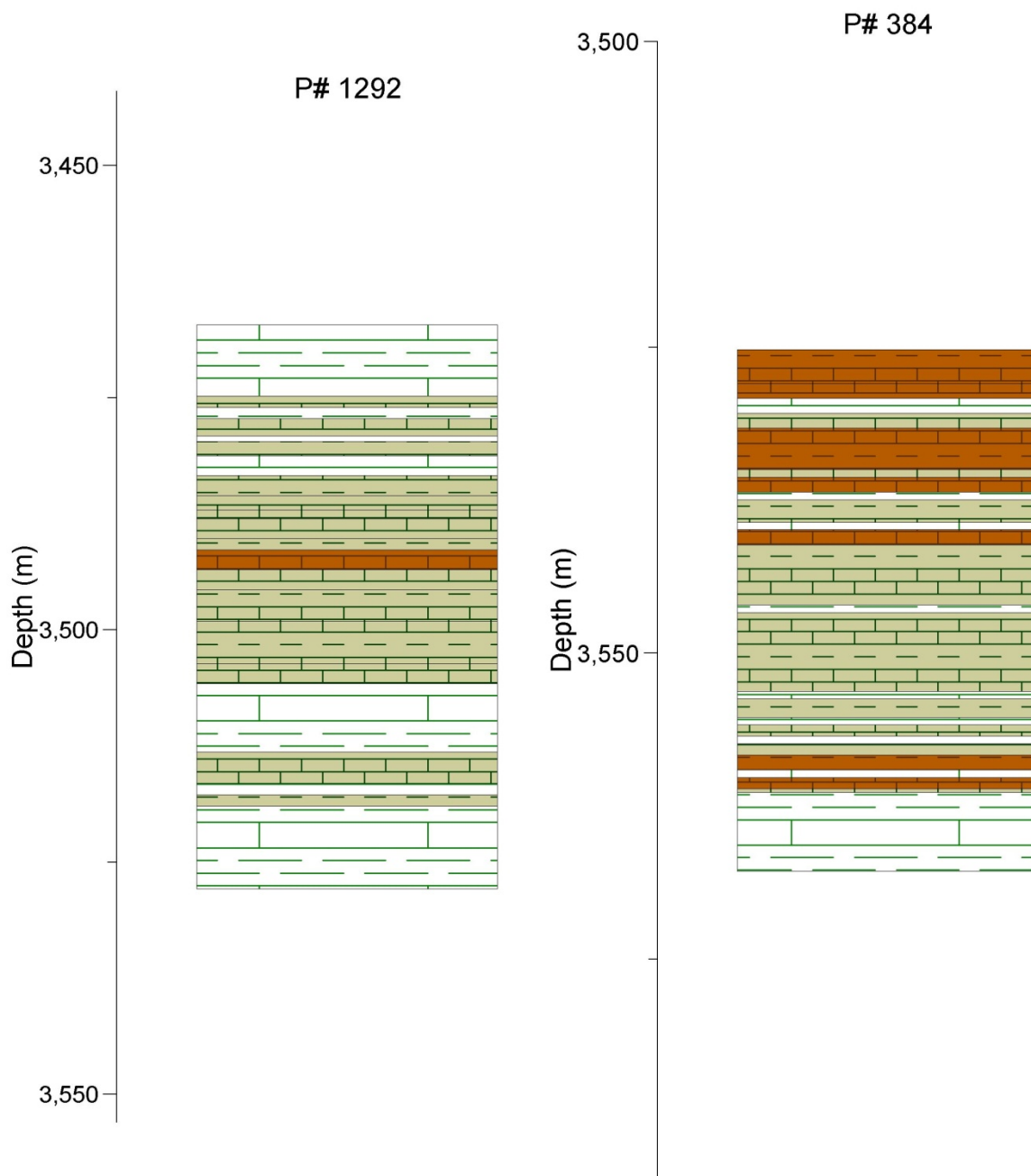
Depth (m)

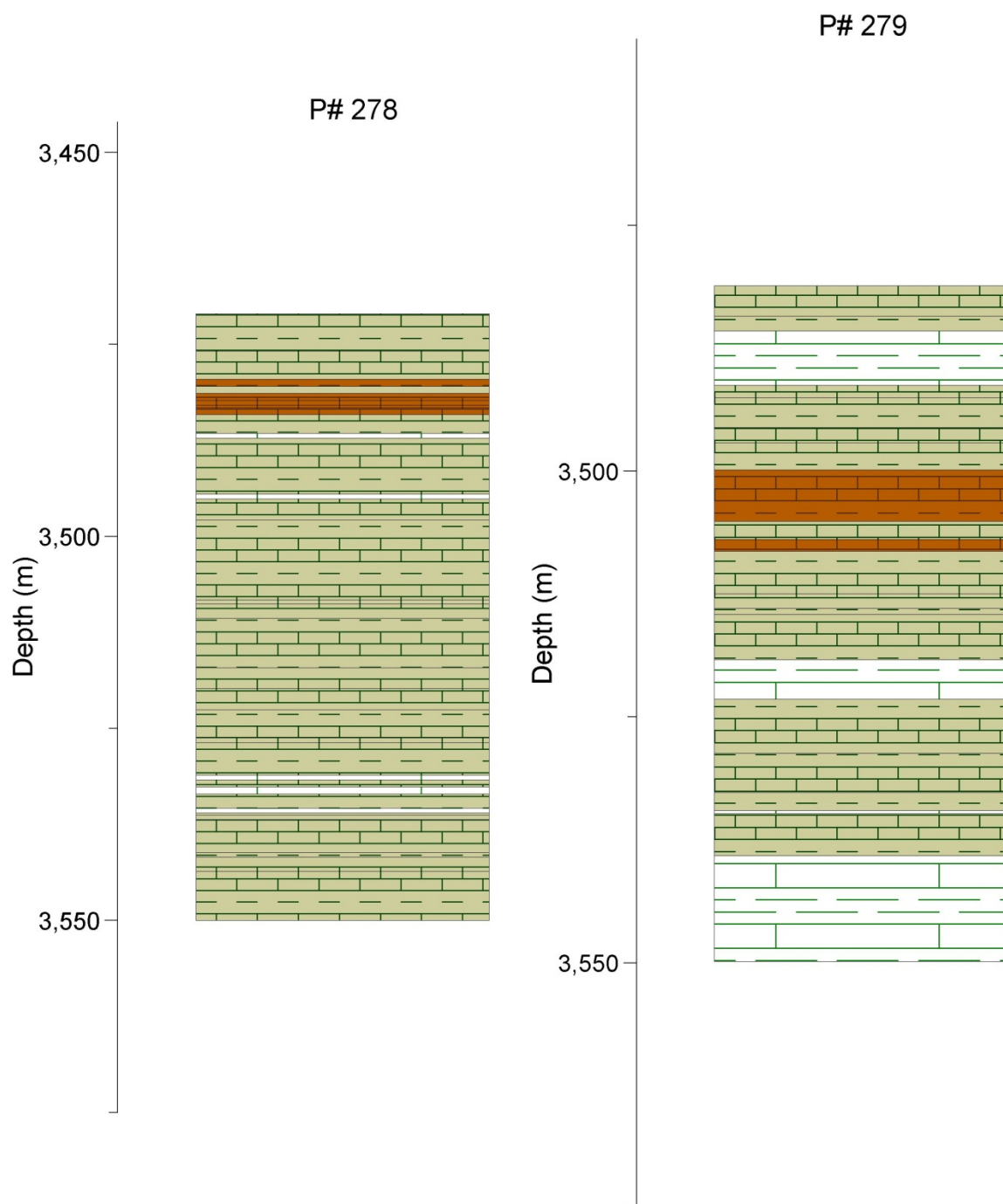


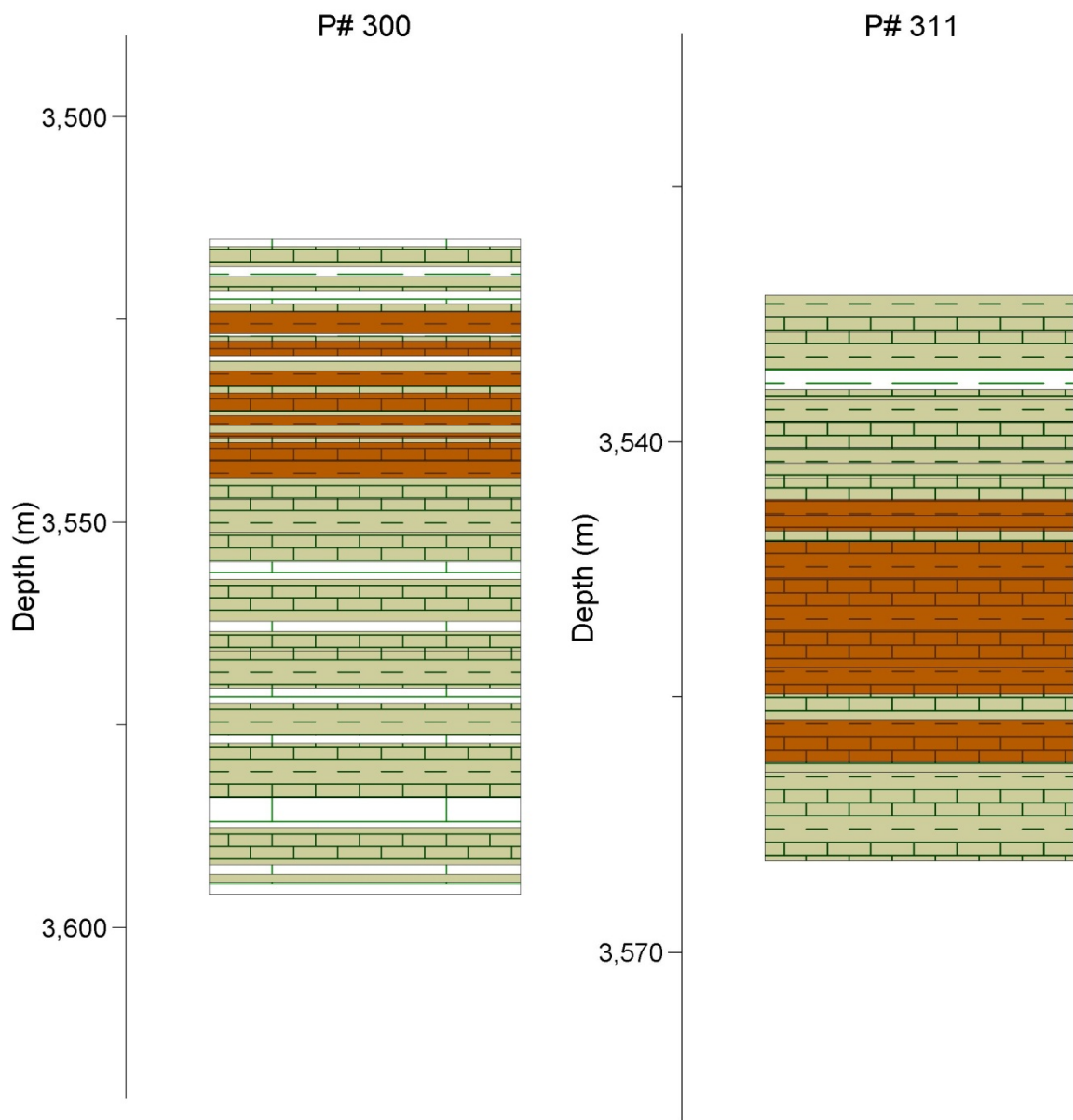
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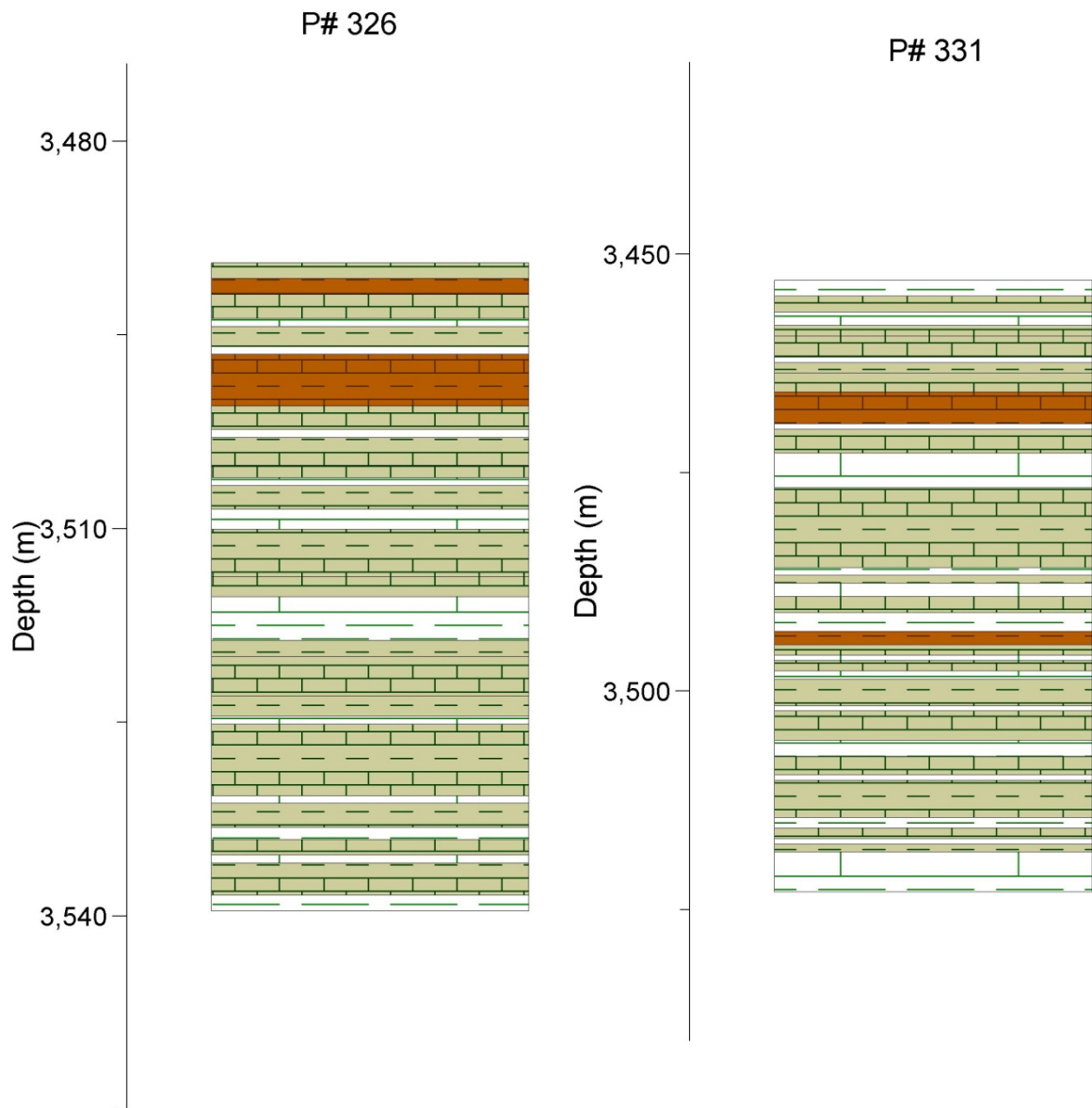




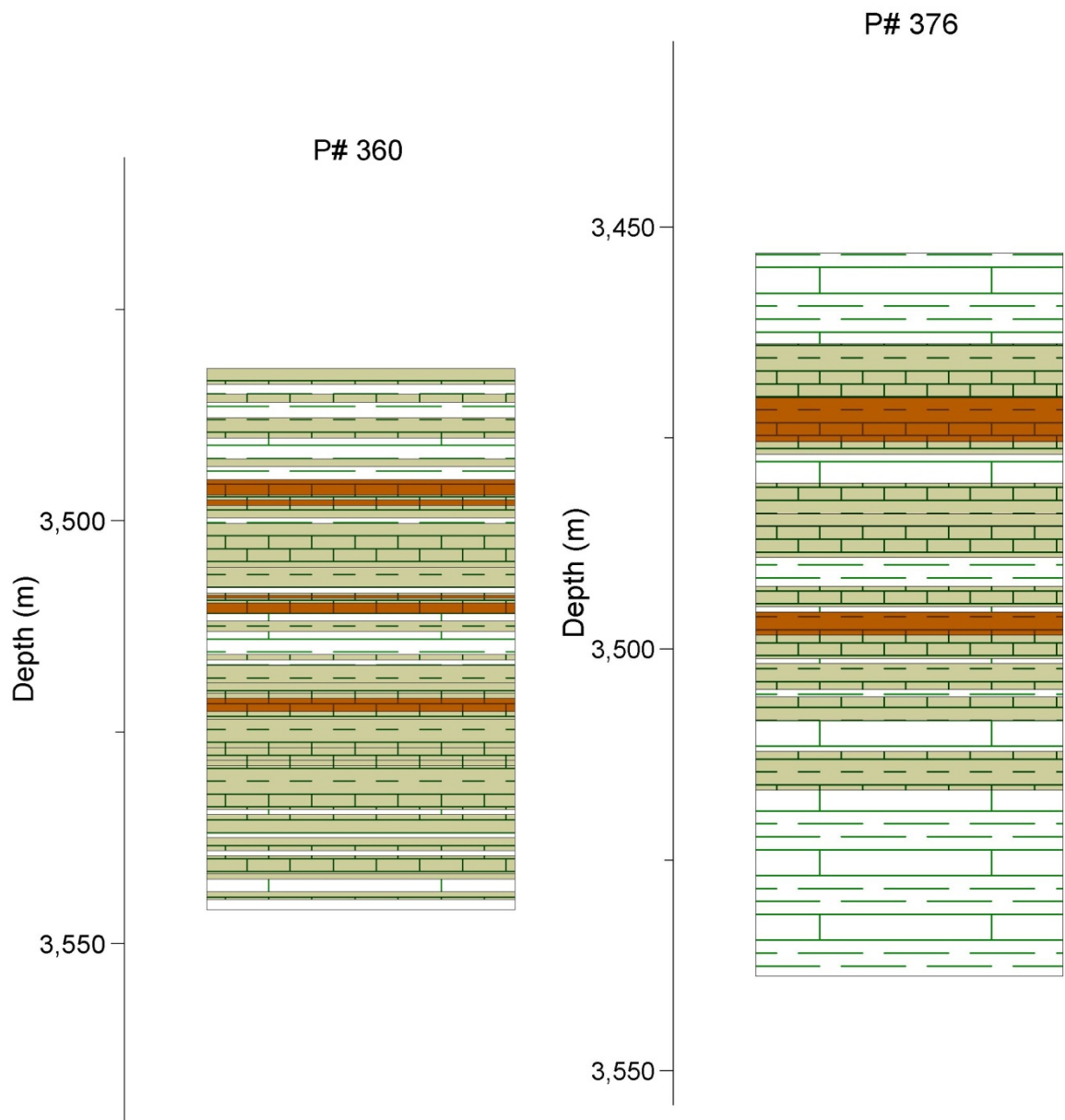




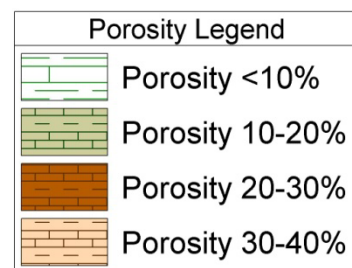
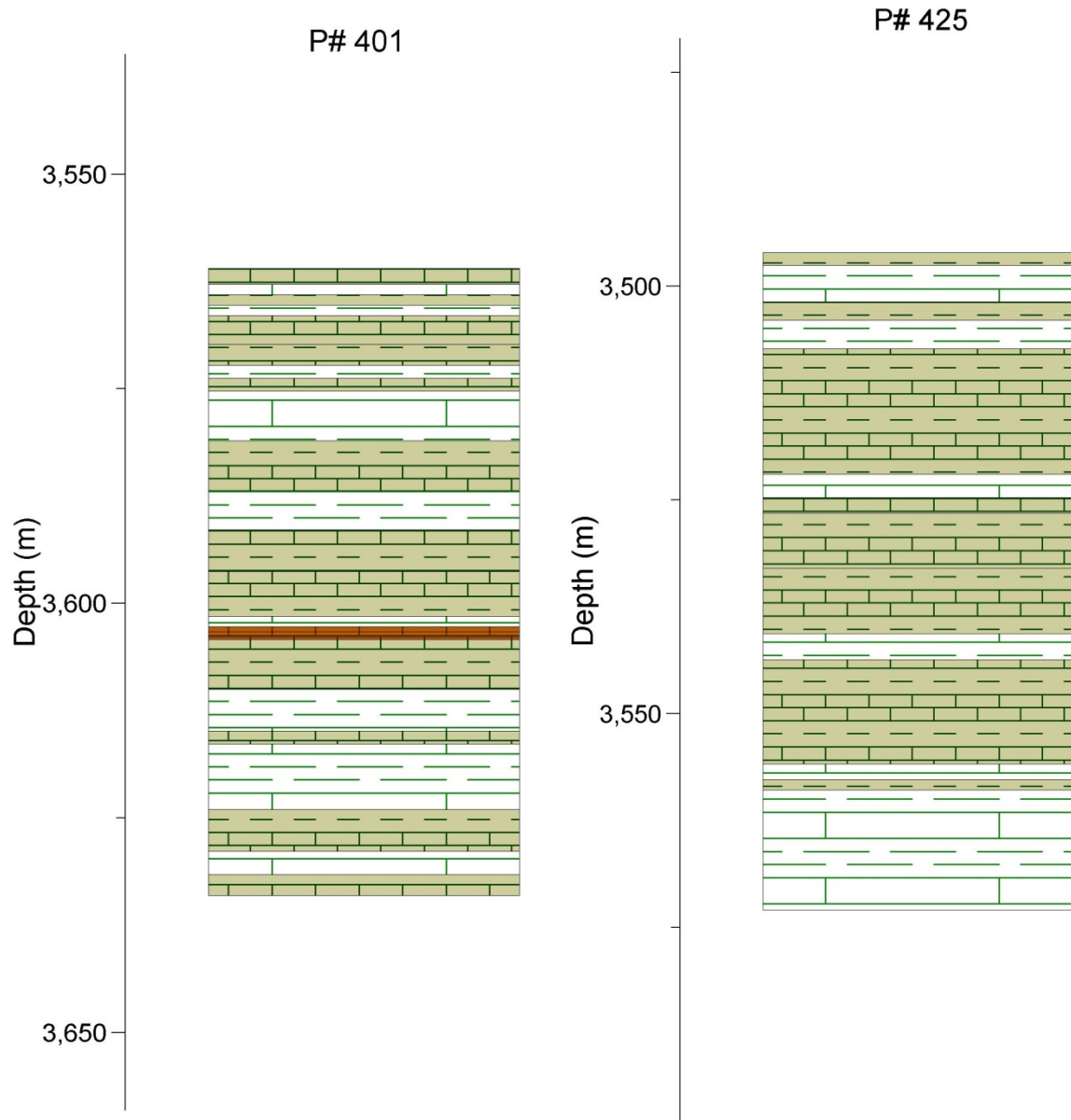


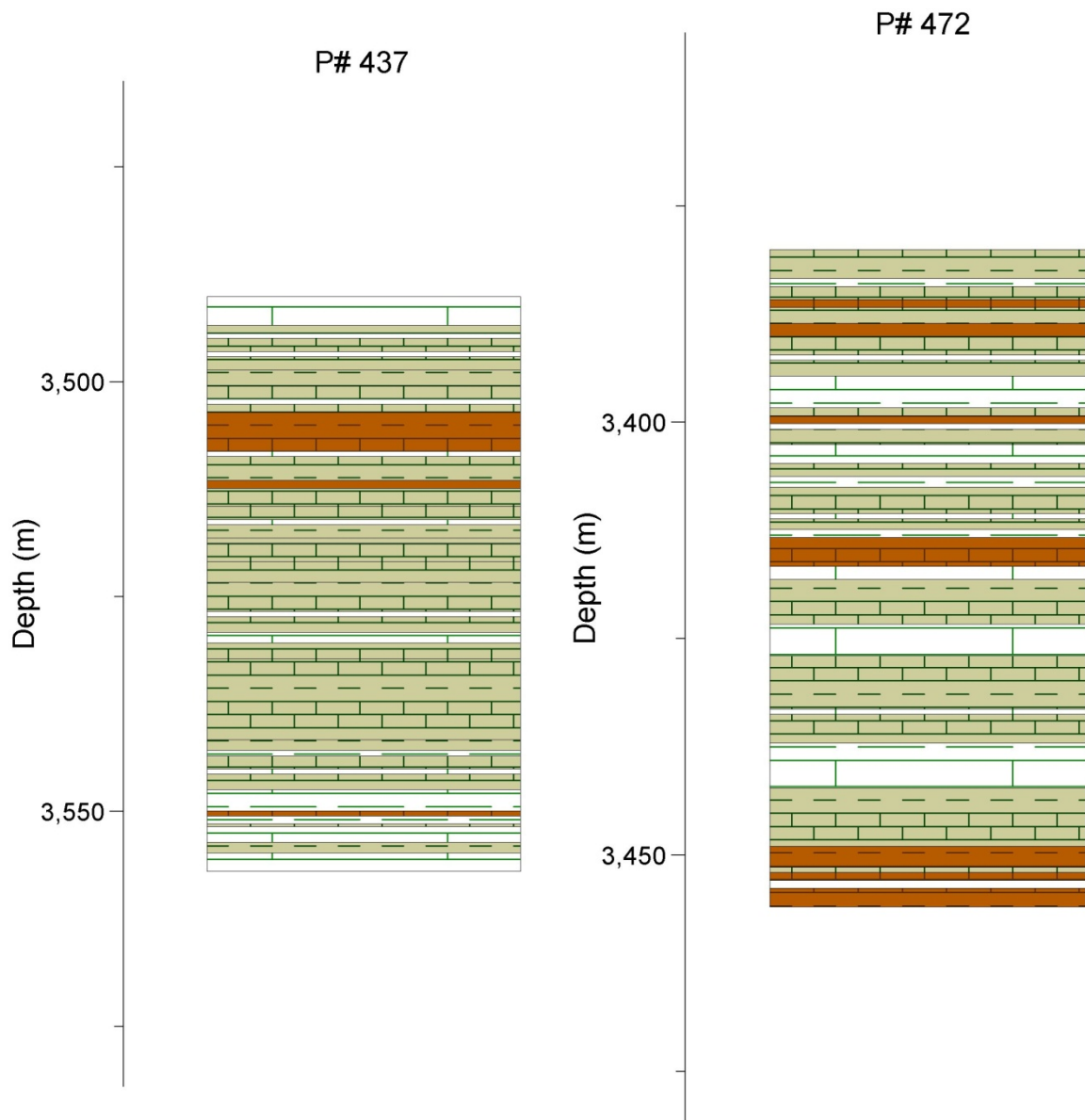


Porosity Legend	
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	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

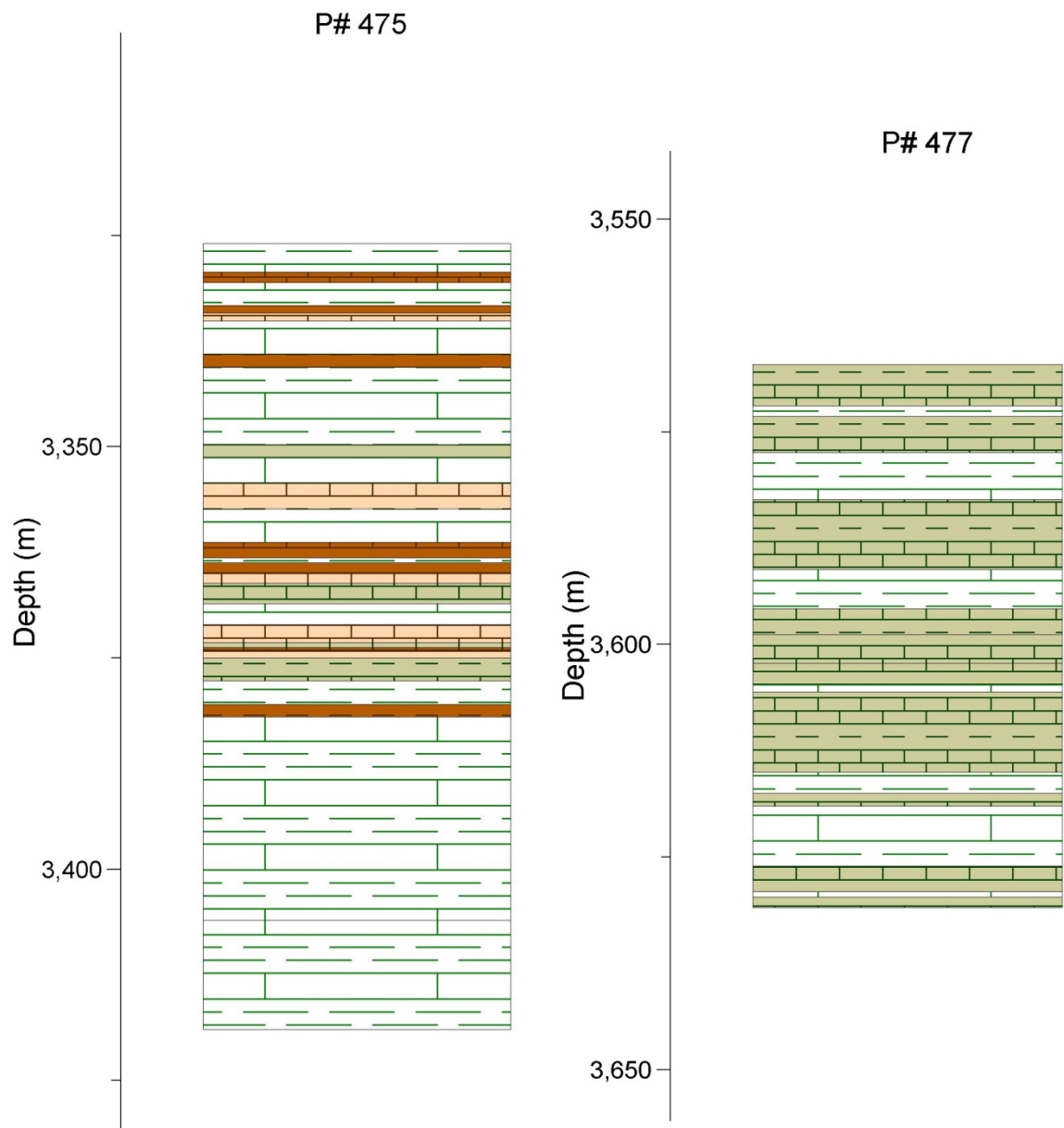


Porosity Legend	
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	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

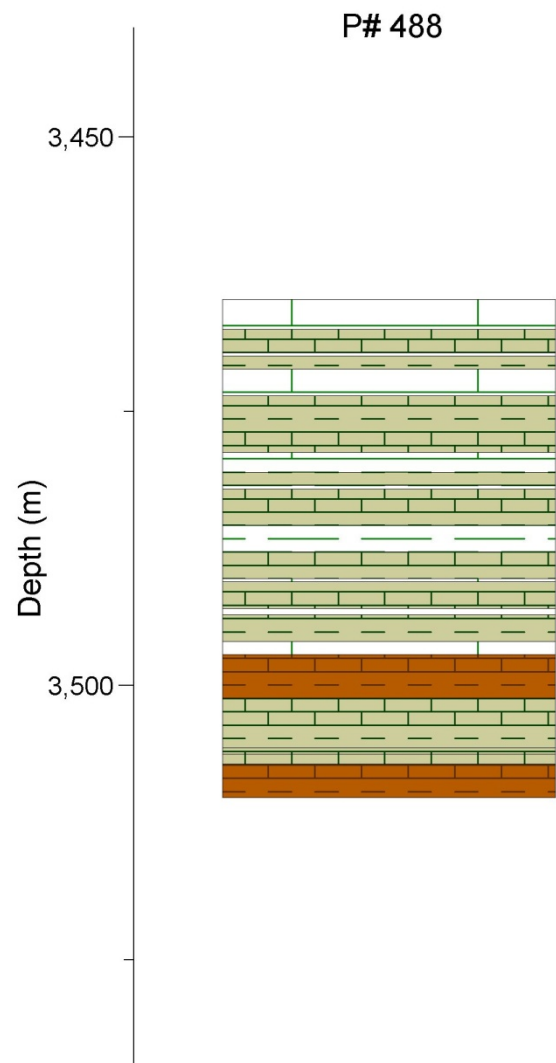
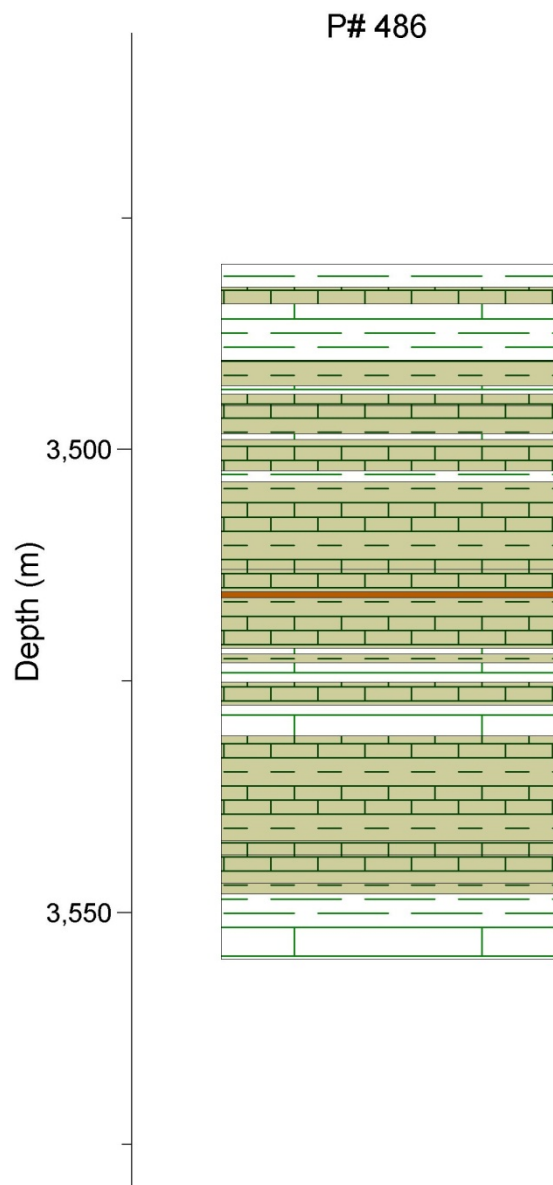




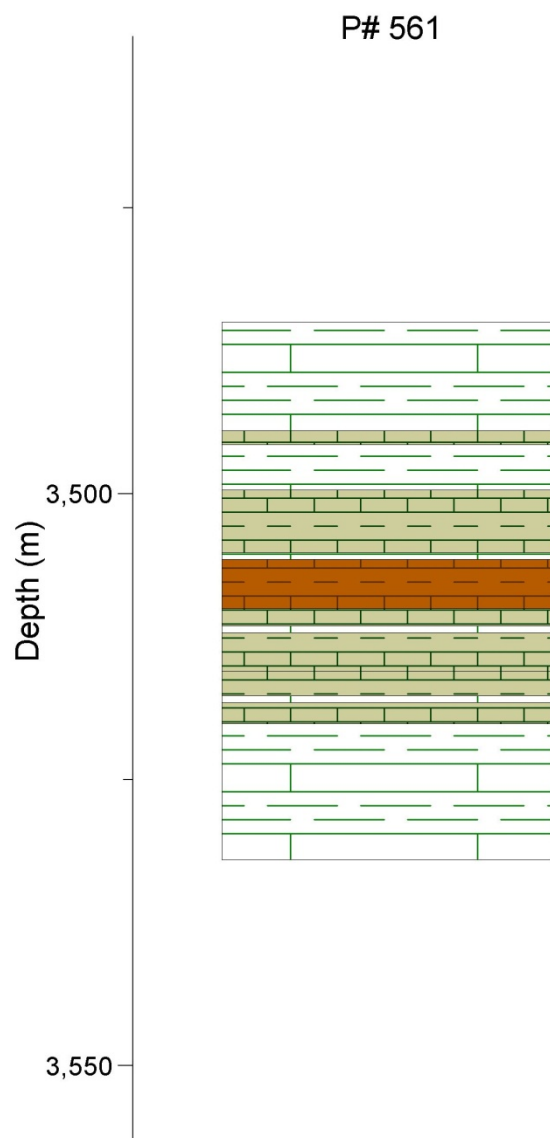
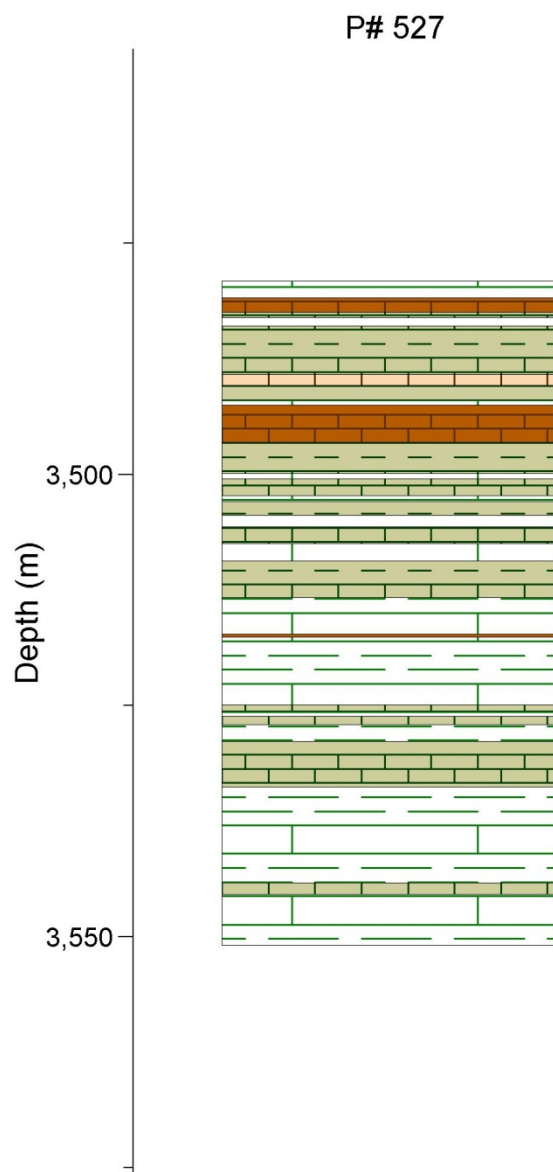
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



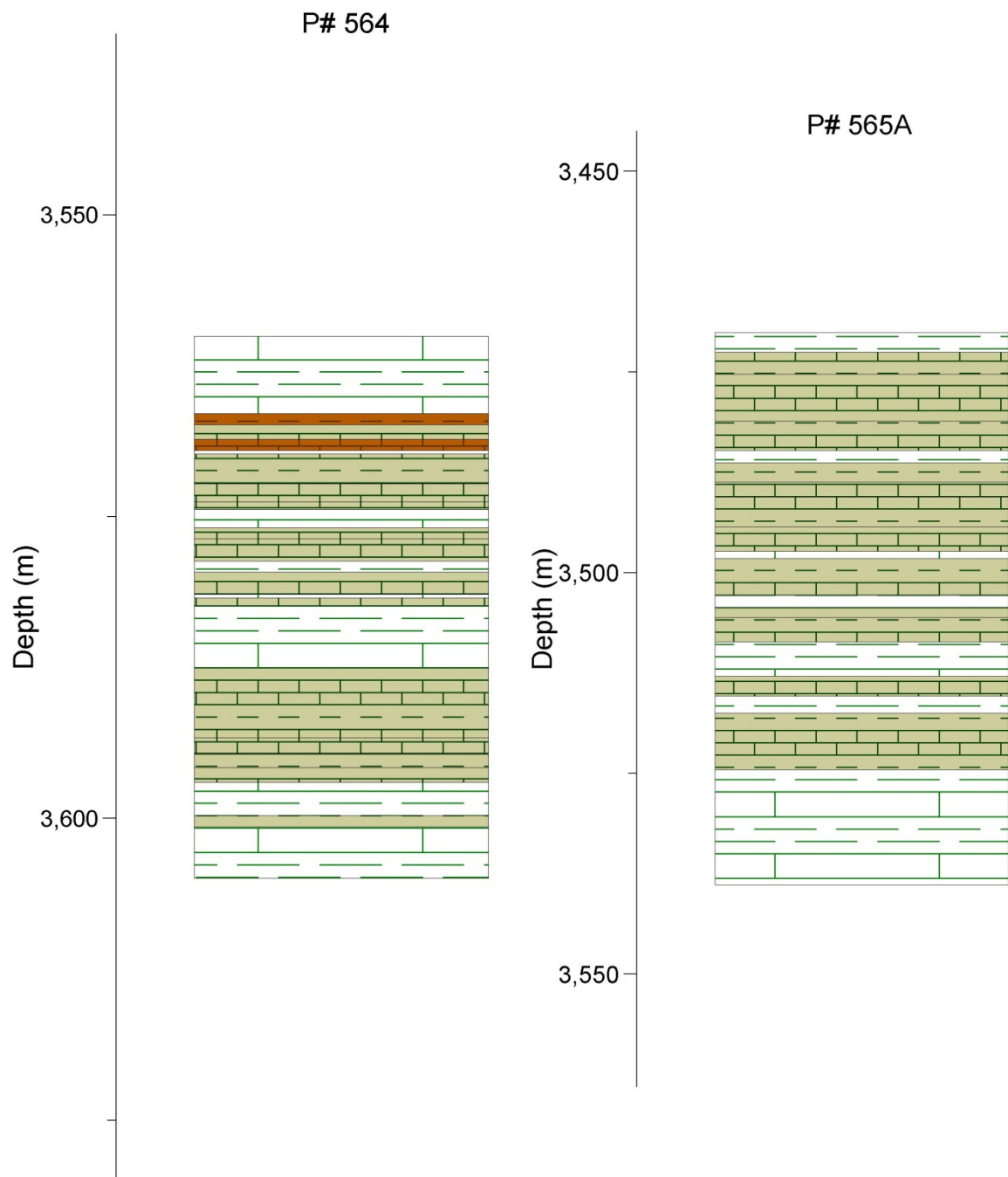
Porosity Legend	
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	Porosity 20-30%
	Porosity 30-40%



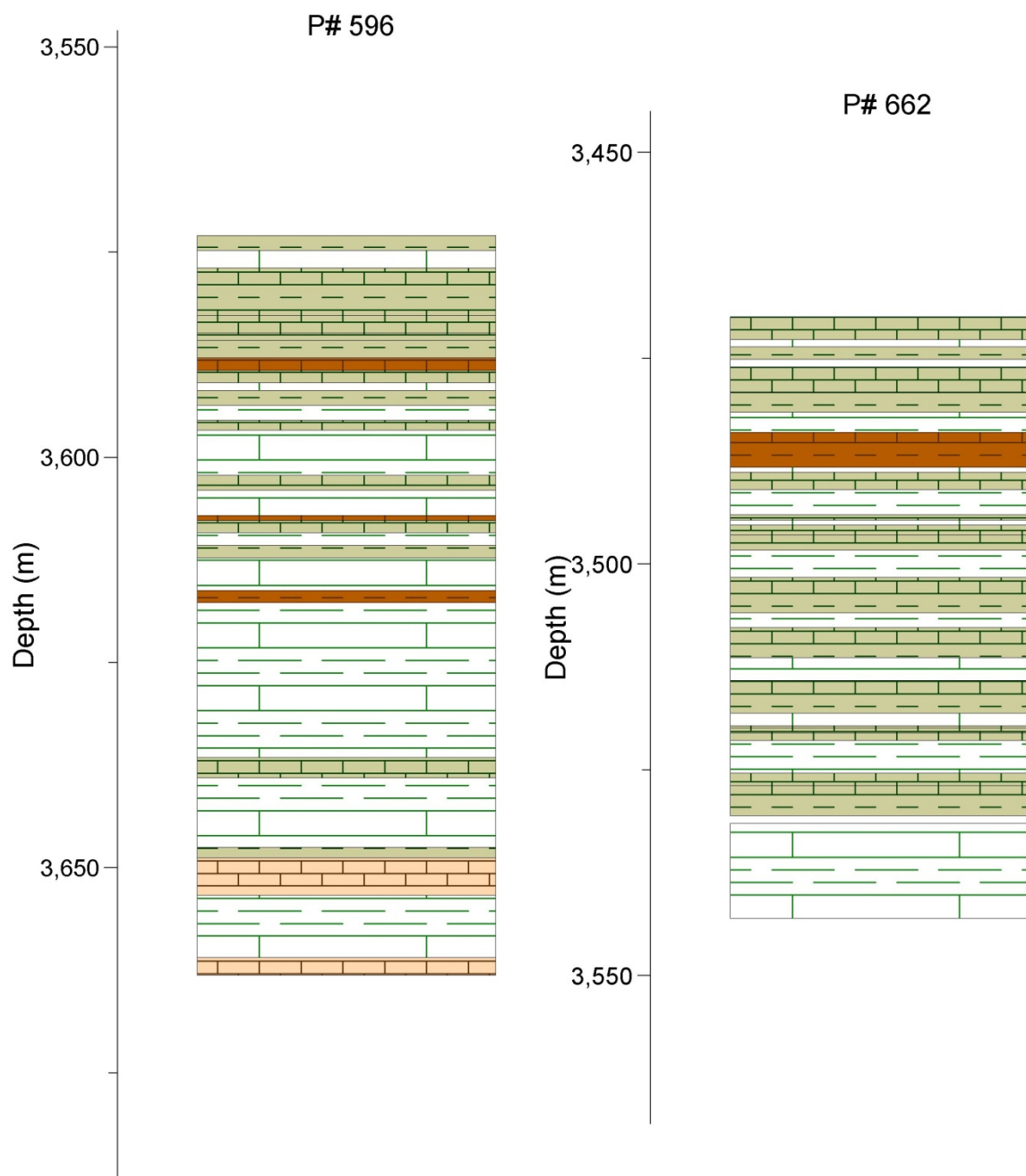
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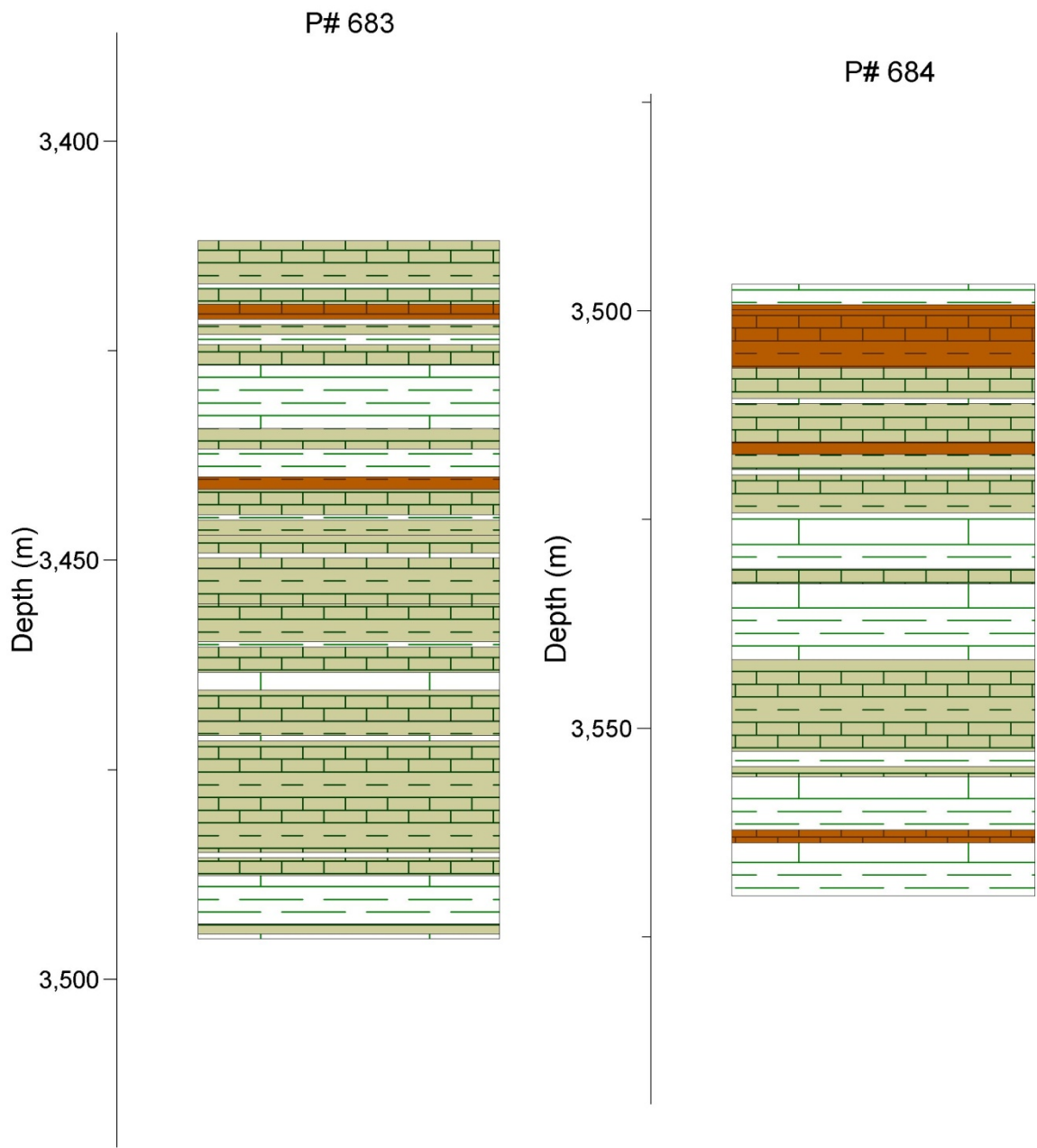
Porosity Legend	
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	Porosity 10-20%
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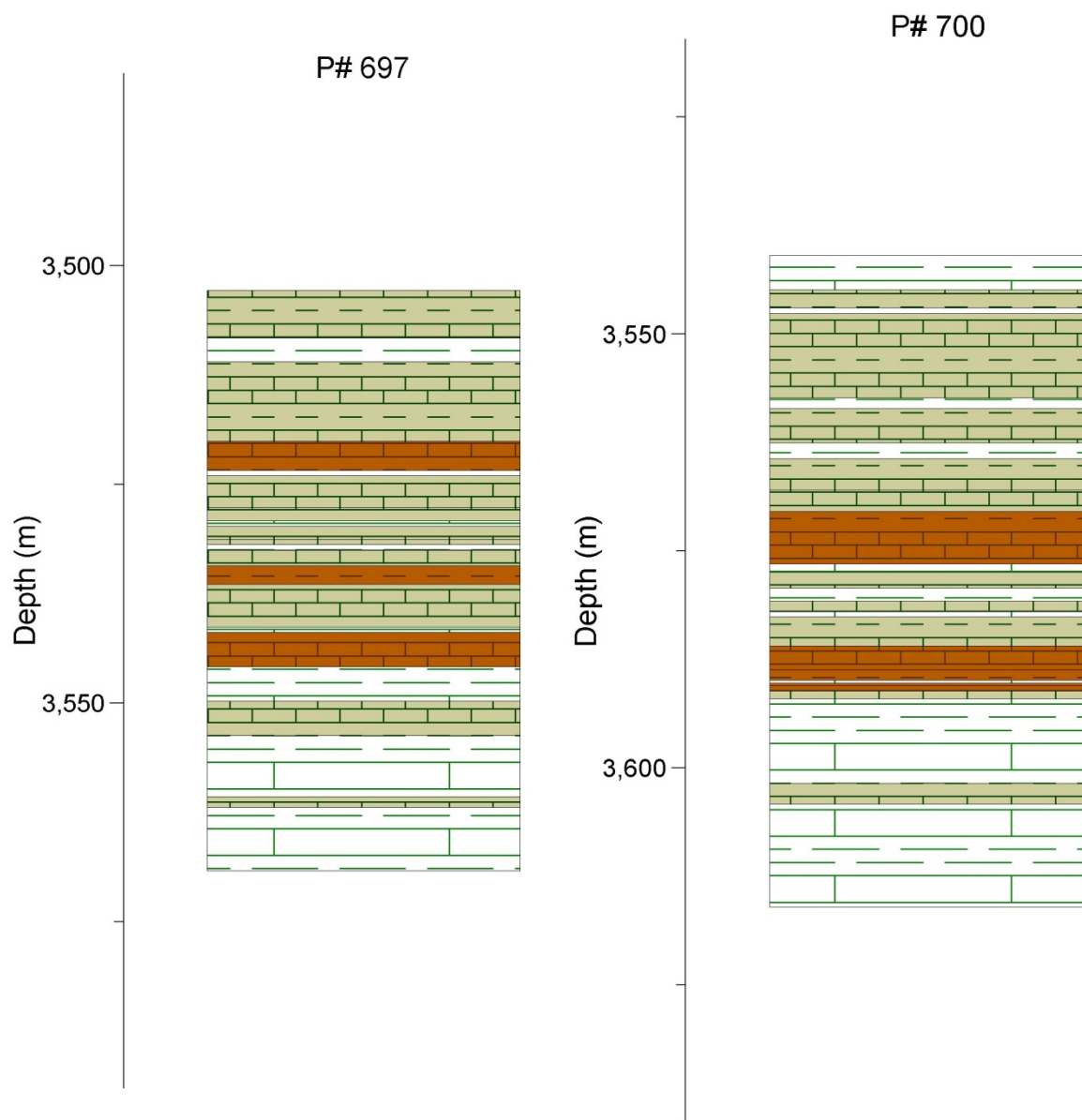


Porosity Legend	
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	Porosity 20-30%
	Porosity 30-40%

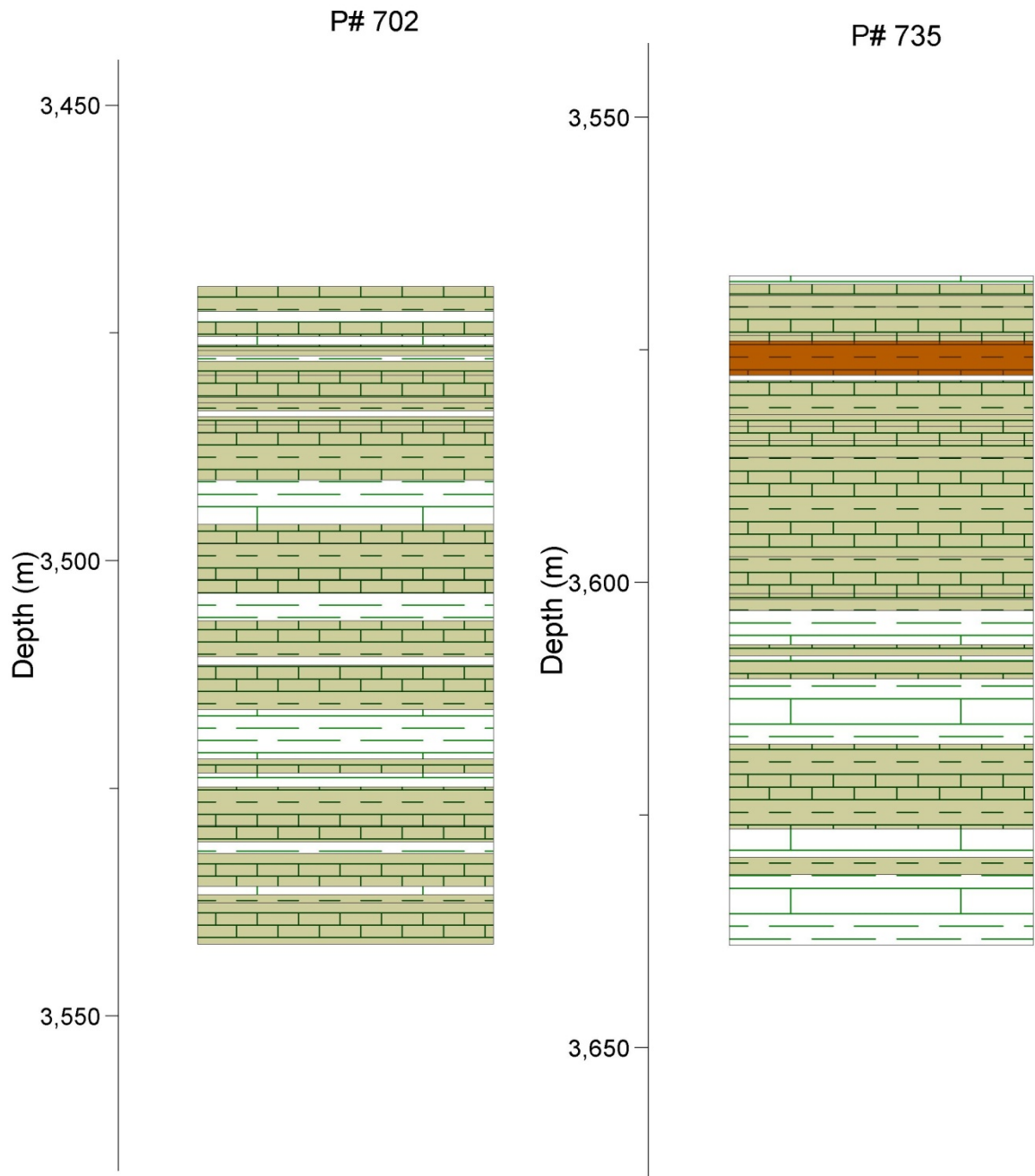


Porosity Legend	
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	Porosity 30-40%

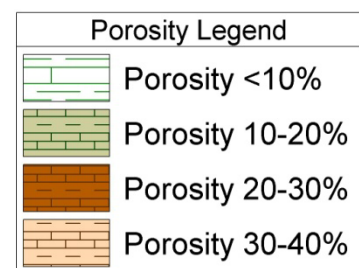
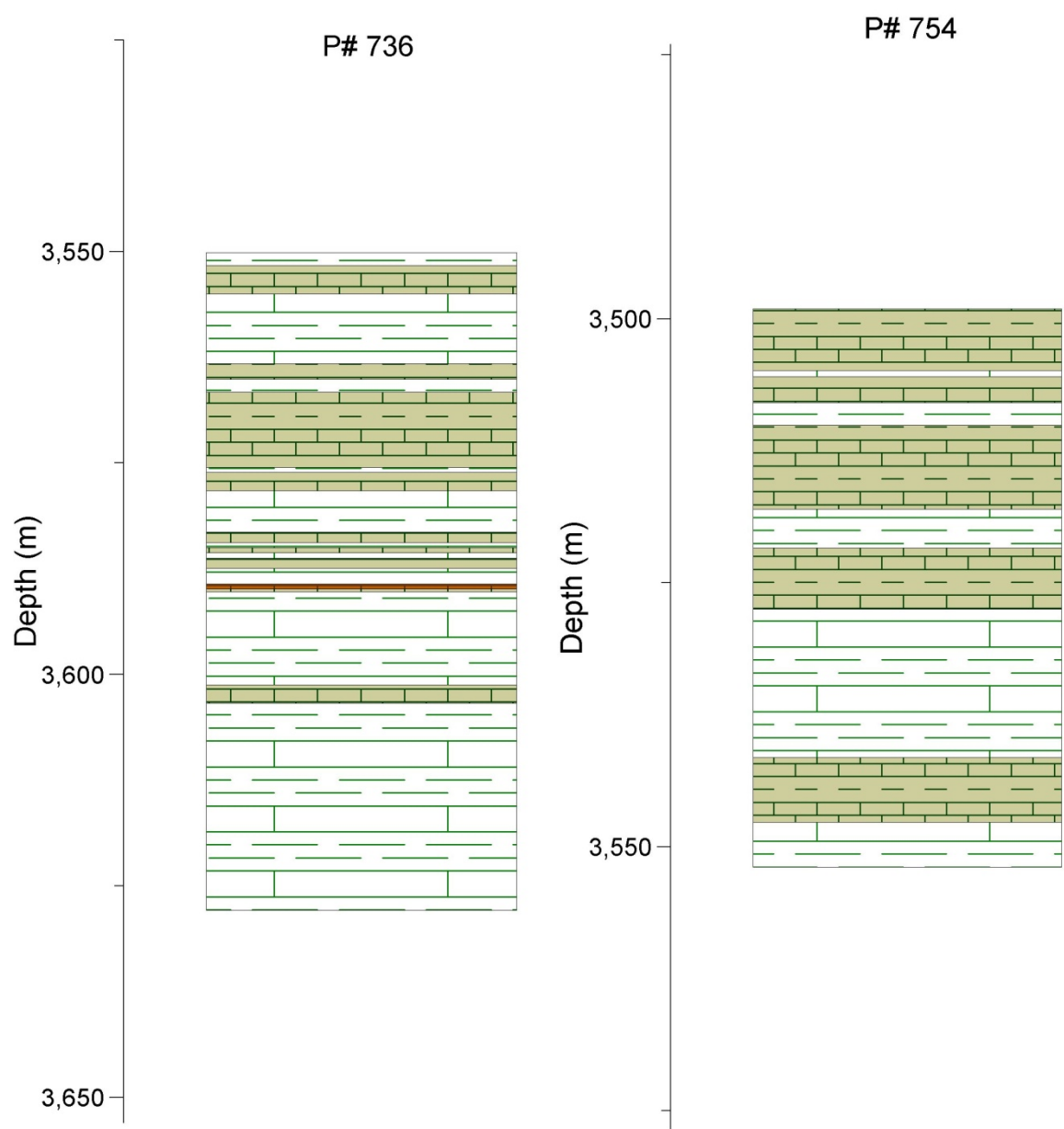


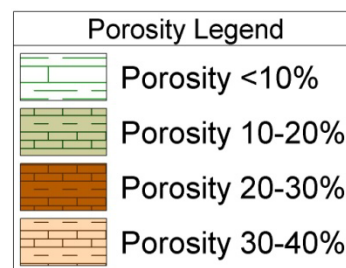
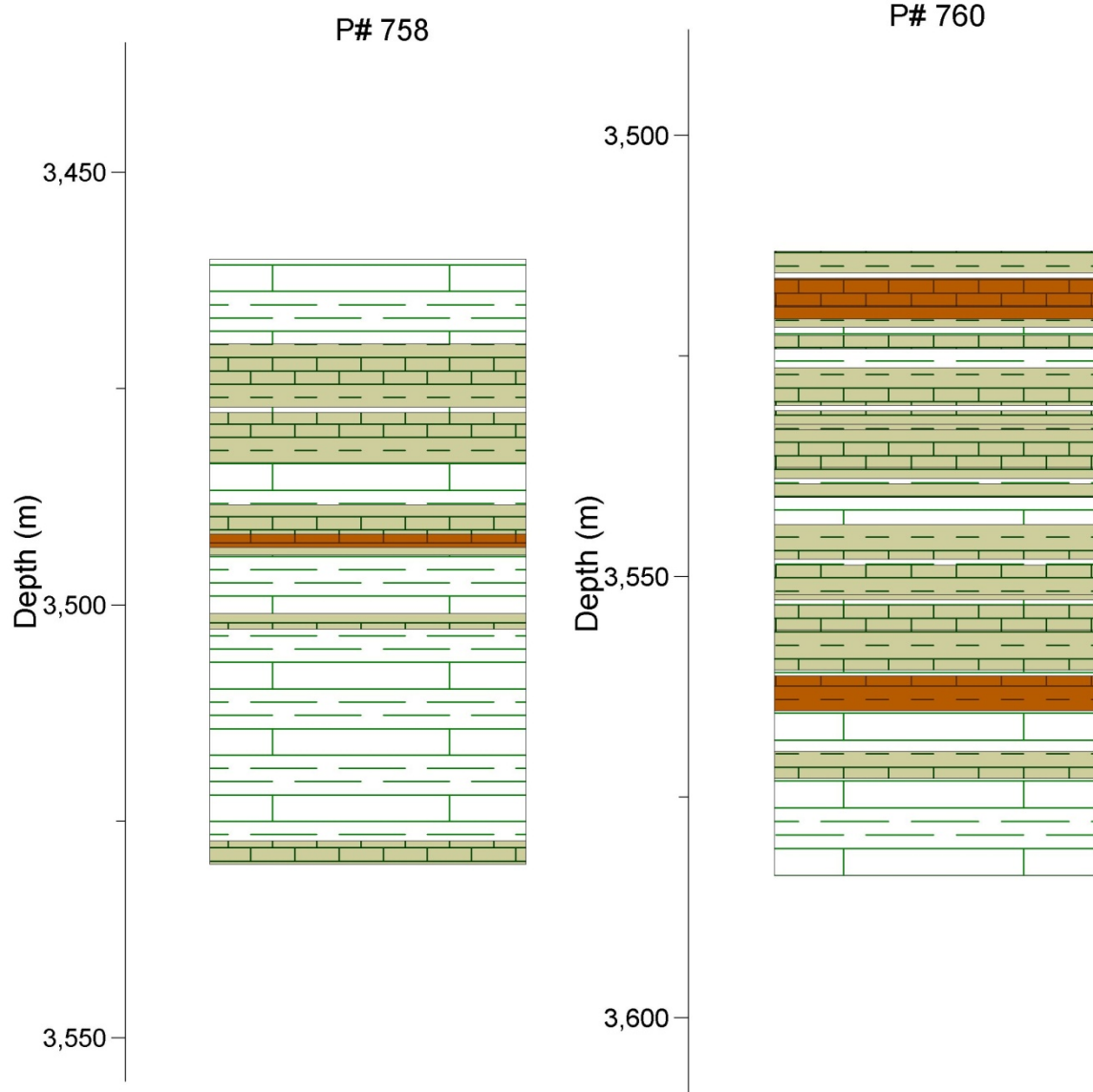


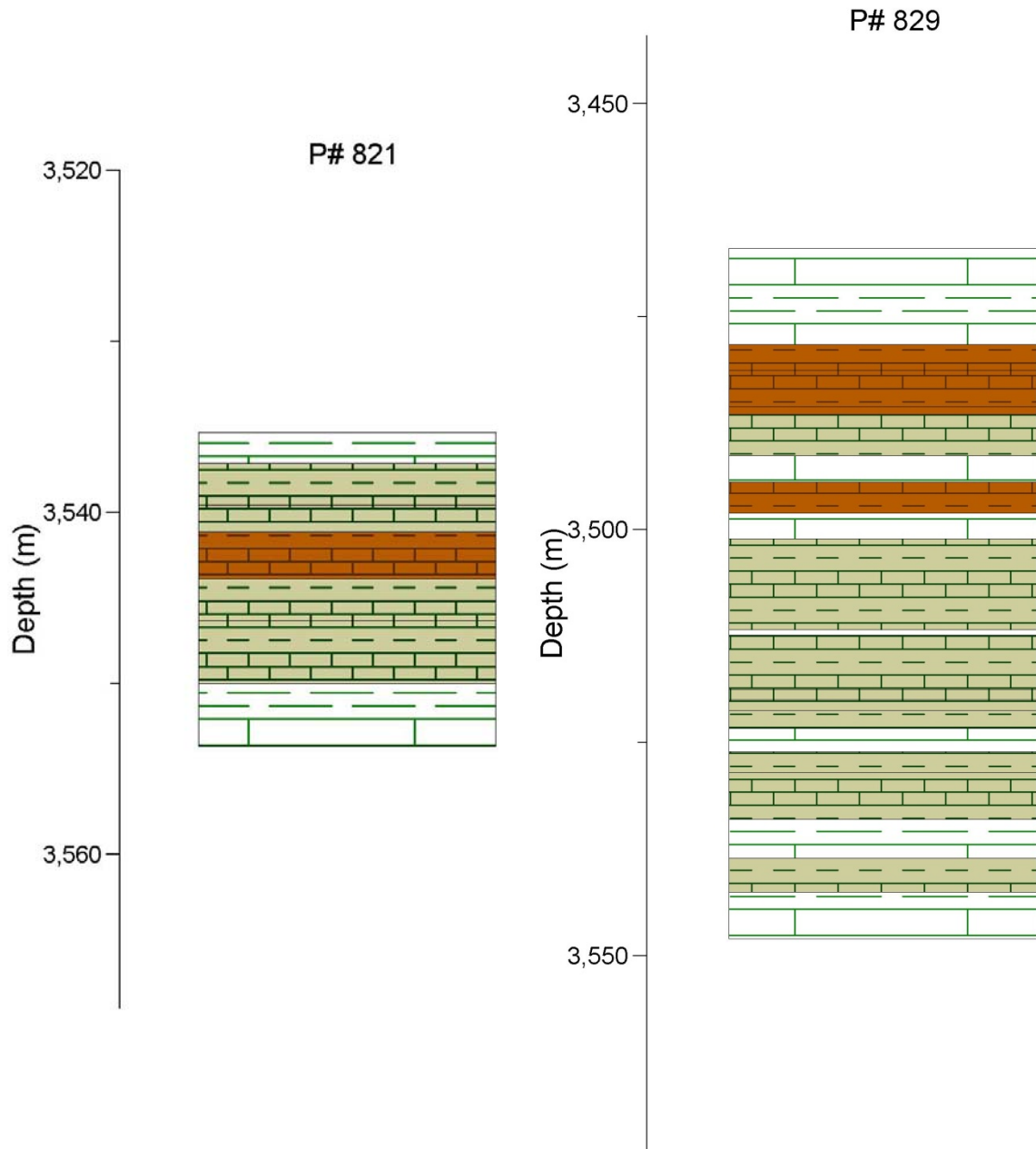
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

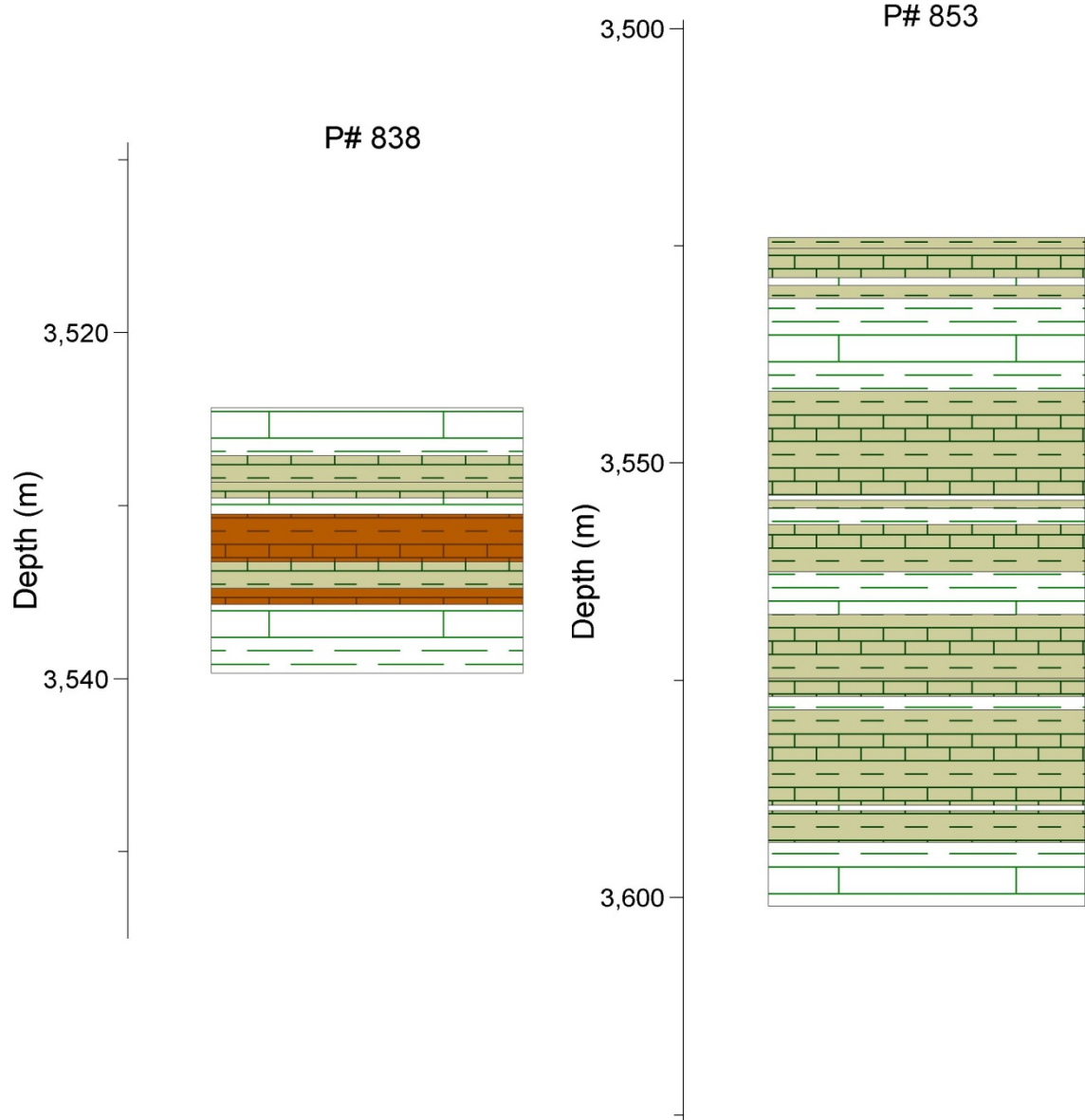


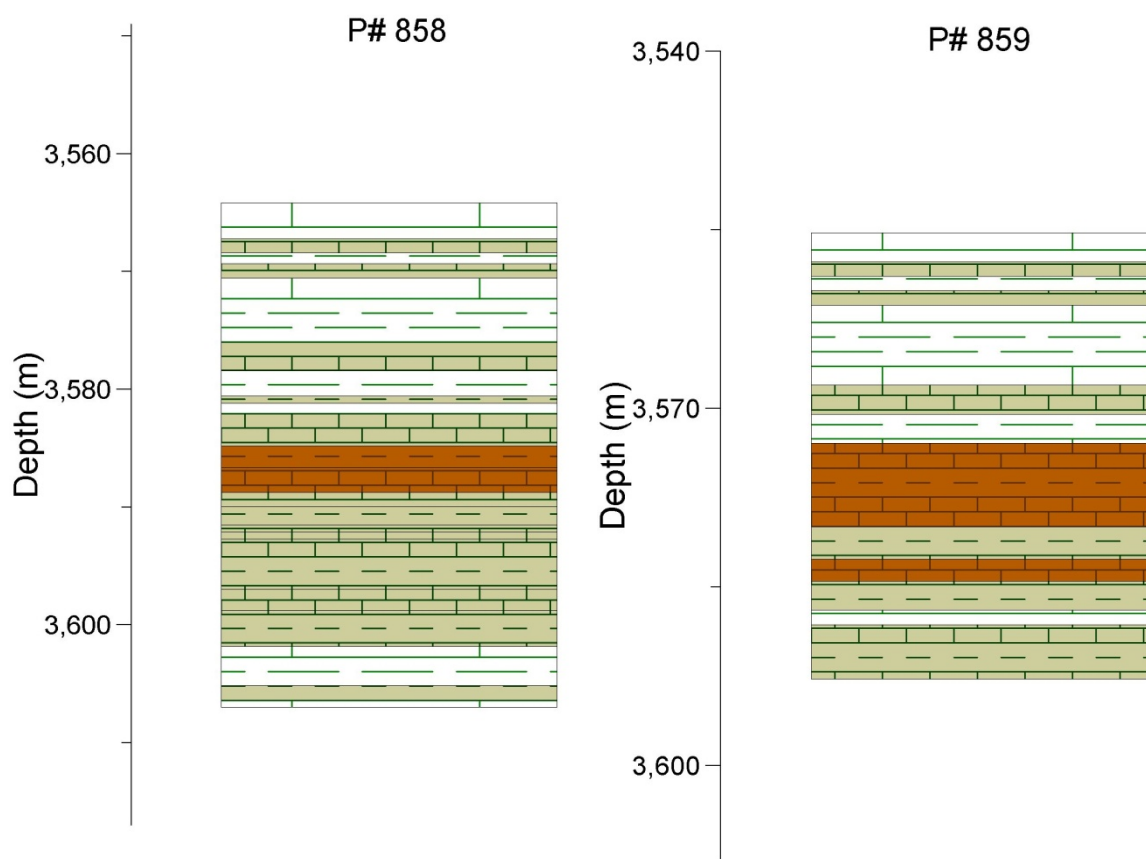
Porosity Legend	
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	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%



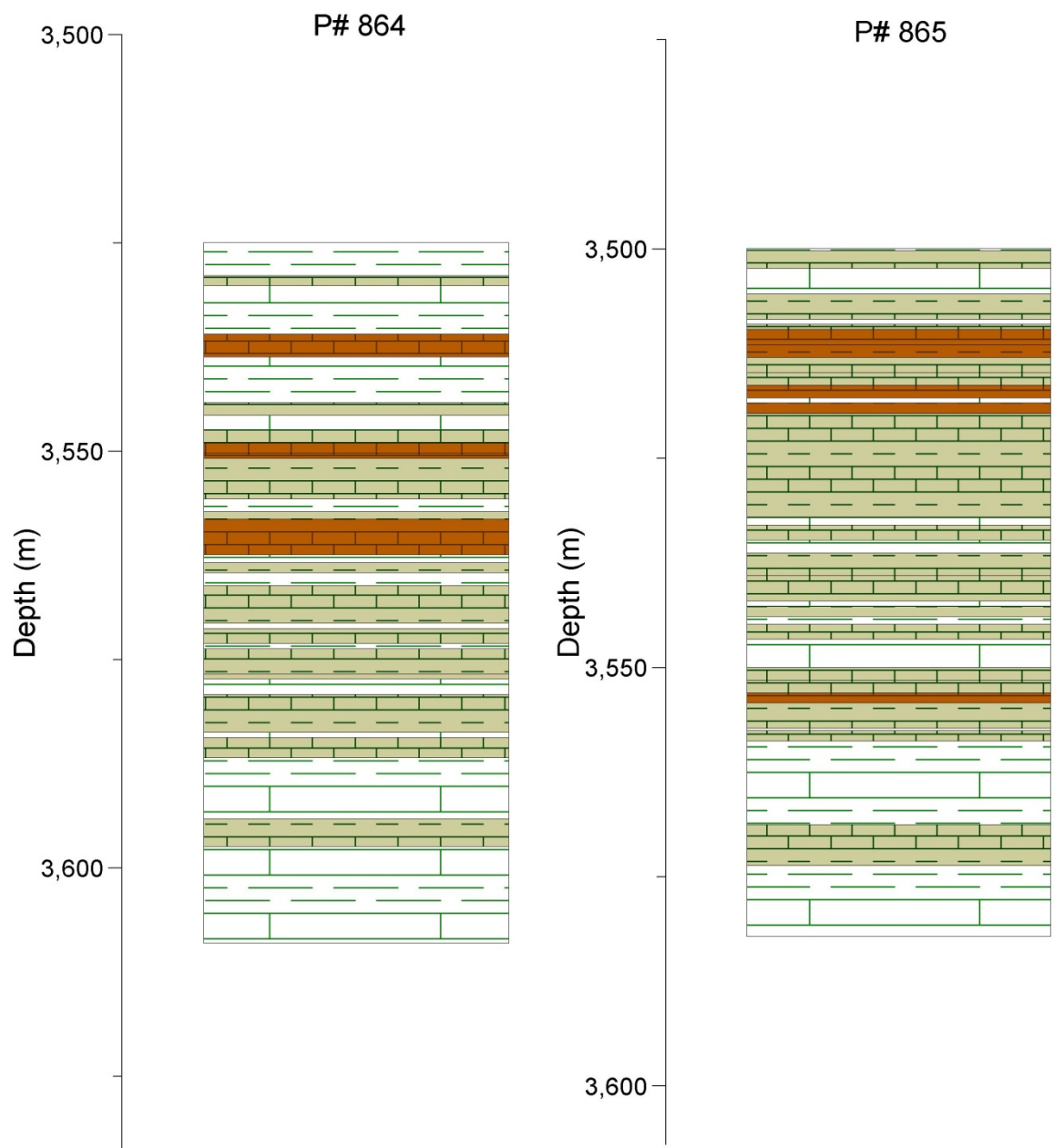




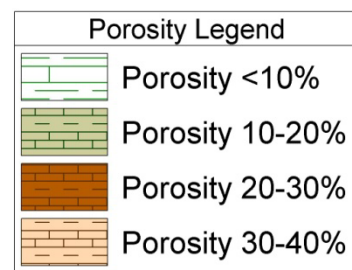
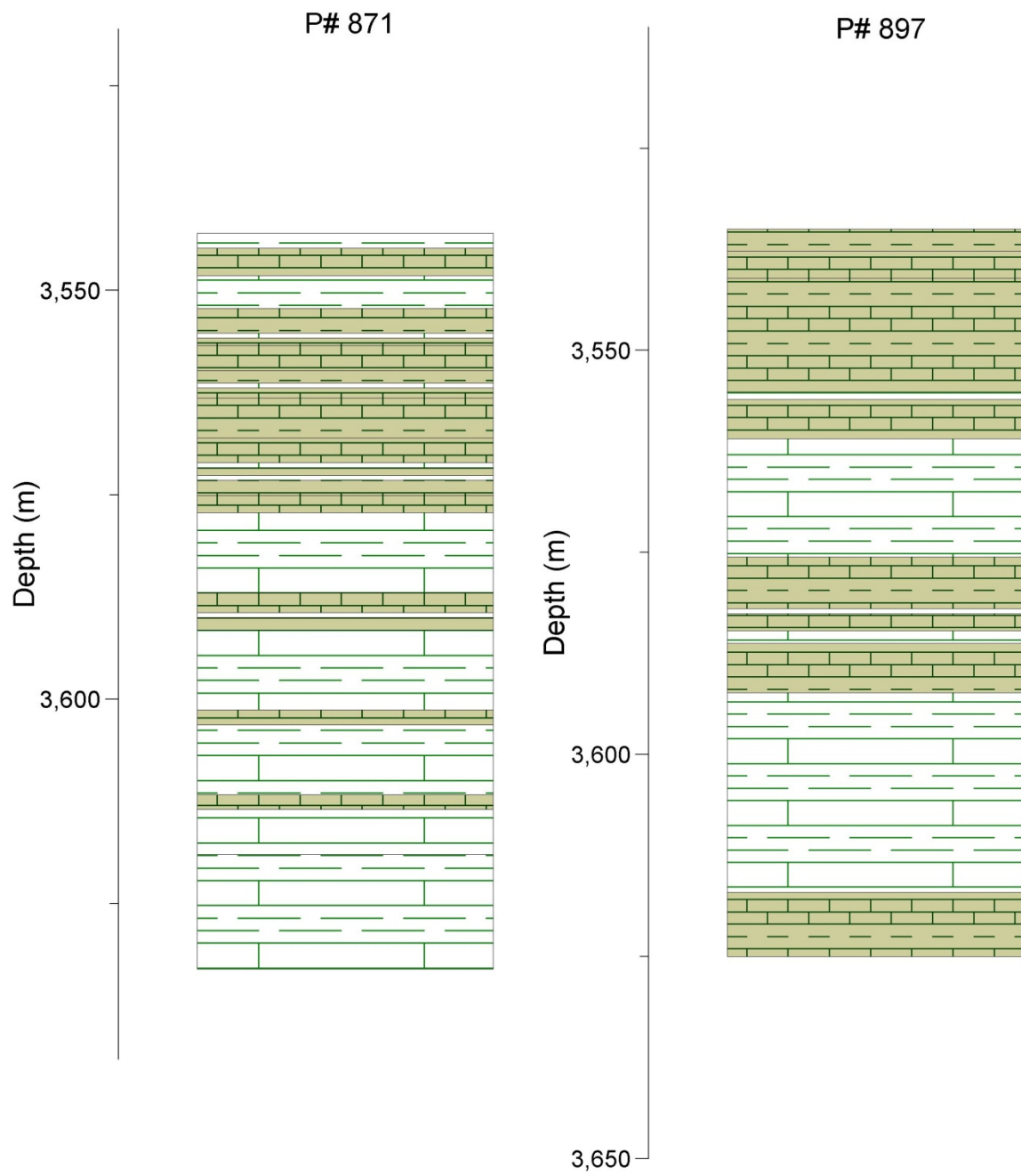


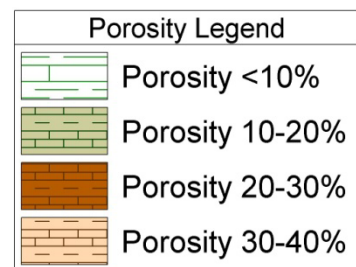
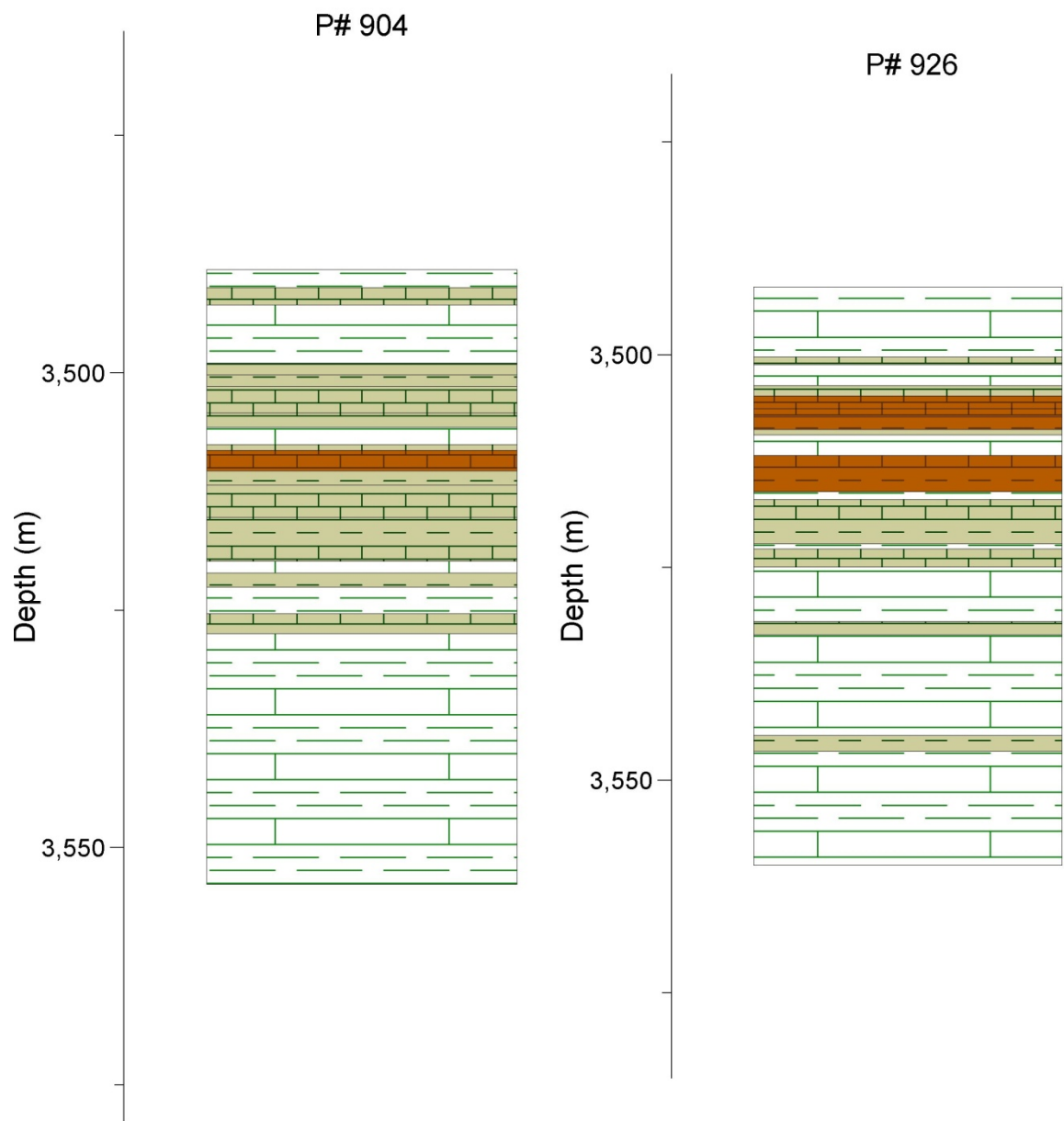


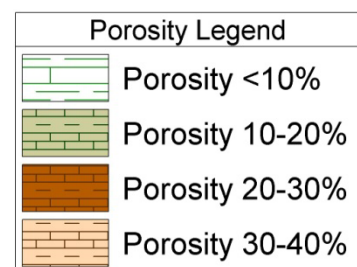
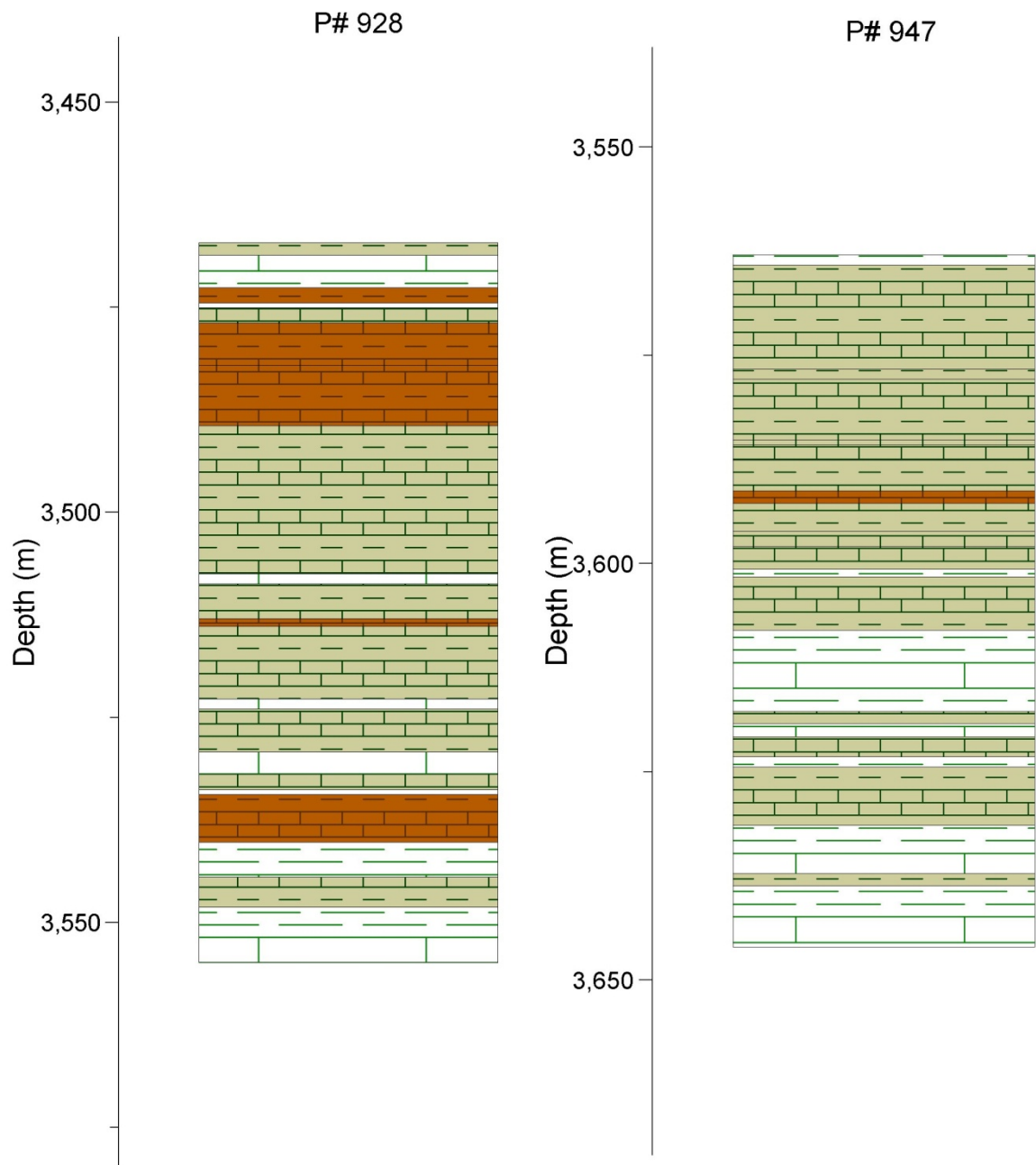
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

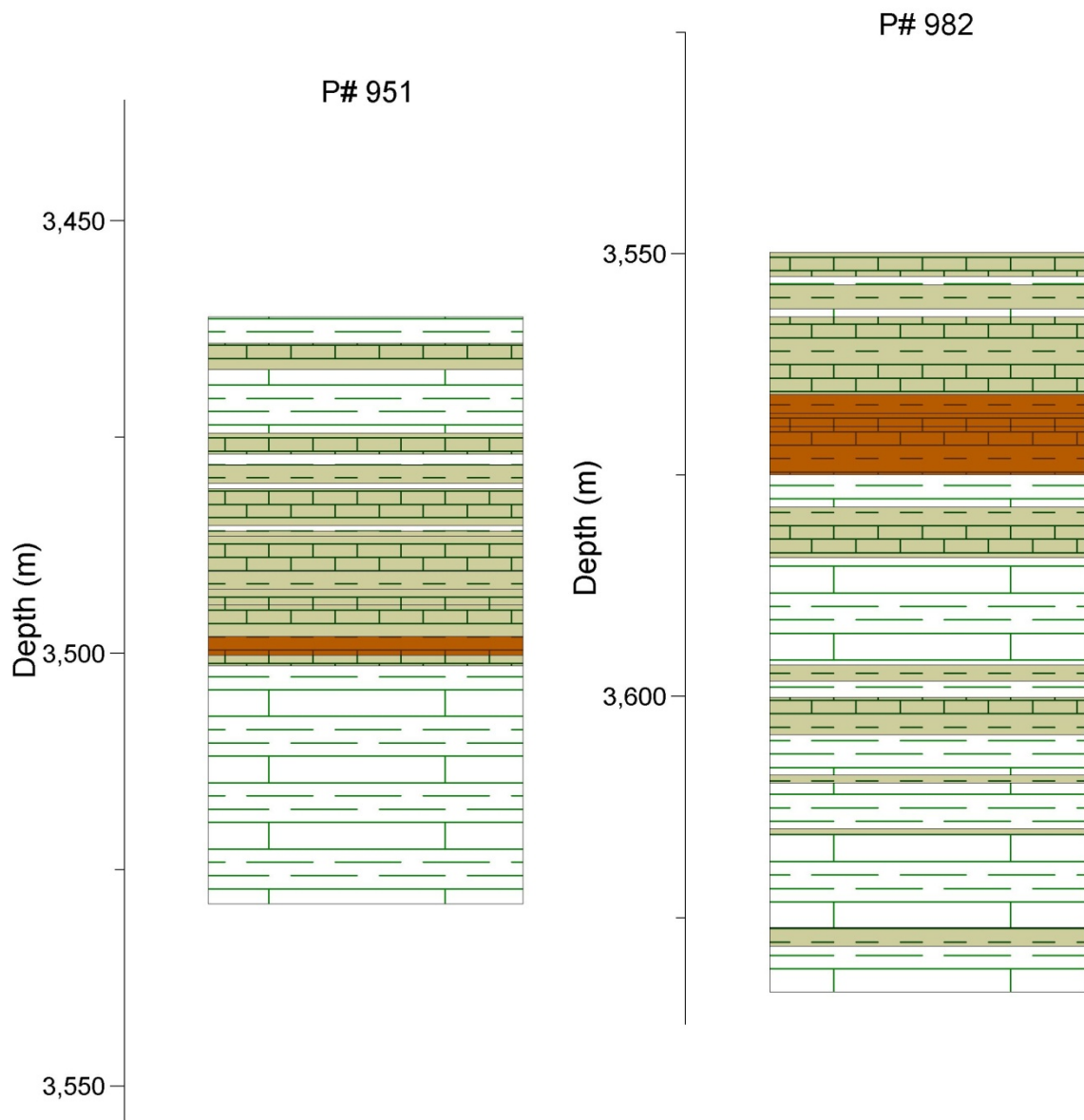


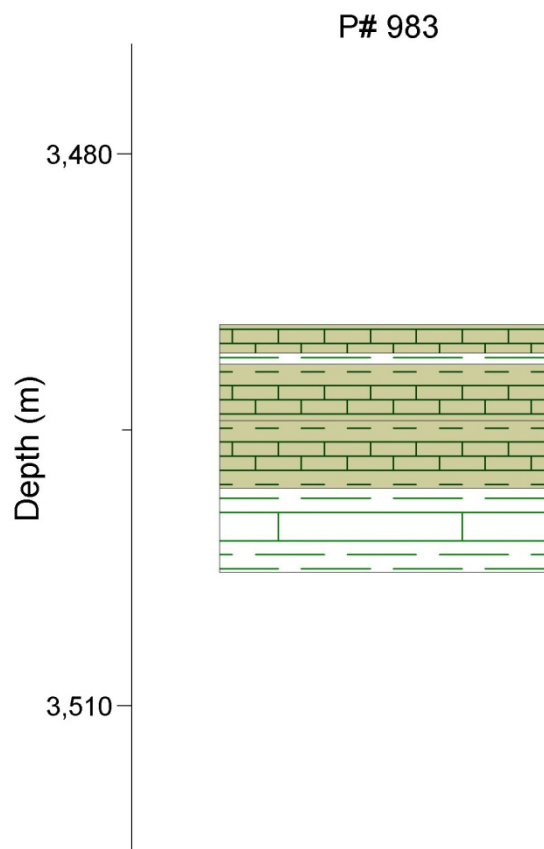
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%





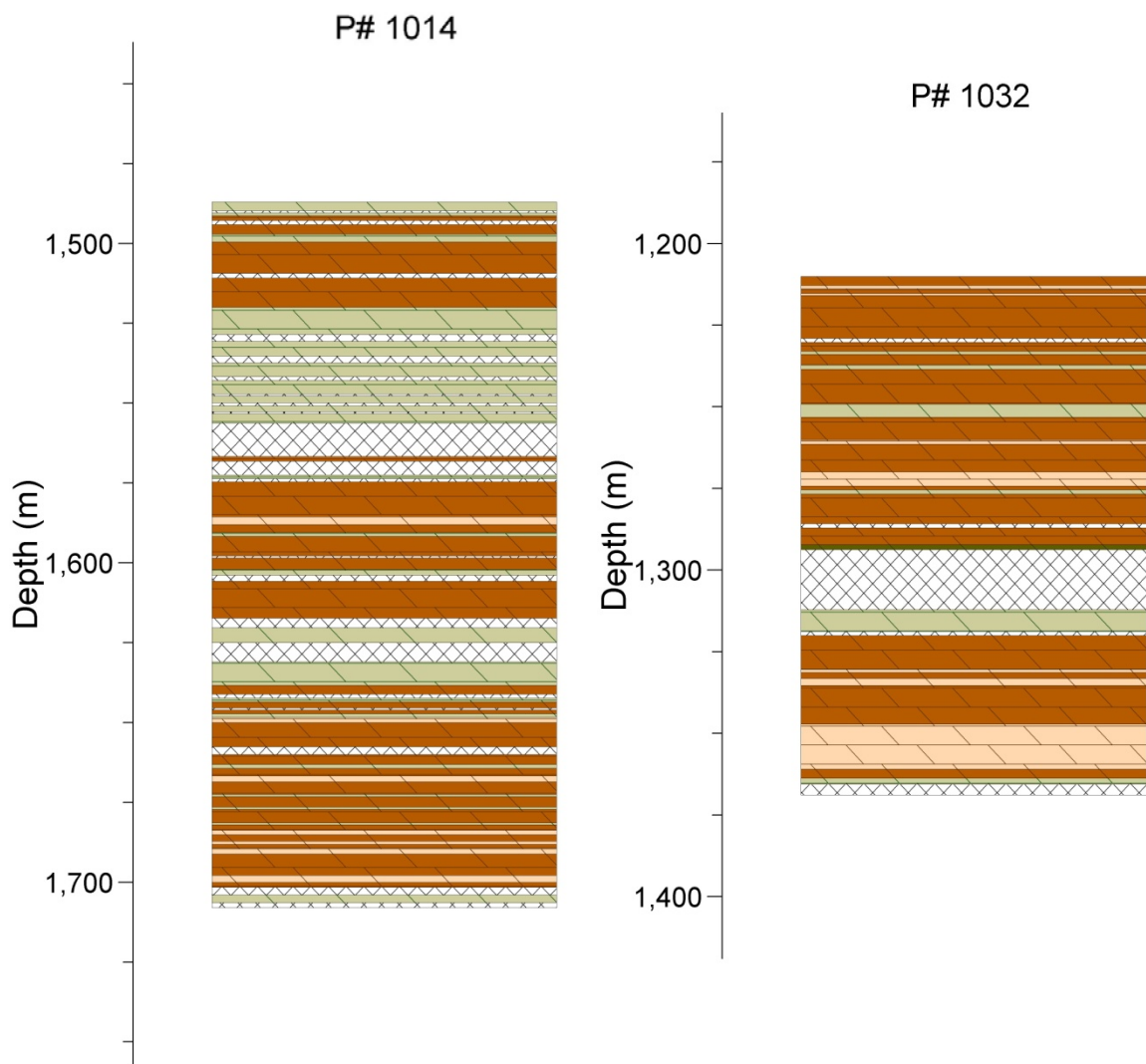


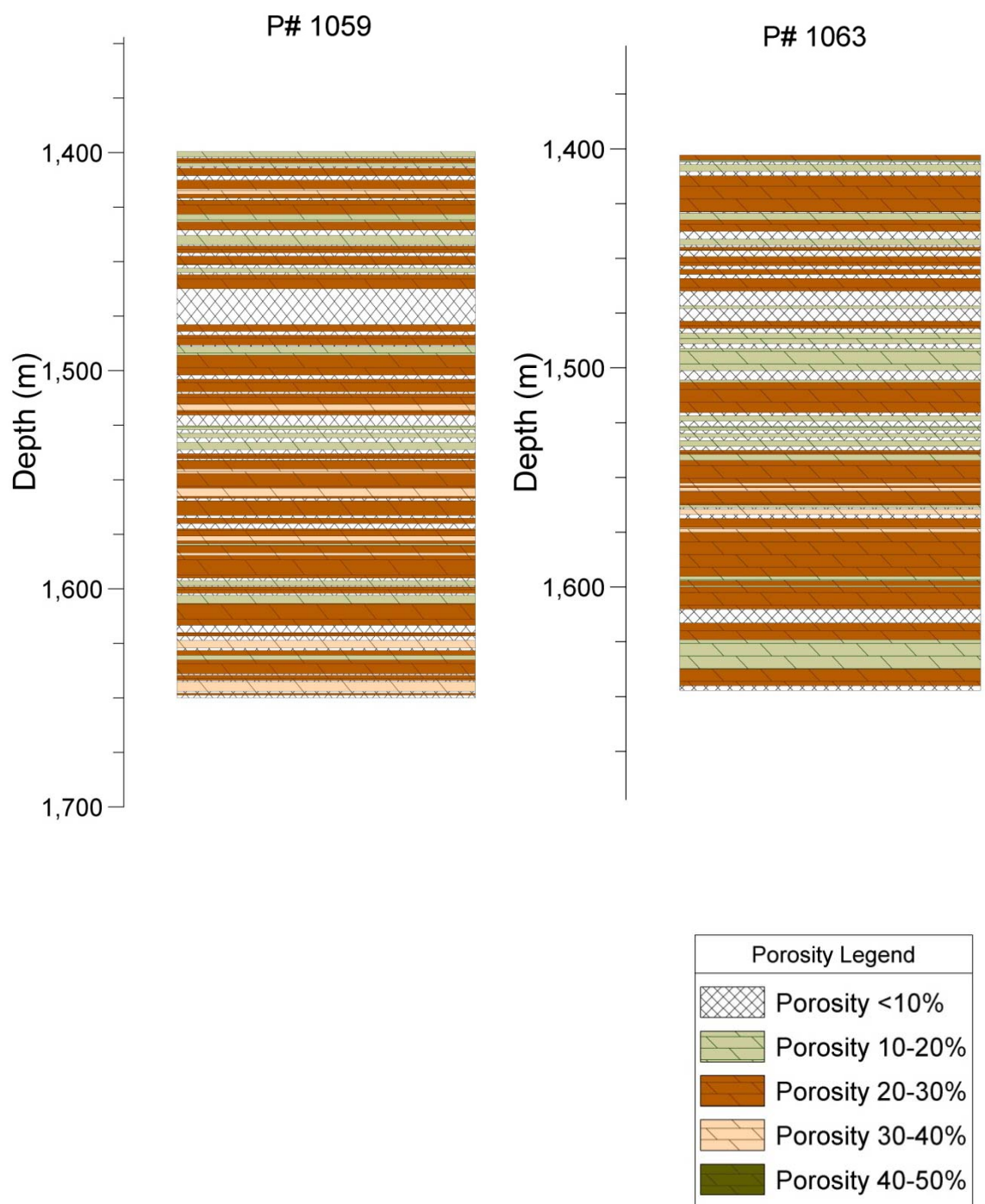


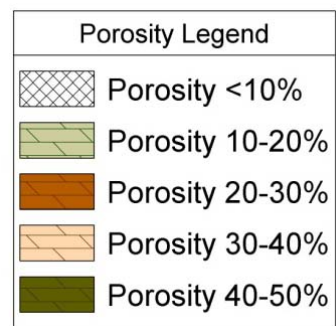
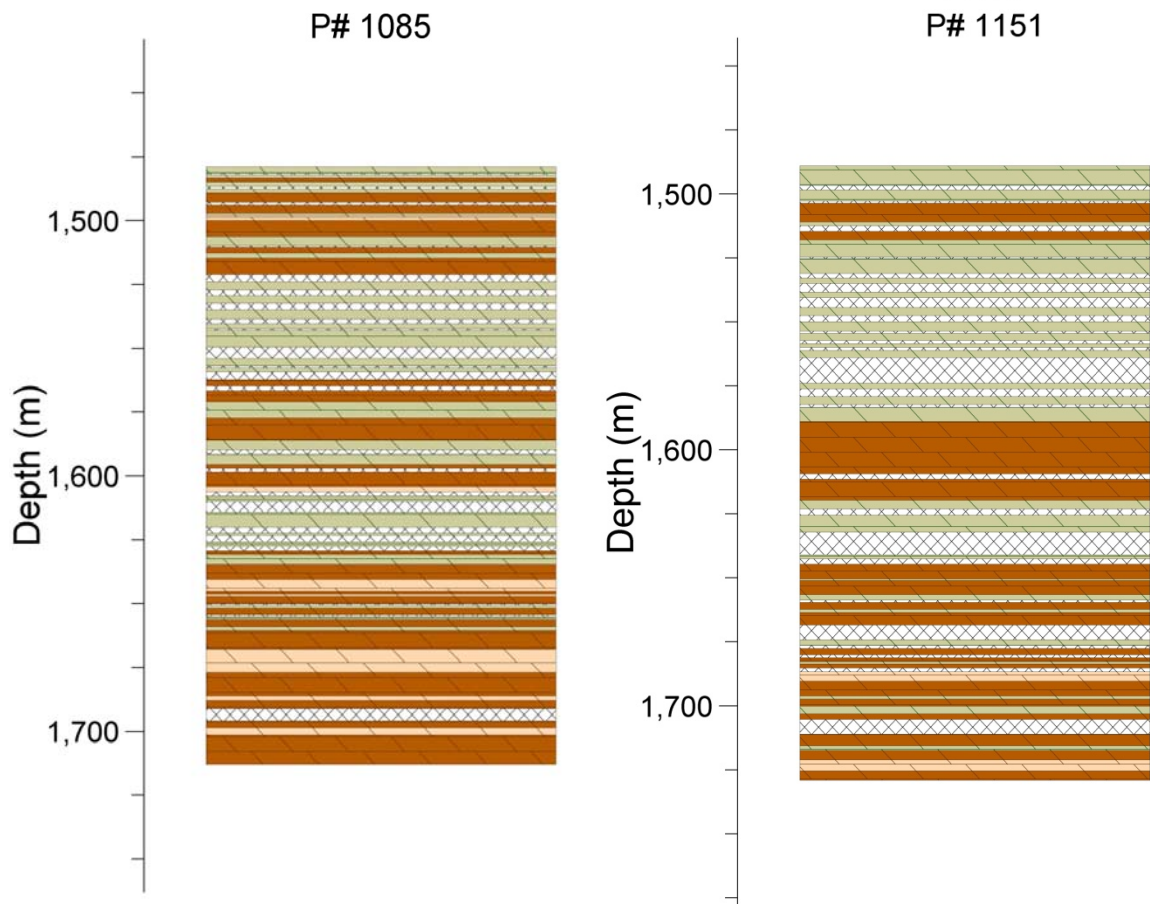


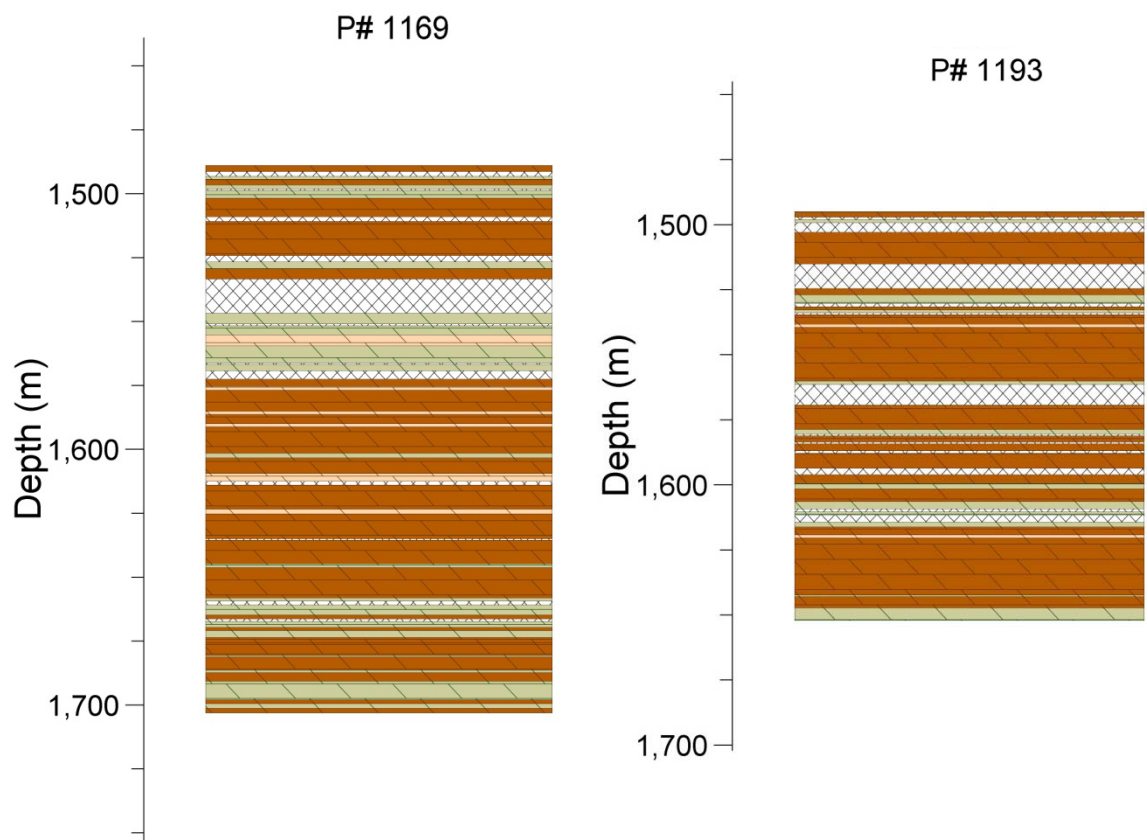
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%

Appendix VI:
Striplogs Displaying Porosity for CKLIZ Study Wells

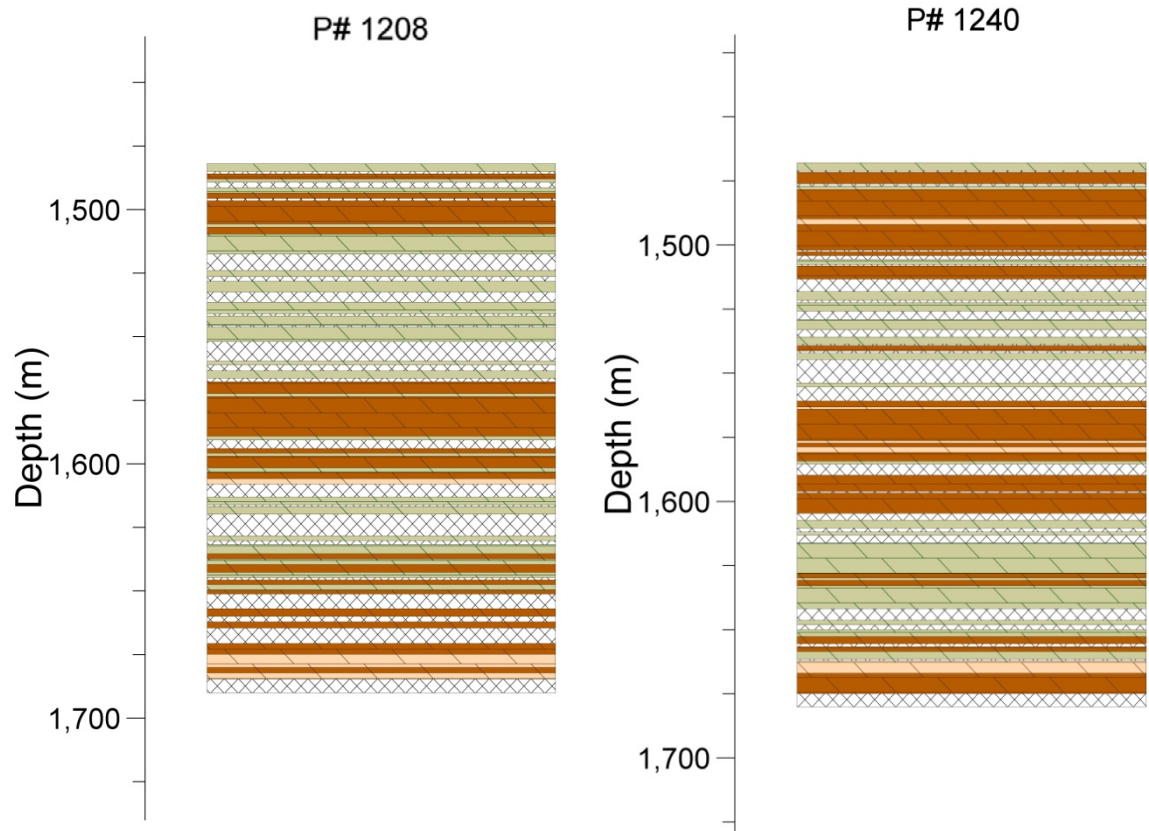




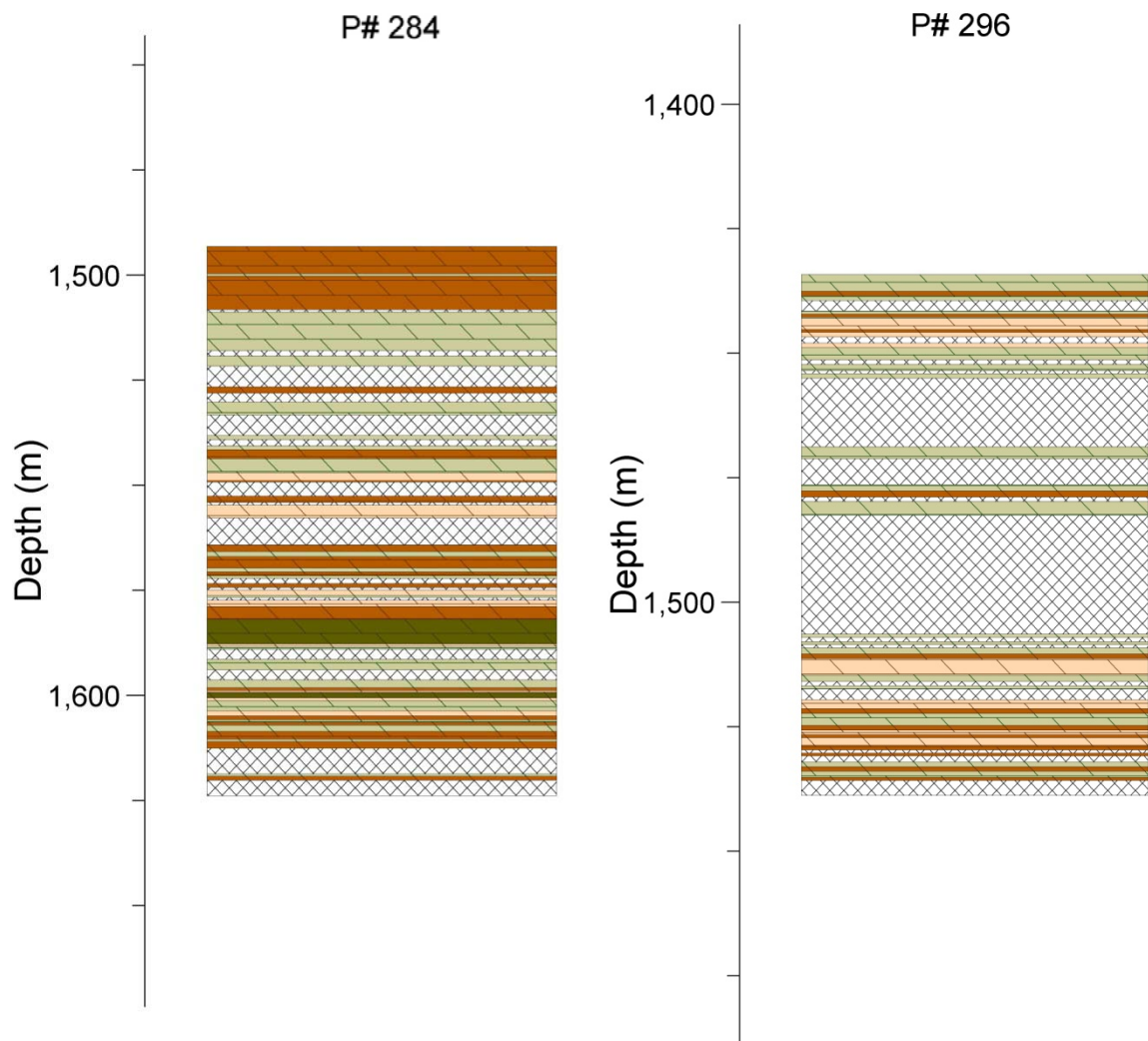




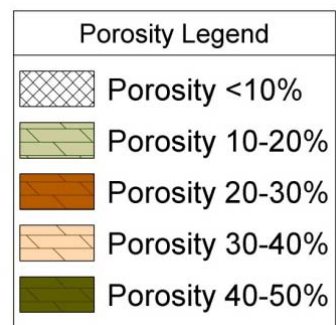
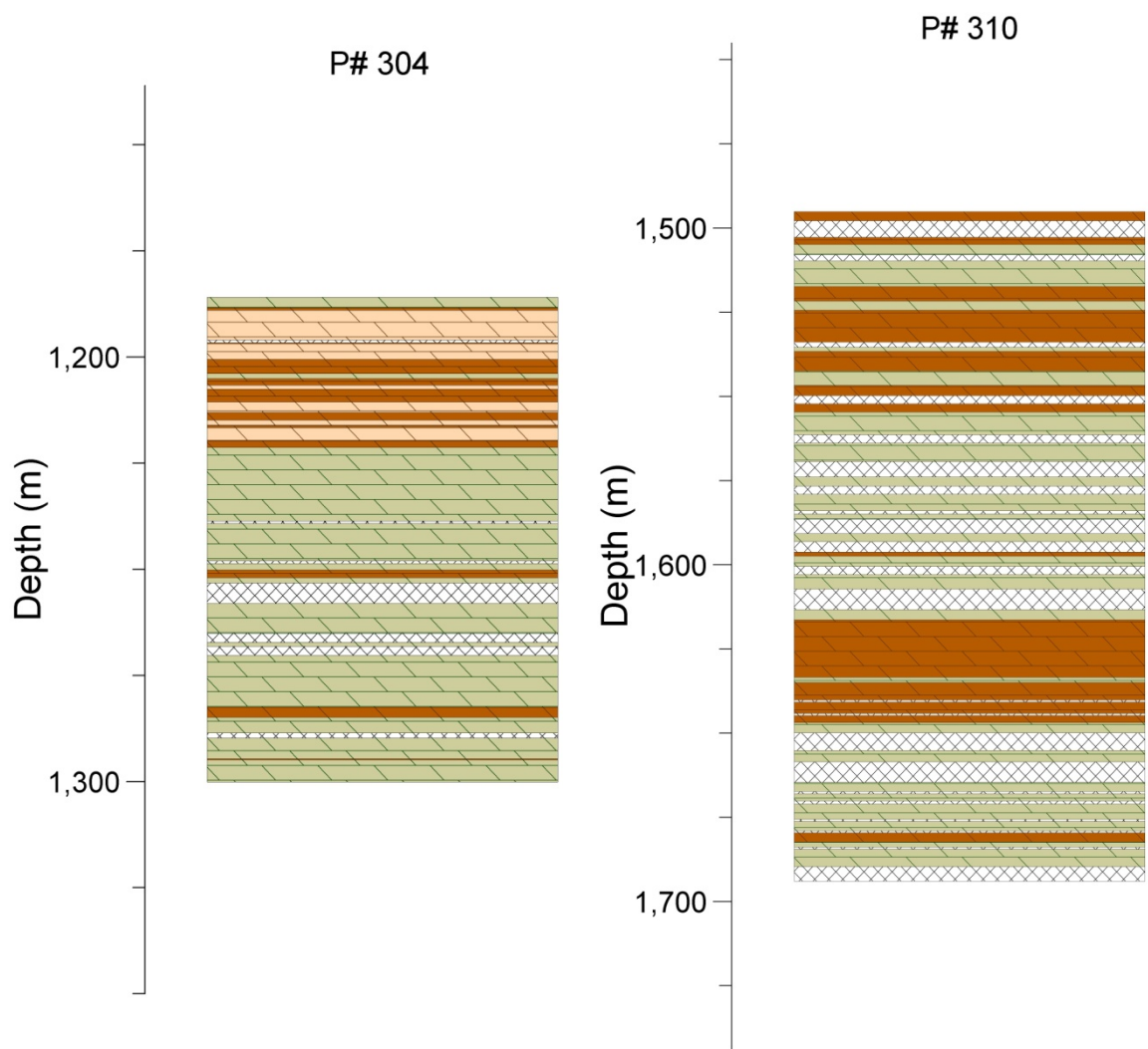
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

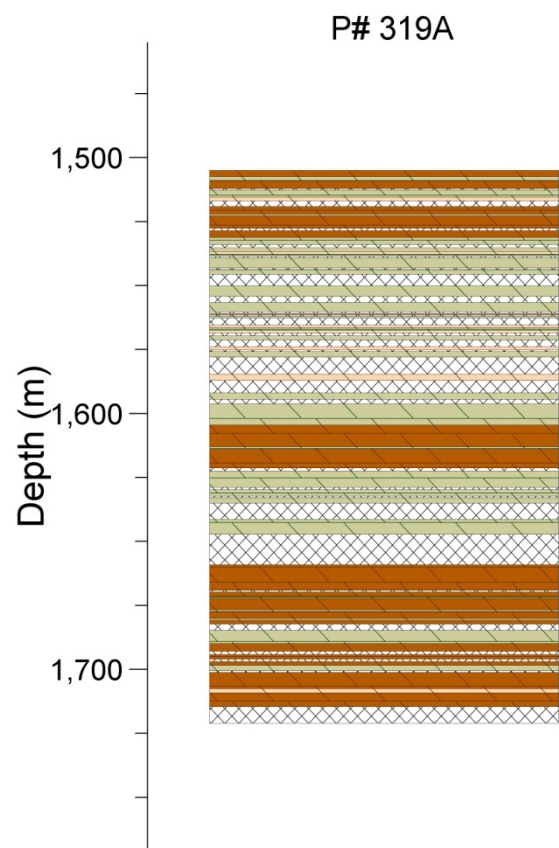
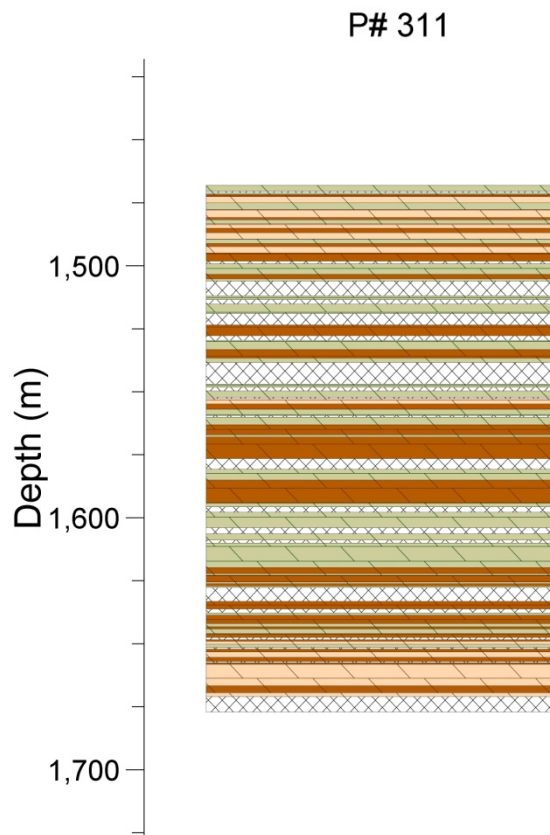


Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

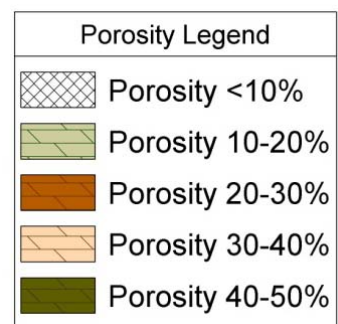
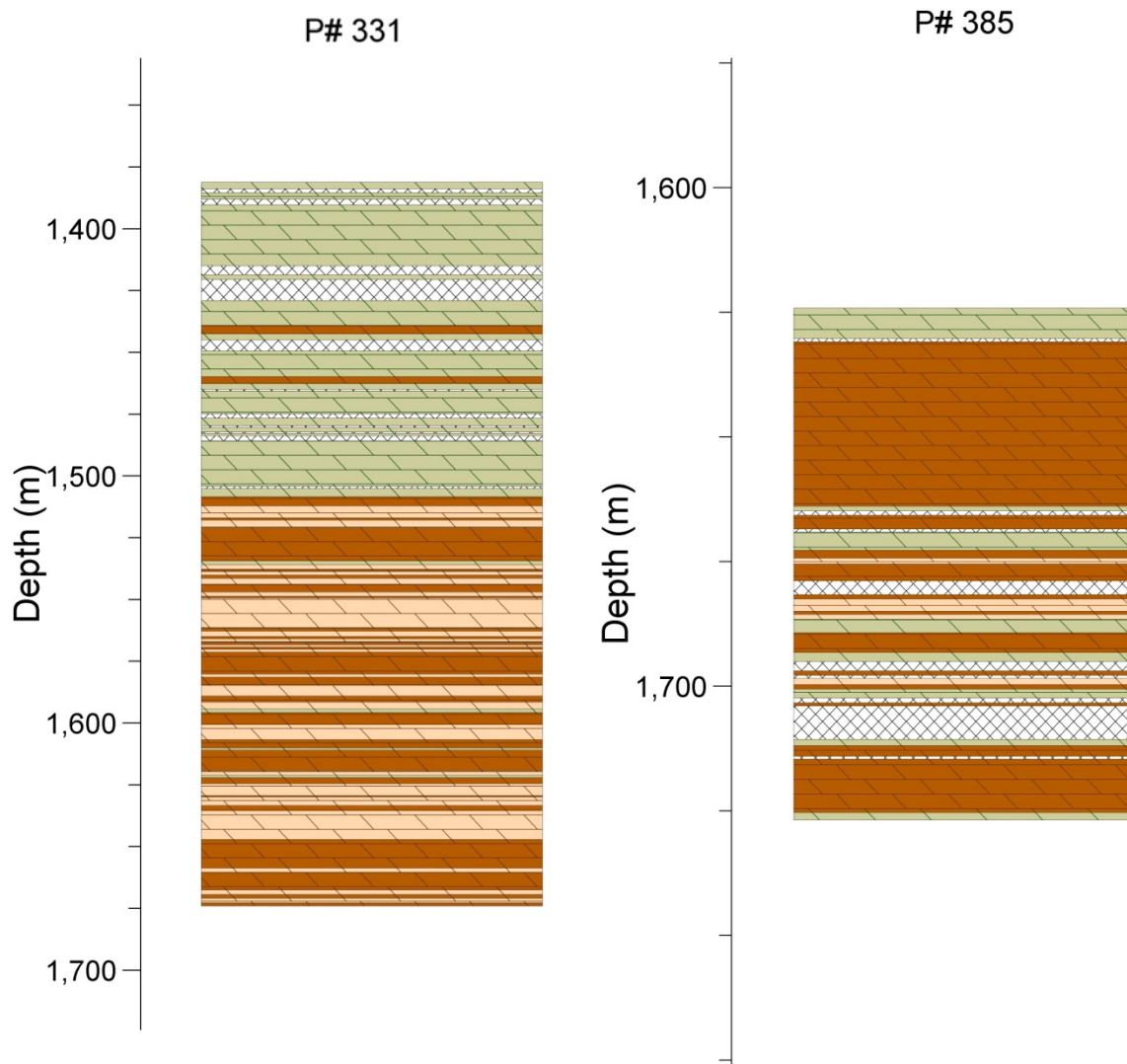


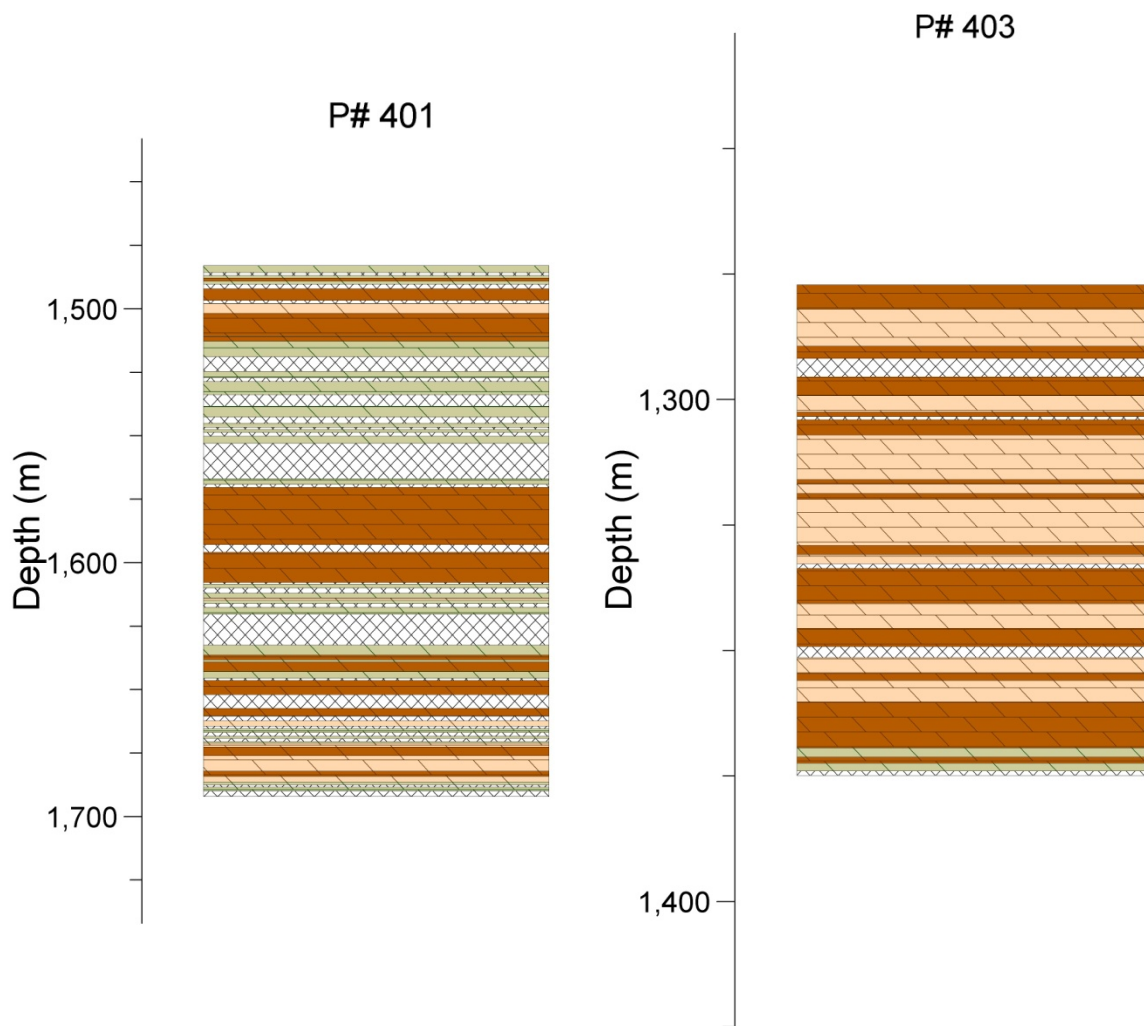
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%



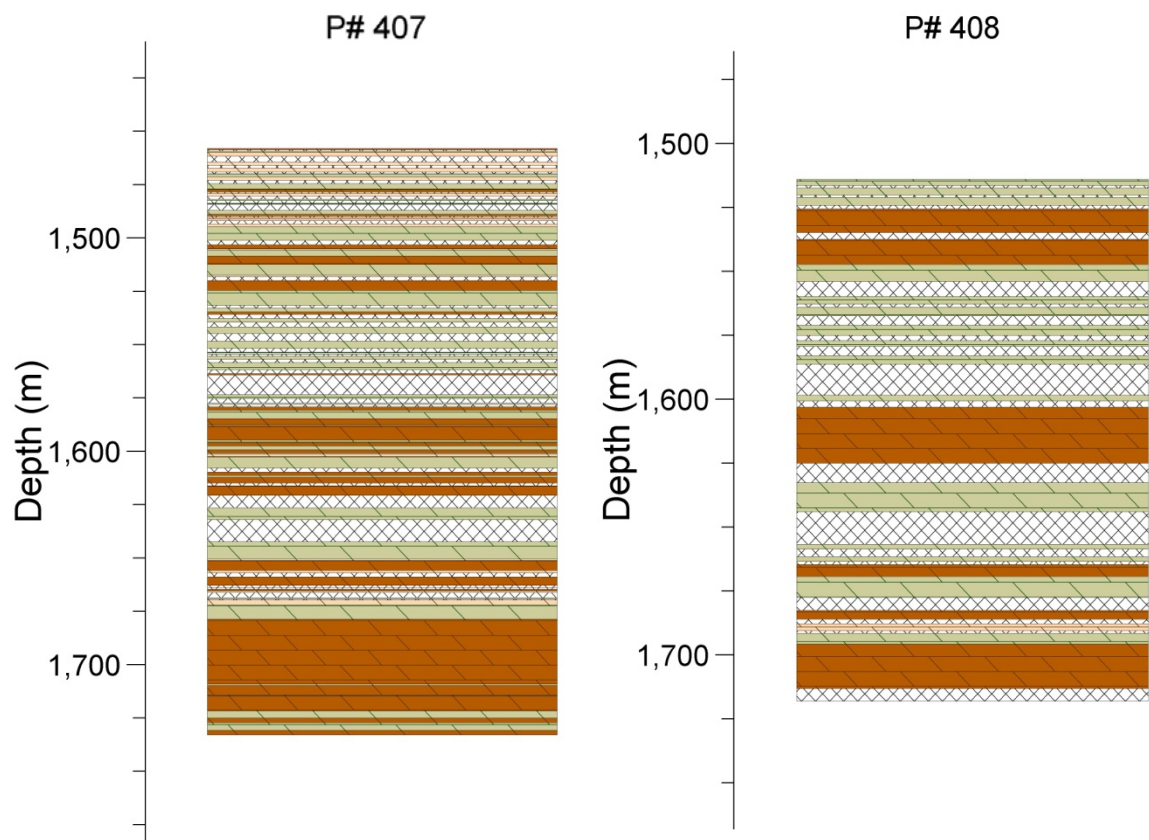


Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

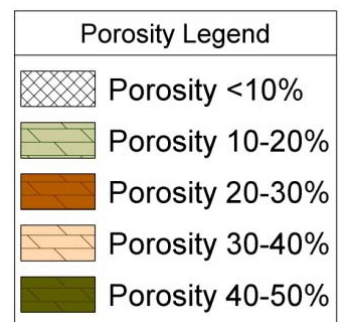
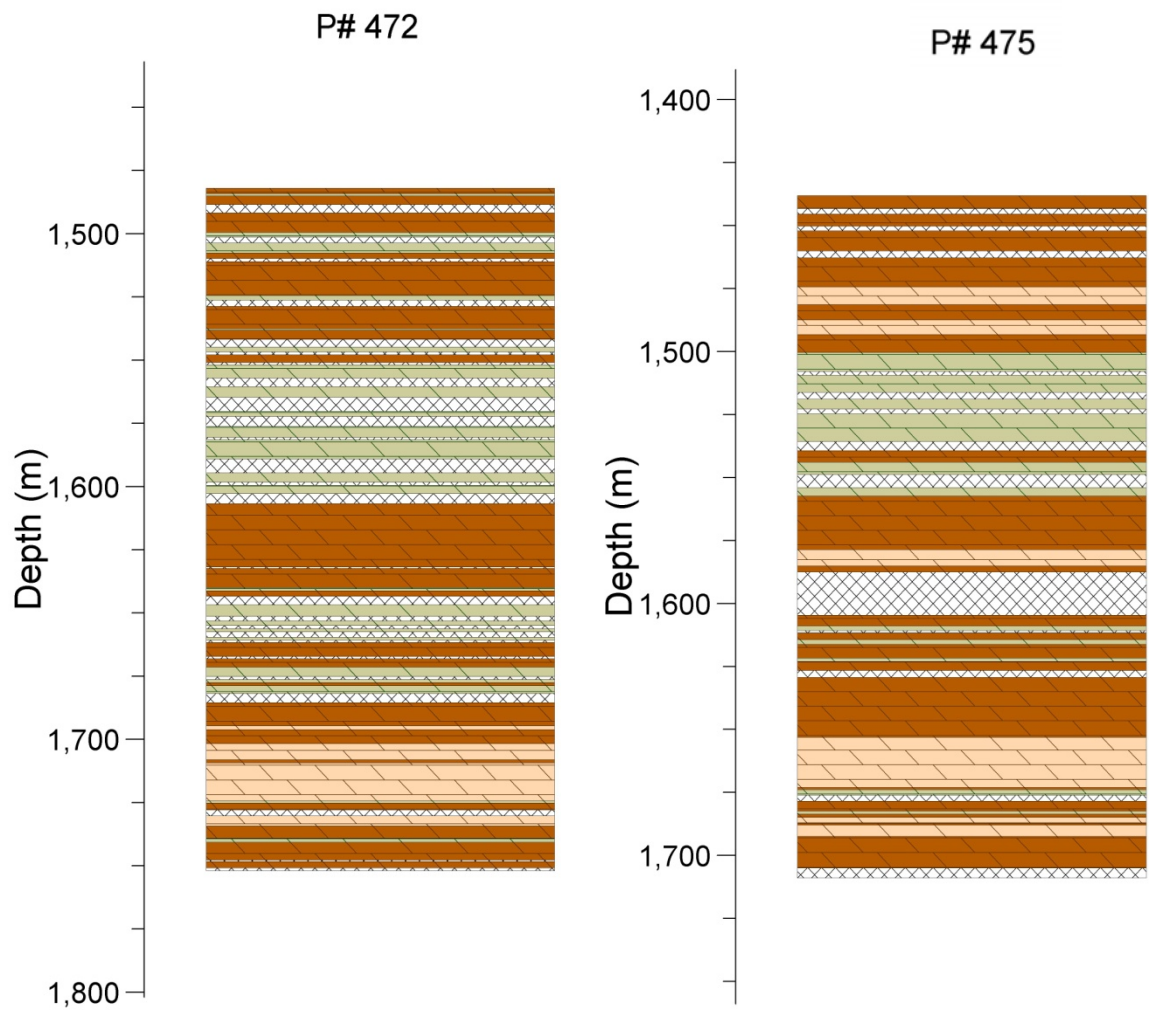


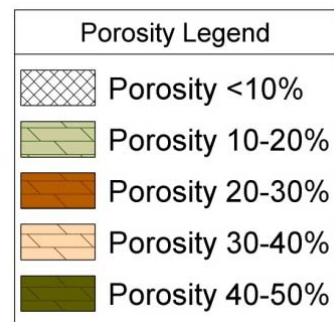
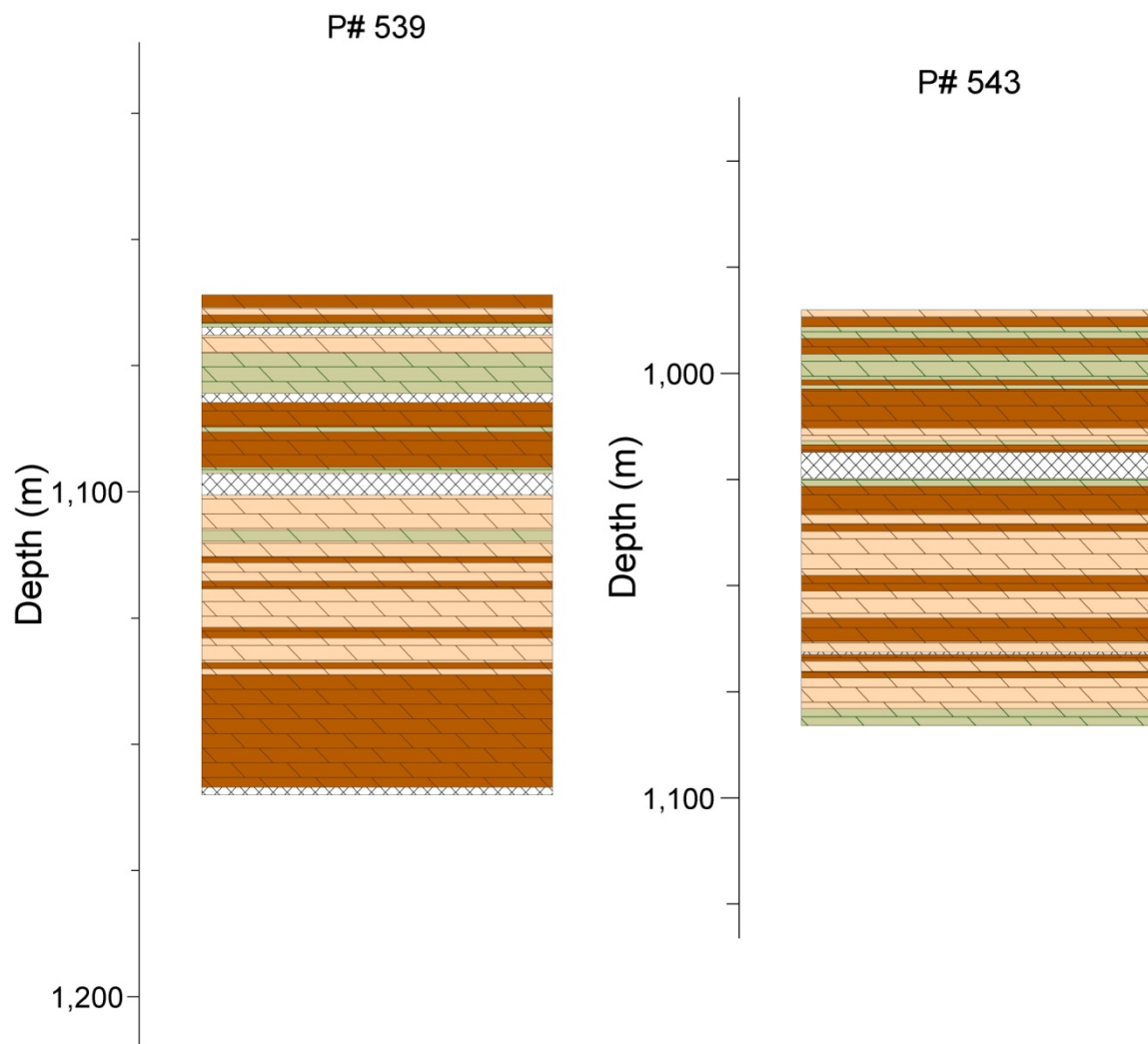


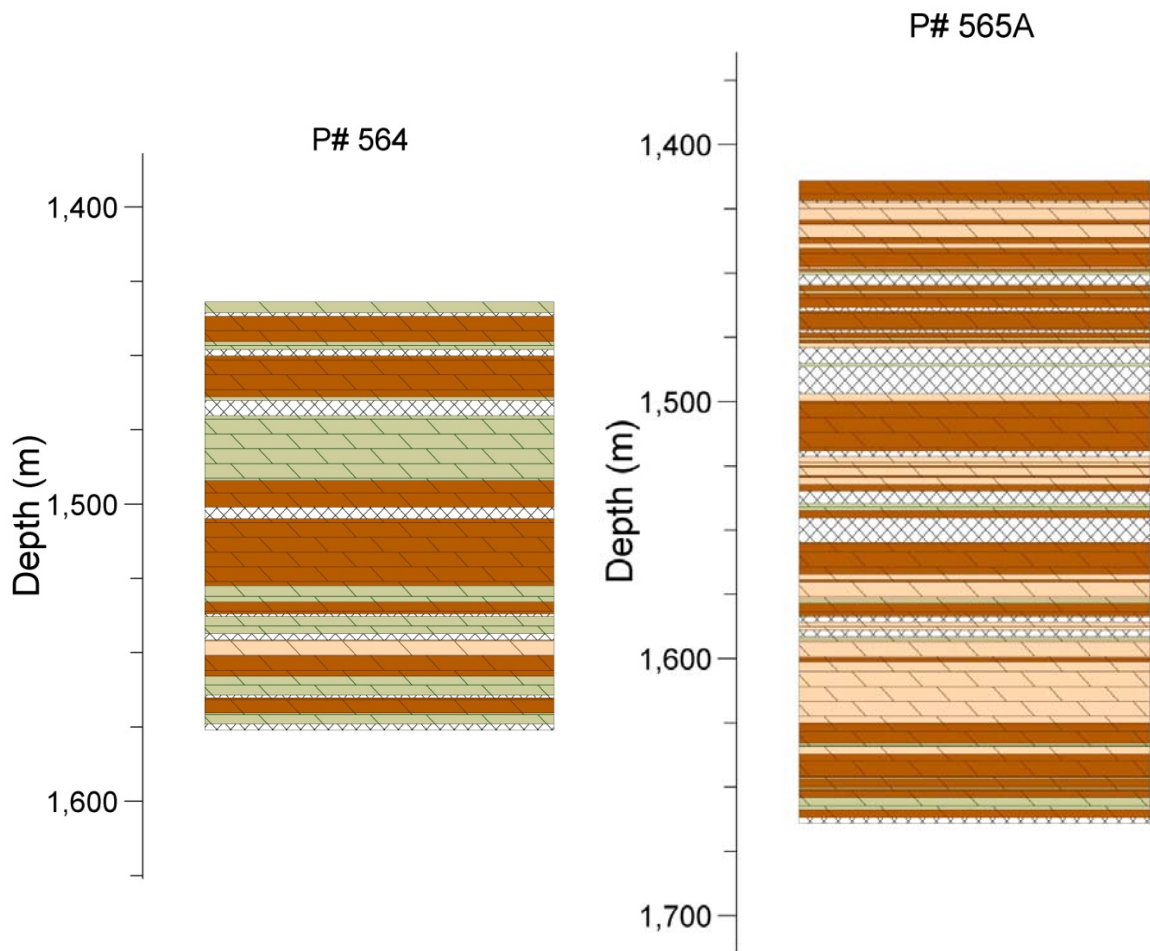
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%



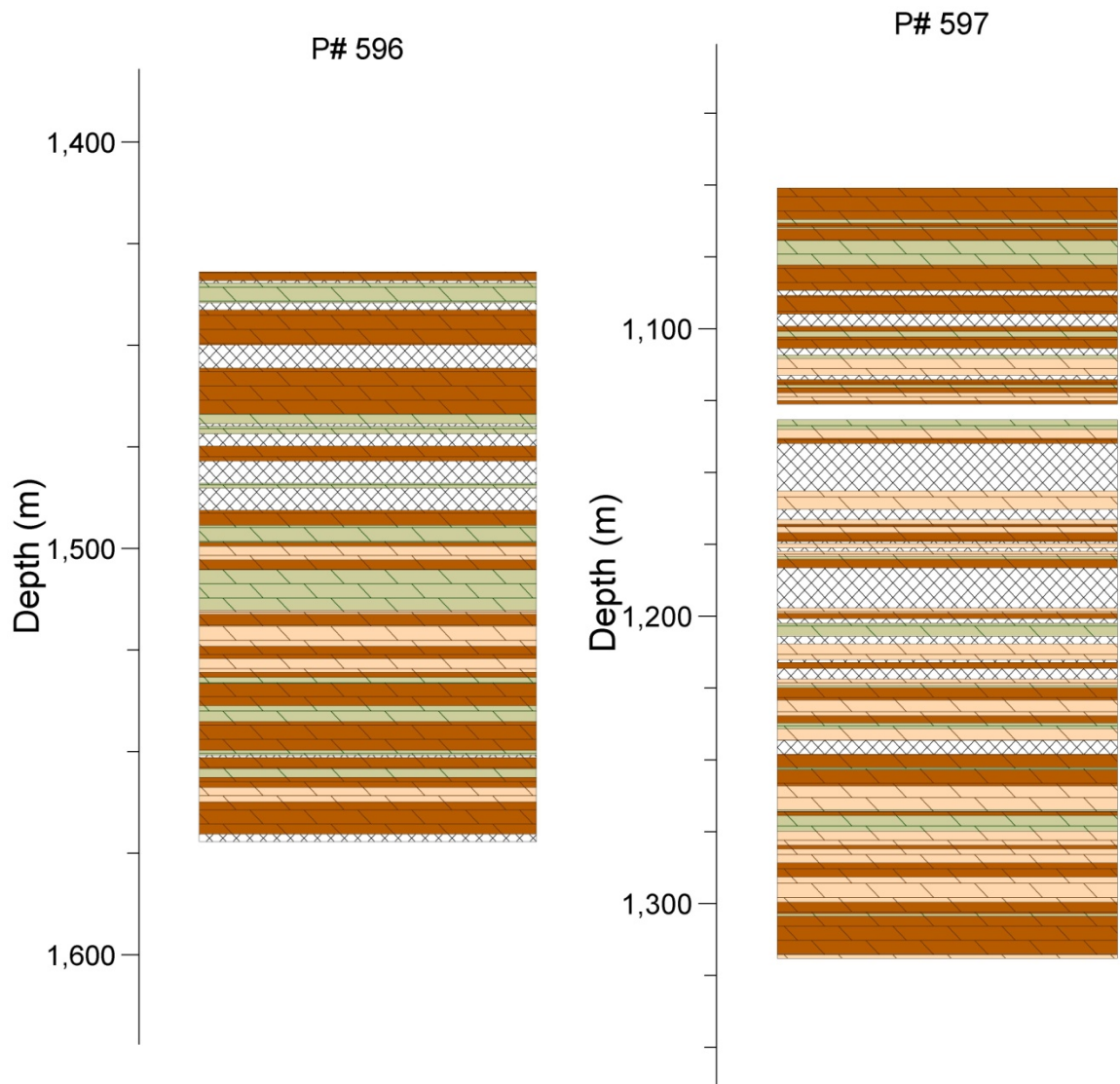
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

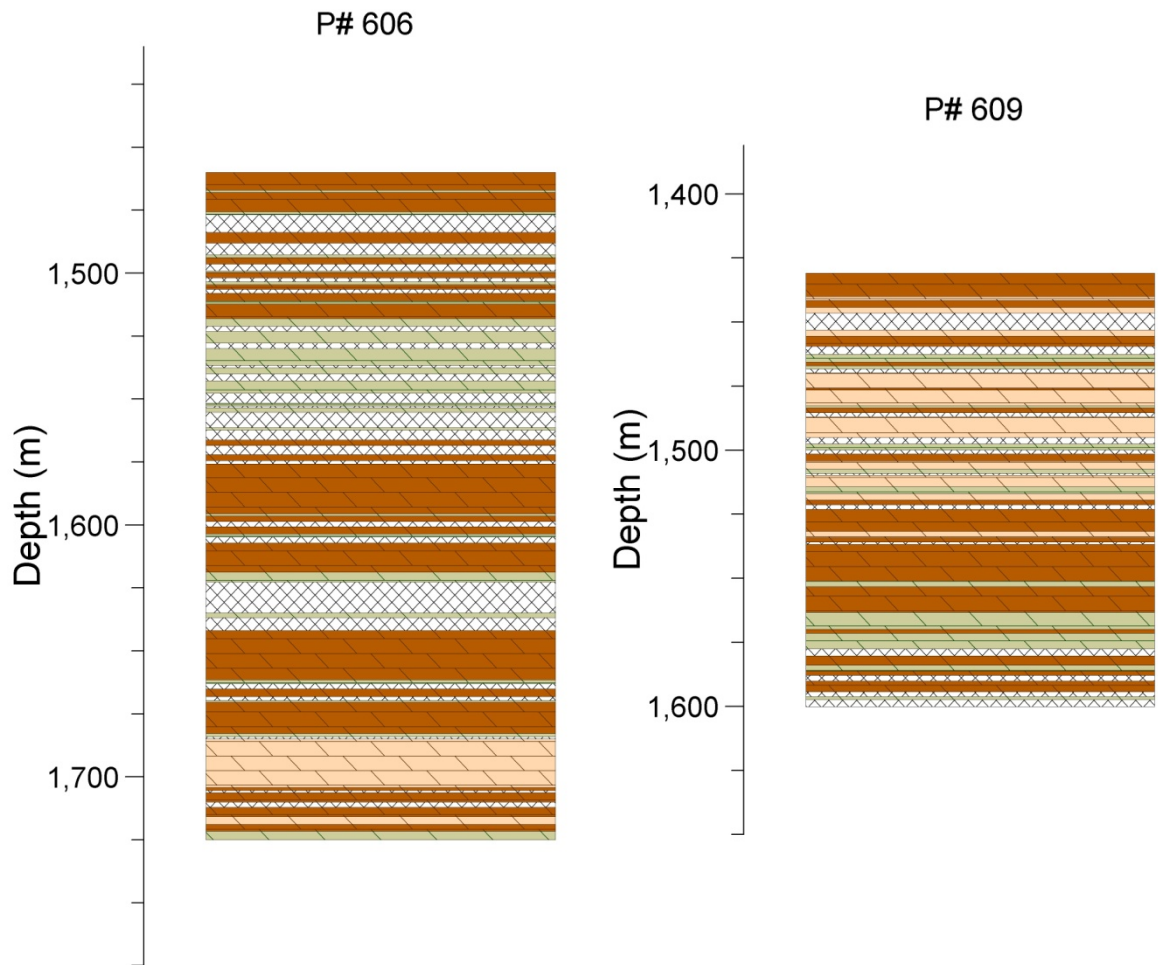


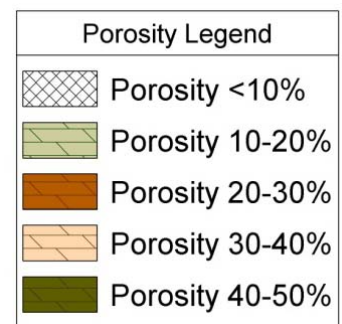
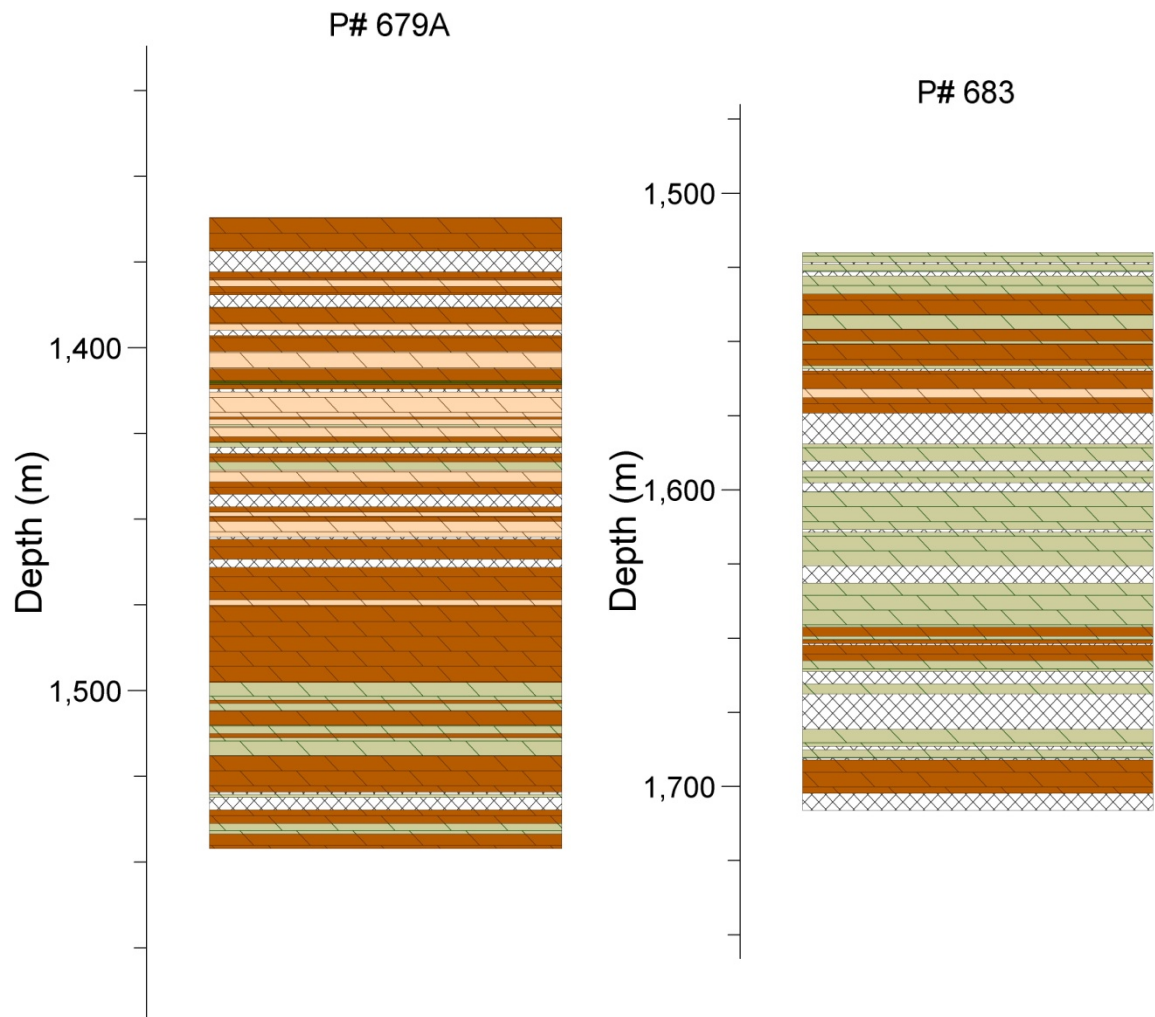


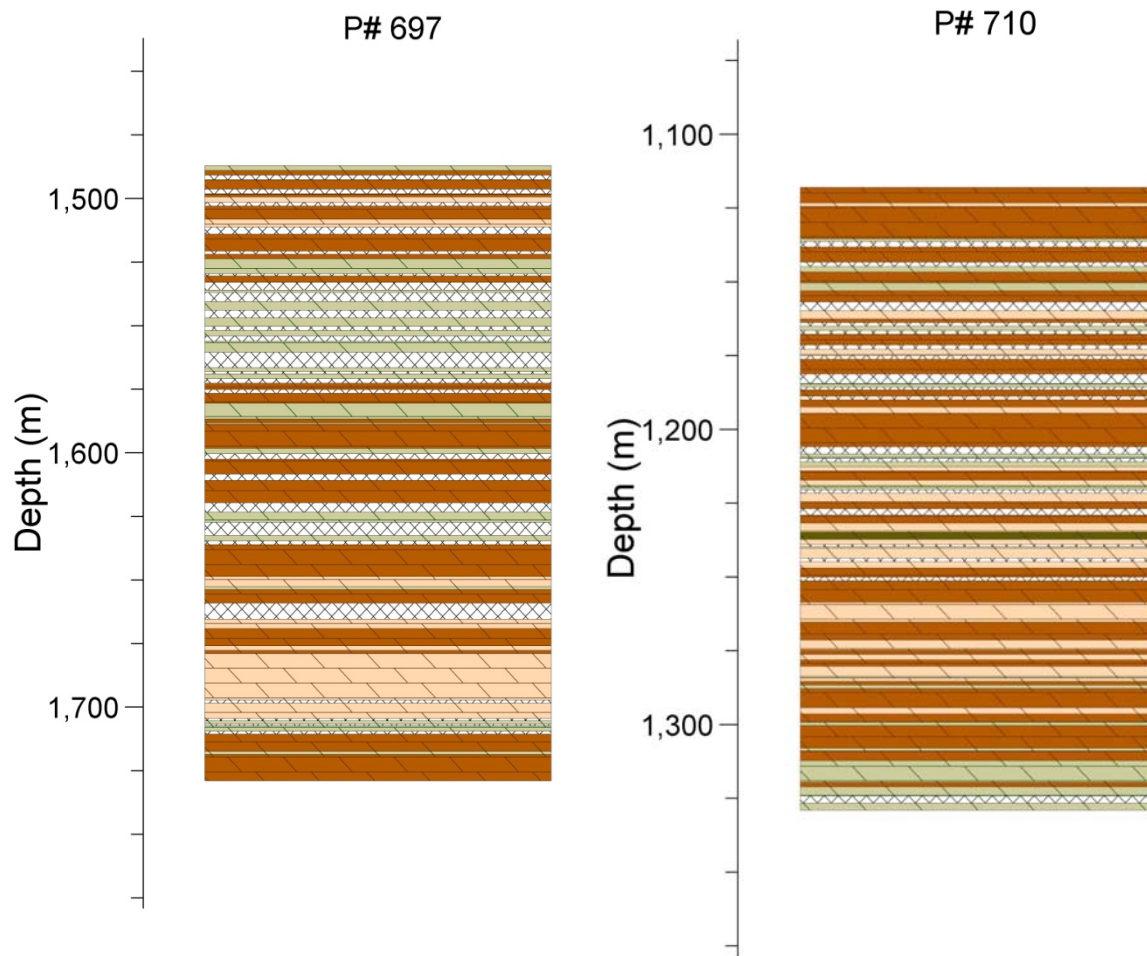


Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

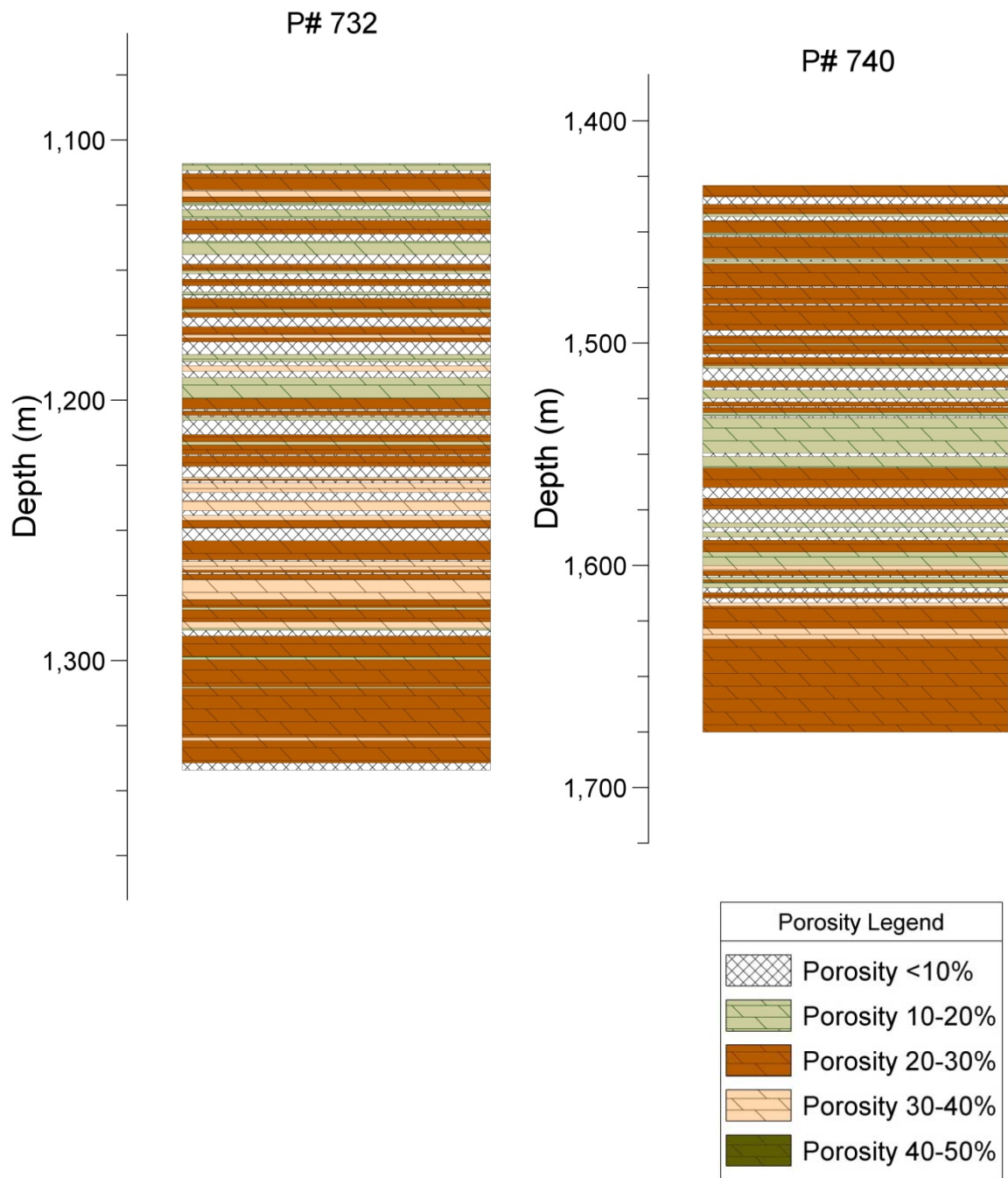


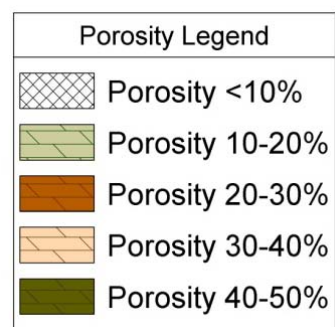
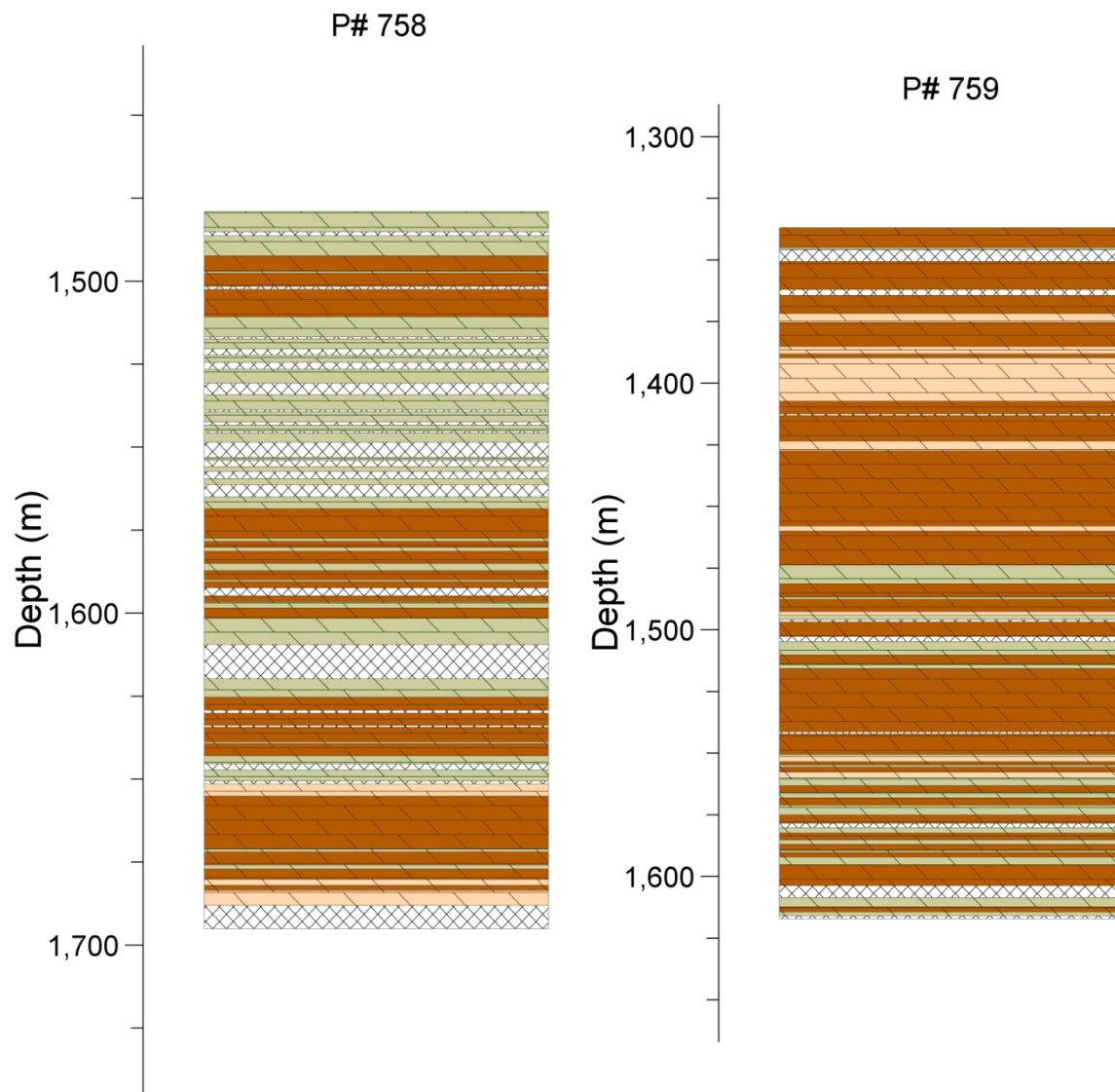


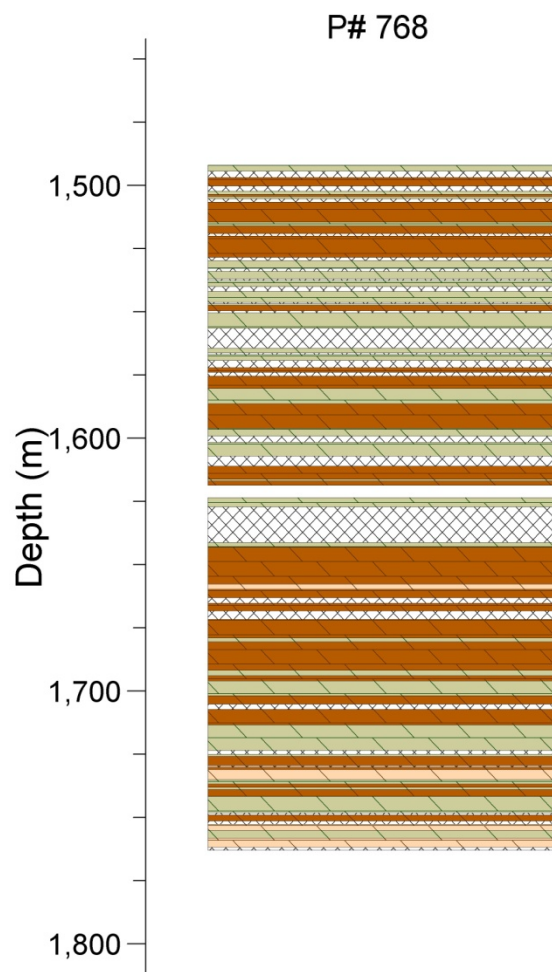
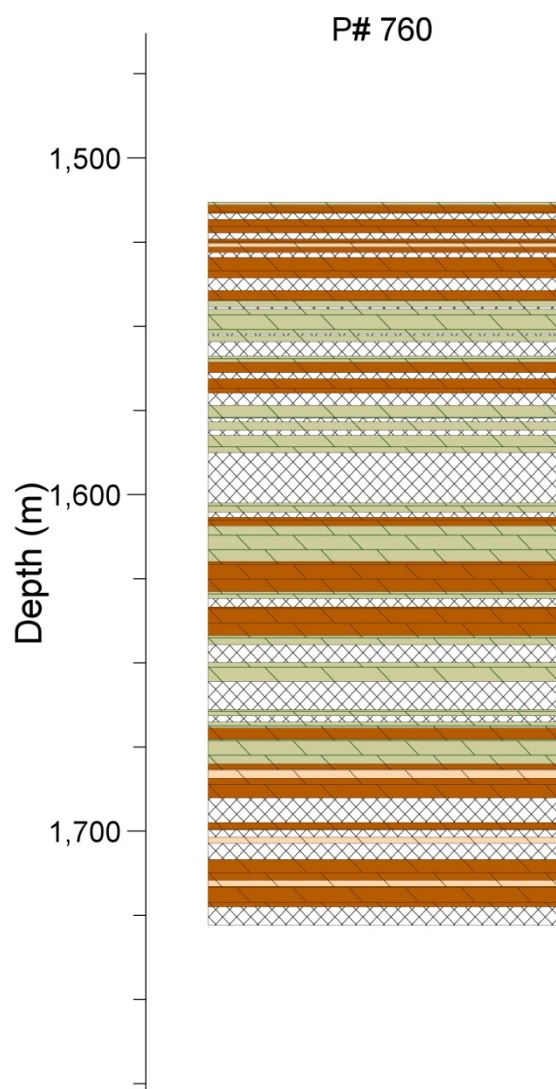




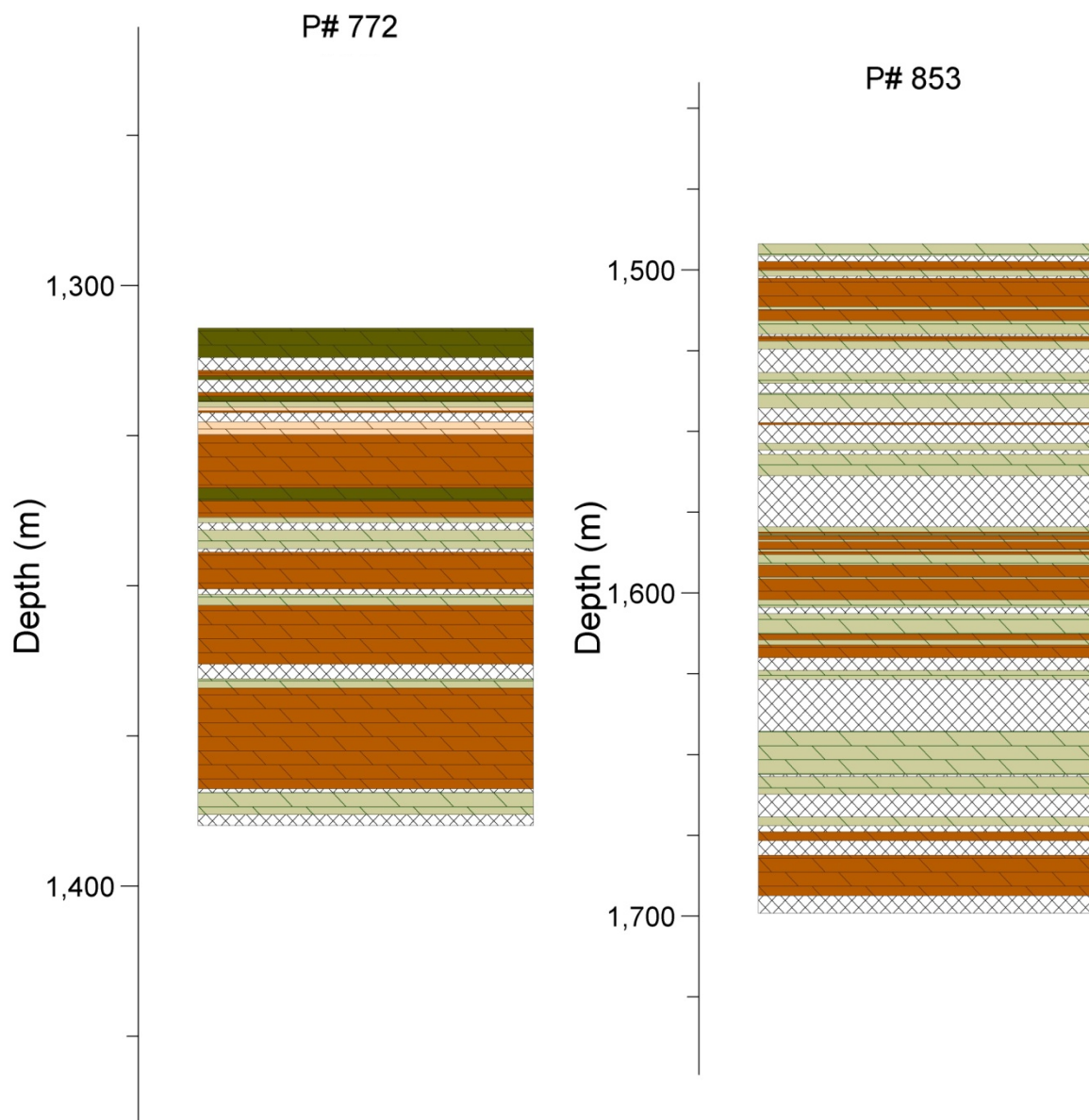
Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%



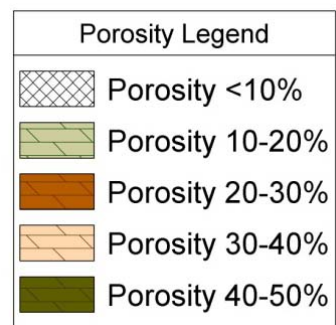
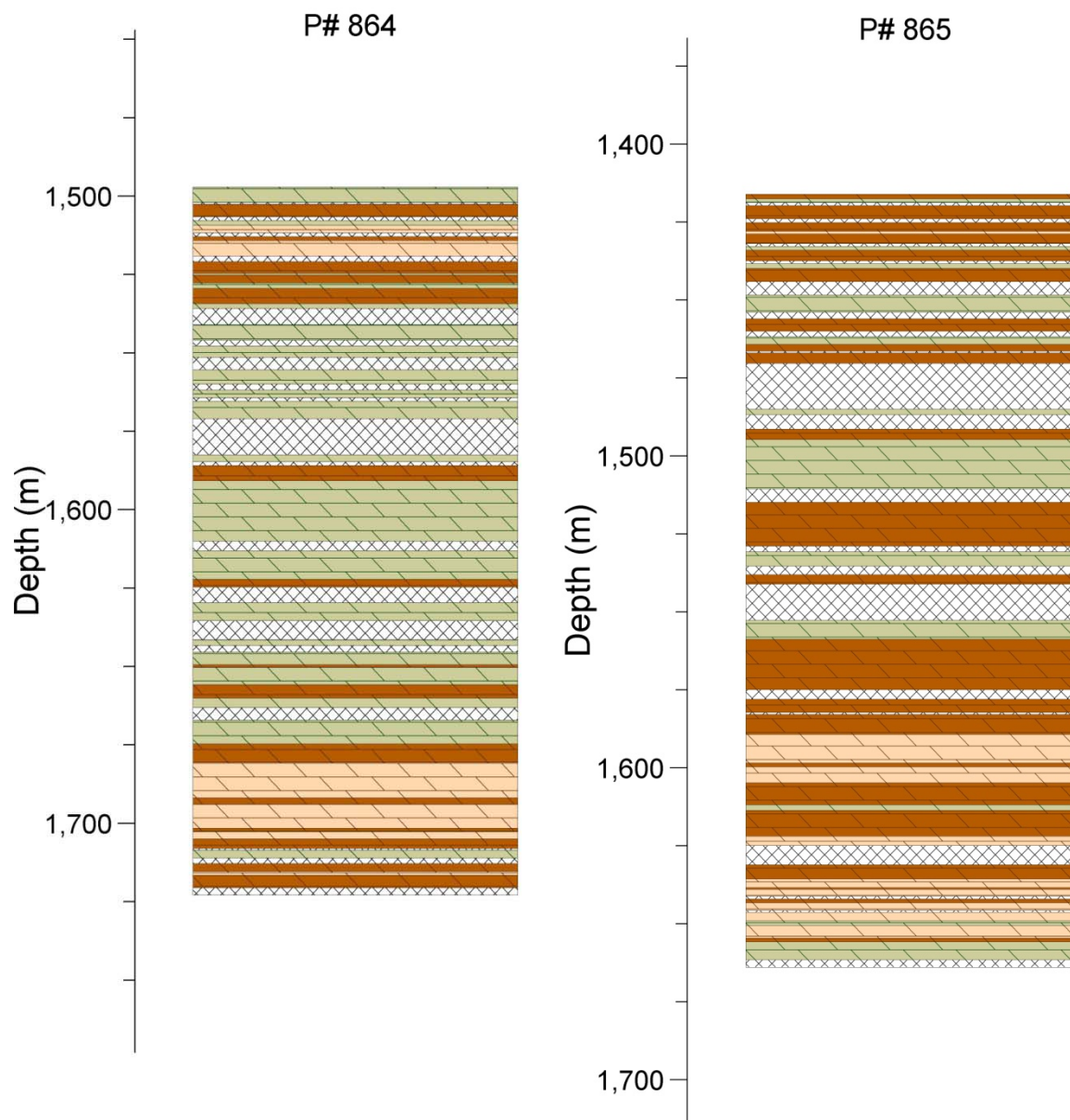


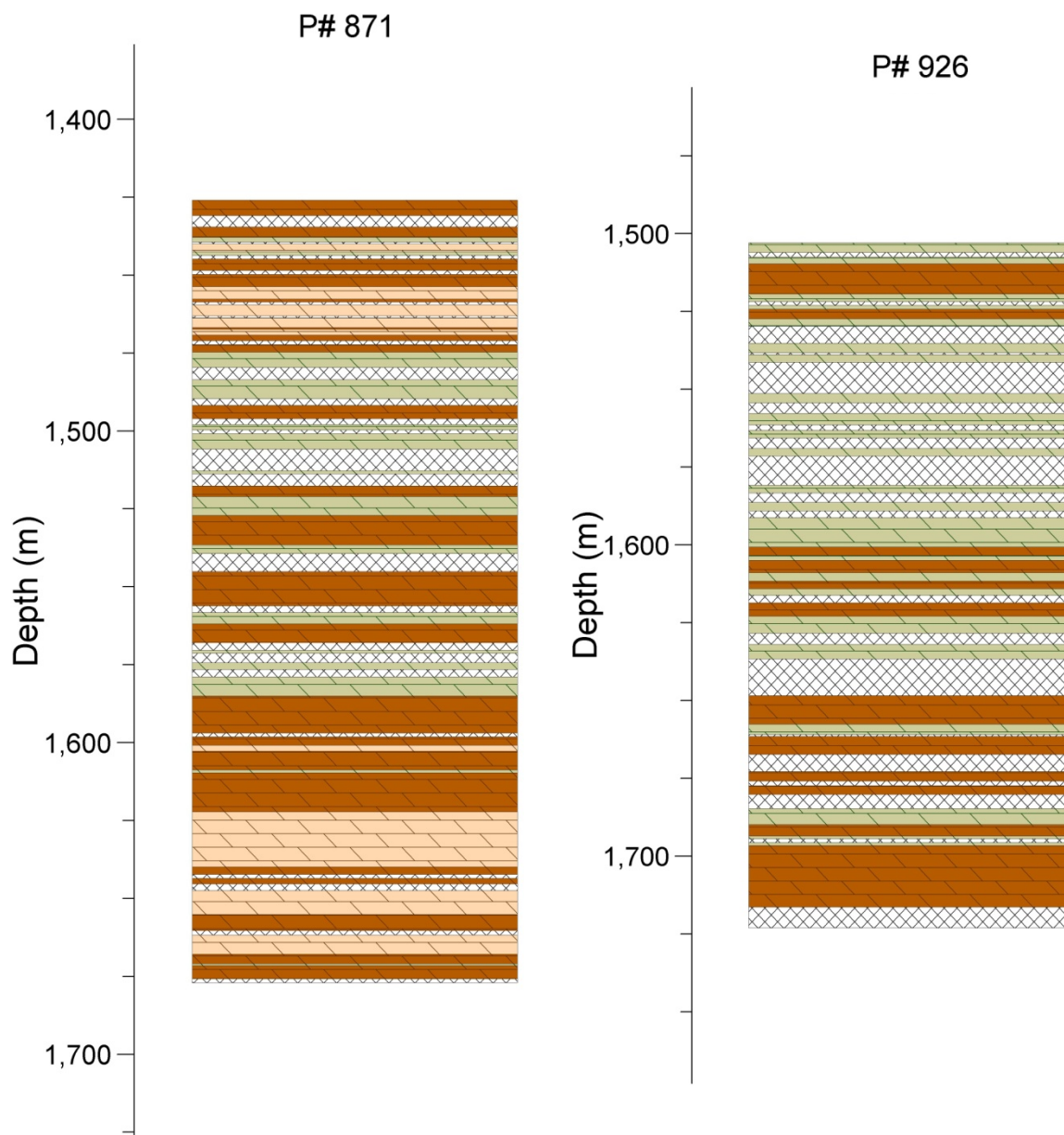


Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%



Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%





Porosity Legend	
	Porosity <10%
	Porosity 10-20%
	Porosity 20-30%
	Porosity 30-40%
	Porosity 40-50%

