

**Review and Data Analysis of the Water Sciences Associates' Aquifer Test Report, Cudjoe Key Wastewater Treatment Plant, September, 2015, Prepared for Florida Keys Aqueduct Authority**

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**Abstract**

A review of the data and report presented by Water Science Associates (WSA) to Florida Keys Aqueduct Authority (FKAA) reveals that all three of the conclusions reached in the report are incorrect or without basis; that data was sometimes misreported; that analysis was invalidly based on momentary maximum data points, rather than statistically appropriate average data; and that the test design was inadequate. FKAA's Winter, 2015 test by Florida International University (FIU) better approximated the actual conditions under which the Cudjoe Regional Wastewater Treatment Plant (Cudjoe Plant) will be operated and the FIU report's conclusions that the wells are inadequate to contain the amount of effluent which will be injected under normal operating conditions are more scientifically rigorous and are supported by visible video and photographic evidence of bubbling at the surface water.

**Description of Well Testing**

Injection well testing of the completed FKAA shallow effluent disposal wells IW-1 through IW-4 located on Cudjoe Key has been performed by two groups to determine if possible environmental harm would come from use of these wells for disposal of treated wastewater effluent. FKAA engaged both as its consultants.

FIU, under the direct supervision of Dr. Henry Briceno, injected a nearly continuous flow of FKAA tap water down one of the 4 shallow wells at the Cudjoe Regional Wastewater Treatment Plant in February and March 2015 at a rate approximating  $\frac{2}{3}$  of an expected average day's flow. The purpose was to determine if the injected water would rise into nearby surface waters and if so, where. The results of the testing were provided in an April 11, 2015 report titled: *Design and implementation of dye-tracer injection test, Cudjoe Key, Florida Keys*. FIU scientists used two tracer chemicals and monitored for these chemicals at the old pre-existing groundwater monitoring wells and also in transects through lagoons and ponds in the vicinity.

FIU detected the tracers in the very shallow monitoring wells and was able to determine the transport rate of the injectate. The tests were discontinued when first air and then muddy water began boiling out of the ground in puddles near the wells. At that point, it was a certainty that the fresh water was rising to the surface. The report states: *After partial results and findings*

were presented to the FCAA on March 19th, indicating the high probability of existence of an underground connection between the injection depth and the unconfined aquifer, the FCAA decided to cease all sampling operations and injection on March 26th, 2015.

As a result of that testing and of ongoing citizen litigation, FCAA decided to recommend development of a deep well for primary disposal, and Monroe County agreed to fund it.

However, FCAA intends to use the shallow wells on an interim basis until the deep well is operational, and afterward as a back-up disposal option, so FCAA contracted with WSA, a private firm, for further testing of the shallow wells. In July 2015, FCAA tap water was injected into the four wells at various rates, while newly installed monitor wells in close proximity were checked for increase in water level. No effort was made to determine where injected water might surface.

After 11 days of intermittent injection of water by WSA, testing was discontinued and the report *Aquifer Test Report- Cudjoe Key Wastewater Treatment Plant* (the WSA report) concluded that the shallow wells were safe and appropriate for interim and back-up use.

Review of the WSA report and analysis of the data reveal that the WSA report presents exaggerated (maximum rather than average) flow rates (see WSA Table 3), and that the testing was not comparable to the flows expected to be generated by the Plant in normal operation.<sup>1</sup> Except for a 2 day test finale, the WSA tests were for brief periods conducted over only a portion of the tidal cycle, with long recovery times between. The final two day test used an average flow rate less than an average day's flow.

The WSA report drew the following conclusions:

- *Each of the four injection wells can accommodate the permitted injection rate of 0.94 million gallons per day or 653 gallons per minute without measurable impacts to groundwater levels.*
- *The multi-well injection well system can accommodate injection rates of over 1800 gpm without measurable impacts to groundwater levels.*
- *The injection well system as designed and constructed is appropriate for use in the startup of the AWTF and as a back-up disposal system to the proposed deep injection well.*

However, the data generated by WSA itself shows that the first two conclusions are incorrect, as

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<sup>1</sup> No information was supplied by WSA concerning its assumptions about the amount of flow during interim use. It is undisputed that if the shallow wells are used as backup during power outages and scheduled maintenance, as well as during repairs, the flow can be much greater than that tested by WSA. Power outages necessitate a dedicated back-up generator for the deep well.

measurable increases in water levels between 0.1 to greater than one foot in one or more of the monitoring wells were observed during the tests (see Figures 13 and 15 in the WSA report). Additionally, the recorded data show that out of 11.26 days of testing, a rate of flow exceeding 1799 gpm was exceeded on only 36 of the over 23,000 one minute interval meter flow data records, and a rate of flow equal to or exceeding the plant peak design capacity of 1632 gpm was achieved for only 88 minutes. Furthermore, the recorded data shows that out of 11.26 days of testing, a rate of flow equal to or exceeding the plant's design annual average daily rate of 653 gpm was only achieved as follows:

- for 52 minutes in well #1,
- for 44 minutes in well #2,
- for 10 minutes in well # 3, and
- for 22 minutes in well #4.

As a result of the errors in the presentation and interpretation, and due to the inadequate duration and rates of injection in the WSA test, the third conclusion -- that the shallow wells are appropriate for back-up use --is also unsupported, particularly given the FIU demonstration of surfacing during long term injection.

Furthermore, water levels in the injection wells during the WSA testing rose to approximately ground surface elevation during the test (see Figure 9 of the WSA report), suggesting that surface flooding is a concern during operation longer than the two days tested, which is confirmed by the earlier three week FIU testing.

#### **Other Observations:**

On Page 1 of the WSA report, it states, *"The AWTF provides...treatment...resulting in water quality that meets all primary drinking water standards."* However, the 2015 UIC application for the deep well indicates that the effluent is expected to contain 200 colonies per mL of fecal coliform.

On Page 2 of the WSA report, it states, *"The FDEP permit FLA671932-001] indicates peak injection rates of 0.94 million gallons per day (MGD), or 653 gallons per minute (GPM)."* However, the 2015 UIC permit application for the deep well states: *The maximum daily flow rate—also the maximum instantaneous flow rate—is 1,632 gpm, based on the peak flow design of 2.35 mgd.*

Table 3 in the WSA report summarizes the testing date, start time, end time, and results for each well tested. The flow rate stated in Table 3 was the maximum flow. The maximum flow is meaningless as it could be momentary. Case in point: a maximum rate of 1163 GPM was cited in Table 3. The recorded well meter data revealed that 1163 GPM was recorded for one well for one of the more than 23,000 minutes recorded. The average flow should be provided in order to meaningfully evaluate the testing. A review of the data suggests that the grand total of water

injected during all of the WSA tests over 11 days was approximately 2.6 million gallons, barely more than a single day of the predicted peak flow.

A comparison of WSA's Table 3 to the Excel files of the data logger water levels and well meter data indicates that the well numbers are sometimes incorrectly reported. This is of particular concern as the report text provides interpretations which discount observed increases in water levels based upon the relative positions of the active injection and monitoring wells.

It is notable that WSA did not monitor the existing very shallow monitor wells which surround the site, and which were used to demonstrate hydraulic connections during the earlier FIU testing.

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John Prosser has decades of engineering & construction experience, including the permitting of shallow injection wells as Monroe County's Design Engineer. He maintains 5 DBPR licenses.

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