of benzene contamination, County representatives Wilbur Mayorga of DERM, Tr. 4710, and Douglas Yoder,[108] Deputy Director of WASD, Tr. 4239, testified that mining presently does not pose a risk to the County's drinking water.[109] DERM's acting Director, Carlos Espinosa, also testified that DERM doesn't believe that the Wellfield will be reclassified as GWUDI based on continued mining over the next 18 to 36 months.

> extensive investigation of this well and concluded that the well lacked proper grouting. The well has been rehabilitated and it has shown, on subsequent MPAs, not to be GWUDI. On May 20, 1999, the State of Florida cleared this well from the GWUDI designation. In addition, the MDWASD is in the process of rehabilitating wells #15, 14, and 13 as a result of slightly high MPAs. The MDWASD rehabilitation program will provide additional protection from surface water influences under current conditions.... [The EIS for fifty years of limestone mining] does not provide reasonable assurance that the Plan will protect the wells from contamination by surface water influence and prevent the reclassification of the wells in both Wellfields. Either case will result in two adverse impacts: Public health risk - the influence from surface water increases the risk of introducing disease-causing microbial contaminants ... in the water supply.... Economic - the water treatment plants' process will have to be modified to provide additional filtration and disinfection which is required for surface water sources. The estimated cost of these improvements is $235 million.

AR608 (letter from William Brant, Director, WASD, to Corps, dated May 28, 1999).

[108]Note that Yoder, who had retired after working for DERM for 29 years, was rehired in August 2006 and detailed to WASD (from DERM) as Deputy Director (for administration, finance, and planning). Tr. 4223 (Dr. Yoder). Dr. Yoder testified in his official capacity with the approval of WASD's Director John Renfrow and Miami-Dade County Manager George Burgess. Tr. 4230 (Dr. Yoder).

[109]This testimony is somewhat inconsistent with that of WASD's former Director, William Brant, who testified credibly that "if the surface waters created by the rock pits got too close to our groundwater system ... it would [then] become a surface water system." Tr. 1573-75. Defendants acknowledge that "County officials disagree with each other" on this issue. Docket No. 350, p. 19.

Tr. 5134 (Espinosa).[110]

Miami-Dade County protects the quality of the Wellfield resource by enforcing protection zones around the wells; these zones, or setback lines, prohibit any activities from occurring within the area of the Wellfield determined to be most vulnerable to contamination of the production wells. When the County's wellfield protection ordinance, Chapter 24-12.1, Code of Miami-Dade County, was enacted in 1985, it established protection zones based on the theoretical distance a pollutant might travel toward a production well during a specific number of days. AR1175, p. 6, 9.

> The "travel time" protection zones were based, in part, on very generalized survival times of bacteria and viruses in soils and groundwater. The majority of pathogenic bacteria die off within an average of 10-30 days and viruses within 30 -100 days. Because very soluble chemical pollutants travel farther than microbiological pollutants and a few viruses can survive more than 100 days, the 210-day zone was included.

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[110]Espinosa's testimony that continued mining will not lead to a reclassification of the Aquifer is somewhat questionable in light of the benzene contamination over the past two years. See discussion *infra*. According to the Miami-Dade County Health Department, the Department must be notified immediately by WASD if the raw water (i.e., the water at the wells themselves) "shows that benzene concentrations have increased in any significant manner from the previous levels or are detected above 20 ppb." Docket No. 366 (Health Department letter, dated March 14, 2007, regarding CAP). Given that the raw water rarely had benzene contamination in the past, and now is expected to have elevated levels of benzene, it appears that the Aquifer may be in trouble. The Defendant's brief asserts that it is

> unlikely that water resources will be harmed from continued mining during the remand period" because there has been no evidence "to date" that "contaminants or water-borne diseases are present in the existing wells in the permit areas or that such contamination was caused by continued mining.

Docket No. 350, p. 34 (emphasis added).

Id.[111] The ordinance imposes an absolute ban on all mining activities within a distance of 30-days travel time to the production wells. This prohibition is designed to protect the wells from contamination by those pathogens that could survive traveling from an origin point within the 30-day setback line to the production wells in the center of the Wellfield. As a precaution, the ordinance also bans mining activities from occurring deeper than 40 feet below the surface[112] within the 210-day line. SAR1323 (Risk Assessment and Groundwater Modeling, prepared for DERM by CH2MHill, October 2001).[113]

According to County documents, several years ago a mining consultant[114]

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[111]The protection zones were established in 1981 and were "based, in part, on an existing (1970s) understanding of bacterial transport rates and rates of viral die-off in soils and ground water." Plaintiffs' Exh. 9, R. A. Renken, K. J. Cunningham, M.R. Zygnerski, M.A. Wacker, A. M. Shapiro, R. W. Harvey, D. W. Metge, C. L. Osborn, and J. N. Ryan, "Assessing the Vulnerability of a Municipal Well Field to Contamination in a Karst Aquifer, Environmental & Engineering Geoscience," Vol. XI, No. 4, November 2005, p. 321.

[112]This is designed to avoid interaction between mining activities and the deeper, faster areas of groundwater travel (the depth from which the production wells draw water for processing at the water treatment plants).

[113]Fortunately there are some layers, described as semi-confining, between the surface of the land and the depth from which the production wells draw water which slow the downward movement of pollutants which may be at the surface of the land. Plaintiffs' Exh. 4, pp. 33-34. Tr. 5176 (Espinosa). Without those layers, for instance if you have only lakes, the risk of contamination increases.

> The more lakes you have ... the water is going to move quicker because water – in essence water moves faster through a lake than it does having to be strained through rock . . . . something would get to the wells quicker because it's going through water rather than through rock.

Tr. 5215-16 (Espinosa).

[114]"[A]n approximation of the 60-day travel time setback was interpolated by a consultant in a rockmine permit application." SAR1323

proposed a "theoretical 60-day travel time" setback which would allow mining below 40 feet at a location closer than the 210-day line;[115] the 60-day[116] line was not modeled nor codified as a specific distance from the Wellfield.[117] The Corps embraced the "60-day" proposal when it issued the mining permits,[118] and imposed a "double cross-hatched area" condition, which denoted areas temporarily off limits to mining, in an attempt to address concerns that mining close to the production wells poses significant risks.[119]

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[115]The 60-day travel time reflected the mining companies' lack of interest in mining when limited to a depth of 40 feet. AR1175, p. 48 Northwest Wellfield Watershed Protection Plan, prepared for the SFWMD by DERM, dated August 16, 2000.

[116]Intervenors now admit that "there is nothing inherently important about 60 days of travel time in the groundwater when discussing the risk of pathogen contamination." Docket No. 352, p. 10, n2.

[117]The line is located approximately half a mile from the wells. Plaintiffs' Exh. 4, p. 11, Exh. 6, Exh. 7, Exh. 29, pp. 1-4, 2-1 and 2-2; SAR 1323, p. 1-4.

[118]"The 404 Permit to Lake Belt provides various restrictions on mining that is further then [sic] 60 days, and provides for a review of those restrictions 3 years after issuance.... Mining further then [sic] 60 days [is] OK by the current county wellfield protection ordinance and the county study may or may not lead to a change in the ordinance. In any case, the County will also likely present that study for consideration when you do your permit review." SAR1307 (email between Corps staff members, December 2003).

[119] The Corps stated that "no mining will be permitted in protected areas within the buffer zones . . . designated by double cross hatching on the maps incorporated in the existing permits." Docket No. 350, p. 33. The Corps' record of enforcement of these protected areas is somewhat unclear. For example, White Rock's mining operations (pursuant to permits issued to APAC), appear to be inside of a surrounding double cross-hatched area, i.e., are closer to the production wells than some of the surrounding double cross-hatched areas. Plaintiffs' Exh. 16 (Lake Belt 2005 Annual Report). White Rock already has demucked and removed the muck from the site, and has continued the pad preparations that are allowable by the permit, including the filling of 40 acres; and a blasting event took place in April or May of 2006. Tr. 5582 (Hurley). This blasting occurred along the eastern side of Section 16 of T53S, R39E. There are

The prohibited area is generally the same as the theoretical 60-day setback area.[120] While mining is permitted adjacent to the "double cross-hatched areas," Defendants' Exh. 4, it remains prohibited within those areas.[121]

In the late 1990s, while the Corps was preparing the EIS in this matter, the County was studying its Wellfield protection measures and recognizing that the protection zones were insufficient. More recent data and modeling suggested that pathogens and water traveled much more rapidly through the Aquifer to reach the production wells than the earlier studies (on which the ordinance was based) predicted. The County hired the United States Geological Survey ("USGS")[122] to perform several field studies including tracer tests.[123] The USGS scientists and others determined that

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production wells approximately one mile away, along the eastern edge of the neighboring section, Section 15.

[120]"The purpose of the double-cross hatched areas was to provide additional protection. The Corps acknowledges that the double-cross hatched areas don't extend the entire [sic] 2500-foot buffer, but it . . . did extend portions of the 2500-foot buffer. . . . [such that some] areas extend beyond the present 60-day setback line originally estimated by the mining companies. Tr. 2744-45, 2754 (Studt).

[121]It is clear that Intervenors hope for those lines to be removed. Tarmac's representative testified that they are "running up against the end of . . . our ten-year permitting" and that they already have cleared/devegetated everything under the current permits "until [they] get special condition seven [restricting the double cross-hatched area from mining] lifted." Tr. 5064 (Albert Townsend). "I hope [special condition 7] is lifted now, since the county has money to be able to build their water treatment plant that they feel is necessary." Tr. 4962 (Townsend).

[122]The County paid $700,000 to the USGS to gather data in 2003. In 2006, USGS was still in the process of publishing additional information based on those studies. Tr. 5113, 5173 (Espinosa).

[123]Tracer tests introduce harmless dye into injection wells to determine the length of time for the dye to reach a particular location, e.g., a production well. Tr. 109-110

there are areas of the Aquifer, called preferential flow zones, through which water moves much more quickly than previously understood.[124] In fact, some of these zones coincide with the depth of the production wells in the Wellfield. Tr. 5174 (Espinosa). Notably, the studies in 2003 revealed a much faster transmissivity in the Aquifer than expected. In one test, USGS injected red dye into the Aquifer using an injection well; the USGS then monitored various areas of the Aquifer, as well as the production wells, for the red dye. The red dye used to conduct the tracer test moved so rapidly through the groundwater of the Aquifer to the production wells, and the water treatment plant that public consumers received pink water that day before the utility shut down the pumps.[125] In light of the emerging field data from USGS and other sources, the County

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(Dr. Papadopulos).

[124]The locations of these zones are unknown. Tr. 5125-26 (Espinosa). One of the County witnesses admits that the preferential flow zones are "unpredictable" and "we don't know where they are," and they also "could change over time." Tr. 5135 (Espinosa).

[125]The dye "shot pretty quickly to the well and created a number of sort of factors, problems, because it sort of tainted the water and created some alarm to some of the residents that are supplied by that Wellfield. But it's sort of an illustration of sort of the problem that we found." Tr. 5134-35 (Espinosa).

> The test [used red dye] to study and quantify aquifer characteristics in the vicinity of the Wellfield . . . . The amount of dye that was used in the initial test was calculated using currently accepted aquifer data for the area, including data used in both County and SFWMD groundwater models. Instead of arriving as predicted at the test well and ultimately the water plant in a period of several days at levels too low to be visible, most of the dye was noticed at the Preston Water Treatment Plant later that evening, within about 8 hours. MDWASD staff purged most of the affected water from the plant and much of the distribution system the same night, substantially minimizing the number of customers exposed to pink tinted tap water the following morning.... [T]he field tracer test had to be prematurely terminated.

hired a private consulting firm, CH2MHill, to update their prior risk assessments for the County,[126] i.e., to recommend the extent of buffer zones necessary for efficient levels of protection.[127] Tr. 5118, 5120.

In early 2004, Plaintiffs hired Dr. Stavros Papodopulos, a groundwater hydrologist[128], to analyze data available from four sets of tracer tests conducted in the Wellfield.[129] Dr. Papadopulos determined that the tracer tests conducted to the west of

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SAR1327 (Memo from County Manager George Burgess to County Commission, March 16, 2004, "Status Report - Northwest Wellfield Studies"). Clearly, the models and historical data are no longer accurate predictors of groundwater movement and contaminant transport in the Aquifer and Wellfield; nor were they considered to be accurate at the time the permits were issued by the Corps. "In 2001, Phase 1 of the Risk Assessment Study was conducted ... [t]he resulting setbacks [for mining] were greater than the current setback of '60-days'." Id.

[126]SAR1323 (CH2MHill Report, October 2001).The CH2MHill firm was paid approximately $200,000 for the updating of their prior report. Tr. 5120 (Espinosa).

[127]Protection levels are discussed in terms of "log removal" – which relates to the probability that an event, i.e., complete disinfection or elimination of the contaminant, will occur to a specified magnitude. A 90% probability is equivalent to a 1-log removal, 99% is equivalent to a 2-log removal, 99.9% is equivalent to a 3-log removal, and 99.99% probability is equivalent to a 4-log removal, etc. Tr. 344 (Dr. Papadopulos).

[128]Dr. Papadopulos earned his Ph.D. from Princeton University. His experience includes work on several projects for federal agencies, including the Corps of Engineers; he has conducted research on groundwater systems and has numerous professional publications. Plaintiffs' Exh. 1.

[129]A test in 1998 measured the time for dye to travel from an injection well located near PW-8 (PW-8 lies to the west of PW-9, and these are the only two production wells which are aligned east to west – the others are aligned vertically from north to south), and another test in 1998 measured the travel time from an injection well to the east of all of the production wells (the injection well was located southeast of PW-9). Plaintiffs' Exh. 8. In 1999 a series of tracer tests were performed, each of which involved an injection of dye into a well to the east of any of the production wells. Finally, in 2003, a tracer test was conducted by injecting dye into an injection well located between PW-8 and PW-9 (the injection well was closer to PW-9 than to PW-8).

the production wells, where mining under these permits is and will be taking place, were a better indicator than those tests which were conducted to the east of the production wells, particularly in light of the downgradient/eastward flow of groundwater in the Wellfield area and the likelihood that such downgradient affected the travel of potential contaminants in the groundwater.[130] Tr. 144 - 145. Dr. Papadopulos used a porosity-thickness product ("Nb")[131] to calculate travel distances.[132]

> The reason that I analyzed for the product rather than for individual porosity and thickness separately ... [is because] there may be some questions on what is the effective thickness of the aquifer through which most of the groundwater is flowing. So to avoid the question of whether the effective thickness is correct or not, I preferred to evaluate the product of thickness and porosity.

Tr. 124-25. These values ranged from a low of 1.33 Nb for the 2003 test conducted by the USGS, which implied that a larger protection zone was necessary, to a higher Nb of 10.3 for the test conducted in 1999 by DERM, which suggested that a smaller zone might be adequate. Tr. 125. Dr. Papadopulos then used these values to form his recommendations as to the appropriate protection zones (each of which would vary

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Tr. 139 - 44 (Dr. Papadopulos).

[130]A test location which is downgradient will affect the result (downgradient will move more quickly than if the groundwater is moving upgradient). Tr. 218 (Dr. Papadopulos).

[131]The porosity-thickness product of a given aquifer is the porosity of the aquifer, usually depicted by the letter "N," times the thickness of the aquifer, depicted by the letter "b." Tr. 125 (Dr. Papadopulos).

[132] "The smallest porosity-thickness product corresponds to a larger travel time – to a larger distance for a given travel time. A higher Nb results in a small distance for the same travel time." Tr. 128 (Dr. Papadopulos). Thus, the smallest Nb will result in protection zones which extend further than those related to a higher Nb.

depending upon the daily pumping rate applied, i.e., 150 MGD or 225 MGD) based on a high Nb and a low Nb. See Plaintiffs' Exh. 2.

> I am a civil engineer. The civil engineer always views a safety factor.... If there is [a chance that the Nb could be] as small as that indicated by the 2003 test . . . then the appropriate value to use was [the one derived from the 2003 test].

Tr. 145-46 (Dr. Papadopulos).

The Court finds the testimony of Dr. Papadopulos to be very persuasive; with more than four decades of experience, including several years' familiarity with the facts of this case, Dr. Papadopulos was the only expert utilizing the most recent testing data from the Wellfield. Plaintiffs' Exh. 2 and Exh. 5. Dr. Papodopulos testified that the existing setback lines are flawed because they are based on the introduction of a contaminant starting at the surface; that assumption is inappropriate in the context of mining pits because the pits are in direct contact with the production zone of the wells. Tr. 222, 523. Moreover, Dr. Papadopulos noted that the modeling done by CH2MHill did not include the preferential flow zones which are understood to be present within the Aquifer, and therefore greatly underestimates the amount of protection required. Tr. 161. Essentially, the relevant factors are the existing downgradient toward the production wells, the easterly flow of groundwater,[133] the porosity of the limestone in the Aquifer (before it is removed by mining), and the preferential flow zones. Dr. Papodolus testified that the County's CH2MHill original model used a higher porosity than what is indicated by recent tests, and also only considered die-off of the cryptosporidium

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[133]The velocity of groundwater is affected by regional gradients, which in turn are "controlled by the hydraulic . . . gradient and the porosity" of the Aquifer and the proximity to the production wells. Tr. 132-33 (Dr. Papadopulos).

pathogen rather than filtration or dilution, suggesting that the model's prediction of 180 to 230-day pathogen travel times are inaccurate.[134] Tr. 161-62. Even when travel times are adjusted for the straining out and dilution of pathogens (instead of merely tracking the travel rate of a particle of groundwater), more distance is needed to protect the Wellfield from contamination than what is reflected in the present 60-day protection zones.[135]

The coalescing view that the setbacks were insufficient was expressed by a senior professional staff member of DERM's, Dr. Susan Markley:

> There has been some consciousness for a while, even prior to the publication of the USGS studies, that the study outcomes were going to suggest, because we know now that the water moves faster through layers of the aquifer than we thought it did before, that the travel time zones will be farther away.

Tr. 526 (Dr. Markley).[136] In a June 14, 2005, memo to the leadership of DERM[137], Dr.

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[134] The CH2MHill models do not delineate the location of setback lines; instead they use field data to develop risk assessments and determine how many days of pathogen travel time should be considered and what levels of risk relate to the different protection zones. Tr. 5117-18 (Espinosa). CH2MHill's original report discussed proposed setbacks of 180 to 230 days, SAR1323; the draft of their updated technical memorandum suggests that 80 to 130 days should be considered as the transport time for pathogens, based on an analysis of target removals of 3.5-log for the mined pits and lakes which have use restrictions, and 4.5-log if the pit or lake use is unrestricted. Plaintiffs' Exh. 10, p. 3 (technical memo, prepared for DERM, 2005 update to the CH2MHill modeling efforts in 2001).

[135] In fact, CH2MHill's recent work recommends that the appropriate travel time should be 80 days or more in order to guarantee the removal of contaminants equivalent to what the water treatment plant could provide with its chemical processes. Tr. 5207 (Espinosa).

[136] DERM's Director, Carlos Espinosa, testified that under the new information from USGS, the 60-day setback line "would be much greater than [the present] 2500 feet." Tr. 5183 (Espinosa). Espinosa also acknowledges that some of the information in the Northwest Wellfield Watershed Protection Plan of August 16, 2000, (AR1175),

Markley voiced her concerns surrounding the likely inadequate models and protective zones:

> There is new evidence from local studies, and other studies elsewhere, that many past assumptions concerning transmission of water and particles through the aquifer were not correct. Generally, the emerging view is that past models do not adequately describe the physical attributes, transport characteristics, variability, and travel time – distance relationships.... [I]t is likely that published reports will conclude that highly transmissive zones are prevalent throughout the aquifer, and that groundwater and substances in it may move much faster between two points. There is capacity for particle removal, but potential is poorer than previously assumed.... It will be necessary to change the zones (and all consequent regulatory actions), ordinance, or some combination of both should it be determined that travel time – distance relationships are different than previously simulated or measured.

Plaintiffs' Exh. 24 (memo from Susan Markley, Chief, Ecosystem Restoration and Planning Division, to Carlos Espinosa, Deputy Director, and John Renfrow, Director, DERM, June 14, 2005). According to Dr. Markley, she received no response to her memo. "I didn't get a specific response to this memo.... We didn't have a meeting, which I was asking for. I didn't get a written response to it." Tr. 527. She noted in her testimony that then Director Renfrow's memo to Joseph Ruiz, Assistant County Manager, on January 17, 2006, (which Dr. Markley had no part in drafting but appears to be based in part, on the concerns she had expressed months earlier), conveyed to County management that the Wellfield setbacks would have to be very large to assure that the regulatory requirements for protecting the groundwater from the influence of

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must be "updated based on the information that we have now." Tr. 5169, 5172 (Espinosa).

[137]At that time, John Renfrow was Director and Carlos Espinosa was Deputy Director, of DERM.

surface water were met and that it was unlikely that such action would be able to be accomplished.

The only witness who did not accept the larger protection zones in principle was Intervenors' witness James Rumbaugh (who did not appear in person before this Court) but he had not carefully reviewed the most recent data, e.g., the USGS 2003 study, nor the articles discussing that data. Deposition Tr. 31-33, 64-65. The Court has decided that the testimony of other witnesses, particularly that of Dr. Papadopulos, presents a far more accurate assessment of the hydrogeologic conditions of the Wellfield and the risks of contamination posed to the Wellfield by these mining activities.

Despite the almost universal understanding that the Wellfield protections, on which these challenged permits are based, are inadequate,[138] the Corps has done nothing to increase the level of protection specified in these permits. The Corps ignored specific evidence presented by Plaintiffs in early 2004 that the Wellfield protections are "no longer accurate." SAR1317 (Letter from NRDC to Corps, dated February 16, 2004).[139] The Corps previously had pushed for a rapid approval of these mining permits

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[138]The County's current setback lines are viewed as inadequate according to the USGS study (Plaintiffs' Exh. 9, p. 319); reports prepared for DERM: Tr. 431 (Dr. Markley), Plaintiffs' Exh. 23; WASD officials: Tr. 4248-49, 4276 (Dr. Yoder), Tr. 1438-40 (Brant); and by Plaintiffs' expert, Dr. Papadopulos.

[139]The Plaintiffs provided the Corps with Dr. Papadopulos' review of the USGS data, and referenced the tests conducted by "several agencies, including the [USGS] and DERM" to evaluate pathogen transport in the Aquifer near the Wellfield, concluding that the indicated travel times boundaries would reach "well into areas targeted for mining." SAR1317. The Corps responded to Plaintiffs' comments, noting that the Corps "was very concerned about potential impacts to the County's Northwest Wellfield" and would consider whether any action was required. "One course of action would be to accelerate our initiation of the 3-year review ...." SAR1328 (letter from

and did not wait for the County to complete its risk analysis[140] – even though the County had asked the Corps to postpone approval of the mining until completion of the studies.

> Dade County believes the [EIS] that is being developed in response to a proposal for rock mining in the region, must not be completed with a recommendation to issue the General Permit until studies are performed which provide answers to the [questions of water quality protection of the water supply, adequate buffer between the lakes and the Northwest Wellfield ("NWWF") to prevent reclassification to GWUDI, [and] quantity of water needed to meet the County's future water needs].

AR477 (letter from County Manager Armando Vidal to John R. Hall, Corps, May 13, 1997).

The Corps' ongoing disregard for this critical information violates several

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Corps to NRDC, dated March 30, 2004). The Corps admitted during the hearing that it never discussed the 2003 USGS study with the USGS. Tr. 2751 (Studt).

[140]These permits were issued before the County completed its study. AR1028, p. 54. A senior Corps staff member noted that he had

> buttonholed [a staff member] of DERM, pushed him pretty hard to get something to the County Commissioners to amend their Wellfield ordinance. As you may recall, the permit conditions related tot he [sic] Wellfield protection are 'interim' and are up for review in 3 years (well, almost a year has gone by now). The the [sic] concept was that they would expire and whatever new restrictions are called for by the risk studies would then be adopted by an amendement [sic] to the County Wellfield Protection Ordinance. [The DERM staff member] indicated to me that they don't have enough data to go to the commission. Jean Evoy [of DERM] said [that it] would be difficult. So we have a situation where in 2 years County staff will still want us to have these various restrictions ... that are above those in their ordinance. The permit condition has a provision that if the ordinance is not passed that the Corps will review whatever new information is available . . . but again this will put us in the position of determining acceptable risk. I reminded Jim of our position that we are concerned about public health but that they are putting us in a bad position . . . . the risk-$-tradeoff-etc. discussion is best done in a County Commission forum.

SAR1237 (message from Bob Barron to John Studt).

statutory and regulatory provisions. For example, the CWA specifically provides that unacceptable adverse effects on municipal water supplies are sufficient grounds for denial of a 404(b) permit. 33 U.S.C. § 1344(c). The implementing regulations of the CWA also direct that the Corps consider water quality and water supply issues (as part of the "Public Interest Review"). 33 C.F.R. § 320.4(a)(1)[141]. Additionally, the special nature of wetlands that perform water purification, 33 C.F.R. § 320.4(b)(2)(vii), or natural drainage functions, 33 C.F.R. § 320.4(b)(2)(iii), should be considered. State water quality standards must be followed in CWA permits according to 40 C.F.R. § 230.10(b), and the Corps must consider the significant degradation of water as well as the persistence and permanence of any risk to that water supply. 40 C.F.R. § 230.10(c).

It appears that the County has determined that the best way to address the acknowledged inadequacies of the current wellfield protection zones, particularly since mining continues in the area, is to upgrade or replace the current water treatment plants in an effort to maintain the quality of the municipal water supply.

> [T]he risk of concern is that the Wellfield eventually may be designated 'groundwater under the direct influence of surface waters' (GWUDI) under future mine-out conditions, land use scenarios and projected Wellfield demands of 220 million gallons per day. A GWUDI designation of the Northwest Wellfield will mandate treatment upgrades to the Hialeah and Preston water treatment facilities to achieve the same level of treatment as surface water sources. [Data and modeling by our staff indicate] that the combined '60-day' travel time area

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[141]The Corps' decision to approve these permits without waiting for the County to complete its assessment of the adequacy of the setbacks based upon updated data was a mistake – a mistake which may be responsible for the persistent incidence of benzene contamination in the Wellfield. If the Corps had waited for the County to revise its Wellfield protection plan, mining (including blasting activities) at locations nearest the production wells might not have been permitted (and the risk of contamination would have been reduced).

> extends well beyond the 2000 land acquisition area. Furthermore, a preliminary risk assessment study conducted by County consultants indicates the '60-day' area might not be sufficient to minimize the risk to the public from cryptosporidium sp. Oocysts.... [T]here is sufficient information emerging to conclude that the amount of land necessary to be set aside as a protective buffer will be substantially greater than the areas currently controlled by regulation and owned by the County and may be unattainable due to the cost and ownership of the land. Even if a large buffer area could be acquired, there is still no guarantee the public would be completely protected given the high uncertainty about the subsurface geology. Therefore, the most effective approach to provide assurance in protecting public health is to upgrade the Hialeah and Preston water treatment facilities, rather than solely relying on an expanded buffer area.

Plaintiffs' Exh. 149 (Memo from John Renfrow, Director, DERM, to Joseph Ruiz, Assistant County Manager, dated January 17, 2006, "Risk assessment of future rockmining and land use activities in the Northwest Wellfield.")[142]

Regardless of the recommendation to upgrade the water treatment plant, DERM insists that there will always be a minimum buffer area,[143] probably the current 60-day or

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[142]Espinosa says the County could use an unmined setback to protect the Wellfield or "upgrade the plant to do the same thing." Tr. 5135 (Espinosa). "[T]he uncertainty of these preferential zones around the Wellfield and the fact that we don't know where they are ... you would have to have pretty substantial areas, I mean, very large areas in terms of setbacks." Tr. 5139-5140 (Espinosa). "[Y]ou could go through a scenario that you could be buying hundreds and hundreds or possibly thousands of acres around the Wellfield and still have a problem because of these preferential zones." Tr. 5140 (Espinosa). It would require that the County "try to secure those lands from certainly companies that are not willing sellers," Tr. 5140 (Espinosa), and there would be "significant economic implications in trying to secure thousands and thousands of acres, significant expense to the residents of Dade County... [and] even if you went through that scenario, you spent the money, you still don't have the assurances that you are protecting the Wellfield because you still could have these preferential zones, and in essence it could short circuit through to the well heads." Tr. 5140 (Espinosa).

[143]"Removal of the [industrial] zoning also served to reduce the perception that industrial development is acceptable in this wellfield area. Accommodations were made for rockmining because it was an established land use in the Northwest Wellfield area when the protection zones were created and the risks posed were significantly

2500 feet, around the production wells themselves. Tr. 5202 (Espinosa).[144] In addition, DERM would like to take ownership of those lakes in the surrounding area – beyond the 60-day line – in order to protect the Wellfield in perpetuity. Tr. 5215.[145] As Dr. Markley has explained, "[a] treatment plant that addresses the cryptosporidium issue in and of itself wouldn't address ... some of these other concerns related to the travel time maps and ... all of the rest of the requirements of the code that depend on them." Tr. 531 (Dr. Markley).

While DERM has reached a conclusion and sent its recommendation to the County Manager, DERM's representative was unable to explain what actions WASD has recommended. Tr. 5200 (Espinosa).[146] According to correspondence dated March 17,

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less than other development and believed to be acceptable, with the prescribed restrictions." AR1175, p. 11, Northwest Wellfield Watershed Protection Plan, prepared for the SFWMD by DERM, dated August 16, 2000.

[144]"[O]ne of the key issues . . . in wellfield protection is land use control." Tr. 5093 (Espinosa)

[145]This suggests that the County believes that the open pits or lakes pose certain risks.

[146]DERM's Acting Director reported to County management in April 2006, that:

> [a] number of studies have been ongoing to determine the correlation between rockmining in the proximity of the Northwest Wellfield and possible risk of pathogenic organism [sic] reaching the wellheads. [DERM] concluded and informed the Manager's office by memo dated January 17, 2006 [from Renfrow] that the water treatment plants should be upgraded to deal with the possibility of pathogenic contamination.... It needs to be understood that the Wellfield issues are commingled with larger and separate issues between environmentalist [sic] and the rock mining industry concerning the impact to wetlands ... which are part of a federal lawsuit.... WASD is engaged in discussions with the rock mining industry regarding the funding requirements for upgrading the treatment plants. WASD Director John Renfrow will be able to provide details concerning the

2006, from WASD's current director, John Renfrow:

> [WASD] is currently assessing the probable costs and financing mechanisms that might be available to formulate a complete proposal [to install appropriate filtration technology].... and all policy recommendations will be available for public comment and input through workshops and hearings prior to final actions being taken.

Plaintiffs' Exh. 194.

> As the rock mining activities encroach on the Wellfield, the risk of being designated UDI increases.... If the Wellfield pulls in water from nearby surface waters containing [algae and diatoms or other indicators of contamination by surface waters] in sufficient concentrations, the Wellfield could be determined to be UDI even without the presence of any pathogens. The ultimate concern is that the Environmental Protection Agency has identified certain disease-causing pathogens which can survive in surface waters, but not ground waters. As surface water (rock pits) encroach on the Wellfield a habitat is created, which can harbor these pathogens.... It does not appear that compelling results [of the DERM contracted USGS study] will be available in time to modify the Wellfield protection zone prior to the April 2005 deadline [in the permits, before the Corps will lift the restriction in the crosshatched areas.] Even if the study were ready on time, it would likely show a significantly expanded Wellfield protection zone to the west of the Wellfield, and a resulting ordinance modification would take away anticipated mining rights owned by rock miners in that area.... If the County is not able to present compelling data that such mining will impose a risk to public health, the Corps may modify the permit to remove the restrictions. Removing the restrictions will allow the rock miners to proceed with their mining activities right up to the existing 60-day Wellfield protection buffer zone. Thus, the Wellfield would eventually be surrounded by surface water up to the existing buffer zone. Thus, the risk of being designated UDI increases, with no funding available to upgrade the water treatment plant.

Intervenors' Exh. 17 (memo from William Brant to County Manager George Burgess,

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> dialog with the rock mining industry. [DERM] will assist WASD in its negotiations with the rock mining industry and will participate in the new Corp [sic] of Engineers permitting process as per Judge Hoeveller's [sic] ruling.

Intervenors' Exh. 115 (Memo dated April 11, 2006, from Carlos Espinosa, Acting Director, DERM, to Roger Carlton, Assistant County Manager, "Status of Water Supply Issues in Relation to Future Rockmining and Land Use Activities in the North West [sic] Wellfield.")

June 14, 2004) (emphasis omitted).

Because this represented a substantially larger zone of protection around the Wellfield, the County determined that it could not afford to acquire the land within the zone necessary to protect the production wells.[147] The limestone miners

> were not going to be willing sellers.... [T]hey pretty much indicated to us that all the equipment that they have, all the cement plants, and all those other extensive amount of investment [sic] that they have is based on rock reserves, and therefore, you know, a taking issue would — they would defend themselves.

Tr. 5208 (Espinosa). This Court's prior Order addressed the mining industry's advocacy with the Corps when seeking these permits and the industry's pointed reminders to the Corps that a takings challenge would be filed if the permits were not issued. Sierra Club, 423 F. Supp. 2d at 1300 - 02.[148]

The Defendants urge this Court to "exercise great caution in reaching any conclusion about the adequacy of the County's regulatory efforts" because "the County is not on trial here." Docket No. 350, p. 13. While that is generally true, the Corps has taken every opportunity to place responsibility on the County for the Corps' water quality assessments and cannot now claim that the County has no role in this matter. Furthermore, this new posture of deferral to the County represents a dramatic change in

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[147]In light of the direct interaction between the quarry pits and the Aquifer, and the widely acknowledged increased risks of contamination of the municipal water source related thereto, the Court found it disturbing to hear the Director of WASD (a former Director of DERM) testify that if the full fifty years of mining were to occur: "I guess ultimately, you know, it may be essentially the Wellfield's an island among a mine-out area, or essentially a very large lake area." Tr. 5133 (Espinosa).

[148]This Court notes that it is somewhat unusual that private purchasers of wetlands might succeed with a takings claim when the regulatory prohibitions on destruction of wetlands clearly have been established for at least two decades.

approach by the Corps from its previous decision to issue these permits in 2002 regardless of the County's objections.[149] The Corps' failure to adequately consider the results of tests performed by another federal agency, or to take any action related thereto, is another example of its failure to base its decisions on credible scientific evidence, 40 C.F.R. § 1502.22(b), and accurate scientific studies, 40 C.F.R. 1500.1(b).[150]

Moreover, the Corps' emphasis on the County's plans to upgrade its water treatment facilities masks the underlying fundamental fact that there is an increased risk of contamination, in the first instance, from these permitted mining activities – regardless of whether such contamination may be remediable.

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[149]If the Corps had engaged in a more complete evaluation on its own, or done anything to suggest that it was in command of the situation with respect to possible drinking water contamination, then this Court might have reached a different conclusion.

[150]It is ironic that the committee which had a role in proposing the seriously ambitious "50 year" mining plan (the Dade County Lake Belt Plan Implementation Committee), was established to develop a plan "to enhance the water supply for Miami-Dade County and the Everglades, including appropriate Wellfield protection measures; to maximize efficient recovery of limestone while promoting the social and economic welfare of the community and protecting the environment; and to educate various groups and the general public of the benefits of the plan." Fla. Stat. §373.4149(1). As noted by the Court, that committee's legislative directive was that:

> Miami-Dade County shall strongly consider limestone mining activities and ancillary operations, such as lake excavation, including use of explosives, rock processing, cement, concrete and asphalt products manufacturing, and ancillary activities, within the rock mining supported and allowable areas of the Miami-Dade County Lake Plan adopted by subsection (1); provided, however, that limerock mining activities are consistent with Wellfield protection.

Fla. Stat. §373.4149(4)(emphasis added), Sierra Club, 423 F. Supp. 2d at 1302.

1. Contamination issues as to cryptosporidium, giardia, and other pathogens

Several pathogens and other contaminants threaten the safety of a municipal water supply. Cryptosporidium and giardia are "microorganisms that during their life cycle form spores, cysts, or oocysts . . . [and] can survive for long periods in the environment and can be very resistant to conventional treatment practices at drinking water facilities." AR1175, p. 37 (citations omitted). The Wellfield protection zones and the mining setback lines are designed to keep these pathogens (and other contaminants) away from the production wells, based upon the likelihood of the contaminants' survival.

> Giardia, cryptosporidium, and relatives such as cyclospora and microsporidium can survive for months in some water environments. Cryptosporidium can survive greater than six months in some water environments and is also resistant to conventional chlorination. Additionally, there are other pathogens emerging as a concern to municipal drinking water supplies. One such pathogen is a bacteria, Mycobacterium avium, which is also chlorine resistant and, unlike giardia and cryptosporidium which need a host to reproduce, regrows in the environment.

Id. "[T]here is no safe level of ingestion [by the public of cryptosporidium and giardia]. There is no [maximum contaminant level ("MCL")] because at this point in time the [maximum contaminant level goal ("MCLG"), which is the target level for public water supplies] is zero."[151] Tr. 269 (Dr. Huffman). The challenged permits require that the Wellfield's water quality be monitored regularly for any indication of impacts from mining, but this monitoring appears to have started much later than intended and is

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[151]The presence of these pathogens is expressed in the number of oocysts per hundred liters. A maximum contaminant level goal [MCLG] "is not an enforceable standard . . . . [T]he maximum contaminant level [MCL] would be the enforceable standard." Tr. 269 (Dr. Debra Huffman).

poorly designed. In January 2003, almost one year after the permits had been issued, the required Wellfield monitoring report was still in draft form. [152] The Corps' failures with respect to requiring an adequate monitoring plan are consistent with this Court's assessment that the Corps rushed through the approval of this mining and was determined to permit the mining regardless of the outcome of the analysis regarding environmental impacts.

Plaintiffs' expert witness, Dr. Debra Huffman, testified that the Wellfield monitoring program, as finally adopted, was not a perfect system, and that past data indicates that "[sampling] methods are relatively imprecise." Tr. 290 (Dr. Huffman).[153]

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[152]A senior Corps staff member noted that he would be getting "revised submittal on the Wellfield groundwater plan to review." SAR1237 (message from Bob Barron to John Studt, January 2003). Apparently the Corps staff member, who in early 2003 was newly charged with monitoring these permits, was uninformed as to the precise nature of the "groundwater monitoring plan" when she assumed her duties. A senior Corps staff member advised her that the "groundwater monitoring plan" had been adopted by the Corps' issuance of a permit to install four monitoring wells. "Sounds like you have already approved their plan via a permit authorization! Just be sure to keep those in your LakeBelt [sic] files. I presume in your documentation for the verifications you noted/referenced the purpose/linkage to the Lake Belt permits.... you just have to be able to show that that permit requirement has been 'checked off'." SAR1279 (message between Corps staff members). This suggests very little analysis of the monitoring plan occurred prior to its "adoption" by the Corps.

[153]The Northwest Wellfield Watershed Protection Plan describes the County's sampling schedule:

> The original water monitoring well network for the Northwest Wellfield was designed and installed in 1985-86. . . . Water levels and water quality data were collected monthly from each well beginning in September 1986. . . . By the end of 1987, sufficient water level data had been collected to depict wet and dry season conditions . . . . By 1993, sufficient water level and water quality data had been collected to determine that the . . . wellfield was free of contaminants. . . . At this time, water quality and water level monitoring was reduced to 4 times per year and the number of water level wells monitored was reduced. The

Dr. Huffman, whose expertise on water-borne diseases (including the fate and transport of cryptosporidium and giardia) was unchallenged by Defendants and Intervenors,[154] testified that the permittees' mining sites are only sampled quarterly and the samples that are taken are too small to be accurate, particularly if the recovery efficiency of the sampling is unknown. Tr. 291-94 (Dr. Huffman).[155] DERM's current Director also

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> monitoring program has subsequently been scaled back twice more . . . . Currently [in 2000] the monitoring program is a requirement of the water use permit issued by [the State]. The current water quality program includes 3 annual samplings of 9 sites . . . and two production wells.

AR1175, p. 30.

[154]The Court found Dr. Huffman's testimony to be very credible, particularly in light of her nearly two decades of experience studying pathogens and contamination of drinking water sources in her laboratory at the University of South Florida. Dr. Huffman has eighteen years' experience working with cryptosporidium and giardia and has published a number of book chapters and peer-reviewed articles related to these pathogens. Dr. Huffman has worked for the EPA to develop test protocols for drinking water and has studied the "fate and transport," i.e., the survival and movement of pathogens under certain conditions, in aquifers throughout Florida. Tr. 250-53. Indeed, Dr. Huffman was contacted earlier by counsel for Intervenors who apparently was interested in "pursuing [her] opinions" and possibly hiring her as an expert witness. Tr. 364 -65. The Court found that Dr. Huffman's testimony reflected a far greater expertise in the relevant area than the testimony offered by Intervenors' expert, Dr. Joseph Cotruvo. Dr. Cotruvo had little experience prior to this case in the specific issues relating to a potential reclassification of the Aquifer to GWUDI, contamination by cryptosporidium or giardia, and groundwater flows generally.

[155]Dr. Huffman testified that quarterly monitoring is not frequent enough (noting that the EPA requests monthly monitoring in its new drinking water treatment rules) because concentrations of cryptosporidium are somewhat seasonal, and the smaller size of the collected samples of groundwater, i.e., only 50 liters instead of the 100 liters provided for in the monitoring plan, makes detection more difficult. Tr. 291-93. Dr. Susan Markley, chief of the ecosystem restoration and planning division of DERM, agreed that the sampling frequency could be improved. Tr. 441 (Dr. Markley). She also noted that she had recommended continuing sampling longer than the three years in the original monitoring plan. Tr. 441-42.

testified that the mining companies are no longer sampling or at least are not reporting the results of the sampling from the surface water of their mining pits; nor is DERM sampling the surface water of these pits. Tr. 5218-19 (Espinosa). DERM still samples the groundwater and canals in the area. Tr. 433-34 (Dr. Markley). Tellingly, a senior member of DERM staff testified that she thought DERM was meeting its requirements, but "would like to see [DERM] do more to monitor water quality in the Northwest Wellfield." Tr. 507 (Dr. Markley).

In light of the infrequent (or discontinued) sampling and its noted problems, Dr. Huffman testified that "the number of negative samples [for pathogens does not reduce] the . . . risk of contamination or [the possibility that] . . . these organisms [are present] in surface waters." Tr. 290 (Dr. Huffman). "[T]he negative sampling results do not tell me definitively that there is no cryptosporidium in the lakes." Tr. 334 (Dr. Huffman).She continued:

> [B]elow detection limit in this case is 12 oocysts per hundred liters. Therefore, any count less than 12 oocyst[s] per hundred liters, if that's the volume that they sampled would be a nondetect. [It] [d]oesn't necessarily mean the organism wasn't present.[156]

Tr. 328 (Dr. Huffman). Nonetheless, a positive indication of giardia was found in a sample of water collected on December 28, 2005, from the surface water in the center of a mining pit located immediately adjacent to the area in which Continental (now owned

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[156]"[B]ecause of that, the fact that this monitoring program only collected 50-liter samples [of groundwater] is an indication that I'm not surprised that they're finding negative results. Clearly they would have had twice the chance if they had collected a larger volume sample." Tr. 292 (Dr. Huffman).

by White Rock) was permitted to mine,. The sample of water had 14.2 cysts[157] of giardia per hundred liters. Plaintiffs' Exhs. 19, 20; Tr. 260-61 (Dr. Huffman).

According to Dr. Huffman, it is "very significant to ever get a positive result [for these pathogens] because the recovery efficiencies of testing methods often miss low numbers of oocysts [i.e., the pathogen]." Tr. 273-74, 289-92, 353-54 (Dr. Huffman). Unfortunately, adding to the difficulty of discovering the presence of pathogens in the raw water supply, is the fact that the manifestation of diseases related to these pathogens in humans is substantially underreported; experts suggest that individuals of average health discount an upset stomach or occasional diarrhea which may be symptoms[158] of exposure to these pathogens.[159] Moreover, cryptosporidium is a pathogen "that is not easily controlled with conventional disinfection practices ... setting the target concentration at the consumer tap is not appropriately conservative in estimation of incremental risk." Plaintiffs' Exh. 29, p. 2-2.[160]

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[157]"In the case of giardia, we refer to the environmentally stable form [of oocysts] as a cyst." Tr. 260 (Dr. Huffman).

[158]Those individuals whose health already is somewhat compromised, e.g., the very young or the very old, may experience more severe symptoms.

[159]Intervenors' witness Dr. Cotruvo agreed with Dr. Huffman that cryptosporidium-related disease is substantially underreported and that established test methods are unlikely to detect the pathogens before contamination. Tr. 4493-94, 4496, 4499 (Dr. Joseph Cotruvo).

[160]Dr. Huffman also testified about two major outbreaks of cryptosporidium in groundwater – one in Texas which resulted in 1400 people getting the pathogen from groundwater from a Wellfield (a sewage spill occurred in a stream that was one mile from the Wellfield at issue, and the river water was drawn in faster than expected because it had been a very dry season), Tr. 283, and the other in Wisconsin in 1993 which killed more than one hundred people and caused illness in another 400,000

The risk of pathogen contamination underscores the importance of respecting accurate Wellfield protection zones and ensuring the County's process of updating its Wellfield protection zones with current modeling results and data. Dr. Huffman testified that

> [T]his is the first place that I have been to, having known all of what I have . . . . First time in my life that I looked at the tap water and drank my bottled water when I brushed my teeth this morning. I'm embarrassed to say that . . . . I've actually limited my consumption of the drinking water here in Miami-Dade County since I've been here, and I was very uncomfortable. . . . I travel throughout the country and I listen to people complain very often about the taste of their drinking water, the odor of their drinking water. . . . And aside from taste and odor issues, I think most utilities work very hard to provide a safe product . . . . And it struck me as being the first time – that I really took some pause in a hotel about drinking the tap water.

Tr. 350 - 51, 362-63 (Dr. Huffman).[161] Dr. Huffman explained that her concerns about drinking the local tap water were based on the information she reviewed in this case, which revealed that some of the monitoring wells showed high levels of algae and were very close to being considered GWUDI. Tr. 363. "[T]he fact that [the miners have] removed . . . 60 feet of soil and aquifer material [in such close] proximity [to the production wells is also of concern]." Tr. 364.

(despite the existence of a functioning water treatment plant – which subsequently was retrofitted and upgraded), Tr. 299-300.

[161]In addition, Dr. Huffman referred to a report from the National Academy of Sciences ("NAS"), which discussed the proposed use of certain of the mining pits as reservoirs for future water storage as part of the overall Everglades restoration project. "[The NAS was] concerned that mining activities, which included blasting in the area of those lake mines that [might be used for] reservoirs, could in fact affect the lake mining pits and the subsurface and the aquifer material in that area." Tr. 305-306.

2. Benzene in the Wellfield

As an initial matter, the Court restates its decision to deny Defendants' and Intervenors' requests to have evidence about the benzene contamination of the Aquifer excluded from consideration.[162] Defendants' counsel suggested that the Court "lacked jurisdiction" over the matter because benzene contamination was not specifically identified in Plaintiffs' Amended Complaint, Tr. 785, 795.[163] This case is in post-summary judgment proceedings to determine remedies for serious violations including the Corps' failure to adequately study the risks of Aquifer contamination, as well as multiple instances where the Corps disregarded public notice and participation requirements of relevant statutes and violated numerous regulations. As the Court indicated at the evidentiary hearing, the Court has determined that Plaintiffs' Amended Complaint and this Court's ruling granting summary judgment[164] are sufficiently broad to

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[162]Intervenors' counsel described the benzene contamination as a "red herring" and "beyond the scope of the issues before the Court," Tr. 769, and attempted to frame the issue as one involving proof of pollution by the mining companies – clearly not an issue before this Court. Later in the hearing, on July 26, 2006, Intervenors' counsel assured the Court that "there aren't problems you need to be concerned about going forward." Tr. 2712. This prediction turned out to be inaccurate; the Court later learned that another benzene contamination incident was detected in July and August 2006 in production wells which weren't previously affected. See discussion *infra*.

[163]Defendants also argued that because the production wells which had been contaminated were not in operation, there was little risk from the benzene contamination. Docket No. 350, pp. 18-19. This argument is moot as those wells now are back in production. See CAP.

[164]As was noted in the March 2006 Order, "[t]he Court ... granted Plaintiffs' request to amend their complaint to include claims based upon new information submitted to the Corps after the permits had issued (in light of all defendants' representations that they had no objection to such amendment)." Sierra Club, 423 F. Supp. 2d 1273, 1280. Plaintiffs' Motion to Amend the Complaint was filed on March 25,

allow consideration of the evidence relating to benzene contamination.[165]

Benzene was detected in the raw untreated water delivered to the Hialeah-Preston water treatment plant on January 4, 2005; benzene levels were initially at .25 parts per billion ("ppb")[166] but increased to 14 ppb during February and April. During this incident of contamination, the levels in the production wells rose as high as 14 ppb in PW-1, and 7.1 ppb in PW-2. Docket No. 366 (Executive Summary of Northwest Wellfield Benzene Investigation, prepared by DERM, February 2007 ("Executive Summary of Investigation"), p. 3. During the same time period, the finished water, after

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2004. On March 30, 2004, the Corps responded to correspondence from one of the Plaintiffs and "request[ed] that [Plaintiff] provide any additional information ... regarding the Wellfield, including the various documents ... reference[d] in [Plaintiffs' submitted] report, as well as any other information you wish us to consider, so that we may address these and other pertinent concerns in a timely manner." SAR1879.

[165]At the very least, the Court notes that it would be a waste of resources to require the Plaintiffs to commence a new challenge related to the benzene contamination which, but for the Corps' failure to advise the Court and the public (including the Plaintiffs) at the time the contamination occurred, might have been raised more than two years ago either before this Court or in an administrative challenge. The Corps simply will not be permitted to keep from revealing such damaging information and then argue that it is not ripe for judicial review because no one yet raised the complaint before the agency. Indeed, it seems odd that the Defendants would attempt to shield the benzene issue from this Court's review by the summoning of legal principles, e.g., standing/exhaustion doctrine, evidence rules, etc. This Court finds that evidence of the benzene contamination is admissible in this proceeding; even it if were not, there would be some merit to it being discussed by the parties prior to the entry of a remedies order by this Court. The benzene issue is clearly relevant to the question of whether this mining should be permitted in the Wellfield.

[166]Parts per billion is equivalent to micrograms per liter. Tr. 1211 (Pitt). The State water quality standards are found at Table 4 of F.A.C. 62-550.824, and provide that the Maximum Contaminant Level ("MCL") for benzene is .001 milligrams per liter (mg/L). One microgram equals one millionth of a gram (.000001), and one milligram is one thousandth of a gram (.001); thus, .001 milligram/L equals 1 microgram/L.

treatment at the plant, was Below Detectable Limits ("BDL"), i.e., not measurable, for benzene. As this was the highest level of benzene ever detected at the plant,[167] the local agencies clearly considered it important [168] to conduct a search despite their assertions that the water treatment plants could handle the contamination.[169] County Management also monitored the investigation:

> The results, so far, indicate that benzene extends to at least a distance of 1200 ft from [PW-1]. The highest concentration found so far is approximately 20 ppb, at a depth of about 60 ft near [PW-1] . . . . The source has not been identified, but we continue to search for potential sources.

Plaintiffs' Exh. 100: Memo from George Burgess to Mayor and Board of County Commissioners, March 17, 2005.

Monitoring wells were installed in the Wellfield to delineate the area of contamination. A cluster of wells was installed at each monitoring well location. Each location included a shallow well, an intermediate depth well, and a deeper well. DERM's investigation concluded that for this first contamination incident (2005), "the highest

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[167]Benzene had been observed before, despite the limited nature of the sampling and monitoring conducted until recent years. William Brant, former Director of WASD, testified persuasively that, looking back at sampling over the years, "there were occasional hits of benzene.... [Y]ou would see it one time and then it would not be there for another year or so." Tr. 1494 (William Brant).

[168]Ana Caveda, a supervisor in hazardous materials management at WASD, testified that the expenses associated with the benzene investigation were more than $1 million, paid by WASD. Tr. 2377-79; Plaintiffs' Exh. 144.

[169]Benzene had been sporadically detected in DERM's sampling of the production wells since Jan. 2001, Plaintiffs' Exh. 203, Tr. 6551, but was being detected in early 2005 at levels which "are several times higher than had been previously detected anywhere in the vicinity of the NWWF." Executive Summary of Investigation, p.2.

contaminant concentrations occurred at depth: the shallow wells exhibited the lowest and the 60-foot wells the highest concentrations." Executive Summary of Investigation by DERM, p. 4. The agency determined that the contamination plume (the path of the contaminant) was delineated as follows: "a narrow, elongated plume extending from the southwest ([monitoring well] NW-126) to the northeast ([monitoring well] NW-119) and a separate localized area of impact located approximately 3000 feet to the south of the PW-1; [at] assessment well NW-109." Executive Summary of Investigation, p. 4.[170] It is important to note that 3000 feet is outside the current mining setback in the challenged permits, i.e., mining is proceeding or is entitled to proceed at that distance from the production wells according to the Corps' permits. The benzene incident in early 2005 revealed the Wellfield's, and the municipal water supply's, vulnerability to contamination:

> Well, it's all one aquifer. ... [I]f you detect benzene at 60 [ppb] in a monitoring well, and then you also have benzene in a production well, the logical conclusion is that the groundwater is being pulled into the production well, bringing the benzene with it. . . . The cones of influence of these [production] wells reaches [sic] out miles.

Tr. 1475-76 (Brant).

Benzene was detected in the production wells again in June and July 2006, Tr. 2364 (Ana Caveda). Benzene was detected at a maximum of 9 ppb in PW-1, 5.8 in PW-

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[170]"The benzene groundwater plume in the vicinity of PW-1 is delineated both horizontally and vertically; however, to date the source of the contamination has not been found. DERM will continue to work with [WASD] to monitor groundwater quality in the vicinity of the impacted production wells and to conduct any additional investigation necessary." Docket No. 366 (DERM letter to County Health Department, dated Feb. 12, 2007).

2 (it was .99 ppb of benzene when benzene was first observed in June 2006), and 1.5 in PW-3 (rising from an original detection of .24 ppb in June 2006). Executive Summary of Investigation, p. 3. The only sampling for benzene by the County at that time was in the cluster of wells near Monitoring Well 109 ("NW-109") and the cluster near NW-126. Tr. 2364-65 (Caveda). Plaintiffs' Exh. 135. For this second major incident of contamination, DERM reached similar conclusions – the greatest impact of the concentration was seen in the deeper wells, i.e., at 60 feet. The data for this episode showed a wider plume extending from the west and southwest (near NW-124 and NW-115) and narrowing in the vicinity of PW-1, then extending to the north (NW-105) and northeast (NW-115) of PW-1. The highest concentrations (17.1 ppb at the deep level monitoring, and 12.7 at intermediate depth) were at NW-124 – a location which had not previously shown benzene. A set of monitoring wells was installed near a mining lake operated by White Rock, approximately 5400 feet west of PW-1, and low concentrations of benzene were found.

A total of 86 monitoring wells were installed, ranging from shallow to deep depths, during WASD's investigation of the benzene contamination, and samples were obtained detecting as much as 60.5 ppb of benzene. Executive Summary of Investigation, p. 3. Groundwater levels of benzene in NW109 (3000 ft south of PW-1), were detected at 14.9 to 50.9 ppb. The record is unclear[171] as to how much sampling for

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[171]It is clear, however, that the Defendants have initiated no investigation into this matter whatsoever, despite having been informed of benzene and the possible connection to mining in the spring of 2005, Tr. 2774-76, Plaintiffs' Exh. 150.

benzene presently is being conducted, other than at the production wells,[172] e.g., what other locations are being sampled, and by whom.[173]

DERM's investigation of the benzene contamination revealed that certain sources (other than blasting related to mining) were not the cause of the contamination, e.g., a submerged vehicle in a rock mining pit, contaminated soils from a mining dragline[174] assembly area.[175] Nor does DERM believe that benzene is the result of a gasoline spill,

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[172]"It should be noted that although the plume [of contamination of benzene] appears to be vertically delineated, the source has not been identified. Consequently, contaminant levels will continue to be evaluated in the production wells on a biweekly basis." CAP, p. 6.

[173]Previously DERM had "implemented a monthly sampling program" of the monitoring wells. Tr. 4687 (Mayorga).

[174]A dragline is a type of heavy equipment used to remove the limestone from the quarry pit. Large draglines must be assembled at the site of the mining activity. For example, the website for White Rock Quarries (the company which mines pursuant to permits issued to Vecellio & Grogan, Continental, and APAC/Pan American Construction) reports that White Rock uses the "world's largest aggregate dragline" with a 105-cubic yard bucket large enough to hold 130 tons of blasted rock. "With an average mining cycle of 75 seconds, the machine can yield 24 million tons of limestone per year." The dragline took a year to be reassembled when it was moved from New Mexico to Miami aboard 175 semi-trucks, and has been operating at White Rock's quarry since September 2005. The dragline works around the lakes by "walking" on "shoes" that measure 12-ft. wide by 60 ft. long. The dragline runs on electricity, and "requires its own nearby, dedicated power substation." "White Rock Steps Up Capacity With World's Largest Aggregate Dragline," dated 1st/2nd Quarter 2006. Available at http://www.wrquarries.com/news_photos18.htm, last visited June 19, 2007.

[175]Defendants argue that "there is no need for the Court to determine whether mining is the source." Docket No. 350, p. 19. The Court agrees – there is no need for this Court to make a conclusive determination that mining is *the* source; rather, environmental statutes and regulations merely require that the agency – as monitored by this Court – properly weigh risks of adverse environmental effects. Benzene is a symptom of the Corps' failures to monitor water quality issues adequately under these permits, and none of the governing statutes require direct causal proof of contamination before determining that a risk is significant. Nor is the Court required to find that the

Tr. 4759, nor of any "continuous source" of discharge, Tr. 4761. While Wilbur Mayorga, of DERM, claims that the County has "not been able to find . . . specific information that could link [the benzene contamination] to the blasting," Tr. 4752, the Court finds this testimony to be at odds with the weight of the evidence. Mayorga himself admitted that "there were some samples targeted to prior to and after the blasting . . . . We found [NW]109 with elevated levels, and that's when we started investigating [NW]109 . . . . [the investigation revealed that levels went up] from 47.5 to 60.5" after a blasting event. Tr. 4750-51.

The County's initial investigation of potential sources of the benzene included an evaluation of the mining activities. William Pitt, a senior professional staff member at WASD, testified that his prior experience working as a subcontractor for the County on a blasting investigation in the Wellfield provided him with background information regarding the blasting associated with mining and the potential for such blasting to be the source of the benzene. He described the blasting process used by the mining companies, stating that core holes are drilled to depths of up to 100 feet, "almost to the bottom of the aquifer," and then filled with as much as 300 pounds of a blasting agent,

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County acted in "bad faith" – as peculiarly implied by the Defendants, Docket No. 350, p. 19 – in order to assess whether the Corps performed its federal legal duties. Intervenors argue that Plaintiffs' evidence was "entirely unfocused, addressing at most 'potential' future harm from mining generally but not any harm from mining under any of the permits during the short remand period." Docket No. 352, p. 7. Such an argument misapprehends the nature of judicial inquiry in these proceedings. This Court will not require further "concrete" evidence of harm, e.g., additional benzene contamination, or proof beyond any reasonable doubt that the benzene is caused by the blasting/mining before taking action to enforce the environmental statutes and regulations which the Corps has violated.

ammonium nitrate fuel oil ("ANFO"), which contains fuel, e.g., diesel, of which benzene is a component. Tr. 1268-70. Ana Caveda,[176] the WASD staff member who conducted the field investigation of the benzene contamination, testified that after the blasting holes[177] are drilled, a cardboard tube is inserted with the explosives and placed at the deepest point of the hole, e.g., 60 feet, continuing until approximately 10 feet below the surface. The top 10 feet then are filled with "blasting caps" and the holes are connected by wires so that they detonate together. Tr. 2320 - 22. Sometimes more than 100 of these blasting holes would be connected in a row. Tr. 1268 - 70 (Pitt).[178]

Ms. Caveda was in the field, collecting samples in late April 2005, when she noticed that blasting was occurring nearby.

> I have notes from being there and pictures and personally witnessed a driller actively drilling rock piles from active mining efforts after the blasting takes place all along the edge – western edge of the south White Rock lake . . . . During the month of ... April ... I was present on-site at a sampling event taken or performed

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[176]The Court found Ms. Caveda's testimony to be credible and candid. Ms. Caveda's total of twelve years of experience at WASD and DERM and her direct role in the benzene investigation made her a very persuasive witness.

[177]Tarmac uses six inch wide vertical holes. Tr. 5028 (Townsend).

[178]"Blasting activity reports" filed with the state's Bureau of Fire Prevention, Regulatory Licensing Section, reveal that Tarmac had seven separate blasting events between mid-January 2005 and mid-May 2005; blasting holes were drilled to 70 feet, and at least fifty holes were used for each event. Plaintiffs' Exh. 189. The amount of explosive material is listed in the activity report along with the amount of explosives used – there is no indication of the unit of measurement, but if it is pounds, then the blasting events are using at least 20,000 pounds and often as high 60,000 pounds. Id. (reporting the amount of explosive per event as 20,010 to 70,570.5). Tarmac's representative also testified that the blasting emulsion used at the mining site is brought "in as a gel in tankers," Tr. 5069 (Townsend), which suggests that a rather large quantity of ammonium nitrate and blasting compounds may be present in the immediate vicinity of the mining operations.

> April 28th, and I witnessed, just from going there to the site all the time, that western edge was being mined actively from day to day. The progression along the lake's edge from the southern corner to the northern corner along the west wall of the lake was - it was progressing. It had reached the northern corner closest to monitoring well 109 .... [I knew blasting was going on] [because I had seen the orange caps in place on some days, then the following days visited those areas, the ground didn't exist and the area was actually being mined and the piles of rock were getting higher. We had an actual like crane or deadline, whatever they call it, piece of heavy equipment that digs the soil out, the loose rock out from the water, and piles it up at the lake's edge.

Tr. 2352-54. See also Plaintiff's Exh. 185.

Ana Caveda collected a sample from the shallow well at NW-109 immediately following a known nearby blasting event to determine if it would detect benzene and it did. Ms. Caveda testified that the WASD team responsible for the investigation:

> witnessed blasting caps in the northwest corner of the White Rock south lake on April 28th [2005] on the occasion of our sampling out there, and the results appeared or revealed benzene at 42 parts per billion for the [mining] consultant's lab, 47 [ppb] for the [WASD] lab and 23.5 [ppb] per billion for the DERM lab in the 40-foot well. And the shallow was below detection limit, and the deep had 28 [ppb] by the consultant's lab, 34 [ppb] by the [WASD] lab and 17 [ppb] per billion by the DERM lab. And then resampling of the same well on May 3rd revealed benzene at higher levels. 61.6 [ppb] in the [intermediate depth well at NW-109], and 50.9 [ppb] in the [deep well at NW-109] . . . . And the photos show that those [blasting] caps that were in place at the previous sampling event were already blasted by the second sampling event . . . . [H]e drew the conclusion that there was a spike due to the blasting effect. I mean, it was just a possibility that needed to be evaluated.

Tr. 2358-59.

On one occasion, Ms. Caveda saw a "cloud of yellow fumes of some sort" and discussed it with a representative of permittee/Intervenor Florida Rock who told her that it "was a dud, an explosion or a detonation that didn't work or didn't happen properly, and that is what comes off of an explosion that doesn't work, I guess, in the ground." Tr.

2323-24. Reportedly, duds or misfires "happen[ ] all the time" Tr. 2324.

It appears that there were several items of information related to the blasting which weren't investigated by DERM. For example, DERM didn't obtain information about "partial detonations and their frequency and magnitude in and around the Northwest Wellfield," Tr. 4757,[179] DERM never tested the blasting material itself, Tr. 4762, DERM also "didn't consult with any blasting ... experts" and "did not conduct any lab or field experiments to determine whether the blasting and what it did to the blasting agents might be the source of the benzene," Tr. 4759.

In contrast, WASD professional engineering staff, who conducted the field investigation and who evaluated its results, found the blasting to be the most likely source of the benzene. Blasting related to mining "was the most likely of the sources that we identified, yes. It was a source that was the only thing in the area that had the same depth where the contamination was found, the mining activity introduces materials at the same depth as the benzene that was found, and also the same depth as the flow zone to our production wells." Tr. 2366 (Ana Caveda)[180]. While the specific source of the benzene remains unidentified, the Court finds the results indicating benzene's persistent presence at depths of 60 feet to be significant.

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[179]Ana Caveda noted that DERM did not issue its standard "notice of required testing" ("NORT") to any of the mining companies regarding the benzene contamination, which Ms. Caveda described as "unusual," Tr. 2300 -01, but Mayorga said that a NORT was not issued because the sampling results already had reduced to below criteria. Tr. 4689.

[180]The highest concentration of benzene was detected at MW-109, and "was probably caused by the blasting of [ANFO] in the process of mining lakes." Tr. 1285, 1300 (Pitt).

> Benzene is a low density chemical, significantly lighter than water, it is not likely that the concentration at the 60-foot depth could have resulted from an above-ground surface spill that leaked downward into the Aquifer, nor is it likely that it could have resulted from a buried tank that leaked or from any other similar disposal at the top of the aquifer. ... [It appears likely] ... that benzene must have entered the aquifer at depth and then moved with the water in the preferential flow layers of the aquifer, maintaining a higher concentration in those flow zones as the benzene plume moves through the aquifer. Day-to-day fluctuations in benzene concentration within the flow zones could be the result of plume pulsations caused by plume direction changes when the flow lines are affected by variation in Wellfield pumpage rates and by the wells actually in operation.

Plaintiffs' Exh. 81 ("Evaluation of the Occurrence of Benzene at the NW Wellfield," undated[181] memo from William Pitt to William Brant). Mr. Pitt, whom the Court found very credible,[182] explained to this Court that the benzene was

> found in high concentrations, ten parts per billion or higher, in the 60-foot zones of the aquifer, and in much lesser concentrations, one parts per billion or less, in the shallow zones. Furthermore the data show that the high concentrations appear to be to the south and southeast of the southernmost well, well number 1.

Tr. 1223-24 (Pitt). See also Plaintiffs' Exh. 81. The County's CAP, prepared by WASD, also notes that:

> As groundwater flow in the vicinity of the Wellfield is towards the production wells, not away from the production wells, the source of the high concentrations of benzene must originate from south of the Wellfield, and from production well 1.

CAP, p. 2.

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[181]Mr. Pitt testified that the memo was written "early during the investigation." Tr. 1217.

[182]Prior to joining the management staff of WASD, Mr. Pitt worked at the USGS for twelve years, and worked for approximately twenty years at private consulting firms. While working as a consultant, Mr. Pitt was hired to conduct the hydrogeology aspects of a County investigation into the effects of mining-related blasting on homes and neighborhoods near the Lake Belt. Tr. 1268 - 69. He has published numerous articles and has written reports on the interconnection between surface water and groundwater. Tr. 1193-98.

In addition to the evidence as to the location from which the benzene originated, the Court is particularly impressed with the testimony of Dr. Hennet regarding the nature of blasting and the release of benzene – regardless of whether benzene is present in the blasting emulsion. His relevant experience, and his careful testimony,[183] indicated that his opinion was thoroughly developed. The Court found that Dr. Hennet's testimony was much more relevant and credible than that of either Dr. Feenstra,[184] or Dr. Machacek, who was unaware even as to the concentration levels of benzene detected in the Wellfield. "I thought parts per million, but I don't know." Tr. 7014.[185]

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[183]Dr. Hennet specifically did not seek to replicate precisely the conditions that occur when an ammonium nitrate emulsion is detonated, because it has a range of conditions, and "not everything happen[s] at one single temperature, one single pressure or the such." Tr. 6531 (Dr. Hennet). "[W]ithin that range of extremes you have conditions that are conducive to the formation of the [benzene and other hydrocarbon by-products]." Tr. 6532-35. Dr. Hennet testified, for example, that no one could make calculations to determine how much of the by-products from the detonation of a blasting emulsion are released into the atmosphere above ground because every case will be different, depending on the depth below the surface at which the explosives are placed, the amount of explosives, etc. Tr. 6533.

[184]Dr. Feenstra testified that EPA's "sector notebooks," which describe specific industrial sectors and the types of risks they pose do not indicate any concern by EPA with regard to groundwater contamination by benzene from blasting operations. Tr. 5340-41 (Dr. Feenstra), but this Court wonders whether EPA has seen ANY limestone mining operations on top of an Aquifer in the middle of a pristine Wellfield anywhere in the country other than Miami-Dade County. Dr. Feenstra also appears to have narrowly defined the problem, despite the existence of "16,000 references related to groundwater and groundwater contamination" in his library. Tr. 5340. "I reviewed the EPA sector notebooks for metal mining and nonmetal mining, and basically looking for any indication that there was a concern by the EPA with regard to groundwater contamination by benzene from blasting operations. . . I found no such notation, no concern indicated with regard to that particular type of potential pollution." Tr. 5341.

[185]Dr. Machacek's experience in the testing of commercial explosives was impressive, but ultimately his testimony was not persuasive. For example, after testifying that he knew of no incidents where there was a correlation between blasting

The evidence is compelling that when a blasting compound contains fuel oil, or any other component which includes benzene, that benzene may be released into the groundwater. While Intervenors' expert, Dr. Feenstra, attempted to dispute this, he was unconvincing. Dr. Feenstra is not an expert in combustion byproducts, as acknowledged by counsel for Intervenors. Tr. 6217. Dr. Feenstra tried to establish that the benzene was related to a distant gasoline spill, but each aspect of his opinion testimony was rebutted convincingly by Plaintiffs' expert Dr. Hennet. Tr. 6577, 6582 (Dr. Hennet).

Dr. Hennet relied on the "state of the art" in the combustion sciences, the most "modern, very recent research in combustion chemistry," Tr. 6531, in forming his expert opinion. He relied on combustion chemistry, and studies of the "chemical pathways that explain what happens during combustion of the products that are present in the blasting mixtures." Tr. 6532 (Hennet). Dr. Hennet testified that the data from the Wellfield, while limited, did reveal that there was an "excellent correlation," Tr. 6448, between the levels of benzene and the levels of corresponding chemicals styrene and ammonia, for example, found in the samples in the deep and intermediate depth wells at NW-109, which supports his opinion that it is inevitable that benzene will form during the

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and benzene contamination in groundwater, he admitted that benzene probably had never been specifically looked for as a result of blasting. Dr. Machacek testified that he did not believe that benzene is created by the use of either diesel fuel nor mineral oil in blasting emulsions. Tr. 7030-31 (Machacek). Aside from his beliefs as to the chemical processes, Dr. Machacek conceded that he wasn't aware of any investigation that had been designed or would have been able to detect the type of benzene contamination problem we have here. Tr. 7014-15.

combustion of ANFO.[186] That correlation indicated a similar source for both the benzene and the ammonia in those levels at that location. Tr. 6498.[187]

Dr. Hennet testified that even if fuel oil is not being used, the formation of benzene is still probable. "So you do not need to start with benzene or anything else to go and yield benzene. You start with hydrocarbons, you break them down through combustion, you form those type of very reactive compounds that are called free radicals that recombine and start to form those aromatic compounds." Tr. 6446-47. The starting product is not that important, as long as it includes hydrocarbon compounds that will break down to form those free radicals. Tr. 6448. Even if fuel, or diesel, oil is not used in the blasting agent, benzene still may form as a result of the combustion of hydrocarbons.

> [W]hen you combust or you heat up vegetable oil, you're going to go through the same process, and you're going to produce those free radicals and then you are going to produce some benzene. . . . So even if you cook a hamburger, you are going to produce free radicals, and some of them will combine to form benzene, and that has been documented, measured, and it is ... in the literature.

Tr. 6448. "You start with hydrocarbon mixtures, you bring enough heat to them to break those compounds into free radicals, and those will recombine to form those type of

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[186]Dr. Hennet testified that the fingerprint of the compounds found in the Wellfield is similar to that produced during combustion experiments. Tr. 6463-70, Plaintiffs' Exh. 237. Styrene is not a very persistent compound in the groundwater environment, and is not found in a groundwater plume from a gasoline spill, because it tends to degrade relatively quickly Tr. 6519. Dr. Hennet also reviewed the ammonia concentration in the groundwater and noted that it varies from place to place. "It's actually very high relative to other locations that I a familiar with." Tr. 6583. Ammonia is detected in the Wellfield in hundreds of parts per billion. Tr. 1332 (Pitt).

[187]Dr. Hennet noted that all of the following compounds had been detected in or near the Wellfield: ethyl benzene, xylenes, and styrene. Tr. 6443.

compounds." Tr. 6448. "The combustion of mineral oil will yield to the formation of benzene under appropriate conditions, . . . [conditions which] are definitely possible] in the Lake Belt." Tr. 6579 (Hennet)

Intervenors attempted to establish that the temperature of the explosions in the Wellfield is too high to have allowed for the release of benzene,[188] but Dr. Hennet credibly testified that the cool temperature of the groundwater surrounding the four-to-six inch blasting holes would maintain the temperature at a range which is conducive to the formation of benzene. It is "very likely, and ... probably unescapable [sic]" that the use of ammonium nitrate blasting agent that contains a hydrocarbon mixture "will form some benzene." Tr. 6581. The blasting process itself may be responsible for the benzene if the hydrocarbon burning during the blasting is the source of the benzene, it may not matter that the source of the hydrocarbon is from diesel fuel or mineral oil. Tr. 6397, 6448, 6494, 6548, 6579 (Dr. Hennet). Benzene spikes occurred at same time as spikes of styrene (hydrocarbon similar to benzene and also produced by the combustion of hydrocarbon mixtures), Tr. 6487-92 (Dr. Hennet), as well as ammonia (the primary ingredient of the blasting agents). Tr. 6341 (Dr. Hennet), Plaintiffs' Exh. 227 & 239.

"[W]hat I am able to establish with confidence as an expert in my field is that when ANFO blasting agent is used, products such as benzene, toluene, styrene, ethyl benzene, xylenes are going to be produced." Tr. 6548 (Dr. Hennet). Dr. Hennet was careful not to testify as to exact amounts, but rather relied only on estimates, noting that

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[188]The Court notes that Intervenors offered no testing results or data to demonstrate the temperature of the blasting event.

it is impossible to know exact amounts based on the insufficient data in this case regarding the amount of explosives used, the depth at which they are placed in the Aquifer, the temperature of the blast, etc.

> We do not have sufficient data from the field to give quantitative answer of how much is being produced for styrene, benzene, toluene, [etc.]. What we know is that it is produced. . . . We know it by the science . . . and we see exactly what we expect [we] would find if we were contributing those compounds from the use of [ammonium nitrate] blasting agents. That's for certain.

Tr. 6549.

Intervenors argue that the lack of prior incidents of benzene contamination despite decades of mining in the area prove that the mining cannot be the source of the benzene. The Court disagrees.

> Whereas before, that Wellfield had never been operated, consistently every well. So at that point we had the most – I guess had reached a certain level of pumpage that may have brought the things in.... by aerial photographs ... it indicates that the lakes were further away in the past. Now they've reached the closest locations.

Tr. 2431 (Ana Caveda).[189] Moreover, the benzene data sampling in the area only started in early 2000, and was so limited that it may not have detected benzene simply because the sampling was performed at a great distance from any blasting occurring at the time.

> [After 2000,] it appeared that samples were collected maybe once a year, maybe a little bit more often than once a year, until 2003, when it was collected three times a year. Then it continued – the frequency of sampling started to increase 2004, 2005 [sic], and then benzene was starting to be detected and you have a

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[189]"I learned that there is an approximate ballpark of eight hours lag time between the production well and when that water is received at the entrance to the plan, and an additional eight hours of when that particular water is discharged as drinking water, finish water." Tr. 2363 (explains benzene drop) (Ana Caveda).

> lot of data. But early on, before 2000, you do not have a lot of data, even though you may have 40 years of blasting. In the early years of this, when you have very few samples, low levels of benzene were detected, not very high. [T]his data . . . [is] not sufficient to understand what happened for the last 40 years. . . . I think the data is pretty sparse for 40 years of blasting, and I don't think anybody can say whether or not it happened before.

Tr. 6552-53 (Hennet).

At some time after a meeting with the permittees' representative, Kerri Barsh, in June 2005, the mining companies reportedly began to use mineral oil as a substitute for fuel oil in the emulsion mixture. Tr. 4763-64 (Mayorga).[190] Tarmac substituted a "food grade mineral oil for the fuel that had the diesel – the benzene component," Tr. 4969, but had been using diesel fuel until February 2006, Tr. 5026, i.e., had been using a product with benzene as a component. Intervening Defendants' Exh. 112. Intervenors' counsel has asserted that his clients have voluntarily stopped using the product "which theoretically possibly could be" the cause. Tr. 2448. On July 25, 2006, Intervenors' Counsel stated that reportedly one company stopped using benzene/fuel oil in 2002, others stopped in 2005, and "nobody's using it anymore." Tr. 2450. The Court notes that the mining companies obviously have a record of compliance with regulations, etc., but the Court finds nothing in the record that suggests that the Corps has taken enough interest in this issue to even verify that the companies are not using a benzene-containing oil. The Corps apparently has not asked for assurances, has imposed no conditions, has conducted no independent analysis – or at least no such efforts have

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[190]A proposed pilot project to test the use of mineral oil in the blasting emulsion instead of diesel fuel wasn't implemented because the companies proceeded to use the mineral oil shortly thereafter. Tr. 4765.

been brought to the Court's attention.

The Corps was aware of the benzene contamination by at least March 2005, see Plaintiffs' Exh. 150. Despite this knowledge, they filed a preview of the "Three Year" report in September 2005, as well as the "Three Year" review report in April 2006 without a single mention of the incident.[191] Moreover, Studt testified that in late 2005 the Corps was "about to propose lifting [the prohibition on the double cross-hatched areas] because we had not been completely made aware of the County's position, and we were made aware by communicating with the County and receiving this [January 17, 2006] memorandum [Plaintiffs' Exh. 149]." Tr. 2759. Studt testified that the Corps was not "imminently" prepared to remove the restrictions but the fact that the Corps was even considering removing them at all after having learned from the County in early 2005 that the benzene posed an "immediate public health hazard to . . . [the] County's public water supply," Plaintiffs' Exh. 150, is troubling.[192] Studt testified that the Corps normally "defers] to the county experts who are delivering the water . . . . If the County came to the Corps . . . and expressed a concern, then we would certainly carefully evaluate that . . . and talk to experts in that area." Tr. 2583.[193] The Corps has as of this

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[191]The Court has expressed its views on this topic already.

[192]Indeed, it appears that the benzene contamination is related to mining in an area that is outside of the currently imposed setbacks. Plaintiffs' Exh. 4, pp. 15, 43; Tr. 1251 (Pitt).

[193]When questioned as to whether there is a regulatory provision that directs the Corps to defer to local authorities on issues of protecting municipal water supplies, Studt was unable to identify any specific provision. "The . . . deference provided to other state and federal agencies is generally within the Clean Water Act itself [and the 404(b)(1) Guidelines] may have a reference to deference to other agencies. I don't

date[194] decided to retain the restrictions on mining in the double cross-hatched area until the SEIS is completed,[195] but it is unclear what the Corps will decide at that time.

The Corps' claim that the benzene contamination was not seen as a problem by the County,[196] is interesting when compared to the County's prediction, more than fifteen

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recall." Tr. 2676-78 (Studt). In fact, the CWA only defers to states regarding the question of "quantities of water," but as to water quality issues the CWA requires federal agencies to "co-operate . . . with . . . local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources." 33 U.S.C. §1251(g), and the Corps' governing regulations specifically require consideration of effects on "municipal water supplies," 40 C.F.R. 230.10(c)(1) (404(b)(1) Guidelines), and "water quality," 33 C.F.R. 320.4(a)(1), and provide that final action by the Corps "will normally not be delayed pending action . . . by state or local agency." 33 C.F.R. 320.4(j)(1).

[194]The Corps reported in its "Three Year" review report that

> The County has not amended the Wellfield Protection Ordinance . . . . [T]he Corps believes that the County is no longer entertaining the option of expanding the County established mining setback within the Lake Belt area. Additionally, the Corps believes that the County's concern, which is that the Corps should not authorize mining outside the setback area prior to allowing the County sufficient time to evaluate whether to expand the setback, has now been resolved.

"Three Year" review report, p. 6. (emphasis added).

[195]The Corps "chose to delay any mining in those areas, and therefore not modify the permits to allow mining in those areas until [the Corps] complete[s] the SEIS." Tr. 2755 (John Studt).

[196]This lack of concern from the Corps is particularly alarming in light of the fact that the Corps knew about the benzene contamination from the County since at least February 16, 2005, when a message between two DERM staff regarding the benzene was forwarded directly to two members of the Corps' staff. The County's "brief written description of the emergency" revealed that there was an "immediate public health hazard to Miami-Dade County's public water supply" from benzene contaminating the production wells in the Northwest Wellfield. Several of the wells were to be shut down permanently "until the source of the contamination is found and mitigated." The message sent to the Corps staff sought information from them about "what State and Federal requirements are possible for an emergency situation [placement of a

years ago, of almost this exact occurrence. On July 29, 1992, John W. Renfrow (then Director of DERM, now Director of WASD),[197] identified the following as an issue in the proposed development of the mining plan: "Does the cumulative use of explosives over the lifespan of the project result in some sort of contamination?" AR44.[198] In any

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monitoring well to detect the source of the benzene]." Plaintiffs' Exh. 150 (email dated February 16, 2005, from DERM staff to DERM and WASD staff, forwarded to two Corps staff members on the same date). Another message was sent to Corps staff members on March 4, 2005, asking "what permits will be required for the proposed work in wetlands [placement of the monitoring wells] and if there is an emergency authorization under the State and Federal programs." On that date, a Corps staff member responded, inquiring as to the level of contamination, and noting that "the EPA target for benzene is not more that [sic] 5 ppb with a goal of zero. Knowing what level has been found so far may help me move this forward faster." Within minutes, a DERM staff member responded that the concentrations detected in the groundwater were as high as 19.7 ppb. The Corps staff member replied: "Thanks!" See Plaintiffs' Exh. 150. Counsel for Defendants told the Court that "there were only two or three e-mails or reports in total that comprised the information that was before the Corps .... And the bottom line is that although benzene had been detected, ... there was no evidence linking this to the mining. And the County did not bring this to the Corps of Engineers as a concern." Tr. 7166-67.

[197]Interestingly, Mr. Renfrow was one of the few witnesses previously identified by Intervenors who ultimately did not testify in this case, as noted by Plaintiffs' counsel in closing argument: "Where was John Renfrow? If there was one witness that the Intervenors could have called, sits at the crossroads of all these issues – he was at DERM when the benzene issue was being investigated, he's the director of the Water and Sewer Department now. He was the one involved in the Bill Brant resignation [former head of WASD, forced to resign in January 2006]. He was their guy.... Sometimes you can learn more about the witnesses you don't hear from than those you do." Tr. 7089. Intervenors' counsel retorted that if Plaintiffs "thought that Mr. Renfrow's testimony was so relevant, they could have subpoenaed him." Tr. 7195. The Court hopes that Mr. Renfrow's predictive power from 1992 is no longer as accurate, as he apparently suggested – in response to WASD's efforts to conduct a study to determine the source of the benzene contamination – that terrorists might have been the source of the benzene in the Wellfield. Tr. 1493-94 (William Brant).

[198]Further, in May 1999, DERM proposed additional language for the draft EIS as follows: "the following potential consequences of the proposed [mining] plan were identified: Accidental spills of fuels, lubricants or other hazardous materials during

event, regardless of the local government's failure to determine precisely[199] the source of the benzene, this Court concludes, based upon the evidence presented to the Court, that the mining activities are a likely source of the benzene.[200]

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mining operations and related activities." SAR1323 (email between two DERM staff members). The Corps also was aware, from its own process of publishing the EIS and ROD, that there were predictions that the presence of the mining pits would subject the Wellfield to a change in its classification from ground water to ground water under the direct influence of surface water ("GWUDI") – a change which would necessitate tens of millions of dollars in water treatment plant upgrades, at a minimum. Based upon that context alone, the Corps should have been particularly alert for warnings about contamination of the Wellfield.

[199]The "source of the high concentrations of benzene must originate from south of the Wellfield." CAP, p. 2.

> [I]mplementation of the CAP as proposed with production wells PW-1 and PW-2 optimally operated to function as recovery wells, will provide a hydraulic barrier preventing the northerly migration of the contaminant plume towards the other production wells and will provide for the rehabilitation of the impacted groundwater.

Docket No. 366 (Letter from Mayora (DERM) to County Health Department, dated Feb. 12, 2007). Remediation activity will continue as long as the benzene contamination is present in the NWWF. Id.

[200]Indeed, apparently the only other potential source identified by DERM in its contamination assessment is the South Florida Reception Center, located more than one mile south of the southernmost production well; that source appears, however, to be unrelated to the first contamination episode which lasted from January 2005 to February 2006. "On August 28, 2006 DERM was notified of an approximately 200 gallons [sic] diesel spill at the South Florida reception Center .... Soil and groundwater samples conducted September 27, 2006 reported low levels of volatile organic compounds (acetone and MEK) in soil and napthalenes in groundwater. All results were below the applicable clean up target level." Docket No. 366 (Intervenors' Notice of Filing, filed March 16, 2007, Attachment 2, Executive Summary of the Northwest Wellfield Benzene Investigation (2005-2007), prepared by DERM, February 2007). The Court notes that DERM's report incorrectly identifies the South Florida Reception Center as a "federal facility." Id., p.7. The Center is operated by the Florida Department of Corrections. See http://www.dc.state.fl.us/facilities/region4/402.html.

3. Treating the water, or not - costs and delays in upgrades to the water treatment plants, and the question of private wells

The federal and state government have established drinking water standards which vary depending upon the source water classification. Some regulations apply to surface water and GWUDI but not to groundwater. Various improvements at the water treatment plants will be required if the Wellfield is classified as GWUDI. The County has received estimates that the total present worth cost of constructing, operating, and maintaining the required plant improvements would be between $97,900,000 to $188,000,000 based upon a 20 year time period.[201] (These figures include an estimated $2.4 to $4.9 million annual cost to operate and maintain the upgraded plants.) Intervenors' Exh. 90, Estimated Present Worth Costs for the GWUDI related improvements, Table 8, p. 14, Miami-Dade Water & Sewer Department, John E. Preston and Hialeah WPS, Update of GWUDI Impact Report, July 2006.[202]

Presently "the [water treatment plants] fall short of the regulations for GWUDI

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[201]In 1999, DERM noted that it could cost at least $235 million to add more filtration and disinfection to the Northwest Wellfield. AR605, p. 85.

[202]In 2004, the Director of WASD attempted to identify possible sources of funds for upgrades to the water treatment plant. "Engineering studies have indicated that the cost to upgrade the existing treatment at the Hialeah-Preston Water Treatment Plant to provide surface water treatment would be approximately $70 million. The funds to provide this upgrade are not in any of the County's plans." Intervenors' Exh. 17 (Brant memo to Burgess, June 14, 2004, recommending negotiation with mining company to receive $70 million in royalties for permission to mine County's lands, designating such royalties for the exclusive purpose of WTP upgrades.) This $70 million estimate did not include operating, monitoring, or transaction costs (bonds, etc.) related to the upgraded plants, Tr. 1576, and Brant testified that he would not have recommended this negotiation if blasting had been shown to introduce benzene to the Wellfield, Tr. 1576-77.

facilities with regards to filtered water effluent turbidity, filter backwash water recycle and disinfection." Id. p. 5. The water treatment plants will have at most eighteen months in which to comply with new standards following reclassification of the source water as GWUDI, id, but it is estimated that the upgrades to the water treatment plants will require three to five years to be completed. Tr. 4291 (Dr. Yoder); Tr. 1576 (Brant).[203] In addition, efforts to upgrade the plants may be complicated by other factors.

> Both [water treatment plants] have been upgraded and expanded several times since their original construction. The expansions have utilized practically all available land at both sites. Additionally, the plants are bordered on three sides by residential streets, leaving no potential land to be readily acquired for expansion. Any treatment upgrades required due to reclassification as GWUDI will need to be carefully sited and the cost estimates will need to reflect the difficult construction requirements due to the congested sites.

Intervenors' Exh. 90, p. 11. More importantly, the processing of benzene in the raw water may raise issues of air pollution.

The treatment at the water treatment facilities involves a technique known as air stripping; that method of treatment can effectively process at most 280 ppb of benzene from source water in order to result in a maximum of .1 ppb output (1/10 of max level of 1 ppb (FAC Chapter 62-550)). CAP, p. 3.[204] The Hialeah/Preston water treatment facilities are classified as a "Major Source of Air Pollution" by Florida code. FAC

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[203]"The proposed improvements will typically take between 30 and 42 months to design and construct; therefore, no watershed activities that would reclassify the source water as GWUDI should take place until treatment upgrades have been completed, unless a variance to [Florida code] is successfully obtained." Intervenors' Exh. 90, p. 11.

[204]WASD spent $41.6 M to install air-stripping towers at Hialeah and Preston, and that air stripping system has been in service since the early 1990's. CAP, p. 3).

Chapter 62-210 (limits on air stripping activities). "While there is no specific limitation in the permit for Benzene, there is a limit for total VOCs emitted of 59 tons in any consecutive 12-month period.... Benzene is classified under Chapter 62-210, F.A.C. as a hazardous air pollutant (HAP) and must be evaluated as such." CAP, pp. 6-7.

> The results show that a maximum of 52 ppb of Benzene in the raw water can be effectively treated to an effluent concentration of 25% of the MCL (Department of Health criteria) with an Air to Water Ratio of 30:1. If the Air to Water Ration [sic] was increased to 60:1 then a maximum concentration of 100 ppb Benzene can be effectively treated to an effluent concentration of less than 25% of the MCL.

CAP, p. 5 (essentially, this indicates that the processing of benzene-contaminated raw water from the Wellfield may raise issues of air pollution at the water treatment facilities).

The former Director of WASD testified that upgrades to the treatment plant would not have been necessary but for the encroachment of the rock pits. Tr. 1575 (Brant). "[I]f one of the existing lakes causes the County to be designated [GWUDI, we would not have the money to immediately respond. Of course, this is true today and has been true for a number of years." Intervenors' Exh. 17 (Brant memo to Burgess, June 14, 2004).[205] In addition, the record suggests that the costs of the million-dollar benzene contamination investigation and other Wellfield monitoring activities are being paid by

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[205]The Corps' "Three Year" review report noted that the County was considering an application for a rock mining permit on County lands within the Lake Belt area, and that "[i]f approved, proceeds from the County's rock mining would be used to pay for upgrades to the water treatment plant." Presumably, this involves a leasing of mining rights to a private mining company in exchange for payments made to the County. Docket No. 103, p. 14 of Exh. B, "Memorandum for Record," dated April 19, 2006, to Exh. 1, "Declaration of John F. Studt, Chief, South Permits Branch, Regulatory Division, Jacksonville District," dated April 24, 2006.

the general public – and not by the mining corporations.

According to Intervenors, a new amendment to Fla. Stat. §373.41492 will increase mitigation fees associated with limestone mining and also create a new fee of $.15 per ton to pay for upgrades to the water treatment plant that treats the water coming from the Wellfield. Docket No. 153, filed June 8, 2006 (Notice of Legislative Development by APAC-FLorida).[206] Intervenors estimate that the new fee will generate $7.5 million a year.[207] Even if the mining were to continue for the five years remaining in these permits, the total collected pursuant to this new fee would be only $37.5 million. This figure is far below the County's prior reasonable estimates as to the costs of the upgrades. Therefore, Intervenors' arguments that the fee will "enable the issuance of bonds to pay for the water treatment plant upgrades" are somewhat misleading. Docket No. 153.[208] Also, it is unclear whether any fees will be owed once the mining has stopped. The quarry pits already exist, and continue to grow as mining continues – it may be that the reclassification of the water source as GWUDI is inevitable. The Corps should have been more vigilant at evaluating these risks prior to issuing these permits.

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[206]The fee "shall be used solely to upgrade a water treatment plant that treats water coming from the Northwest Wellfield in Miami-Dade County. . .. necessary to treat or filter a surface water source or supply or both." Fla. Stat. §373.41492.

[207]The calculations are as follows: $.15/ton times 50 million tons/yr produced by the mining companies in the Lake Belt equals $7.5 million.

[208]For example, Intervenors' emphasis of the following passage: "[t]he fee ceases once the total amount collected reaches the necessary levels to pay for the design and construction of the water treatment plant upgrade," Docket No. 153, suggests that the fee collected potentially might exceed the cost of designing and construction of the upgrades – an unlikely event. The fee is not designed to cover ongoing operation and maintenance costs for the upgraded treatment plants.