NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

Before the Licensing Board:

E. Roy Hawkens, Chair

Dr. Michael F. Kennedy

Dr. William C. Burnett

In the Matter of:	)	
Florida Power & Light Company	)	Docket Nos. 52-040 and 52-041
(Turkey Point, Units 6 and 7	)	ASLBP No. 10-903-02-COL-BD01
_____	)	

JOINT INTERVENORS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW REGARDING CONTENTION 2.1

Jason Totoiu
Everglades Law Center, Inc.
331 West Central Avenue, Suite 213
Winter Haven, FL 33880
(863) 298-8000
E-mail: jason@evergladeslaw.org

Mindy Goldstein
Turner Environmental Law Clinic
Emory University School of Law
1301 Clifton Road
Atlanta, GA 30322
(404) 727-3432
Email: magolds@emory.edu

Diane Curran
Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
1725 DeSales Street N.W., Suite 500
Washington, D.C. 20036
240-393-9285
Email: dcurran@harmoncurran.com

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GLOSSARY

APPZ	Avon Park Permeable Zone
ASLB	Atomic Safety and Licensing Board
ASR	Aquifer Storage and Recharge
ATSDR	Agency for Toxic Substances and Disease Registry
COL	Combined License
DEIS	Draft Environmental Impact Statement
DZMW	Dual-Zone" groundwater Monitoring Well
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
EW-1	Exploratory Well 1
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FPL	Florida Power & Light Co.
MCL	Maximum Contaminant Level
MCL	Maximum Contaminant Level Goal
MCU	Middle Confining Unit
NEPA	National Environmental Policy Act of 1969
SVOC	Semi-Volatile Organic Compound
UIC	Underground Injection Control
USGS	U.S. Geological Survey
UIC	Underground Injection Control
USDW	Underground Sources of Drinking Water
VOC	Volatile Organic Compound

JOINT INTERVENORS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW REGARDING CONTENTION 2.1

Pursuant to 10 C.F.R. § 2.1207(a)(2) and the Atomic Safety and Licensing Board's (the "Board's" or "ASLB's") October 5, 2016 Memorandum and Order (Prehearing Conference Call Summary, Case Management Directives, and Scheduling Order) and November 22, 2016 Order Amending the Final Scheduling Order, Southern Alliance for Clean Energy, National Parks Conservation Association, Dan Kipnis, and Mark Oncavage (collectively "Joint Intervenors") submit their proposed findings of fact and conclusions of law regarding Contention 2.1.

The proposed decision below is organized as follows: Section I contains an introduction, Section II describes the applicable legal requirements, Section III sets forth the factual background and procedural history of the case, Section IV presents the findings of fact, and Section V contains the conclusions of law.

I. INTRODUCTION

This case concerns the adequacy of the U.S. Nuclear Regulatory Commission Staff's ("NRC Staff's" or "NRC's") Final Environmental Impact Statement ("FEIS") for the proposed construction and operation of Units 6 and 7 at the Turkey Point nuclear power plant. Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7 (Oct. 2016) (**Exhibits NRC-008A-008D**) ("FEIS"). In Contention 2.1 and their supporting evidentiary case, Joint Intervenors contend that the FEIS violates the procedural requirements of the National Environmental Policy Act of 1969, 42 U.S.C. § 4321-4370f ("NEPA") by failing to adequately examine the significant impacts of injecting municipal wastewater containing the industrial contaminants toluene, tetrachloroethylene, heptachlor, and ethylbenzene under the Turkey Point site.

The license applicant—Florida Power & Light Co. ("FPL")—intends to use wastewater supplied by Miami Dade County's South District Wastewater Treatment Plant ("South District Plant") to cool its reactors. FPL will then inject the wastewater into the Boulder Zone, a highly permeable cavernous zone which lies 3,000 feet under the Turkey Point site. The FEIS concludes that the environmental impacts of upward migration of the injected wastewater will be "SMALL" because the wastewater is "extremely unlikely" to migrate into the Upper Floridan Aquifer, an underground source of drinking water ("USDW") (FEIS at 5-26); and that even if it does, concentrations of the contaminants it contains will not be great enough to harm public health. *Id.* at 5-40 - 5-42.

The question at the heart of this case is whether the NRC Staff's conclusion is supported by the "hard look" NEPA requires for a valid evaluation of environmental impacts. *Klamath-Syskiyou Wildlands Center v. Bureau of Land Management*, 387 F.3d 989, 993 (9th Cir. 2004). For the reasons discussed below, the ASLB should rule that the NRC has fallen far short of NRC's "hard look" standard. Accordingly, the ASLB should rule that the NRC Staff lacks an adequate basis to issue a COL for Turkey Point Units 6 and 7, and remand the FEIS to the Staff for further proceedings.

II. LEGAL REQUIREMENTS

A. National Environmental Policy Act

In Contention 2.1, Joint Intervenors seek the NRC Staff's compliance with the procedural requirements of NEPA, which are intended to implement a "broad national commitment to protecting and promoting environmental quality." *Louisiana Energy Services, L.P.* (Claiborne Enrichment Center), CLI-98-3, 47 NRC 77, 87 (1998) (quoting *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989) and citing 42 U.S.C. § 4331). NEPA requires that federal agencies prepare "a detailed statement…on the environmental impact" of any federal

actions "significantly affecting the quality of the human environment." 42 U.S.C. § 4332(c). The preparation of an environmental impact statement ("EIS") is "[c]hief among [the] procedures" established by NEPA for protection of the environment. *Louisiana Energy Services, L.P.* 47 NRC at 87. As the Supreme Court explained in *Robertson*, "the statutory requirement that a federal agency contemplating a major action prepare such an environmental impact statement serves NEPA's "action-forcing" purpose in two important respects." 490 U.S. at 349 (internal citations omitted). NEPA "ensures that the agency, in reaching its decision, will have available, and will carefully consider, detailed information concerning significant environmental impacts; it also guarantees that the relevant information will be made available to the larger audience that may also play a role in both the decision making process and the implementation of that decision." *Id*.

Fundamental to NEPA is the requirement that agencies must consider the environmental impacts of their actions *before* they approve the actions, rather than waiting until "the die [is] otherwise cast." *Id*. *See also Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 371 (1989) (emphasizing "the importance of coherent and comprehensive up-front environmental analysis to ensure informed decision making to the end that the agency will not act on incomplete information, only to regret its decision after it is too late to correct"); *Sierra Club v. Marsh*, 872 F.2d 497, 500 (1st Cir. 1989) ("[W]hen a decision to which NEPA obligations attach is made without the informed environmental considerations that NEPA requires, the harm that NEPA intends to prevent has been suffered.").

In an EIS, an agency must take a "hard look" at the environmental consequences of a proposed project. *Robertson,* 490 U.S. at 349-50; *Hughes River Watershed Conservancy v. Glickman,* 81 F.3d 437, 443 (4th Cir. 1996). The result of this "hard look" must be published for

public comment "to permit the public a role in the agency's decision-making process." *Id.* ["T]he very purpose of NEPA's requirement that an EIS be prepared for all actions that may significantly affect the environment is to obviate the need for []speculation by insuring that available data is gathered and analyzed prior to the implementation of the proposed action." *Foundation for N. Am. Wild Sheep v. U.S. Dep't of Agric*., 681 F.2d 1172, 1179 (9th Cir. 1982).

"Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA." 40 C.F.R. § 1500.1(b). Where there is uncertainty, agencies must take steps to address the uncertainty. "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an [EIS] and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking." *Id*. § 1502.22. "If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency *shall include the information in the [EIS]*." *Id*. § 1502.22 (a)(emphasis added). *See, San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016, 1033 (9th Cir. 2006).

Where a proposed action will have environmental impacts that are significant, NEPA requires an agency consider alternatives for avoiding or mitigating those impacts. *Van Eye v. EPA*, 202 F.3d 296, 309 (D.C. Cir. 2000). Therefore, the designation of impacts as "significant" or "insignificant" is important. The NRC characterizes the significance of environmental impacts as "SMALL," "MODERATE," or "LARGE," with "LARGE" impacts being the only impacts having significance. 10 C.F.R. Part 51, Appendix B, Table B-1 n.3. *See also* FEIS Vol. 1 at xxxiv. According to the NRC, impacts of "LARGE" significance "are clearly noticeable and are

sufficient to destabilize important attributes of the resource." *Id.*[1] Only if the impacts in a potentially affected region are "remote and speculative" may they be disregarded. *City of New York v. Dept. of Transp.*, 715 F.2d 732, 738 (2d Cir. 1983).

B. Burden of Proof

The applicant generally carries the burden of proof in NRC licensing proceedings. 10 C.F.R. § 2.325 (2011) ("Unless the presiding officer otherwise orders, the applicant or the proponent of an order has the burden of proof."). In a hearing on NEPA issues, the NRC Staff bears the ultimate burden of proof. *Louisiana Energy Services*, 47 NRC at 89.

Joint Intervenors also carry a "burden of going forward." *Amergen Energy Co., L.L.C.* (Oyster Creek Nuclear Generating Station), CLI-09-07, 69 NRC 235, 269 (2009). The NRC has compared the burden of proof with Joint Intervenors' burden of going forward as follows:

> The ultimate burden of proof on the question of whether the permit or the license should be issued is … upon the applicant. But where … one of the other parties contends that, for a specific reason … the permit or license should be denied, that party has the *burden of going forward* with evidence to buttress that contention. Once he has introduced sufficient evidence to establish a *prima facie* case, the burden then shifts to the applicant who, as part of his overall burden of proof, must provide sufficient rebuttal to satisfy the Board that it should reject the contention as a basis for denial of the permit or license.

Id.

[1] The definitions of "SMALL" and "MODERATE" significance are as follows:

> SMALL--Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
> MODERATE--Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

Id.

III. PROCEDURAL HISTORY

On June 30, 2009, FPL submitted an application for a combined license for two new AP1000 nuclear reactors ("Units 6 and 7") at its Turkey Point site near Homestead, Florida. FEIS at 1-1. The application included an environmental report ("ER") that discussed the environmental impacts of the proposed project. *Id.* at 1-3. On August 3, 2009, the NRC Staff published a notice in the Federal Register of the receipt and availability of the application. Joint List of Undisputed Facts ¶¶ 1-2; 4 Fed. Reg. 38, 477.

On June 18, 2010, the NRC issued a Notice of Hearing and Opportunity to Petition for Leave to Intervene. 75 Fed. Reg. 34, 777. Joint Intervenors filed a timely petition to intervene. On February 18, 2011, the Board ruled that Joint Intervenors had standing to participate in the proceeding and admitted the following contention ("Contention 2.1"):

> [T]he ER fails to analyze and discuss the potential impacts on groundwater quality of injecting into the Floridan Aquifer via underground injection wells heptachlor, ethylbenzene, toluene, selenium, thallium, and tetrachloroethylene, which have been found in injection wells in Florida but are not listed in FPL's ER as wastewater constituent chemicals.

Memorandum and Order (Ruling on Petitions to Intervene), LBP-11-06, 73 NRC 149, 190 (2011). In admitting Contention 2.1, the Board stated that Joint Intervenors had "asserted (with adequate supporting information…) that these specified chemicals might be in the wastewater discharged via deep well injection wells into the Boulder Zone of the Lower Floridan Aquifer, and that the wastewater could possibly migrate into the Upper Floridan Aquifer, contaminating the groundwater (including potential drinking water) with these chemicals." *Id.* at 191.

On December 16, 2011, FPL submitted to the NRC Revision 3 of its combined license application. Joint List of Undisputed Facts ¶7. FPL followed this submittal with a Motion to Dismiss Contention 2.1 on January 3, 2012. *Id.*, ¶8. Joint Intervenors filed an answer opposing FPL's motion on January 23, 2012, and alternatively moved the Board to admit an amended

version of Contention 2.1. *Id.*, ¶9. On January 26, 2012, the Board dismissed Contention 2.1 as moot, finding that the original ER had listed two of the six chemical contaminants named in the contention and that an amendment to the ER had provided information regarding the other four chemicals. Memorandum and Order (Granting FPL's Motion to Dismiss Joint Intervenors' Contention 2.1 and CASE's Contention 6 as Moot) (Jan. 26, 2012). On May 2, 2012, however, the Board granted in part Joint Intervenor's Motion to amend Contention 2.1. LBP-12-09, 75 NRC 615, 629 (2012). Amended Contention 2.1 read:

> The ER is deficient in concluding that the environmental impacts from FPL's proposed deep injection wells will be "small" because the ER fails to identify the source data of the chemical concentrations in ER Rev. 3 Table 3.6-2 for ethylbenzene, heptachlor, tetrachloroethylene, and toluene. Such information is necessary to ensure the accuracy and reliability of those concentrations, so it might reasonably be concluded that those chemicals will not adversely impact the groundwater by migrating from the Boulder Zone to the Upper Floridan Aquifer.

Id., 75 NRC at 629.

On July 19, 2012, FPL filed a Motion for Summary Disposition of Amended Contention 2.1. Joint Intervenors filed an answer on August 6, 2012; and the NRC Staff filed an answer in support of FPL's motion on August 8, 2012. Joint List of Undisputed Facts ¶¶ 15-17. The Board issued an order on August 30, 2012 granting in part and denying in part FPL's Motion for Summary Disposition of Amended Contention 2.1. Memorandum and Order (Granting in Part and Denying in Part Motion for Summary Disposition of Amended Contention 2.1) (unpublished). The Board reformulated Amended Contention 2.1 to read as follows:

> The ER is deficient in concluding that the environmental impacts from FPL's proposed deep injection wells will be "small" because the chemical concentrations in ER Rev. 3 Table 3.6-2 for ethylbenzene, heptachlor, tetrachloroethylene, and toluene may be inaccurate and unreliable. Accurate and reliable calculations of the concentrations of those chemicals in the wastewater are necessary so it might reasonably be concluded that those chemicals will not adversely impact the groundwater should they migrate from the Boulder Zone to the Upper Floridan Aquifer.

Id. at 10.

In February 2015, the NRC Staff published the Draft Environmental Impact Statement ("DEIS") for Turkey Point Units 6 and 7. NUREG-2176, Vol. 1, Environmental Impact Statement for Combined Licenses (COLs) for Turkey Point Nuclear Plant Units 6 and 7 (Draft Report for Comment) (Feb. 2015) ("DEIS") (**Exhibits NRC-007A-B)**; Joint List of Undisputed Facts ¶19. On December 15, 2015, based on the DEIS, FPL filed a motion for summary disposition on Amended Contention 2.1. Joint List of Undisputed Facts ¶20. On February 3, 2015, Joint Intervenors and NRC Staff filed responses. *Id.*, ¶22. On April 5, 2016, oral argument was held on FPL's motion for summary disposition. *Id.*, ¶23.

On April 21, 2016, the Board granted in part, and denied in part, FPL's motion for summary disposition, concluding that:

> Joint Intervenors have proffered an expert opinion that raises credible disagreements with the following factual assertions advanced by FPL's and the NRC Staff's experts: (1) the wastewater will be confined in, or near, the Boulder Zone; (2) the injection wells' design and testing will prevent leaks; and (3) if wastewater were to migrate from the Boulder Zone or leak from an injection well, it would be detected and its effects would be mitigated before reaching the Upper Floridan Aquifer and adversely impacting an Underground Source of Drinking Water.

Memorandum and Order (Granting in part and Denying in Part FPL's Motion for Summary Disposition), LBP-16-03, 83 NRC 169, 185 (2016). The Board reformulated the contention to read as follows:

> The DEIS is deficient in concluding that the environmental impacts from FPL's proposed deep injection wells will be "small." The chemicals ethylbenzene, heptachlor, tetrachloroethylene, and toluene in the wastewater injections at concentrations listed in DEIS Table 3-5 may adversely impact the groundwater should they migrate from the Boulder Zone to the Upper Floridan Aquifer.

Id. at 186. The Board further determined that an evidentiary hearing must be conducted on the reformulated contention so that the Board could "question the experts, assess their credibility, and weigh their testimony and the evidence." *Id*.

On October 5, 2016 the Board issued a Memorandum and Order summarizing a prehearing conference call, providing case management directives, and setting a scheduling order for the evidentiary hearing. Memorandum and Order (Prehearing Conference Call Summary, Case Management Directives, and Scheduling Order). On October 28, 2016, the NRC published the FEIS. Joint List of Undisputed Facts ¶25. The Board amended its Final Scheduling Order on November 22, 2016. Order (Amending Final Scheduling Order).

The parties submitted pre-filed initial testimony, statements of position, and exhibits on March 1, 2017; and pre-filed rebuttal testimony, responsive statements of position, and exhibits on March 23, 2017. Joint Intervenors submitted the Pre-Filed Initial Testimony of Mark A. Quarles (**Exhibit INT-022)** ("Quarles Testimony") and Pre-Filed Rebuttal Testimony of Mark A. Quarles, Regarding Joint Intervenors' Contention 2.1 (**Exhibit INT-023)** ("Quarles Rebuttal Testimony"). *See also* **Exhibit INT-001** (Curriculum Vitae of Mark Quarles).

The NRC Staff presented pre-filed direct testimony by Daniel O. Barnhurst, Ann L. Miracle, Paul D. Thorne, and Alicia Williamson-Dickerson. NRC Staff Testimony of Ann L. Miracle, Daniel O. Barnhurst, Paul D. Thorne, and Alicia Williamson-Dickerson Concerning Contention NEPA 2.1 (Impacts of Deep Well Injection of Four Constituents in Cooling-Tower Blowdown) (**Exhibit NRC-002-R2)** ("NRC Staff Testimony"); *see also* **Exhibit NRC-006 (**Curriculum Vitae of Alicia Williamson-Dickerson), **Exhibit NRC-003** (Curriculum Vitae of Ann L. Miracle), **Exhibit NRC-004** (Curriculum Vitae of Daniel O. Barnhurst), and **Exhibit NRC-005 (**Curriculum Vitae of Paul Thorne). Rebuttal testimony by the NRC Staff was presented by the same panel of witnesses with the exception of Alicia Williamson-Dickerson. **Exhibit NRC-072.**

FPL provided pre-filed direct testimony by Paul Jacobs (**Exhibit FPL-001**), and direct

and rebuttal testimony by David McNabb (**Exhibit FPL-002**, **Exhibit FPL-060**), Robert G. Maliva (**Exhibit FPL-003**, **Exhibit FPL-061**), and Christopher M. Teaf (**Exhibit FPL-004**, **Exhibit FPL-062**).

On March 8, 2017, NRC Staff filed a motion in limine to exclude or strike portions of Joint Intervenors' exhibits. Joint Intervenors filed a response in opposition to NRC Staff's motion on March 13, 2017. On March 15, 2017 in an unpublished memorandum and order, the Board partially granted NRC Staff's motion to strike portions of Joint Intervenors' exhibits that exceed the scope of Contention 2.1.

On March 30, 2017, NRC Staff filed a motion in limine to exclude a portion of the Joint Intervenors' rebuttal testimony or in the alternative strike portions thereof. On April 3, 2017, Joint Intervenors' filed a response in opposition. On April 5, 2017, the Board denied the NRC Staff's motion. Memorandum and Order, ASLBP No. 10-903-02-COL-BD01.

On April 10, 2017 the parties submitted *in camera* questions for the Board to ask the panels of expert witnesses at the evidentiary hearing. On May 2-3, 2017, the Board conducted an evidentiary hearing in which it admitted the parties' testimony as revised, and all of their exhibits. The Board also questioned the parties' witnesses regarding their written pre-filed testimony.

IV. FINDINGS OF FACT

A. General Findings Regarding the Turkey Point Site, Geology, and History of Underground Injection

1. The Turkey Point Site

The 9,460-acre Turkey Point site lies in southeastern Miami-Dade County approximately twenty-five miles south of Miami, eight miles east of Florida City, and four and a half miles east of Homestead. FEIS at 1-1, 2-2. The facility currently consists of three power generating

reactors, Units 3, 4, and 5. *Id.* at 1-1. FPL proposes to build Units 6 and 7 south of the existing Turkey Point Units 3 and 4 on approximately 218 acres. Transmission lines and pipelines for reclaimed water are planned to be constructed off-site. *Id.*

Units 6 and 7 would be located adjacent to waters that are part of Biscayne National Park and within three miles of the Model Lands Basin (a state conservation area). The Turkey Point site borders Biscayne Bay and Card Sound, and a portion of the Biscayne Bay Aquatic Preserve is located adjacent to the coastal boundary of the site. *Id.* at 2-4.

2. Geology of the Turkey Point Site

The geology of the Turkey Point site includes the Floridan aquifer system. *Id.* 2-53. The Floridan aquifer system consists of three units, which are, from shallowest to deepest, the Upper Floridan Aquifer, the Middle Confining Unit ("MCU"), and the Lower Floridan Aquifer. *Id*. The Biscayne Aquifer is positioned just beneath the ground surface in Southeast Florida.

The Upper Floridan Aquifer and the Biscayne Aquifer are important sources of freshwater in Florida and are designated USDWs at the Turkey Point site. *Id.* at 2-54. Below the USDWs is the Middle Confining Unit. The U.S. Geological Survey ("USGS") characterizes the MCU as actually consisting of two "semi-confining" units because of their tendancy to leak. Kevin J. Cunningham, *Seismic-Sequence Stratigraphy and Geologic Structure of the Floridan Aquifer System Near "Boulder Zone" Deep Wells in Miami-Dade County, Florida*, U.S. Geological Survey Scientific Investigations Report 2015-5013, at 5, Figure 4 (2015) (**Exhibit INT-009)** ("Cunningham 2015"). Reese and Richardson concluded that the degree of "confinement" is in fact "uncertain." Ronald Reese & Emily Richardson, Sceintific Investigations Report 2007-5207, *Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System and Delineation of the Major Avon Park Permeable Zone in Central and*

Southern Florida, U.S. Geological Survey Scientific Investigations Report 2007-5207, at 2 (2008) (**Exhibit INT-011)** ("Reese and Richardson 2008"). In addition, Walsh and Price of the Miami-Dade Water and Sewer Department found vertical and horizontal migration pathways of contaminated wastewater in portions of the MCU in their studies of the South District and North District plants in Miami-Dade County. Virginia Walsh & M. Price, *Determination of Vertical and Horizontal Pathways of Injected Fresh Wastewater Into a Deep Saline Aquifer (Florida, USA) Using Natural Chemical Tracers*, Hydrogeology Journal, 18 (4): 1027, 1040-41 (2009) (**Exhibit INT-012**) ("Walsh and Price"). *See also* FEIS at 2-56.

The Lower Floridan Aquifer contains the Boulder Zone, the geologic zone that has been identified for deep-well injection of water from proposed Turkey Point Units 6 and 7. FEIS at 2-54. "The Boulder Zone is an extremely permeable zone within a karstic fractured dolomite layer within the Lower Floridan aquifer in southeastern Florida." *Id.* at 3-9. The water in the Boulder Zone is saline. *Id.* Karst collapse structures, tectonic faults, and the cavernous nature of the Boulder Zone create an extremely fractured bedrock with caverns and solution-enlarged fractures. Quarles Testimony, A29.

Seismic-reflection studies performed by the USGS in southeastern Florida have identified both tectonic faults and "karst collapse" structures up to about 2 miles in diameter that may result in areas of increased vertical flow through the Floridan aquifer confining units such as the MCU. FEIS at 2-55. Such seismic data has not been collected at the Turkey Point site (*id.*), and the USGS concluded its study before nearing Turkey Point. The 2015 USGS report concluded:

> If present at or near wastewater injection utilities, these features represent a plausible physical system for the upward migration of effluent injected into the Boulder Zone to overlying U.S. Environmental Protection Agency designated underground sources of drinking water in the upper part of the Floridan aquifer system.

Cunningham 2015 at 24. According to USGS, "other evidence for karst collapse includes borehole geophysical log signatures that indicate highly fractured rock." *Id*. at 23; FEIS at 2-55.

3. The Floridan Aquifer is a Protected Underground Source of Drinking Water.

The Upper Floridan Aquifer is an important source of freshwater in Florida and is a designated USDW at the Turkey Point site. *Id.* at 2-54. The purpose of designating aquifers as USDW is to ensure that they are protected for both present *and* future uses. As defined in federal Safe Drinking Water Act regulations, a USDW includes not just current sources of drinking water, but aquifers containing "a sufficient quantity of ground water to supply a public water system," if they contain fewer than 10,000 mg/l total dissolved solids. 40 C.F.R. § 144.3(a)(2)(ii). Given the high and expanding population of Florida, and given the limited supply of fresh water (and particularly the shallowness of the Biscayne Aquifer used in Southeast Florida), any aquifer with the potential to provide drinking water should be protected. Quarles Testimony, A19.

4. History of Underground Injection and Regulation in South Florida

a. Florida's UIC Program and Single Borehole Testing

The Florida Department of Environmental Protection ("FDEP)" has permitted over 180 Class I injection wells for municipal and industrial wastewater disposal. FEIS at 2-55. These wells predominately inject into the Boulder Zone of the Lower Floridan Aquifer. *Id*.

Under Florida's Underground Injection Control ("UIC") program, applicants may apply for a Class I permit to inject wastewater into underground aquifers. In order to obtain a Class 1 operating permit, the applicant must first seek a permit to drill a single exploratory well to evaluate the hydrogeology of the site. The site's geological characteristics are assessed based on core samples, hydrogeological testing, and geophysical logging. The exploratory well

construction permit is then converted to a Class I well construction permit and finally a Class I operation permit.

Historically, FDEP has granted Class 1 injection permits based on site characterizations that rely on a single exploratory well. Maliva Testimony at ¶19. As discussed in the subsections below, however, these site investigations have repeatedly proven inadequate to prevent the upward migration of wastewater into a USDW.

b. Repeated Migrations of Injected Wastewater into the Floridan Aquifer

In eighteen documented instances, wastewater injected into the Boulder Zone, with the assumption it would be contained there, has migrated upward. Quarles Testimony, A17; U.S. EPA Office of Water, Relative Risk Assessment of Management Options for Treated Wastewater in South Florida, 4-12 (2003) (**Exhibit INT-015**) ("EPA Risk Assessment"). Wastewater injected at three sites in Pinellas, Dade, and Palm Beach counties has moved upward into the USDW. Quarles Testimony, A17; EPA Risk Assessment at 4-12**.** An additional six sites have experienced probable fluid movement into USDWs. *Id*. The confirmed instance of upward migration into a USDW in Miami-Dade County is particularly significant because Turkey Point is also located in Miami-Dade County. Quarles Testimony, A17.

Two site-specific studies for the Miami-Dade County Water and Sewer Department's South District Plant – the proposed source of cooling water for Turkey Point – confirm that deep well injection operations in the Boulder Zone have in fact contaminated the Floridan Aquifer as a result of unintended upward migration of injected wastewater into the aquifer. *Id.* First, the Walsh & Price study, conducted by the Miami-Dade Water and Sewer Department for the South District Plant, concluded that deep well injection into the Boulder Zone contaminated the Floridan Aquifer as a result of unintended vertical and horizontal migration of municipal

wastewater into the aquifer from nine injection wells. Quarles Testimony, A17; Walsh and Price, at 1040-41. Second, a study by Robert Starr et. al. determined that groundwater in the Upper Floridan Aquifer at the South District Plant is contaminated with treated wastewater. Quarles Testimony, A17; Robert C. Starr, Timothy S. Green, & Laurence C. Hull, *Evaluation of Confining Layer Integrity Beneath the South District Wastewater Treatment Plant, Miami-Dade Water and Sewer Department, Dade County, Florida,* Idaho National Engineering and Environmental Laboratory Accession No. ML14216A601INEEL/EXT-2001-00046, Idaho Falls, Idaho, at vi (2001) (**Exhibit INT-013**) ("Starr et. al."). Starr, et al. found that based on the data the MCU at the South District Plant "is not a competent confining layer." *Id.* at iv. *See also id.* at 38. Studies by Cunningham in 2012 and Dr. Maliva in 2007 further document the upward migration of wastewater into the aquifer. Kevin J. Cunningham, Cameron Walker, & Richard L. Westcott, Near Surface, Marine Seismic-Reflection Data Define Potential Hydrogeologic Confinement Bypass in the Carbonate Floridan Aquifer System, Southeastern Florida, SEG Technical Program Expanded Abstracts 2012, at 1 (2012) (**Exhibit INT-006**) ("Cunningham 2012"); Robert G. Maliva et. al., Vertical Migration of Municipal Wastewater in Deep Injection Well Systems, South Florida, USA, at 2 (2007) (**Exhibit INT-014**) ("Maliva 2007").

c. U.S. EPA Regulatory Response to Vertical Migration of Wastewater

In 2005, faced with mounting evidence that injection wells have contaminated the USDW in South Florida, the EPA promulgated new rules for the disposal of wastewater, tailored especially for the hydrogeological conditions of South Florida. UIC Rule at 70,516. The EPA explained that when deep well injection began more than 20 years before, "it was thought there was adequate confinement" and "it was believed that injection fluids would never migrate upwards into the shallower geologic formations containing USDWs." *Id.* Based on more recent

monitoring of injection operations, EPA now found that:

> some deep geologic zones provide less confinement between formations than was originally thought. . . . It now appears, from recent well monitoring data, that upward fluid movement from some Class I municipal disposal operations occurs in Florida because the injection fluid from Class I municipal disposal wells has a lower density (lower TDS) than the native formation fluids. This tends to cause the less dense injection fluids to rise to the top of the injection zone preferentially through fractures that may exist within the formations and above the injection zone if migration pathways, such as fractures, exist.

Id. The EPA identified at least eight facilities where injected wastewater had entered the USDW. *Id.*

The EPA also found that "the full areal extent of USDW contamination is not known." *Id*. at 70,519. As EPA further explained, "The unknown degree of migration is not only because of limited availability of monitoring data, but also because the location and connectivity of natural conduits for fluid flow (fractures and solution cavities in underground formations) are difficult to predict." *Id*.

Given the "uncertainties about the subsurface geology of Florida, the ability of ground water monitoring to identify and characterize the full extent of fluid movement, and the ability of models to predict the movement of fluids in the Florida subsurface," EPA "determined that relying on hydrogeologic demonstrations would not be sufficiently protective of USDWs." *Id.* at 70,527. *See also id.* at 70,515. Therefore, EPA declared that it would rely on two systems for the removal of contaminants from wastewater before injection. For industrial contaminants (including the volatile and semi-volatile constituents at issue in Contention 2.1), EPA would continue to rely on secondary treatment at the municipal wastewater treatment facility. *Id.* at 70,525-26. For pathogens, such as Cryptosporidium and Giardia, EPA now stated that it would require new tertiary treatment systems for high-level disinfection of the municipal wastewater prior to injection. *Id*. at 70,518.

Thus, in promulgating the 2005 UIC rule, the EPA recognized that the traditional methods of characterizing the hydrogeology of injection sites provided an inadequate basis for ensuring that injected wastewater would not migrate into USDWs, because a significant number of site investigations were not representative of actual hydrogeological conditions at the sites. Tr. at 673 (Quarles). Henceforth, EPA would place its reliance on pre-injection treatment rather than hydrogeological site characterization. 70 Fed. Reg 70,527.

d. Seismic Reflection Testing in South Florida by the USGS

The consistent and repeated experiences of injected wastewater migration into the USDW also prompted study by the USGS, a federal agency whose mission is to "serve the nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological energy, and mineral resources; and enhance and protect our quality of life."[2] USGS concluded the need for a "subsurface assessment" (*i.e.*, seismic reflection testing) was "immediate," given (a) the occurrences of upward migration of injected wastewater into the USDW at some of the wastewater treatment plants in South Florida, and (b) the "risk to public health" posed by the excursions. Cunningham 2012 at 1 (citing Walsh and Price, Maliva 2007).

USGS responded to the crisis by collecting, between 2007 and 2011, "near-surface, high-frequency, marine seismic-reflection data . . . on the shallow-marine shelf of southeastern Florida." *Id.* at 1. While seismic-reflection tools had been available previously, the technique for gathering data had been improved recently. *Id.* (citing more recent "boomer-sourced acquisition methods."). USGS concluded that "[t]his innovative near-surface, seismic-reflection technology could serve to drive new discoveries in the subsurface Cenozoic stratigraphic section of southern

[2] www.usgs.gov/about/about-us/who-we-are. Site visited most recently on June 12, 2017.

Florida." *Id.* In particular, USGS found that the "high-resolution data set provides an opportunity to evaluate geologic structures that cut across confining units of the carbonate rocks forming the Floridan aquifer system." *Id.* According to USGS:

> Seismic profiles image two structural systems, tectonic faults and karst collapse structures, which breach confining beds in the Floridan aquifer system. Both structural systems may serve as pathways for vertical groundwater flow across relatively low-permeability carbonate strata that separate zones of regionally extensive high-permeability rocks in the Floridan aquifer system. The tectonic faults occur as normal and reverse faults, and collapse-related faults have normal throw. The most common fault occurrence delineated on the reflection profiles is associated with karst collapse structures.

Id. As USGS explained in greater detail:

> This advance in seismic-reflection technology has provided an opportunity to evaluate geologic structures that breach confining units of the karst-carbonate Floridan aquifer system within the southeastern Florida Platform. Two types of structural systems have been identified on seismic profiles that have the potential for producing a breach in confinement in the Floridan aquifer system: (1) tectonic faults and (2) karst collapse structures. The tectonic faults are of two types, normal and reverse faults. Most faults identified in the set of seismic profiles are associated with karst collapse structures. These two fault systems may serve as a pathway for vertical groundwater flow across relatively low permeability carbonate strata that separate zones of regionally extensive high-permeability in the Floridan aquifer system.

Id. at 4.

USGS also found that the technique of seismic-reflection testing, which had been improved in recent years, constituted a useful technique to evaluate the evidence for geologic structures that could act as vertical passageways for upward migration of wastewater, because "high-frequency seismic data" collected through seismic reflection "are providing high quality structural analogs to unprecedented depths on the southeastern Florida Platform." *Id.* at 1.

Over the next three years, USGS performed three additional seismic-reflection studies in cooperation with Broward County and the Miami-Dade Water and Sewer Department. Kevin J. Cunningham, *Integrating Seismic-Reflection and Sequence-Stratigraphic Methods to*

Characterize the Hydrogeology of the Floridan Aquifer System in Southeast Florida, U.S. Geological Survey Open File Report 2013-1181, (2013) (**Exhibit INT-007**) ("Cunningham 2013") (reiterating the importance and usefulness of seismic-reflection testing); Kevin J. Cunningham, *Integration of Seismic-Reflection and Well Data to Assess the Potential Impact of Stratigraphic and Structural Features on Sustainable Water Supply from the Floridan Aquifer System, Broward County, Florida*, U.S. Geological Survey Open-File Report 2014-1136 (2016) **(Exhibit INT-008)** ("Cunningham 2014") (observing that seismic reflection "allows, for the first time in southeastern Florida, a level of resolution in mapping of hydrogeologic units never before accomplished using well data alone"); and Cunningham 2015 (confirming the initial conclusions of the 2012 report by adding more site-specific subsurface data beneath actual deep well municipal wastewater injection sites). The 2015 study also confirmed the presence of subsurface geologic faults and karst collapse structures that can transmit injected wastewater upwards into the Upper Floridan aquifer. Quarles Testimony, A15; Cunningham 2015 at 24.

The Cunningham 2015 study provided even more essential geologic information than the previous studies because the study specifically used seismic-reflection surveys from both water-borne and land-based seismic reflections at both the North and South District Plants, where wastewater injection and Floridan aquifer contamination has occurred. Quarles Testimony, A15; Cunningham 2015. The study made several important findings relative to upward wastewater migration and connectivity to the Upper Floridan aquifer. These findings include:

> • Seismic-reflection data determined that both karst collapse structures and faults occur beneath the South District Plant. Karst collapse structures were present at three locations. Cunningham 2015 at 1, 24.
>
> • Tectonic faults (one strike-slip and multiple reverse faults) exist in the area. Cunningham 2015 at 18.

> • The strike-slip fault and karst collapse structures "span confining units of the Floridan aquifer system and could provide high permeability passageways for groundwater movement." Cunningham 2015 at 24.
>
> • Faults and karst collapse structures "represent a physical system for the upward migration of effluent injected into the Boulder Zone to overlying US EPA designated underground sources of drinking water in the upper part of the Floridan aquifer system." Cunningham 2015 at 24.
>
> • The Middle Confining Unit of the of the Florida Aquifer system, characterized in the FEIS as "less permeable" (FEIS 2-53) and having "low-permeability" (FEIS 2-54) is now characterized as consisting of two "*semi*-confining" units because of their tendency to leak. Cunningham 2015 at 5, Figure 4 (emphasis added).

e. Comprehensive Study and Recommendations by the Chief of the Miami-Dade County Water and Sewer Department

The chief of the Miami-Dade Water and Sewer Department's hydrogeology section responsible for overseeing deep well injection of municipal wastewater, Dr. Virginia Walsh, has probably studied the hydrogeology of the South District and North District plant sites more than any other scientist. Tr. at 683 (Quarles). In her 2012 Ph.D. dissertation, Dr. Walsh examined two deep well injection sites in Miami-Dade County to determine the fate and transport of injected wastewater. Walsh at vii. Dr. Walsh found that injected wastewater was the source of elevated ammonium concentrations above ambient water levels in MCU of the Floridan Aquifer. Walsh at viii. Dr. Walsh identified various possible fluid migration pathways at these sites. *Id.*

At the south site, the data suggested that vertical pathways to overlying aquifers were present. *Id.* These pathways bypassed confining units with little mixing of injected wastewater with native water as it migrated upward. *Id.* Dr. Walsh reported, "Geochemical modeling indicated that Co2-enriched injected wastewater allowed for carbonate dissolution along the vertical pathways, enhancing permeability along these pathways." *Id.*

Dr. Walsh's comprehensive survey of the current literature and analyses of the fate and

transport of wastewater at the south and north district sites led her to recommend seismic reflection testing "for any future injection sites." *Id.* at 161-62. As Dr. Walsh explained, seismic reflection testing "may be able to optimize the location of future injection sites in areas where subsurface features are not found." *Id.*

B. FPL's Proposed Action and Environmental Analyses by FPL and NRC

1. FPL's Proposed Use and Disposal of Municipal Wastewater at the Turkey Point Site

FPL proposes to pipe approximately 60 million gallons/day of wastewater from the South District Plant to Turkey Point Units 6 and 7, which lies about nine miles south of the South District Plant. The wastewater would be collected and treated at an onsite treatment facility. FEIS at 3-31. From the on-site treatment facility, the wastewater would go to the makeup water reservoir, and then to the Unit 6 and 7 cooling towers. Joint List of Undisputed Facts, ¶32. A portion of the reclaimed wastewater would evaporate in the cooling towers in the process of removing heat from the service water system, with the remainder (the "blowdown") and other plant wastewater ultimately going to the blowdown sump and from the blowdown sump to the injection wells. *Id.*, ¶33.

The blowdown, which would total approximately 18-18.6 million gallons a day when operating on reclaimed water, would be injected into the Boulder Zone under Turkey Point via injection wells. Joint List of Undisputed Facts, ¶34; FEIS at 3-32. FPL has already drilled one exploratory well, EW-1, at the Turkey Point site and intends to drill twelve additional deep injection wells at the site. *Id.*, ¶¶ 26, 36. The Boulder Zone has not yet been used for wastewater injection at Turkey Point.

2. FPL's Environmental Report and Borehole Investigation

a. *Environmental Report*

In 2009, FPL submitted an Environmental Report ("ER") as part of its application for a COL. The ER went through several revisions, culminating in Revision 6. *See* NRC Staff Initial Statement of Position at 4.

Section 5.2.1.1.9 of the ER describes FPL's proposed program for obtaining a Class I injection permit and monitoring the wastewater injection wells in order to satisfy FDEP requirements. According to the ER, "data collected during drilling and testing of the exploratory well would be used to evaluate the proposed system and would be submitted to the FDEP in support of the Class I injection well construction permit application for the Units 6 & 7 deep injection wells." ER Rev. 6 at 5.2-12 (ML14311A285). The ER adds that water quality and pressure monitoring would be conducted and that mechanical integrity tests would be performed every five years. *Id.* The ER states that the "monitoring program objective would be to detect vertical migration of injected fluids into the Upper Floridan aquifer through the confining layer overlying the Boulder Zone." *Id.*

The ER concludes based on a future exploratory well test, generalized data, and its proposed monitoring program that "potential impacts from the operation of the deep injection wells to groundwater would be SMALL and not warrant mitigation beyond that described previously." *Id.* at 5.2-13.

b. FPL's Single Borehole Investigation

In 2012, FPL installed a single exploratory well (EW-1) on the Turkey Point site to investigate the properties of the Boulder Zone and the confining nature of the overlying MCU that separates the Boulder Zone from the USDW zone within the Upper Floridan Aquifer. FEIS at 2-57. The results of FPL's investigation of EW-1 are not reported in the ER, but they are discussed in the Draft and Final EIS for Turkey Point. They are also documented in a report by

David McNabb. McNabb Hydrogeologic Consulting, Inc., Report on the Construction and Testing of Class V Exploratory Well EW-1 at the Florida Power and Light Company Turkey Point Units 6 & 7 (2012)(**Exhibit INT-010)**("McNabb Report")**.**

Exploratory well EW-1 was constructed to a depth of 3,232 feet below the drill pad. FEIS at 2-57. The well location water quality samples and rock core samples were collected and analyzed at various depths, and geophysical logging, video surveys, and packer testing were performed to determine the hydraulogic paramaters of the bedrock layers. *Id*.

Based on these tests, the rocks encountered between depths of 1,535 and 3,232 feet were divided into three zones. *Id*. These zones roughly coincided with the MC1 and Avon Park Permeable Zone ("APPZ") of the MCU, the MC2 of the MCU, and the Boulder Zone of the Lower Floridan aquifer. *Id.* FPL characterized the first zone (1,535 to 1,980 feet) as having variable lithology and porosity and therefore not provding a reliable barrier to vertical flow of water. *Id.* FPL determined the second zone (between 1,980 and 2,915 feet) "was more confining than over and underlying units" and "likely provides a barrier to vertical groundwater flow." *Id* at 2-58. FPL surmised, "these preliminary results indicate that a thick low-permeability confining layer exists between the proposed injection point within the Boulder Zone and the overlying USDW aquifer." *Id*. FPL then determined that the third zone (3,020 to 3,232 feet) was found to contain highly porous and permeable rocks that form the Boulder Zone of the Lower Floridan aquifer. *Id.* Based on the results of this single test well, FPL concluded that there was "no indication of verticially extensive or significant fracturing at several intervals throughout the MCU." *Id.* at 2-57.

3. Environmental Impact Statement

After circulating the Draft EIS for public comment in 2015, the NRC Staff issued the

FEIS for Turkey Point Units 6 and 7 in October 2016. The FEIS describes the NRC Staff's evaluation of the impacts of deep well injection as follows:

> To evaluate the impacts of deep well injection at the Turkey Point site, the review team 1) reviewed studies that characterized the confining ability of the MCU and the cases and extent of upwelling at other deep well injection sites, 2) compared hydrogeological conditions and parameters at the sites at which upwelling occurred to conditions and parameters at the proposed site, 3) evaluated numerical modeling of flow of injected wastewater presented by the applicant and performed confirmatory calculations, and 4) considered the injection well testing and groundwater monitoring requirements of the FDEP UIC program.

Id. at 5-21.

Throughout its evaluation of the impacts of deep well injection at the Turkey Point site, the NRC Staff recognize that unexpected, upward migration of treated municipal wastewater has occurred throughout Florida. *See id*. at 2-56-57, 5-20, 5-23-25. The FEIS notes that wastewater injected into the Boulder Zone has already been observed at the South District Plant because injected wastewater moved upward through the MCU. *Id.* at 7-15. The NRC Staff further recognize that even if wells are properly installed upwelling may occur due to fracturing or other natural geologic features within the confining unit. *Id.* at 5-25. Citing Cunningham, the NRC Staff acknowledge that "if present at or near wastewater injection utilities, these features represent a plausible physical system for the upward migration of effluent injected into the Boulder Zone to overlying EPA-designated USDW in the upper part of the Floridan aquifer system." *Id.* The NRC Staff further acknowledge that "karst collapse features have been identified in the vicinity of the North and South District Wastewater Treatment Plants as well as locations beneath Biscayne Bay and have been found to extend from the MCU to above the Upper Floridan aquifer." *Id.* The FEIS also explains that "[s]eismic-reflection studies performed by the USGS in southeastern Florida have identified both linear tectonic faults and 'karst collapse' structures up to about 2 miles in diameter that may result in areas of increased vertical

flow through the Floridan aquifer confining units such as the MCU…" *Id.* at 2-55.

Despite recognizing repeated past contamination events, multiple studies documenting fractures extending from the MCU to above the Upper Floridan aquifer, and the conclusions reached by the USGS through seismic studies that these features represent a plausible system for the upward migration of wastewater into the Boulder Zone and to the USDW, the NRC Staff concede that "deep seismic data has not been collected at the Turkey Point site." *Id.* at 5-25. The FEIS does not include any site-specific information other than the results from the 2012 EW-1 well test. Quarles Testimony, A10; FEIS at 2-55, 5-25. Based on this single well test and regional studies, the FEIS concludes that fractures and other potential conduits are not present at the site. *Id.* at 5-25-26. According to the FEIS, the review team "concluded that in general the matrix of the MCU would confine injected effluent and that incidences of upwelling at other sites have been coincident with features that provide vertical pathways for upward migration such as fractures or improperly completed wells." *Id.* at 5-22.

The FEIS further states that "[s]ite data indicates (sic) that substantial fracturing of the confining layers is not evident at the Turkey Point site and well construction related issues are not expected to create potential for upwelling at the Turkey Point site because of improved understanding of the confining zones within the MCU and improved construction techniques." *Id*. The FEIS adds, "studies of other injection sites indicate that if rapid vertical migration occurs, it is not likely to reach the Upper Floridan aquifer and that, if it did, it would not noticeably impact drinking water quality." According to the FEIS, "[t]he review team believes that enhanced vertical flow through the confining units to the Upper Floridan aquifer is extremely unlikely, and if leakage associated with an injection well did occur it could be detected and mitigated as required by the FDEP UIC program." *Id.* at 5-26.

Without any site specific studies other than the results of a single borehole test, and assuming no fractures or other preferential pathways exist at the site, the FEIS further concludes that based on local and regional studies and modeling, "wastewater is not expected to migrate far beyond the site in the Boulder Zone" and (while not quantified) dilution could significantly reduce the concentrations of constituents in wastewater. *Id.* at 5-26 - 5-28; *See also id.* at 5-39 - 5-40. The FEIS further states that well monitoring programs would detect for leaks before "significant releases to upper aquifers may occur." *Id.* at 5-40. The FEIS concludes:

> Based on the evidence of adequate isolation of the Boulder Zone from the overlying USDW by layers of low-permeability rock, the potential effect of advanced treatment received by reclaimed wastewater before leaving the SDWWTP, the evaluation of the extent and fate of injected effluent at the Turkey Point site, risk assessments of deep well disposal, and the UIC monitoring requirements, the review team determined that the Upper Floridan aquifer USDW would be protected from degradation…Therefore, the staff concludes that operational groundwater-quality impacts would be SMALL, and mitigation beyond the FDEP final Conditions of Certification would not be warranted.

Id. at 5-41-5-42.

C. Findings Regarding Upward Migration of Injected Wastewater

As discussed above, the FEIS conclues that vertical migration of wastewater is extremely unlikely, based on two factors: the general literature regarding the subject of upward migration, and the results of exploratory well EW-1. *Id.* at 5-22, 5-25-5-26. The FEIS' conclusion is not reasonable, or even credible, for four reasons. First, the EPA has already determined in the UIC rule that the ability of the aquifer to retain injected wastewater may not be relied upon. Second, the scientific literature on the subject – including literature cited in the FEIS -- contradicts rather than supports the FEIS. Third, a single borehole does not provide a reasonable amount of information regarding the hydrogeology of the Turkey Point site to support a finding of no significant impact; the scientific investigation supporting the FEIS should have included seismic-reflection testing in additon to the borehole test results. Finally, deficiencies in FPL's borehole

testing rendered the data produced by the well inadequate, even as a complement to seismic-reflection testing.

1. EPA Has determined that the Capability of Aquifers to Confine Injected Wastewater May Not Be Relied On.

First, as discussed above in Section IV.A.4.c, the EPA has recognized that bedrock conditions in South Florida have allowed unintended vertical migration of injected wastewater and that "some deep geologic zones provide less confinement between formations than was previously thought." Quarles Rebuttal Testimony, A11; UIC rule, 70 Fed. Reg. at 70,516. EPA also concluded that the "uncertainties about the subsurface geology of Florida, the ability of ground water monitoring to identify and characterize the full extent of fluid movement, and the ability of models to predict the movement of fluids in the Florida subsurface" were so significant that "hydrogeologic demonstrations would not be sufficiently protective of USDWs." *Id.* at 70,527. *See also id.* at 70,515. Therefore, rather than relying on hydrogeological testing, EPA declared that it would require secondary treatment for industrial contaminants and high-level disinfection of the municipal wastewater prior to injection. *Id.* at 70,518, 70,525-26. EPA's rejection of hydrogeological testing to assure the impermeability of confining aquifers effectively repudiates the adequacy of the FEIS' grounds for concluding that injected wastewater is unlikely to migrate into the USDW.

2. The Scientific Literature Does Not Support the NRC's Position that the Middle Confining Unit Has "Low Permeability."

NRC Staff and FPL contend that the MCU has "low permeability" and is adequate to prevent any upward migration of wastewater into the USDW. FEIS at 2-53, 2-54. In support, the FEIS cites to the 2007 Maliva study for the proposition that "matrix hydraulic conductivities of the limestone and dolostones that constitute the confining strata between the injection zone and

the base of the USDW in South Florida are sufficiently low to retard significant vertical fluid movement and that minimal vertical migration would occur through sections where vertical hydraulic conductivity was 10^{-6} cm/sec or less." *Id.* at 5-24 (internal quotations omitted). But the FEIS' reliance on Maliva 2007 is misplaced, because Maliva's study fails to consider the more likely vertical transport mechanisms associated with vertical leakage-bedrock vertical fractures and faults that can extend hundreds and thousands of feet; it also fails to consider well failures as recognized by the Starr, Walsh and Price, and Cunningham studies. Quarles Testimony, A16.

The FEIS' reliance on Maliva 2007 is further contradicted by the fact that Dr. Maliva recognized bedrock heterogeneity in his study of injectate movement at seventeen deep well injection sites. Dr. Maliva found "fracture zones may have a limited horizontal extent, creating chimneys that were conduits for vertical fluid migration." Maliva 2007 at 7-8. Dr. Maliva found "the upward migration of reclaimed water at the 17 sites occurred at a much more rapid rate than expected at the times of both the design and construction of the injection wells." Maliva 2007 at 2. Therefore, the bedrock and aquifer data beneath deep well injection sites may not be determinative on the question of whether a confining layer actually exists; nor does it address the question that if leakage does occur, how quickly that leakage can migrate. Quarles Rebuttal Testimony, A11**.**

Several other studies cited in the FEIS further undermine the NRC Staff's conclusion that a confining layer of low permeability exists at the Turkey Point site. First, Cunningham 2015 finds that the MCU consists of two "semi-confining units." Quarles Testimony, A16; Cunningham 2015 at 5, Figure 4. The FEIS also acknowledges that "[s]eismic-reflection studies performed by the USGS in southeastern Florida have identified both linear tectonic faults and 'karst collapse' structures up to about 2 miles in diameter that may result in areas of increased

vertical flow through the Floridan aquifer confining units such as the MCU…" FEIS at 2-55.

Second, Reese and Richardson (cited repeatedly in the FEIS) concluded that the degree of confinement provided by confining units below the Upper Floridan Aquifer is "uncertain." Quarles Testimony, A16; Reese & Richardson at 2.

Third, Walsh and Price (also cited repeatedly in the FEIS) concluded that deep well injection into the Boulder Zone near the South District Plant contaminated the Floridan Aquifer as a result of unintended vertical and horizontal migration of municipal wastewater into the aquifer from wastewater injection wells. Quarles Testimony, A16; Walsh and Price at 1, 14.

Fourth, Starr, et. al., determined that groundwater in the Upper Floridan Aquifer is contaminated with treated wastewater, which implies that contaminants are migrating through the MCU. Quarles Testimony, A16; Starr et. al. at 39. Despite claiming that the MCU is generally impermeable, the FEIS acknowledges the conclusion of the Starr study that "the geologic data provided for review are not sufficient to demonstrate that the MCU is a competent, low hydraulic conductivity layer that is capable of preventing upward migrations of fluids from the Boulder Zone into the overlying underground source of drinking water." Quarles Testimony, A16; FEIS at 5-23-5-24.

Accordingly, the scientific literature – including literature cited in the FEIS itself -- does not support the finding in the FEIS that the MCU has low permeability and seismic reflection analysis is necessary to determine the extent and distribution of fracturing at the Turkey Point site.

3. NRC Staff's Reliance on the Results of a Single Well Test Was Not Reasonable.

a. A Single Borehole Does Not Provide A Reasonable Amount Of Information Regarding The Hydrogeology Of The Turkey Point Site To Support A Finding Of No Significant Impact.

It was unreasonable for the NRC Staff to rely on the results of a single test well to support their determination that an adequate bedrock confining layer exists at Turkey Point. The findings and recommendations contained in studies by the EPA, Starr, USGS, Dr. Virginia Walsh, and even FPL's own witness Dr. Maliva, over the last decade and a half strongly undermine the FEIS' conclusion that the Turkey Point site has an appropriate confining layer to prevent upward migration of injected wastewater and that a single well test is sufficent to determine whether any fractures or similar features may be present at the site. Quarles Testimony, A15.

FPL testified that a single test well has long been the method for determining whether an adequate confining layer exists at proposed injection site. Maliva Testimony ¶19. Since at least 2001, however, researchers have found that the Upper Floridan Aquifer has been contaminated with wastewater, which implies that contaminants are migrating through the MCU. Quarles Testimony, A16; Starr et. al. at 39. In 2005, the EPA determined that a UIC permit (which requires only a single exploratory well) can no longer be completely justified based on the rationale that injected wastewater will not migrate from its intended geologic formation. UIC rule at 70,515. Two years later, Dr. Maliva concluded that geologic conditions at deep well injection sites are, in fact, a contributing factor to "rapid vertical migration" and that the focus needs to be on the extent and distribution of fracturing rather than borehole data. Maliva 2007 at 2, 9. In 2012, the USGS identified an "immediate need" for a subsurface assessment because wastewater has migrated upward into the USDW. That same year Dr. Virginia Walsh stated that

seismic reflection analysis should be performed prior to constructing and operating any new deep injection wells in South Florida. Walsh 2012. Three years later, Cunningham concluded that faults and karst collapse structures "represent a plausible physical system for the upward migration of effluent injected into the Boulder Zone to overlying US EPA designated underground sources of drinking water in the upper part of the Floridan aquifer system." Cunningham 2015 at 24.

These studies demonstrate a need to conduct a similar site-specific seismic study at the Turkey Point site, in conjunction with traditional investigative methods, to determine whether or not sufficient confining layers exist. Quarles Testimony, A15. Such a study has never been performed at Turkey Point. *Id.;* FEIS at 2-55 and 5-25. Although the NRC Staff cited the Cunningham studies in the FEIS, the Staff understated the significance of these essential reports relative to lessons that should have been made for Turkey Point and the need to complete a thorough site-specific analysis at Turkey Point. The results of a single exploratory well, or even multiple test wells for that matter, cannot, by their very nature, provide the comprehensive imagery of faults and karst collapse structures that are key to understanding the potential for upward migration. Quarles Rebuttal Testimony, A.5, A.6.

The data collected from a single well test is too limited to support a conclusion that a confining layer with sufficient aerial extent, thickness, or lithological and hydraulic conditions exist to prevent wastewater from immigrating horizontally and vertically into the USDW. Quarles Testimony, A14. Injected wastewater, which is more buoyant than the surrounding groundwater, may first migrate horizontally until it encounters vertical pathways. *Id*. Vertical flow pathways such as faults or similar bedrock fractures may only be a few inches to a few feet wide. Thus, the likelihood that a randomly located single boring – or numerous other borings -

can intercept a fault or vertical fracture is very low. *Id*. As Dr. Maliva notes, even 100 exploratory wells could miss a nearby fault that may be only a few feet wide. Maliva Testimony, ¶20. Given the limited scope of a single well test, the study cannot provide sufficiently thorough subsurface data at the site to support the FEIS conclusion that it is "extremely unlikely" that wastewater will upwardly migrate at Turkey Point. Quarles Testimony, A14.

b. The Scientific Investigation Supporting The FEIS Should Have Included Seismic-Reflection Testing In Additon To The Borehole Test Results.

The FEIS almost complete ignores the technology of seismic reflection analysis, even though it has become an extremely important tool for evaluating the hydrogeology of South Florida. The NRC Staff's disregard for seismic-reflection technology is arbitrary, given that it provides what no other method can -- a comprehensive, three-dimensional picture of a site to determine whether a confining layer with sufficient aerial extent, thickness, or lithological and hydraulic conditions exist to prevent horizontal and vertical migration of injected wastewater into underground sources of drinking water. Quarles Testimony, A9, A14. *See also* discussion above in Section IV, A, 4d. It is also the preferred tool of the USGS (Quarles Testimony, A15) and is recommended by the chief of the Miami-Dade County Water and Sewer Department's hydrogeology section. *See* discussion above in Section IV.A.4.e.

c. The EW-1 Well Test Was Too Limited To Conclude That A Sufficient Confining Layer Exists And The Sample Results Do Not Support And Even Contradicts Such A Conclusion.

To the extent it would be reasonable for the NRC Staff and FPL to rely on a single well test in this instance, *i.e.,* as a complement to seismic-reflection testing, the core sampling program performed by FPL was too limited to conclude that a confining layer with sufficient aerial extent, thickness, or lithological and hydraulic conditions exist to prevent wastewater from immigrating horizontally and vertically into the USDW.

First, the samples collected were from a mere 122 feet (or 4%) of a 3,230 foot-deep well. Quarles Testimony, A14. Thus, bedrock conditions reported by Mr. McNabb for the remaining 96 percent of the boring were generalized. *Id*.; McNabb Report at 12-13.

Second, Mr. McNabb determined the geologic bedrock type and the presence of aquifers and confining layers in part by interpreting pulverized drill cuttings. Quarles Testimony, A14; McNabb Report at 5, 11. Pulverized drilling cuttings that are inspected on the ground surface from deep drilling depths do not provide adequate information to determine bedrock conditions such as the presence of voids, fractures, faults, hydraulic capacity, or the confining nature of the bedrock. Any determination of those findings would be a qualitative, general evaluation only. Quarles Testimony, A14.

Third, the results of the EW-1 test, which included actual borehole test results from bedrock samples with low percent bedrock recoveries, high percent porosity of bedrock intervals, and inconclusive straddle packer testing results, do not support and in some instances even contradict the conclusions reached by FPL that an adequate confining layer exists at Turkey Point.

Each of these points is discussed in more detail below.

1) Low Percent Bedrock Recoveries

The "percent recovery" is a measurement of how much of the bedrock core sample from a specified sample interval actually contains bedrock rather than voids. *Id.*, A11. This measurement can be used to determine the amount of air or water-filled voids in the bedrock due to fracturing and weathering of the bedrock. Low percent recoveries are suggestive of voids when the bedrock has been weathered away. Voids indicate an ineffective confinement layer because they suggest significant fractures or weathering that may allow substantial vertical and

horizontal migration of injected wastewater. *Id*. The weight of the evidence demonstrates that the low percent recoveries of the core samples reported by Mr. McNabb suggest that the bedrock is not sufficiently "low" in permeability or hydraulic conductivity to be considered a confining layer capable of preventing the upward migration of municipal wastewater at the Turkey Point Site. *Id.*; McNabb Report at 13. For the interval within the "primary confinement unit" identified by Mr. McNabb (1,930 to 2,915 feet deep), the percent recoveries ranged from 8 to 92.9 percent, with an average of approximately 54 percent recovery. *Id*. This average percent recovery suggests that there is a significant amount of voids and fractures in the bedrock. For example, the 8 percent recovery of one interval means that voids or very soft or fractured rock made up more than 90 percent of one bedrock core sample. These low percent recoveries indicate a presence of voids and fractures, which makes for an ineffective confinement layer. Quarles Testimony, A11.

2) High Percent Porosity of Bedrock Intervals

Percent porosity is another measure of the quantity of voids within a specific portion of a bedrock core sample. *Id.*, A12. The more porous the bedrock, the greater the quantity of voids contained in the bedrock. *Id.* As discussed earlier, voids indicate an ineffective confinement layer. *Id*.; McNabb Report at 24. The higher the percent porosity in bedrock, the greater the quantity of voids contained in the bedrock, and therefore the less effective the confinement. Quarles Testimony, A12.[3]

The porosity measurements collected by Mr. McNabb ranged from 27.5 to 43.4 percent,

[3] Dr. Maliva testified that high porosity values do not indicate a high permeability and poor confinement, stating that clays have both high porosities and very low permeabilities, and can thus serve as highly effective confining units. Maliva Rebuttal Testimony, ¶ 15. But as Mr. Quarles explains, comparing porosity of bedrock to porosity of clays "is really an apples and oranges comparison" because "flow through a bedrock, if the porosity is isolated, and focused on a fracture, would be much faster in a straight line as opposed to going around the individual particles of a clay or sand." Tr. at 684 (Quarles).

with an average of 37 percent. *Id*.; McNabb Report at 19. In other words, up to 43.4 percent of the entire bedrock core section consists of voids and extremely fractured and weathered bedrock. In some instances, core samples could not be tested because "some of the core samples did not contain enough intact pieces to perform each of the laboratory analyses." Quarles Testimony, A12; McNabb Report at 18-19. Because these measurements indicate that a significant amount of voids and fractures are present in the bedrock, the percent measurements do not support a conclusion that upward migration is "extremely unlikely" to occur at the Turkey Point site. Quarles Testimony, A12.

3) Inconclusive Straddle Packer Testing of Bedrock Intervals

A straddle packer test evaluates how easily water flows across a layer(s) of bedrock that is thought to be within the confining layer above the injection zone and below the base of the lowermost underground source of drinking water. Quarles Testimony, A13. The test consists of inflating two balloon-like packers to isolate a section of the boring. The interval is filled with water and pumped. Any water level changes within the interval and above the packer are then recorded. *Id.*

Mr. McNabb attempted to conduct nineteen (19) straddle packer tests. Eight of the thirteen tests that were attempted within the "confinement unit" identified by Mr. McNabb (1,930 to 2,915 feet) failed and were "[t]erminated due to packers not isolating test interval." *Id.*; McNabb Report at 21. Although Mr. McNabb concluded that the "only way" for a packer test to fail is leakage due to the lack of a seal between the packer and the wall of the geological strata (McNabb Report at 19-20), Mr. Quarles testified that this conclusion does not recognize that the bedrock strata within the packer and above/below the packers could also be hydraulically connected through voids and fractures in the bedrock. Quarles Testimony, A13. The presence of

voids and fractures would be consistent with the conditions that were demonstrated by the low percent recovery and percent porosity results. *Id.* The failed straddle packer tests are at best inconclusive and further cast doubt on the FEIS conclusion that upward migration is "extremely unlikely" to occur at the Turkey Point site. *Id.*

d. The Maliva Groundwater Model Does Not Support A Finding That Sufficient Confinement Exists At The Turkey Point Site.

FPL cites a groundwater model developed by Dr. Maliva, which is "based largely on data collected from well EW-1," to support its position that sufficient confinement exists beneath Turkey Point to prevent upward migration of injected wastewater to protect the USDW. Maliva Testimony, ¶ 40. While Dr. Maliva asserts that "[p]ervasive fracturing of the type associated with vertical fluid migration is not evident in the Turkey Point exploratory well (EW-1)" (*Id.* ¶ 64), Dr. Maliva concluded in his 2007 study that bedrock in South Florida is heterogeneous and conditions can dramatically vary within short distances. Quarles Rebuttal Testimony, A15; Maliva 2007 at 4. As such, a bedrock boring and samples collected from it might miss faults and fracture systems. As Dr. Maliva concluded in 2007, "[t]he focus of confinement analyses should, therefore, be on the extent and distribution of fracturing rather than analyses of the properties of the rock matrix." *Id*. at 9. Failing to account for such complex and variable geology undermines the reliability of any model. Quarles Rebuttal Testimony, A15. In fact, Dr. Maliva found in his 2007 study that borehole data underestimated actual migration rates by four orders of magnitude. In other words, actual migration was 10,000 times faster than the predicted leakage rate. Maliva 2007 at 7, 9.

The EPA recognized the problems with modeling in its 2005 rulemaking, where it announced that it "does not believe that that modeling can provide an adequate demonstration in the complex geology of Florida." UIC rule, 70 Fed. Reg. at 70,526. The EPA concluded that if a

groundwater model is developed to make a confinement determination, that model should include extensive input parameters. Quarles Rebuttal Testimony A15; UIC rule, 70 Fed. Reg. at 70,526. Specifically, the EPA concluded that a more in-depth model "would require[] information on the location and extent of fissures, cracks, voids, and channels which is impossible, using current technologies, to obtain with any certainty." Quarles Rebuttal Testimony, A15; UIC rule at 70,526. *See also* Maliva 2007 at 9 ("[t]he focus of confinement analyses should, therefore, be on the extent and distribution of fracturing rather than analyses of the properties of the rock matrix.").

Therefore, the groundwater model developed by Dr. Maliva and which is based largely on data collected from the EW-1 well, cannot be relied upon by the NRC Staff and FPL to find that an adequate confining layer exists at Turkey Point.

4. Summary of Findings of Fact Regarding Vertical Migration

The FEIS's conclusion that vertical migration of wastewater is extremely unlikely to occur is not reasonable based on the evidence. The EPA has already determined in the UIC rule that the bedrock conditions in South Florida have allowed unintended vertical migration of injected wastewater, and that current methods for predicting the confining capacity of the aquifers are not sufficiently reliable. Therefore, EPA now relies upon secondary treatment of industrial contaminants and high-level disinfection of wastewater rather than predictions regarding the likelihood that wastewater will migrate upward.

Second, the literature cited by the NRC Staff contradicts rather than supports the FEIS. The Maliva 2007 study recognized bedrock heterogeneity and found "fracture zones may have a limited horizontal extent, creating chimneys that were conduits for vertical fluid migration." Maliva 2007 at 7-8. Further, studies by Cunningham 2015, Reese & Richardson, Walsh & Price,

and Starr et. al. (all cited in the FEIS and some extensively) do not support the FEIS' conclusions that an adequate confining layer exists. Third, the findings and recommendations contained in studies by the EPA, Starr, USGS, Dr. Virginia Walsh, and even FPL's own witness Dr. Maliva, over the last decade and a half strongly undermine the FEIS' conclusion that a single well test is sufficent to to support a finding of no significant impact. The scientific investigation supporting the FEIS should have included seismic-reflection testing in additon to the borehole test results. Finally, deficiencies in FPL's borehole testing from collected samples from a mere 4% of a 3,230 foot-deep well to results that included low percent bedrock recoveries, high percent porosity of bedrock intervals, and inconclusive straddle packer tests rendered the data produced by the well inadequate, even as a complement to seismic-reflection testing.

In sum, the weight of the record evidence does not support the NRC Staff's findings in the FEIS that a confining layer of "low permeability" exists at the Turkey Point site (FEIS at 2-47), and the FEIS is inadequate to support NRC Staff's conclusion that it is "extremely unlikely" that wastewater injected into the Boulder Zone will migrate upward into the Upper Floridan Aquifer, an underground source of drinking water ("USDW"). *Id.* at 5-26.

D. Findings Regarding Impacts of Chemical Constituents Migrating into a USDW

1. Chemical Constituents Levels and their Health Impacts

Table 3-5 of the FEIS identifies the expected concentrations of constituents that will be injected underground at Turkey Point. *Id.* at Table 3-5. These constituents include, among many others, heptachlor, ethylbenzene, toluene, and tetrachloroethylene. *Id*. The following table includes the projected concentration for ethylbenzene, heptachlor, tetrachloroethylene, and

toluene if 100% wastewater is used, and the EPA Maximum Contaminant Levels ("MCLs") and the EPA Maximum Contaminant Level Goals ("MCLGs") for the constituents:

Contaminant Name	**Concentration (mg/L)**	**EPA MCL**	**EPA MCLG**
Heptachlor	0.000023	0.0004	0
Ethylbenzene	(a)	0.7	0.7
Toluene	0.00174	1.0	1.0
Tetrachloroethylene	0.00359	0.005	0
(a) Constituent concentration was below the method detection limit. mg/L = milligrams per liter.			

Joint List of Joint List of Undisputed Facts ¶¶ 40, 42; Table 3-5, FEIS.

The NRC Staff assert that the environmental impacts of wastewater would be small if it entered a drinking water supply, because the concentration of constituents at issue is below the federal MCL. NRC Staff Testimony, A.6. While the federal MCL is one useful benchmark for assessing impacts to drinking water sources, other standards such as state standards and federal MCLGs should be considered in a NEPA analysis as well. States can choose to have more restrictive standards to represent unique risks specific to that state. For example, while the EPA MCL for tetrachloroethylene is 0.005 mg/L, the Florida standard is 0.003 mg/L. Teaf Testimony, ¶29.

As the EPA explains, MCLs are derived from MCLGs, "the level at which no known or anticipated adverse effect on the health of persons occur and which allow an adequate margin of safety." Quarles Rebuttal Testimony, A20; Notice of Final Rule, National Primary Drinking Water Regulations; Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants, 52 Fed. Reg. 25,690-91 (July 8, 1987) (**Exhibit INT-0021**). MCLs, in contrast, are "enforceable standard(s) which the [Safe Drinking Water] Act directs EPA to set as close to the MCLGs as feasible." *Id.* "Feasible" includes the use of the best technology, treatment techniques, or other

means which the Administrator finds available (taking costs into consideration) after examination for efficacy under field conditions and not solely under laboratory conditions. *Id.***.**

In other words, MCLs reflect EPA's balancing assessment of the health risks of exposure weighed against the cost and feasibility of limiting this exposure. MCLGs, on the other hand, are based solely on the health risks chemicals pose to the public. Considerations of feasibility and cost, which may be relevant to the establishment of an MCL, are not relevant to the issue of whether the contaminant has significant public health, i.e. environmental effects. Quarles Testimony, A6.

While none of the expected concentrations exceed EPA's MCL, the concentration level identified in Table 3-5 for tetrachloroethylene does exceed the Florida DEP's MCL of 0.003 mg/L. *Id.;* Teaf Testimony, ¶29. FDEP's MCL is the standard that is applicable to FPL's UIC permit and establishes the safe level for a chemical constituent in Florida's drinking water. Quarles Rebuttal Testimony, A21. Dr. Teaf testified that the state MCL may change sometime in the future; however, this is mere speculation on Dr. Teaf's part. Tr. 816-19. NRC Staff and FPL provided no support of this claim. Furthermore, 0.003 mg/L remains the current legally enforceable drinking water standard in Florida today. FDEP (Florida Department of Environmental Protection). 2015. Chapter 62-550. Drinking Water Standards, Monitoring, and Reporting. July 7, 2015 (**Exhibit FPL-053).**

Dr. Teaf testified that because the levels of the four constituents are "all below federal drinking water standards…[t]his means that, with regard to these four chemicals, the injectate would not be harmful to public health." Quarles Rebuttal Testimony, A21; Teaf Testimony, ¶15. Dr. Teaf skirted the fact the tetrachloroethylene concentration identified in the FEIS exceeds the state MCL. Dr. Teaf recognizes that the EPA, in addition to the Agency for Toxic Substances

and Disease Registry ("ATSDR"), has significant concerns regarding tetrachloroethylene because it is "likely to be carcinogenic in humans." Quarles Rebuttal Testimony, A21; Teaf Testimony, ¶53. Dr. Teaf further acknowledges that this carcinogenic factor is "addressed in establishment of the state and federal MCLs." *Id.* Dr. Teaf's testimony does not provide sufficient support to disregard the fact that the tetrachloroethylene levels exceed the Florida MCL.

While the MCLs can serve as useful benchmarks, they are not the only standards that should be used in assessing a project's impacts to a USDW. The MCLG should also have been considered. In this instance two of the four constituents at issue—tetrachloroethylene and heptachlor—have MCLGs of zero. That is, the U.S. EPA states there is no safe dose of these constituents in drinking water. The concentrations of tetrachloroethylene and heptachlor listed in Table 3-5 are well above the MCLGs for these constituents. Quarles Testimony, A22. Their presence at these levels is cause for concern about their impacts on public health. *Id.*, A20. This is of particular concern for vulnerable populations such as the elderly, the young, the sick, and expectant mothers. It is because of these vulnerable populations that the MCLGs for these types of constituents were developed and the reason why the EPA has set the MCLG for both heptachlor and tetrachorloethylene at zero. *Id.*

As the ATSDR makes clear, heptachlor, ethylbenzene, toulene, and tetrachloroethylene carry with them a host of harmful effects. Affidavit of Mark A. Quarles, ¶31 **(Exhibit INT-002-R)**; ATSDR, Division of Toxicology and Environmental Medicine ToxFAQs (compiled for ethylbenzene (2007), tetrachloroethylene (2014), and heptachlor (2007) (**Exhibit INT-016**) ("ATSDR ToxFAQs"). Heptachlor is a manufactured chemical insecticide that evaporates very slowly in air and can stay in soil and water for many years. Declaration of Mark A. Quarles In

Support of Joint Intervenors' Answer to FPL's Motion for Summary Disposition of Joint Intervenors' Amended Contention 2.1, ¶18 (**Exhibit INT-004-R)** ("Quarles Declaration"). It is a possible human carcinogen with immune and nervous system effects. Affidavit of Mark A. Quarles ¶31; ATSDR ToxFAQs**.** Ethylbenzene is a possible human carcinogen linked to kidney damage. *Id***.** Toluene can cause naseua and have effects on the nervous sytem. *Id.* Tetrachloroethylene is a manufactured chemical used in dry cleaning operations and also as an industrial degreaser to remove oils and greases from industrial machinery during manufacturing or maintenace. Quarles Declaration, ¶14. It is a probable human carcinogen that can cause liver damage, impaired heart function and death. Affidavit of Mark A. Quarles, ¶31; ATSDR ToxFAQs.

The FEIS fails to adequately explain why the impacts to vulnerable populations would not be significant in doses that exceed the MCLG and for tetrachloroethylene at a dose that exceeds the Florida MCL for this probable carcinogen. The NRC Staff must fully evaluate and discuss the potential impacts these constituents would have on the USDW for public and private water supply uses.

2. High Level Disinfection Treatment

The NRC Staff contend that high-level disinfection installed at the South District Plant in 2013 reduces the concentration levels of the four constituents in the wastewater stream and would "provide an effluent quality that would not endanger Underground Sources of Drinking Water." NRC Staff Testimony, A20, A38, A42, A59, A67. The NRC Staff did not supply facts to support this contention.

The EPA declared that high-level disinfection is only designed to remove pathogens, such as Cryptosporidium and Giardia. Quarles Rebuttal Testimony, A16; UIC rule at 70,518.

High-level disinfection is not designed to remove other compounds, including volatile organic compounds ("VOCs") or semi-volatile organic compounds ("SVOCs") like the constituents at issue. Quarles Rebuttal Testimony, A16; A18. As EPA stated in the preamble to the 2005 UIC rule:

> Although pretreatment, secondary treatment, and high-level disinfection will remove many contaminants that may be present in municipal wastewater, EPA agrees with commenters who said that a large variety of contaminants, such as pharmaceutical products and disinfection byproducts, that may be present in treated municipal wastewater, may not be removed.

UIC rule at 70,525.

EPA recognized that other contaminants may be present in wastewater, and those contaminants may not be removed by the high-level disinfection process. EPA addressed only pathogens in its 2005 rule update and did not require that these other contaminants be removed by advanced treatment because EPA found that those other contaminants would be addressed because:

> (1) The Relative Risk Assessment found that the only contaminants that posed a potential threat were pathogenic microorganisms; (2) Class I municipal disposal wells are precluded from injecting listed or characteristically hazardous waste streams; (3) Class I municipal disposal wells are allowed to inject only wastewater that has received a level of treatment, specified in individual permits, deemed necessary by the Director to prevent endangerment; and (4) many other contaminants are addressed through EPA's existing pretreatment regulations . . . *If the Director finds that any other contaminants pose a threat to USDWs, that threat can be addressed on a site-specific basis under existing authorities*.

Quarles Rebuttal Testimony, A17; UIC rule, 70 Fed. Reg. at 70,525-26 (emphasis added). However, the four chemical constituents at issue are also indicator constituents of chemicals commonly associated with industrial or agricultural wastewater streams that are discharged into the sewerage system prior to reaching the plant. Their presence in the South District Plant's wastewater after primary and secondary treatment in the past demonstrates that the plant is ineffective at removing all such constituents form the wastewater. Quarles Rebuttal Testimony,

A18. These other treatments are not always effective in eliminating such contaminants from the treated wastewater effluent that would be discharged to Turkey Point. *Id.*, A16; A18.

But NRC Staff contend that the fact that measurements of the four constituents taken since the high-level disinfection process was implemented at the South District Plant have decreased from the original samples is evidence that the disinfection reduces the levels of the four constituents in the wastewater. NRC Staff Testimony, A 38 and A59; Teaf Testimony, ¶17. NRC Staff's reliance on 40 milliliter grab samples provides limited insight as these sample solely reflect the water quality of that minute volume at the mere few seconds that it took FPL to fill the sample vials. Quarles Rebuttal Testimony, A18; FPL (FPL Central Laboratory). 2013a. Laboratory results for work order 13D0159. May 1, 2013 **(Exhibit FPL-041)**; FPL (FPL Central Laboratory). 2013b. Laboratory results for work order 13H0145. August 13, 2013 **(Exhibit FPL-042)**; FPL (FPL Central Laboratory). 2013c. Laboratory results for work order 13H0286. August 26, 2013 **(Exhibit FPL-043)**; FPL (FPL Central Laboratory). 2013d. Laboratory results for work order 13J0216. October 31, 2013 **(Exhibit FPL-044)**; FPL (FPL Central Laboratory). 2014a. Laboratory results for work order 14C0184. March 19, 2014 **(Exhibit FPL-045)**; FPL (FPL Central Laboratory). 2014b. Laboratory results for work order 14C0268. April 10, 2014 **(Exhibit FPL-046)**. The correlation between the high-level disinfection and the decrease in measured contaminant levels does not provide enough to conclude there is causation between the two. Quarles Rebuttal Testimony, A18.

Moreover, the current wastewater permit for the South District Plant does not include any specific sampling to monitor or otherwise verify whether high-level disinfection reduces or removes the contaminants that the system is not designed to treat. In fact, there are no monitoring requirements for any of the four constituents at issue in Contention 2.1. *Id.*; Florida Department

of Environmental Protection, Miami-Dade South District Wastewater Treatment Plant, Domestic Wastewater Facility Permit, Permit Number FLA042137 (Dec. 10, 2012) (**Exhibit INT-019)**.

In sum, the weight of the evidence casts significant doubt on the ability of the high-level disinfection process at the South District Plant to remove the four constituents from the wastewater stream prior to injection into the Boulder Zone.

3. Dilution

The FEIS concludes the impacts will be "small" in part because migration of injected wastewater would sufficiently dilute the constituents, such that they would only be in low concentrations and there would be no human health impact. Quarles Testimony, A22. The NRC Staff cite to three studies in support of their position: Dausman, Bloetscher, and the EPA Risk Assessment. These studies, however, provide limited insight into whether the four constituents at issue here will be diluted in their concentration levels as they migrate from the Boulder Zone and into the USDW at the Turkey Point site. The weight of evidence does not support the contention that dilution will ensure impacts will be small because (1) the studies do not address Turkey Point's site specific characteristics, (2) the studies do not consider human health impacts, and (3) current location of wells and water quality of underground sources cannot nullify future impacts.

a. The Studies Cited In The FEIS Do Not Address Turkey Point's Site Specific Characteristcs

First, the studies cited in the FEIS do not address the specific characteristics of the Turkey Point site, including the potentially high rate of vertical migration of wastewater into the drinking water aquifer. *Id.,* A23. The Dausman Study was performed at the South District Plant. *Id.,* A22. The Bloetscher study was also not designed or performed specific to Turkey Point (or even the South District Plant). *Id.,* A23. Instead, the Bloetscher study was a "comparative assessment" that evaluated, generalized, and compared wastewater disposal alternatives in the

southeast Florida region. *Id.*; Frederick Bloetscher et al., Comparative Assessment of Municipal Wastewater Disposal Methods in Southeast Florida, Water Environment Research 77(5):480-490, Alexandria, Virginia (2005) (**Exhibit INT-018)**. The EPA Risk Study was also not designed to be a site-specific investigation of the subsurface conditions and wastewater effluent migration for the Turkey Point site. Quarles Testimony, A23. The study was a generic study that evaluated regional conditions that might be expected in Dade County. *Id.*.

A site-specific analysis of the underlying geologic features is necessary because the rate of migration, and in turn the amount of dilution, is influenced by the type of features present at the site. Groundwater contaminant migration that follows "isolated conduits" can be rapid. In these instances, there is less dilution. The Dausman study concluded that vertical migration of wastewater into the drinking water aquifer occurred beneath the South District Plant site and has a relatively direct connectivity to that injection because of the 20-foot rise in groundwater elevations at the site. Id., A25**;** Alyssa Dausman, Christian Langevin, Michael C. Sukop, & Virginia Walsh, Saltwater/Freshwater Interface Movement in Response to Deep-Well Injection in a Coastal Aquifer, Proceedings of the 20th Salt Water Intrusion Meeting, June 23-27, Naples, Florida, at 50 (2008) (**Exhibit INT-017)**. The Starr study of the South District Plant concluded that "the spatial patterns of contamination in the Upper Floridan Aquifer are consistent with migration of contaminated water through isolated conduits" and that those isolated conduits "could be either natural features or man-made features such as inadequately sealed wells." Quarles Testimony, A25; Starr e al. at 38. Walsh and Price concluded that the vertical migration was "rapid" through vertical pathways; that the "warmer injectate retained the temperature signal as it vertically migrated upwards"; contamination was widespread "throughout the site"; and the concentration of ammonia (an indicator of wastewater) correlated well in one aquifer monitor

well with the injected wastewater concentrations. Quarles Testimony, A25; Walsh and Price at 1, 4, and Figure 5. These conclusions suggest a direct and quick vertical leakage rate. Quarles Testimony, A25.

Groundwater contaminant migration that is rapid and follows such "isolated conduits" results in less dilution because the flow is concentrated along discrete vertical pathways. *Id.* With a faster rate of upward migration along these discrete conduits, the contaminant concentrations of the constituents will be less diluted and will be more representative of the injected wastewater constituents at the point of connectivity with the drinking water aquifer. *Id.*

At least one groundwater flow model used by FPL in the FEIS predicted vertical migration of groundwater injected into the Boulder Zone would "likely be less than 300 feet" – but that model assumed there were no "well-developed pathways" that would enable rapid, conduit-like flow. *Id.*; FEIS at 5-27 and Appendix G. Such conduit-like flow conditions exist just to the north at the South District Plant.

The NRC Staff relied on a regional study of South Florida injection well sites by Maliva that evaluated the permeability of bedrock layers to measure the vertical rate of groundwater flow. Quarles Testimony, A25; FEIS at 5-24. Based on the results of that study, the Staff concluded that "minimal vertical migration would occur through sections where vertical hydraulic conductivity was 10^{-6} cm/sec or less" and used that generic conclusion to support its conclusion that the same conditions exist at Turkey Point "to prevent or limit vertical migration." *Id.*. This NRC Staff conclusion is substantially flawed because it fails to consider the more likely vertical transport mechanisms associated with vertical leakage, bedrock fractures and faults that can extend hundreds and thousands of feet (see Cunningham 2015 at 13, 15, 17, 19 – 22), and

well failures recognized by Starr, Walsh and Price, and Cunningham studies. Quarles Testimony, A15.

As explained above, a Turkey Point site-specific investigation that at a minimum includes a seismic analysis and other hydrogeological analyses is necessary to determine if confining conditions sufficiently exist vertically and horizontally to prevent migration and contamination of the drinking water aquifer. *Id.*, A25.

b. The Studies Do Not Address Human Health Impacts Of Migration

Second, in addition to not addressing the specific characteristics of the Turkey Point site, the three studies cited by the NRC Staff in the FEIS were also not specifically designed to address human health impacts of migrated contaminants. *Id.*, A23. The Dausman study was not designed to predict constituent concentrations in any aquifer and as such, it should not be used to determine risks to human health. The study was instead designed to determine if the freshwater-saline interface layer would change over time due to wastewater injection. *Id*. The Bloetscher study relied on samples being collected and analyzed for constituents of concern prior to use of the water, which is not planned at Turkey Point. Quarles Testimony, A23.

The EPA Risk Study was also not designed to be a site-specific investigation of the subsurface conditions and wastewater effluent migration for the Turkey Point site. The study was a generic study that evaluated regional conditions that might be expected in Dade County. *Id*. Although the EPA study included groundwater flow models to predict groundwater concentrations in the aquifer if leakage occurs, EPA admitted that the study has two significant limitations. First, "[t]he presence and extent of preferential flow paths, or alternative wastewater migration pathways, is not adequately known. The significance of these pathways to both wastewater transport and risk can only be estimated." EPA Risk Assessment at 4-40. Second,

"substantial data gaps exist. There are limited data and information that may be used to develop and assign accurate values for some model input parameters. At present, this is an unavoidable source of remaining uncertainty." *Id.*

c. The Current Location Of The Wells Does Not Make The Impact Small

Third, even if migration was rapid and dilution was limited, FPL and the NRC Staff argue that the threat would still be small. Dr. Maliva testified that the nearest existing or planned Floridan Aquifer public supply wells are located over 10 miles west of the Turkey Point site, in the up-gradient direction and opposite from the direction of groundwater flow. Maliva Testimony ¶14; NRC Staff Testimony, A64. This direction of groundwater flow assumes a natural state without leakage and did not consider the potential for flow direction changes due to leakage. NRC Staff also testified that the Upper Floridan Aquifer at Turkey Point is too saline to be used for drinking water without treatment. NRC Staff Testimony, A24. Studies show, however, that groundwater contamination can migrate far from the point of injection. For example, the Dausman study concluded that wastewater injected at the South District Plant can migrate 13 miles horizontally. Quarles Testimony, A26.

In addition, Dr. Maliva's focus on the present location of drinking water wells is short sighted and inconsistent with the federal Safe Drinking Water Act. *Id.*, A19. The purpose of designating aquifers as Underground Sources of Drinking Water is to ensure that they are protected for both present *and* future uses. As defined in federal Safe Drinking Water Act regulations, a USDW includes not just current sources of drinking water, but aquifers containing "a sufficient quantity of ground water to supply a public water system," if they contain fewer than 10,000 mg/l total dissolved solids. 40 C.F.R. § 144.3(a)(2)(ii). Given the high and expanding population of Florida, and given the limited supply of fresh water (and particularly the

shallowness of the Biscayne Aquifer used in Southeast Florida), any aquifer with the potential to provide drinking water should be protected. Quarles Testimony, A19.

The Florida Department of Environmental Protection has acknowledged that demand for water will continue to increase in Florida, and that additional and diversified water sources are needed to maintain a reliable supply of water for the expected increase in demand. *Id.*; Florida Department of Environmental Proteciton, Regional Water Supply Planning, 2015 Annual Report (**Exhibit INT-020)**. The fact that an aquifer may require desalinization at some point in the future does not provide valid grounds for failing to protect it like any other USDW, because desalinization may become necessary in the future to support the population in the state. Quarles Testimony, A19.

Therefore, the weight of the evidence does not support the NRC Staff's conclusions that the chemical constituents would be sufficiently diluted before reaching the USDW.

4. Injection Well Design And Testing

The FEIS further concludes that any impact of injected wastewater will be "small" because the design and testing of the injection well will prevent any leaks. *Id.* However, seals and wells can fail at any time. And, as the FEIS acknowledges, even a wastewater injection well application that is reviewed and approved by FDEP and constructed to FDEP standards can fail. *Id.*; FEIS at 2-56.

Studies and expert testimony actually document past well failures in the region. Walsh and Price; Starr et. al. The Starr study concluded that Floridan aquifer contamination at the South District Plant was due to upward migration along "localized pathways such as wells that are not adequately sealed or natural conduits." Quarles Testimony, A29; Starr et al. at iv. That study recommended additional investigations to better define the subsurface geology and groundwater conditions. Quarles Testimony, A29; Starr et. al. at 38. The Walsh and Price study also

concluded that a leaking well at the North District Plant allowed wastewater to migrate vertically into the overlying aquifers. That study found "data provide strong evidence of a one-time pulse of injectate into the overlying aquifers due to improper well construction." Quarles Testimony, A29; Walsh and Price at 1.

Well installation procedures involve injecting "grout," a cement mixture, to adequately seal the exterior of a metal well casing with the surrounding bedrock. Quarles Testimony, A29. The more fractured the bedrock, the more difficult the process to inject the grout in a manner that fully encases the well casing and the surrounding bedrock to provide a seal to prevent upward migration of injectate. *Id*. Mr. McNabb documented such highly weathered bedrock conditions with voids during the installation of well EW-1. *Id.*; Third Affidavit of Mark A. Quarles (Feb. 2, 2016) (filed in response to FPL's Statement of Material Facts As to Which No Genuine Issue Exists, in support of FPL's Motion for Summary Disposition of Intervenors' Amended Contention 2.1 ¶ 18-24 (Dec. 15, 2015)) (**Exhibit INT-005-R**).

Thus, while good design and testing are important, alone they do not reduce impacts to small. And in fact, the FEIS relies on the lower injection rates planned for the proposed site relative to the South District Plant to limit formation pressures and ensure the integrity of the constructed well. Quarles Testimony, A27; FEIS at 5-40. But as Mr. Quarles testified, no formation pressure test was ever conducted on well EW-1 to monitor leakage between the concrete that is in contact with bedrock formations and all outer steel casings. Quarles Testimony, A19; Third Affidavit of Mark A. Quarles, ¶ 43. The contact between the bedrock and outer casing must be sealed for the entire depth of the well to prevent upward migration of wastewater along this pathway. This is especially critical where the bedrock is significantly fractured or where voids are present. Without these tests, it is not possible to document whether

cement coverage and seal would prevent leakage. Quarles Testimony, A27. Furthermore, the FEIS fails to provide adequate support that mechanical integrity tests performed every five years will be sufficient enough to detect stresses and strains on the injection wells that would allow for leakage. *Id.*, A19.

Therefore, injection well design and testing will not necessarily prevent any leaks and, as a result, the NRC's reliance on well design and testing cannot support a determination that the impacts would be "small."

5. Proposed Monitoring Program

Mr. McNabb testified that the dual-zone monitoring program FPL intends to implement will identify any wastewater leaks or migration into the USDW. The testimony of Mr. Quarles, however, demonstrates that the monitoring program may be unlikely to detect upward migration before contamination occurs because (1) sampling will not be frequent enough due to the possibility of a rapid rate of migration, (2) the constituents may migrate horizontally before they migrate upward, and (3) vertical migration of wastewater can also bypass shallower monitoring wells through discrete vertical fractures in the upper-lying bedrock. Quarles Testimony, A28. Additionally, EPA even disregards monitoring programs' ability to provide early warming for migration.

First, upward migration of wastewater along vertical pathways can occur in a matter of days. *Id*. However, FPL's groundwater monitoring program consist of quarterly or semi-annual sampling frequencies. *Id*. EPA's assessment of the Lower Floridan Aquifer "supports the existence of vertical joints and high rates of migration flow in the planned Boulder Zone injection formation," such that groundwater flow may occur "at extremely rapid rates." *Id*. The Walsh & Price study also confirms a fast rate of upward migration near the Turkey Point site.

Id.; Walsh and Price at 1038. Therefore, the constituents are likely to reach the Upper Floridan Aquifer before FPL's monitoring system detects the contamination. Quarles Testimony, A28.

Second, the wastewater may migrate horizontally within the Boulder Zone prior to migrating vertically. FPL's intent to use a "dual-zone" groundwater monitoring well ("DZMW") to detect upward migration of wastewater may not provide an early indication of groundwater contamination because the DZMW is located 75 feet from the injection well. Quarles Testimony, A28; FEIS at 5-39 – 5-40.

Third, discrete vertical migration of wastewater can also bypass shallower monitoring wells through discrete vertical fractures in the upper-lying bedrock. Quarles Testimony, A28. Cunningham explained in his 2012 study that seismic reflection data is being used to evaluate vertical hydraulic bypass of confinement within the Floridan aquifer system. Cunningham 2012 at 1. As the NRC Staff recognizes in the FEIS, the Walsh & Price study concluded that upward migration "likely resulted from issues related to well installation or failure because effluent appeared to bypass deeper monitored intervals before being detected at higher depths." FEIS 5-25. The EPA has also determined that "existing compliance monitoring programs are not sufficient to protect against movement of contaminants into USDWs, nor do they provide sufficient early warning of contamination." Quarles Rebuttal Testimony, A14; UIC rule at 70,526. EPA concluded in its rulemaking for the UIC program:

> groundwater monitoring wells at most deep well injection facilities in Florida are only intended to provide some initial indication of fluid movement and are not capable of characterizing the full areal extent of fluid movement, especially where natural conduits for flow are present. Moreover, once any contamination is detected, it may be too late to prevent endangerment.

Id.

Thus, as explained earlier, without seismic reflection analysis to locate monitoring points along those conduits, the monitoring program will likely not detect the migration of upward

migration of wastewater before the USDW is contaminated.

Therefore, the record does not support a finding that FPL's monitoring program will adequately identify and resolve any contamination prior to any wastewater migrating upward and impacting the USDW.

6. Summary of Findings Regarding Chemical Contaminants

The NRC Staff have also failed to satisfy NEPA with respect to their conclusion that even if upward migration of injected wastewater were to occur, impacts from chemical contaminants in that water would be "SMALL."

First, it was unreasonable for the NRC Staff to rely on MCLs to make a determination that the impacts would be "small." The NRC Staff failed to adequately evaluate and discuss the potential impacts these constituents would have on the public, particularly vulnerable populations such as the elderly, the young, the sick, and expectant mothers. Further, the level of tetrachloroethylene reported in the FEIS is above Florida's legal limit for drinking water, and therefore should not be ruled out as insignificant.

Second, the FEIS fails to adequately explain why the impacts to vulnerable populations would not be significant in doses that exceed the MCLG and for tetrachloroethylene at a dose that exceeds the Florida MCL for this probable carcinogen. Further, the NRC Staff cannot rely on high-level disinfection technology installed at the South District Plant to lower contaminant levels in the wastewater, thereby minimizing their environmental impacts. As EPA cautions, disinfection is not designed to remove volatile organic compounds and semi-volatile organic compounds, like the contaminants at issue in Contention 2.1, from wastewater. UIC rule, 70 Fed. Reg. at 70,525-26.

Third, the weight of evidence does not support NRC Staff's position that the impacts will be "small" in part because the wastewater will be treated and migration of injected wastewater

would sufficiently dilute the constituents, such that they would only be in low concentrations and there would be no human health impact. As noted above, disinfection is not designed to remove volatile organic compounds and semi-volatile organic compounds, like the contaminants at issue in Contention 2.1, from wastewater. Further, the studies NRC cites to in support of its conclusions do not address Turkey Point's site specific characteristics and do not consider human health impacts. In addition, current location of wells and water quality of underground sources cannot nullify future impacts.

Fourth, the injection well design and testing will not necessarily prevent any leaks. There have been documented well failures in the past, necessary tests were not performed to confirm that leakage would not occur, and the mechanical integrity tests performed every five years are not sufficient to detect stresses and strains on the injection wells that would allow for leakage. As a result, the NRC's reliance on well design and testing cannot support a determination that the impacts would be "small."

Fifth, the monitoring program relied upon by FPL and NRC Staff may not detect upward migration before contamination occurs because sampling will not be frequent enough due to the possibility of a rapid rate of migration and the constituents may migrate horizontally before they migrate upward. Vertical migration of wastewater can also bypass shallower monitoring wells through discrete vertical fractures in the upper-lying bedrock. Thus, as explained earlier, without seismic reflection analysis to locate monitoring points along those faults and fractures, the monitoring program will likely not detect the migration of upward migration of wastewater before the USDW is contaminated.

V. CONCLUSIONS OF LAW

In this case, the ASLB is called upon to determine whether the NRC's FEIS meets NEPA's "hard look" standard (*Klamath-Syskiyou Wildlands Center v. Bureau of Land*

Management, 387 F.3d 989, 993 (9th Cir. 2004)) with respect to its conclusion that the environmental impacts of upward migration of injected wastewater will be "SMALL" because (a) the wastewater is "extremely unlikely" to migrate into the Upper Floridan Aquifer, an USDW (FEIS at 5-26); and (b) that even if the wastewater does migrate, concentrations of the contaminants it contains will not be great enough to harm public health. *Id.* at 5-40 - 5-42. For the reasons discussed below, the ASLB should conclude that the NRC has fallen far short of NEPA's "hard look" standard in coming to this conclusion. Accordingly, the ASLB should rule that the NRC Staff lacks an adequate legal basis to issue a COL for Turkey Point Units 6 and 7, and remand the FEIS to the Staff for further proceedings.

A. The FEIS Fails to Provide a Reasonable Amount of Technical Support for the Conclusion that Upward Migration is "Extremely Unlikely to Occur" and Ignores Evidence that Upward Migration of Wastewater Constitutes a Significant Environmental Risk in the Region of the Turkey Point Site.

The NRC's conclusion that upward migration of injected wastewater is "extremely unlikely to occur" fails NEPA's "hard look" test in every relevant measure. The FEIS acknowledges, but fails to address the significance of, repeated observations during the past decade of upward migration of wastewater from the supposedly impregnable Boulder Zone into the aquifers above, including scientific literature cited in the FEIS itself. The FEIS also ignores the documented experience of two federal agencies – the EPA and USGS – and the availability of proven seismic reflection technology for identifying potential conduits for migration of wastewater. For instance, the EPA has found "hydrogeologic demonstrations" to be so unreliable for demonstrating competence of confining aquifers in South Florida that it no longer relies on them for its UIC permitting process. UIC rule, 70 Fed. Reg. at 70,532.

By ignoring or failing to address the significance of relevant information, the NRC Staff violates NEPA's cardinal principle that it must thoroughly examine the potential adverse

consequences of its actions before taking them. *Klamath-Syskiyou Wildlands Ctr.,* 387 F.3d at 993. The FEIS also violates the basic principle of NEPA and administrative decision-making that an agency's conclusions must bear a reasonable relationship to the record before it. *National Audubon Soc. V. Dept. of the Navy,* 422 F.3d 174, 192 (4th Cir. 2005) (faulting the Navy for relying on studies that "do not support" its conclusions).

The requisite robust inquiry into the geological characteristics of the Turkey Point site may not be postponed until after licensing, when FPL proposes to gather more data from the additional injection wells it will install. An agency must inform itself regarding the environmental impacts of its action *prior* to taking that action, *i.e.,* "before the die is cast." *Robertson,* 490 U.S. at 349. Here, the NRC Staff's failure to perform an adequate site investigation prior to approving the Turkey Point project constitutes a particularly egregious violation of NEPA, given the observations by federal agencies USGS and EPA regarding repeated excursions of wastewater into the USDW and the failure of the same methods relied on by FPL and the NRC Staff to make reliable predictions regarding the likelihood that wastewater could be contained by the aquifer. Under the circumstances, the NRC Staff utterly failed to take the requisite hard look at the risk of upward migration of injected wastewater.

B. The NRC Staff Should Have Conducted or Required Seismic Reflection Testing of the Turkey Point Site.

An EIS "must utiliz[e] public comment and the best available scientific information" and disclose and analyze "the costs of uncertainty [and] the costs of proceeding without more and better information." *Colorado Environmental Coalition v. Dombeck,* 185 F.3d 1162, 1171-72 (10th Cir. 1999); *S. Oregon Citizens Against Toxic Sprays, Inc. v. Clark,* 720 F.2d 1475, 1478 (9th Cir. 1983). An EIS that relies on incorrect assumptions, incomplete data, or misleading information violates NEPA. *Native Ecosystems Council v. U.S. Forest Service,* 418 F.3d 953,

964-66 (9th Cir. 2005); *see also Seattle Audubon Society v. Espy*, 998 F.2d 699, 704-05 (9th Cir. 1993) (reversing EIS that rested on "stale scientific evidence, incomplete discussion of environmental impacts, and false assumptions"). *See also* 40 C.F.R. § 1500.1(b) ("Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA.").

In violation of these requirements, the FEIS gives only passing mention to seismic reflection as a tool for characterizing the hydrogeology of the Turkey Point site, and FPL and the NRC Staff attempt to brush it aside as a mere research tool or "flyspeck[ing]." Tr. 902 (Lepre); NRC Staff Initial Statement of Position at 9, 19 (Mar. 1, 2017). But they ignore three fundamentally important facts that establish seismic reflection technology as not only reasonable, but necessary for assessing environmental conditions at the Turkey Point site. First, the USGS has identified an "immediate need" for seismic reflection studies in South Florida, given the migration of injected wastewater into the USDW there; and has determined that seismic reflection technology provides valuable information about the existence and location of conduits for groundwater flow. Cunningham 2012. Second, seismic reflection testing is recommended as a matter of course, for all injection wells, by the official with the most direct knowledge and experience regarding wastewater injection in the vicinity of Turkey Point, chief hydrogeologist of the Miami-Dade regional water authority, Dr. Virginia Walsh. Finally, as discussed above, the EPA has rejected the sufficiency of the methodology used by FPL and NRC to predict the likelihood that wastewater will migrate upward, and therefore it is unreasonable to rely on that methodology alone. Accordingly, the NRC Staff has failed to take the "hard look" required by NEPA at the environmental impacts of injecting wastewater from Turkey Point Units 6 and 7 into the Boulder Zone beneath the site.

Moreover, the single borehole well test conducted by FPL is attended by so much uncertainty that it is not possible to reasonably conclude that upward migration of wastewater is so unlikely as to be insignificant. Only by using seismic reflection technology could the NRC Staff claim to have sufficient information to make a reasonable determination regarding the likelihood of upward migration of wastewater. Where there is uncertainty, agencies must take steps to address the uncertainty. "When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an [EIS] and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking." *Id*. § 1502.22. "If the incomplete information relevant to reasonably foreseeable significant adverse impacts is essential to a reasoned choice among alternatives and the overall costs of obtaining it are not exorbitant, the agency *shall include the information in the [EIS]*." *Id*. § 1502.22 (a)(emphasis added). If the NRC Staff chooses not to conduct or require seismic reflection testing, then it must take the significant uncertainty of upward migration into account in its impact analysis. *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016, 1033 (9th Cir. 2016). Having failed to conduct or require seismic reflection testing, the NRC Staff had no reasonable basis for concluding that wastewater was unlikely to migrate into the USDW.

C. The FEIS Fails to Provide a Reasonable Amount of Technical Support for the Conclusion that the Environmental Impacts of Wastewater will be "SMALL" if it Does Reach the USDW.

The NRC Staff have also failed to satisfy NEPA with respect to their conclusion that even if upward migration of injected wastewater were to occur, impacts from chemical contaminants in that water would be "SMALL" because wastewater sampling results indicate that the concentration levels are below the EPA's Maximum Contaminant Levels ("MCLs"). As a matter of law under a NEPA analysis, MCLs may not be relied on to establish a threshold for concluding that environmental impacts are significant, because they are discounted by cost and

feasibility considerations that have no bearing on the health or environmental impacts of the constituents at issue. 10 C.F.R. Part 51, Appendix A, § I(b)(7) (requiring an environmental analysis to discuss "*any adverse environmental effects* which cannot be avoided should the [proposed] alternative be implemented.") (emphasis added). MCLs reflect EPA's balancing assessment of the health risks of exposure weighed against the cost and feasibility of limiting this exposure. Consideration of health effects is diluted by consideration of feasibility and costs. Therefore, the MCLs do not reflect consideration of "any environmental effects" of exposure to the constituents.

In contrast, the NRC should have judged the significance of the health impacts of the contaminants against the EPA's Maximum Contaminant Level Goals ("MCLGs"), which are based solely on the health risks these chemicals pose to the public, particularly vulnerable populations such as the elderly, the young, the sick, and expectant mothers. For two contaminants — tetrachloroethylene and heptachlor — the MCLGs establish that there is *no* safe dose in drinking water. While costs and feasibility may be relevant to a comparison of alternative actions under NEPA, the statute requires that an agency must examine the significance of the impacts themselves, without introducing extraneous considerations.

In any event, even if the NRC Staff's reliance on MCLs were appropriate, the level of tetrachloroethylene reported in the FEIS is above Florida's legal limit for drinking water, and therefore may not be ruled out as insignificant.

The NRC Staff also falls short of NEPA compliance by claiming that high-level disinfection technology installed at the South District Plant in 2013 will lower contaminant levels in the wastewater, thereby minimizing their environmental impacts. As EPA cautions, disinfection is not designed to remove volatile organic compounds and semi-volatile organic

compounds, like the contaminants at issue in Contention 2.1, from wastewater. UIC rule, 70 Fed. Reg. at 70,525-26. Because the effectiveness of disinfection technology to reduce volatile organic compounds is pure happenstance, NRC's reliance on it amounts to "speculation" rather than the "informed decision-making" required by NEPA. *Foundation for N. Am. Wild Sheep v. U.S. Dep't of Agric*., 681 F.2d 1172, 1179 (9th Cir. 1982).

Further, the NRC Staff violated NEPA by reaching an unsupported conclusion that even if the wastewater migrates upward, dilution will ensure impacts will be small by the time it reaches the USDW. The studies the NRC Staff rely on do not address Turkey Point's site specific characteristics and do not consider human health impacts. Moreover, the current location of wells and water quality of underground sources cannot nullify future impacts. The NRC Staff may not reach conclusions "unsupported by data, authorities, or explanatory information." *Seattle Audubon Soc'y v. Mosely*, 798 F.Supp. 1473, 1482 (W.D. Wash. 1992).

In addition, under NEPA, the NRC Staff failed to make a reasoned decision as the evidence does not support a finding that well design, testing, and monitoring would render the impacts "SMALL." *See Envtl. Def. v. U.S. Army Corps of Engineers*, 515 F. Supp. 2d 69, 78 (D.D.C. 2007) (explaining that reviewing court must "independently evaluate the record to confirm that the agency made a reasoned decision based on its analysis of the evidence before it."). In the UIC rule, EPA itself concluded that monitoring was too uncertain to be reliable. 70 Fed. Reg. at 70,519. Nothing in the record of this case shows otherwise. The documented occurrence of numerous unexpected past contamination events precludes any reasonable conclusion that injection well design and testing will prevent future leaks. Further, the monitoring program may be unlikely to detect upward migration before contamination occurs because sampling will not be frequent enough to detect rapid migration, the constituents may

migrate horizontally before they migrate upward, and vertical migration of wastewater can also bypass shallower monitoring wells through discrete vertical fractures in the upper-lying bedrock. Thus, the NRC Staff and FPL violated NEPA by relying on future well design, testing, and monitoring to conclude that significant impacts will not occur.

Finally, the FEIS violates NEPA by failing to address the uncertainty surrounding the likelihood that contamination of the Upper Floridan Aquifer, if it occurs, will cause significant harm. An impact can be significant when the possible effects on the human environment are highly uncertain or involve unique or unknown risks —such as the risks heptachlor and tetrachloroethylene pose to vulnerable populations. 40 C.F.R. § 1508.27(b)(5). It is because of these vulnerable populations that the MCLGs for these types of constituents were developed and the reason why the EPA has set the MCLG for both heptachlor and tetrachloroethylene at zero. Moreover, the concentration level of tetrachloroethylene exceeds the Florida MCL for this probable carcinogen. The NRC Staff's failure to address the uncertainty surrounding the impacts deep well injection will have on a protected underground source of drinking water and the unique risks these constituents pose to vulnerable populations, violates NEPA. *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016, 1033 (9th Cir. 2006).

Respectfully submitted this 15th day of June, 2017.

__/signed electronically by/___
Jason Totoiu
Executive Director
Everglades Law Center, Inc.
331 West Central Avenue, Suite 213
Winter Haven, FL 33880
Office: (863) 298-8000
Mobile: (561) 568-6740

__/signed electronically by/___
Mindy Goldstein
Turner Environmental Law Clinic
Emory University School of Law
1301 Clifton Road
Atlanta, GA 30322
Phone: (404) 727-3432
Email: magolds@emory.edu

__/signed electronically by/___
Diane Curran
Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
1725 DeSales Street N.W., Suite 500
Washington, D.C. 20036
240-393-9285
dcurran@harmoncurran.com

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	Docket Nos. 52-040 and 52-041
Florida Power & Light Company	)	
	)	ASLBP No. 10-903-02-COL-BD01
Turkey Point, Units 6 and 7	)	

CERTIFICATE OF SERVICE

I hereby certify that on June 15, 2017, I posted JOINT INTERVENORS' PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW on the NRC's Electronic Information Exchange System.

___/signed electronically by/__

Diane Curran
Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
1725 DeSales Street N.W., Suite 500
Washington, D.C. 20036
240-393-9285
dcurran@harmoncurran.com