CITY OF STUART
DEEP MONITOR WELL REHABILITATION PLAN

The following plan outlines the proposed rehabilitation of Deep Monitor Well DMW-1, a 2,100 feet deep monitor well associated with the City of Stuart's Deep Injection Well System. Deep Monitor Well DMW-1 is the deep monitor well associated with Injection Well IW-2, located approximately 50 feet from IW-2 at the City's Water Reclamation Facility on Stypmann Boulevard in Stuart. The operation of this system is authorized by UIC permit No. 0043090-081-UO issued by the Florida Department of Environmental Protection (FDEP).

Following discussions with the Florida Department of Environmental Protection (FDEP) regarding the status of this well and experiences with similarly-aged monitoring wells at other injection well facilities in the Florida Southeast District, it has been recommended that this plan consider the implementation and timing of potential repair options, in addition to the well rehabilitation, in case there is damage to the well casing under the surface deposit. This revised plan addresses the proposed rehabilitation of the monitor well and in addition, an option to repair and/or replace the monitoring well, if it becomes necessary to do so. Lining the existing well or constructing a new monitor well would only be considered if catastrophic circumstances were encountered during the proposed well rehabilitation process.

Consequently, this revised plan comprises the following contingencies:

1. Well cleaning, inspection and testing, to place the well back into service as soon as possible.
2. If, during the rehabilitation activities, it is discovered that the well is in need of repair, or is shown to lack mechanical integrity upon inspection or testing, a liner will be installed in the well;
3. Should circumstances prove impossible for the installation of a liner in the deep monitoring well, a new well would have to be constructed, at an appropriate location within the Water Reclamation Facility, within 150 feet of IW-2.

The City acknowledges that various permit applications are necessary to either modify or construct a new monitor well. A minor modification application will be submitted, if and when required together with the applicable permit fee, if the well needs to be repaired or lined. It is not anticipated that construction of a new monitoring well will be necessary, but if, at some future time this becomes necessary, specifications and a permit application addressing this procedure will be prepared and filed. A plugging and abandonment plan for DMW-1 is already on file with the FDEP, but a plugging and abandonment permit also would be required.

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7438 Pinetree Lane, Lake Clarke Shores, Florida 33406

In addition to the above additions to the plan, a more comprehensive testing of the existing well after rehabilitation and prior to placing back on-line, also is proposed.

BACKGROUND

The City has two existing injection wells, IW-1, a ten-inch diameter Class I municipal injection well, constructed in 1974 and IW-2, a 24-inch diameter Class I municipal injection well, constructed in 1997. The injection wells are used as the back-up effluent disposal system for the Reclaimed Water Reclamation Facility located at Stypmann Boulevard in Stuart. The injection well system also comprises three monitor wells and an annular monitor tube, described as follows:

- One single-zone monitor well (MW2-2) 1,600 feet deep located within 75 feet of Injection Well IW-2, constructed in 1997.
- One single zone monitor well (DMW-1) 2,100 feet deep located approximately 50 feet from Injection Well IW-2, constructed in 1982.
- One single zone deep monitor well (MW-2) 1,600 feet deep, located within 150 feet of IW-1, installed in 1995.
- An annular monitor zone MW-1) in IW-1 which taps a zone below 1,000 feet below land surface.

Figure 1 represents the reported construction details for the various wells associated with the City's Injection Well System.

The City's injection well system has successfully operated since the 1970's with no issues; the last mechanical integrity tests were conducted in both wells in 2010. The results indicated continuing mechanical integrity in both injection wells. Water quality data presented in the mechanical integrity testing report confirmed that there were no external mechanical integrity concerns.

Deep Monitor Well DMW-1

Deep Monitor Well, DMW-1 was originally constructed as an exploratory or observation well in connection with Injection Well IW-1, which was constructed in 1974. Well DMW-1 was plugged back to its current configuration in 1982 and was part of the IW-1 monitoring system until 1995, when FDEP required the City to install a deep monitor well closer to IW-1. When Injection Well IW-2 was constructed in 1997, DMW-1 became the deep monitor well associated with IW-2 since it was located only 50 feet from IW-2. A diagram showing the construction details of DMW-1, as described in the report entitled "Rehabilitation of the Deep Injection and Monitoring Wells at the Stuart Wastewater Treatment Plant, dated April 1982. The diagram showing the known construction details of DMW-1 is presented as Figure 2.

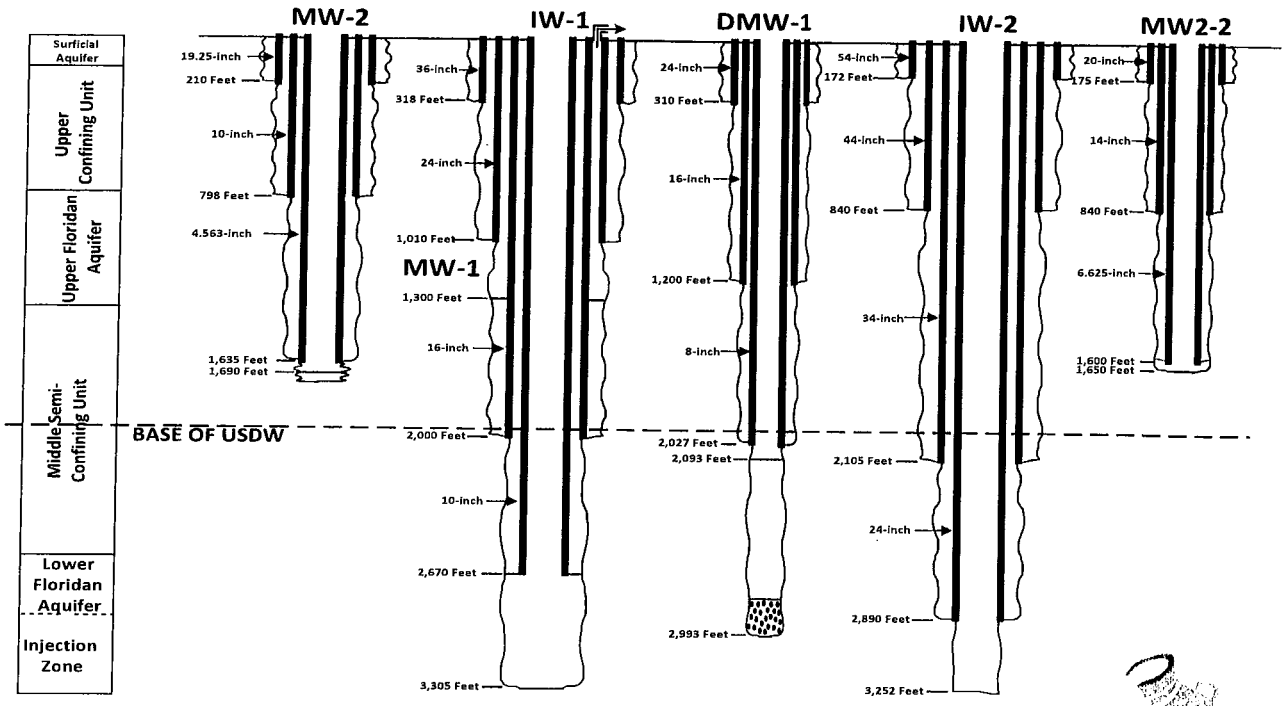

FIGURE 1
CITY OF STUART INJECTION WELL SYSTEM DIAGRAM

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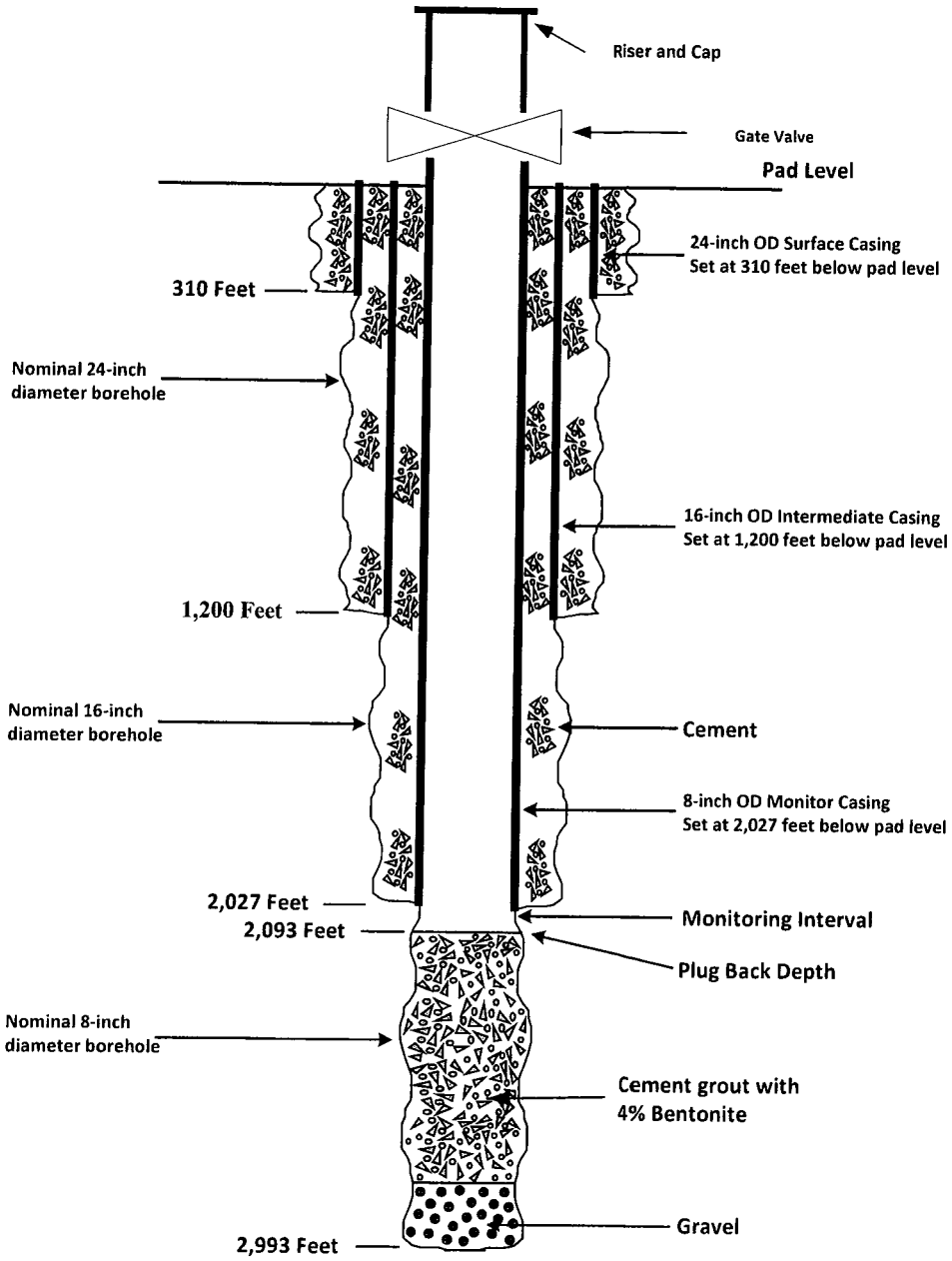


Modified From CH2M Hill, 1990

City of Stuart Water Reclamation Facility
Deep Monitor Well - DMW-1
Figure 2

Aquatech
Geosciences Inc

Water Quality Data

The following table summarizes the typical water quality data for Deep Monitor Well DMW-1, selected dates from monthly sampling over the past year.

	Water Quality Parameters				
Date	Specific Conductance umhos/cm	TDS mg/L	Chloride mg/L	TKN mg/L	Sulfate mg/L
April 2011	48,000	32,000	17,000	0.55	1,200
July 2011	47,000	30,000	18,000	0.64	1,100
Nov. 2011	47,000	30,000	18,000	0.4U	1,100
Feb. 2012	47,000	30,000	18,000	0.5	1,100

Additionally, graphs showing water quality data trends for DMW-1 during 2010 and 2011 are shown as Figures 3 and 4.

Current Condition

During the routine monthly water sampling for March 2012, City staff discovered that DMW-1 would not produce sufficient water to evacuate the well. They assumed that the sampling pump used to evacuate the well was not operating correctly, so obtained a replacement pump. However, after they replaced the pump, the well still did not produce water. FDEP was informed of this situation on March 16, 2012, and also that the monthly sample would not be able to be collected.

A small 1-1/2 hp sampling pump evacuates the well using a 1-inch diameter PVC line tapped into the DMW-1 casing approximately one foot above the ground level; there is no drop pipe inside the well casing. The original static water level in the well was recorded at four feet above land surface at construction. An 8-inch diameter gate valve is located approximately 2 feet above land surface which typically remains in the closed position. Above the gate valve there is an approximately four feet piece of flanged pipe with a flanged plate bolted to the top.

Initial Evaluation

On March 19, 2012, Aquifer Maintenance and Performance Systems (AMPS), a licensed Drilling Contractor and Aquatech Geosciences Inc. Groundwater Consultants, performed a basic flow and pressure test on the well and confirmed that it was not producing water; significant drawdown was recorded in the well while pumping at a negligible flow rate.

On March 23rd 2012, a Video Television Survey was conducted in the well. Almost immediately upon entering the well with the camera, it was observed that there was looked like a thick deposit on the well casing, which continued to thicken with increasing depth. The material

Figure 3
Monitor Well DMW-1 Water Quality Data 2010

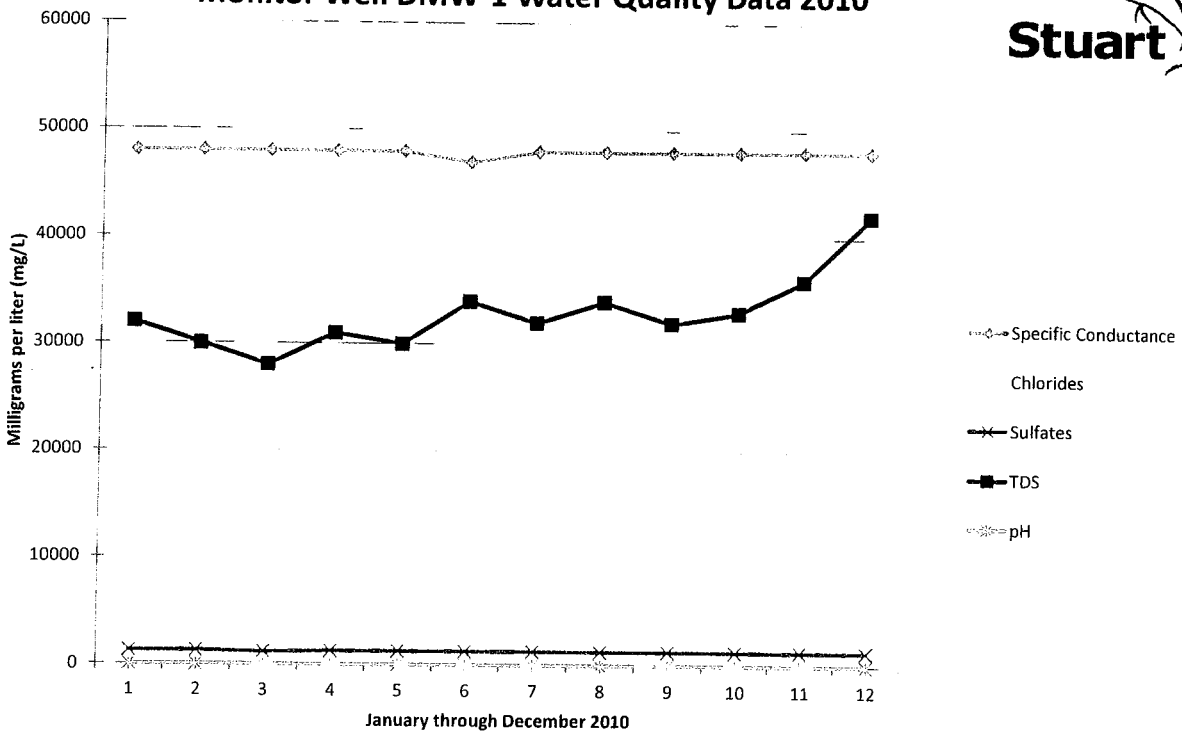
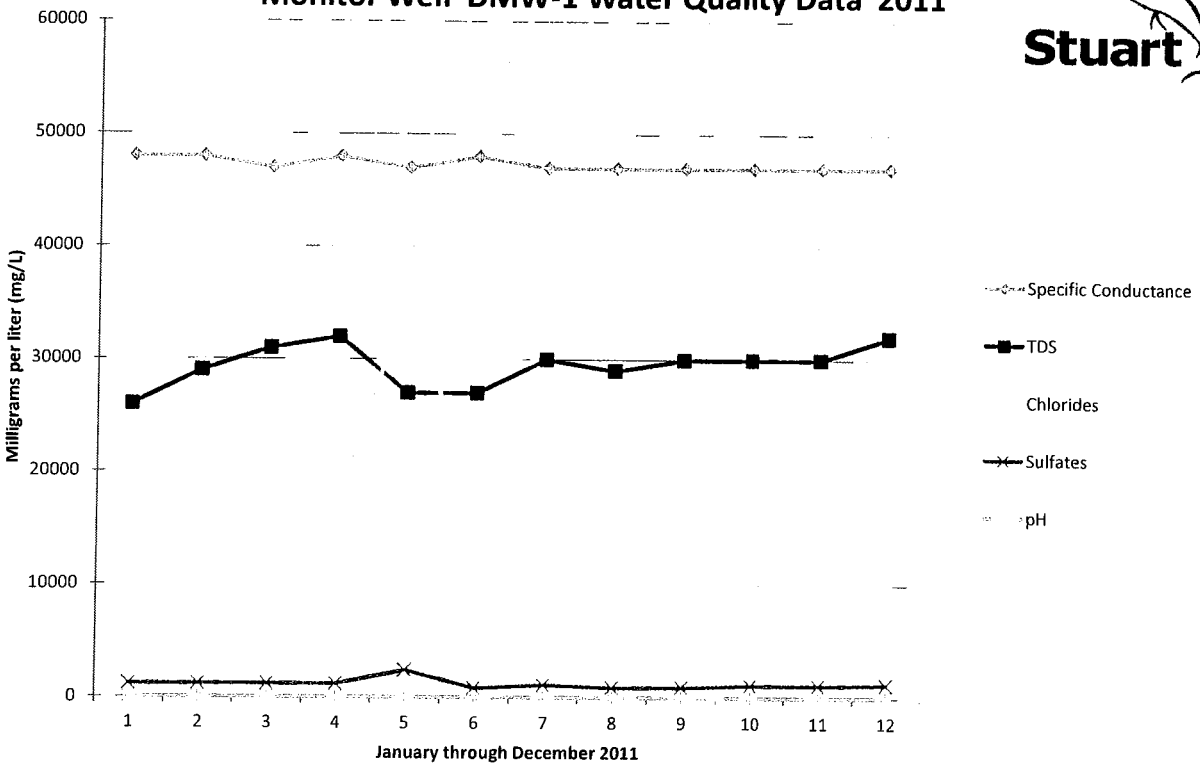


Figure 4
Monitor Well DMW-1 Water Quality Data 2011



obscured the casing completely and was estimated to be approximately two inches thick, based upon the reported casing diameter. At some places there were large semi-soft nodules that protruded from the casing. It was not possible to discern if the casing was corroded or the deposit was mineralized in nature. As the camera went down the well, the centralizers dislodged small amounts of the material on the casing and it fell past the camera; it had a flaky appearance.

The TV survey was discontinued at 254 feet below land surface due to concerns that if the deposit sloughed off the casing, it could fall in on top of the TV camera preventing its retrieval.

On July 13, 2012 a water sample was collected from DMW-1 and analyzed for microbial analysis (HPC, Total Coliform, Fecal Coliform, Fungal Count, and Algea). Results obtained from these analyses indicate that there was no microbial presence in the well; all results were negative. A copy of these results are attached to this plan.

PROPOSED REHABILITATION, WELL REPAIR ACTIVITIES AND ESTIMATED TIMELINE

Based upon the observed condition of the first 254 feet of the well casing, it is projected that the well may be plugged by the deposited material below the termination depth of the video survey, preventing water from being pumped from the well. The plugging is reported by City staff to have occurred over the past month, since the last sampling event which took place on February 17, 2012.

The next steps to assess the condition and re-establish flow to the well are outlined as follows:

1. Re-Establishing Flow

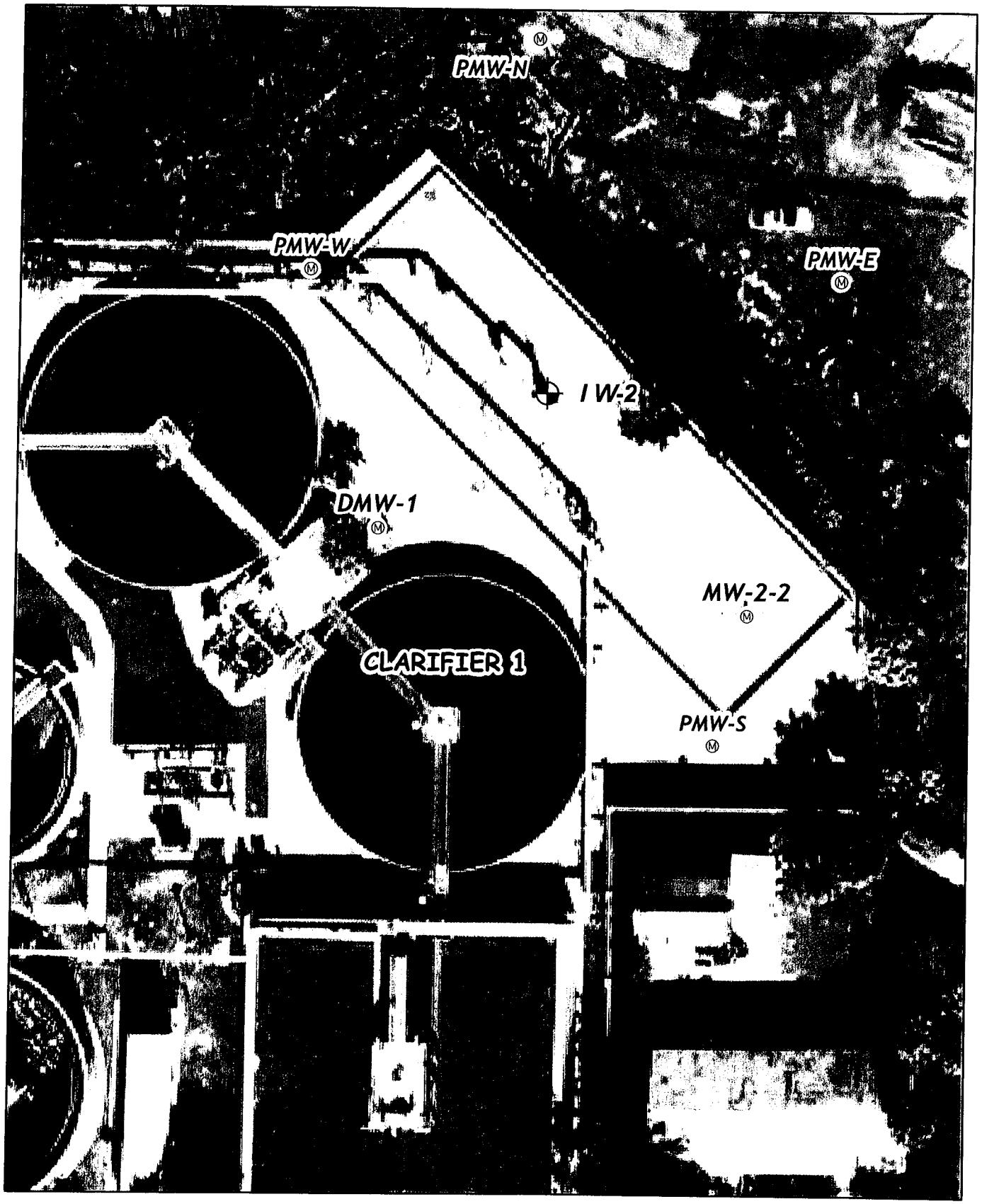
Initially, the City proposes to attempt to re-establish flow to DMW-1. This will occur using potable water delivered through 1-inch HDP tubing, lowered to various depths to initiate upward flow.

The current wellhead configuration as described above will be changed to add a tee above the gate valve to enable entry into the well from above, as well as a discharge pipeline to an empty clarifier (Clarifier #1) which will be used to collect and isolate the water discharged from the well. Figure 5 shows a recent plant site map, showing the location of DMW-1 relative to Clarifier #1 and IW-2. A settling tank also will be used to isolate a majority of the material scraped from the casing so it does not go into the clarifier.

The water removed from the well will initially be isolated in an un-used clarifier tank at the plant. The high chloride water will slowly be added into the plant flow over a period of days without disrupting the wastewater process. A settling tank will be used to contain some of the

CLARIFIER 1 LOCATION
FIGURE 5

Stuart



solid material retrieved from the well; a majority of the material will probably be directed into the clarifier and ultimately cleaned out.

2. Well Cleaning and Rehabilitation

The drilling contractor will use a mechanical method to remove the majority of the material deposited on the inside of the casing. A drilling rig capable of supporting the load of 2,100 feet of drill pipe and tools, or the weight of the tubing that might be utilized if it becomes necessary to place a liner in the well, will be mobilized to the site. The City may need to temporarily move part of the water reclamation facility infrastructure in order to move the drilling rig into place over the monitoring well. The parts of the facility removed will be temporarily re-routed during the period that the drilling equipment is in place and will be permanently replaced upon completion of the work. It may be possible to use a large crane to place the equipment and avoid disassembling sections of the wastewater plant infrastructure.

Mechanical cleaning with a coring-type barrel and bit will be used to scrape off the deposited material and a brush, will be initiated using due care. The open form of the barrel is designed to permit removal of the material using reverse air circulation between the outer barrel and using the drill pipe as airline. Simultaneous cleaning and back-flushing of the well will help bring the material removed from the casing to the surface, limiting the amount that will fall to the bottom of the well. Periodically, during and upon completion of the cleaning operation, video surveys will be performed to observe the progress of the work, condition of the casing and of the open borehole. If this operation is successful, well repair may not be necessary.

It is hoped that once the casing and open hole are cleaned out, the well can be returned to service.

Upon completion of the final casing and open borehole video survey, the well will be developed until free from particulate matter. The video survey of the casing and open borehole will serve to document the condition of the existing well casing in the deep monitor well after cleaning.

If there is any apparent damage to the casing or welds, a one hour pressure test will be conducted to confirm whether the existing well casing is leaking.

3. Well Repair

In the event that there is an issue with the integrity of the casing in DMW-1, determined during

rehabilitation, or during the final video survey or pressure test, and it becomes necessary to perform repairs on the well, the following will occur:

- FDEP will be notified, verbally and in writing.
- A minor modification to the existing City of Stuart Injection Well System will be completed. This will include final details of the proposed repair technique or replacement tubing, method of installation and tests employed to verify correct installation of the tubing and/or repair.
- If casing damage is identified during the final video survey of DMW-1, and it is small enough to be repaired using a casing patch, this method of repair will be employed by the drilling contractor.
- If the damage to the casing is judged significant by the City, in consultation with the FDEP, the appropriate length of material and method of installation approved in the minor modification documents, will be ordered and installed. (Manufacture and delivery time on typical pipe used for this type of repair is four to seven weeks).
- Drilling equipment of sufficient size to install up to 2,000 feet of the appropriate tubing will be used for the well cleaning so that no equipment change will be necessary in order to repair the well with a casing patch or to install a new liner.
- If a liner is placed in the well, the final repair will be pressure-tested in compliance with manufacturer's recommendations, to verify that the well will hold pressure.
- To verify that the repair or liner is properly installed, a video survey will be conducted in the casing and open borehole, after completion.
- A modified wellhead will be constructed to accommodate the new liner.

4. Verification of Well Rehabilitation or Repair

Subsequent to the completion of testing, the well will be continuously purged and water samples collected weekly until the monitoring zone returns to background conditions. The water samples will be analyzed for the following parameters:

- Total dissolved solids (TDS)
- Specific conductance
- Chlorides
- pH
- Temperature

During this period of purging, a report of results will be submitted to FDEP on a monthly basis. Upon acceptance of the work by FDEP, the monitoring well sampling and reporting schedule will return to the original monitoring and reporting schedule.

Regulatory Notifications

The City proposes to provide periodic notification to the FDEP during the rehabilitation and repair process (if necessary). Notification of planned start-up after approval of the Rehabilitation Plan is proposed. In addition, FDEP will receive periodic email or telephone notification at significant points in the rehabilitation and repair, when the final television survey is taking place and of any significant results. If circumstances occur causing a need to deviate from the proposed plan, FDEP will be notified prior to any actions.

The City will follow-up the rehabilitation and or repair of the deep monitor well with a letter report documenting the work performed and the results, including test results.

5. Estimated Timeline

The estimated timeline for completion of this work is tabulated below:

Phase	Milestone	Duration (weeks)	Weeks from FDEP Authorization
	Equipment Mobilization and Set-up	4	4
1	Well Cleaning	2	6
	Video, Development, Testing, Wellhead	2	8
	Report Preparation and Submittal	2	10
	Well Purging & Sampling (estimated 3 months)	12	22
	FDEP Approval	4	26
2	Pressure Test	1	7
	FDEP Modification Approval	4	11
	Minor Casing Repair	1	12
	Video, Development, Testing, Wellhead	2	14
	Report Preparation and Submittal	2	16
	Well Purging & Sampling (estimated 3 months)	12	25
	FDEP Approval	4	29
3	Liner Material Ordering and Delivery	8	14
	Liner Installation	2	16
	Video, Development, Testing, Wellhead	3	18
	Report Preparation and Submittal	2	20
	Well Purging & Sampling (estimated 3 months)	12	29
	FDEP Approval	4	33

6. Contact Information

Correspondence and reports will be submitted to FDEP UIC representatives via mail and in Adobe "pdf" format. A distribution list is attached.

The City of Stuart Reclaimed Water System Team Leader 3 / Chief Operator is Don Long. He can be contacted at the Reclamation Facility on 772-288-1292 extension 5291, cell phone 772-678-1892 or via email at dlong@ci.stuart.fl.us.

The Drilling Contractor is Aquifer Maintenance and Performance Systems Inc. (AMPS). Jim Murray will be in responsible charge of the rehabilitation operation and can be contacted at 561-494-2844 or via email at jmurray@amps.com.

Aquatech Geosciences Inc. is the City's consultant for this project. Helen V. Madeksho-Hickman P.G. is the hydrogeologist who will be working together with the City and AMPS in executing the work to rehabilitate or repair the well and will be providing notification and documentation of the rehabilitation efforts. Ms. Hickman can be contacted at 561-307-2369 or via email at hickmanhydro@att.net.

Respectfully Submitted,

Digitally signed by Helen Hickman
DN: cn=Helen Hickman, o=Aquatech GeoSciences Inc, ou=President, email=hickmanhydro@att.net, c=US
Date: 2012.08.02 12:05:31 -04'00'

Helen V. Madeksho-Hickman PG CPG
Principal Hydrogeologist
Florida PG License No: 000960

AQUATECH GEOSCIENCES INC.

MICRIM LABS, INC
800 N.E. 62ND STREET
SUITE 202
FT. LAUDERDALE, FL 33334

TEST RESULTS

DATE RECEIVED: 07-13-2012
PAGE 1 OF 1
SAMPLE # WELL 1

CITY OF STUART
301 STYPMANN BLVD.
STUART, FLORIDA 34994

TEL: (772) 288 – 1292
FAX: (772) 288 - 1405

COMMENTS OR FINDINGS

REPORT #	PARAMETER	RESULTS	METHOD
E12G0188	HPC:	< 1 CFU / ML	SM 9215 B
E12G0189	TCC:	TOTAL COLIFORMS ABSENT	SM 9223 B
E12G0190	FCC:	E. COLI ABSENT	SM 9223 B
E12G0191	FUNGAL:	< 1 CFU / 100 ML	SM 9610 H
E12G0192	ALGAL:	NO ALGAL MORPHOLOGIES SEEN	SM 102000 C

SET UP DATE	ANALYSIS DATE	REPORTED DATE	ANALYST
07-13-2012	07-20-2012	07-20-2012	