STEALTH REUSE
OCALA'S AIRPORT SOLUTION

DOUG G. HARRIS, P.E., DEPUTY CITY ENGINEER

ED T. EARNEST, P.E., UTILITY ENGINEER

CITY OF OCALA ENGINEERING DEPARTMENT

OCALA, FLORIDA

ABSTRACT

In 1996, the City of Ocala constructed a subsurface reuse irrigation project in the clear zone at the local airport. This site is the first reuse project permitted on an airport property by FAA in the southeast in over 20 years. The site is a key element in Ocala's reuse system, which was recently named the MOST INNOVATIVE AND EFFECTIVE REUSE SYSTEM in EPA Region 4.

The site earned the nickname STEALTH REUSE for it's almost invisible presence despite being located next to two of Ocala's most traveled roads. In addition, the project flew through FFA and FDER permitting without a hitch and came in under the NIMBY radar with no public opposition.

The system consists of a small operations building housing a filtration system and valve controllers, and a 44-acre wetted area underlain by a network of mains and distribution pipes. The site has operated successfully at an average of 500,000 gpd over a three-year period. Monitoring data reveals that groundwater quality has not been adversely effected despite high loading rates.

The topics covered in the paper include:

- A background of Ocala's reuse/disposal system from the FDER doghouse to EPA award winner.
- A review of permitting strategy to get reclaimed water on an airport site.
- Lessons learned from Ocala's two previous subsurface test sites.
- A description of the system with typical sections and an operational schematic.
- Three years of groundwater monitoring data and the story it tells.
- The operational and maintenance history of the facility.
- The applicability of this technology to other users.
- A comparison of capital and maintenance costs of underground systems and conventional irrigation.

INTRODUCTION

Ocala is a City of 50,000, located in North Central Florida. The area is best known for its thoroughbred industry, second only to Kentucky in breeding and training of champions. The Ocala area has experienced dynamic growth over the last 20 years with the resulting demand for infrastructure expansion.

The topography of this area is generally low rolling sand hills. The well-drained surficial soils are underlain by intermittent clays and fractured limerock. The only surface water features in the area are spring fed streams and small ponds. Silver Springs, on the east side of Ocala, is the world's largest Artesian spring producing over 300 million gallons per day of crystal-clear water.

The City of Ocala has provided sewer service since the 1940's. The traditional method of disposal for reclaimed water has been percolation ponds. The constant hydraulic loading of these ponds tend to weaken the underlying limerock and cause collapses or sinkholes. These failures allow direct surface connection to the Floridan Aquifer from which all of Central Florida's drinking water is drawn.

In the mid 1980's, the Florida Department of Environmental Regulation (FDER) had seen enough effluent dumped to the aquifer through sinkholes and hit Ocala with a moratorium on sewer connections until the City developed alternate reuse/disposal methods. This shot over the bow precipitated the hiring of a new water and sewer consultant and a new City Engineer and staff. The new team went to work designing one of the most diverse and innovative reuse systems in place in America today. The system includes traditional uses such as irrigation of golf courses, recreation facilities, and landscaping. On the more innovative side are an airport firefighter training facility, a dedicated agricultural site, and the two subsurface reuse sites

SUBSURFACE REUSE OVERVIEW

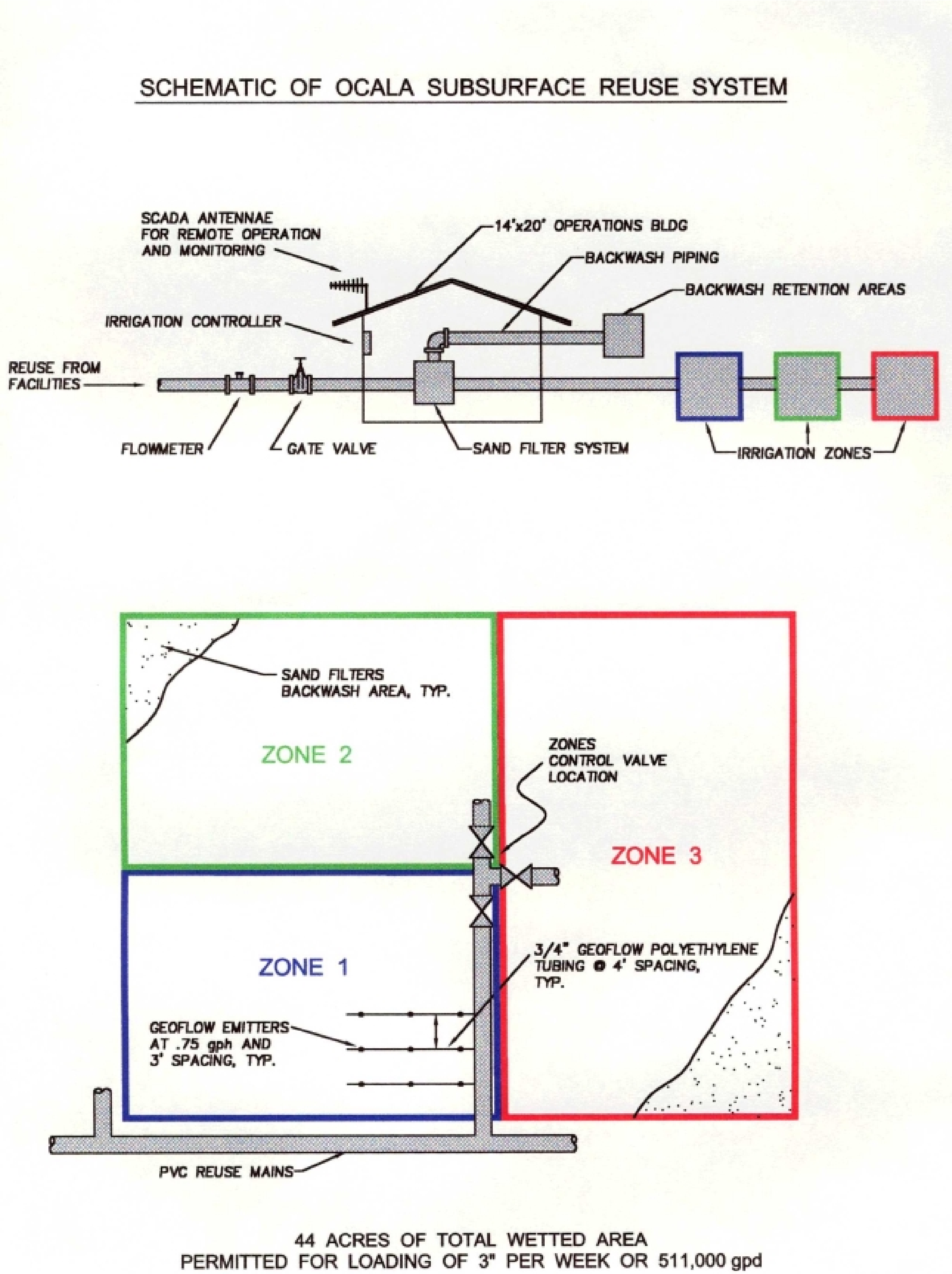
The subsurface systems constructed in Ocala consist basically of a filter and a drainfield. The filters are little more than large pool filters to minimize clogging of emitters and pipes with solids. The distribution fields are some form of plastic pipes placed 8" to 12" below the surface delivering the water to the soil.

This description is deliberately vague, as many of the subsurface irrigation systems available are proprietary. The engineer has the option to do a detailed design of the system, which would exclude some proprietary systems and bidders, or to performance spec the systems for design build. Ocala chose the latter course with specified performance and durability criteria and an extended maintenance line item. The successful bidder was qualified by presenting a system, which met the specified criteria and selected on present worth of the proposed system.

Russell Daniels Irrigation built the Ocala airport project. The system installed was a GEO FLOW tubing emitter system with FLOW Guard sand filters and HARDIE irrigation controllers. The system is designed to deliver up to 500 gpm to a 44 acre wetted area.

The Ocala airport system is operated 16 to 20 hours per day in wet weather. In dry weather it normally operates less than eight hours as other sites need the reclaimed water for irrigation.

The system has operated essentially maintenance free for it's first three years with very limited operational effort required.


SCHEMATIC OF OCALA SUBSURFACE REUSE SYSTEM
SCADA ANTENNAE FOR REMOTE OPERATION AND MONITORING
14'x20' OPERATIONS BLDG
BACKWASH PIPING
BACKWASH RETENTION AREAS
IRRIGATION CONTROLLER
REUSE FROM FACILITIES
FLOWMETER
GATE VALVE
SAND FILTER SYSTEM
IRRIGATION ZONES
SAND FILTERS BACKWASH AREA, TYP.
ZONE 2
ZONES CONTROL VALVE LOCATION
ZONE 3
ZONE 1
3/4" GEOFLOW POLYETHYLENE TUBING @ 4' SPACING, TYP.
GEOFLOW EMITTERS AT .75 gph AND 3' SPACING, TYP.
PVC REUSE MAINS
44 ACRES OF TOTAL WETTED AREA
PERMITTED FOR LOADING OF 3" PER WEEK OR 511,000 gpd

PERMITTING

FAA

The permitting of wastewater facilities at airports was prohibited by a letter from the FAA Atlanta Regional Office in the early 80s. The potential to attract birds and wildlife and mist from conventional irrigation was the basis for the wastewater ban.

To overcome this hurdle, a different approach was required for permitting. As with most reuse, the positive effect of reclaimed water must be preached to overcome the "no sewage in my backyard" mentality. In this case the sandy soils around the runway posed a minor dust and erosion hazard for aviation. Subsurface reuse was a perfect fit. The underground system did not create ponding, which FAA was concerned could attract animals. There was no mist or odor from the system. Non seed bearing grasses were chosen to minimize the bird attraction. The irrigated grass forms a thick mat minimizing erosion and dust problems around the runways and the system and maintenance were provided at no cost to the airport.

With minor changes to meet FFA construction requirements local and regional FAA Offices approved the "Ocala Airport Dust Reduction Project".

FDEP

In 1991, when Ocala ventured into testing underground reuse systems the FDEP was justifiably skeptical. By 1996, Ocala had a track record with five years logged on two test systems. While operation of the test systems had been far from smooth, Ocala had gained enough experience and FDEP had gained enough confidence to proceed with a full-scale project.

One of the major advantages of an airport location is permitting. The property around Ocala's airport is primarily commercial and industrial with some low income housing. When the permit was filed and noticed there was no objection filed, no public outcry, and no bad press. The permit slid through without a hitch.

FEASIBILITY

The subsurface system in Ocala was installed for $1.25 per gallon. This is considerably higher than the $.75 to $1.00 per gallon range for traditional irrigation on similar local projects.

In the case of airport reuse, the big savings up front is the land. In Ocala where land values are low, the cost of property for dedicated reuse sites runs from $4,000 to $8,000 per acre or the equivalent of $.50 to $1.00 per gallon. The land at an airport is generally publicly owned and the property in the clear zones has no value for other uses. Even at Ocala's small regional airport, the zones cover almost 400 acres. This "free land" makes the capital costs very competitive for subsurface.

In the long term, the savings of subsurface reuse are on the operation and maintenance end. The only moving parts are the operating valve and filter backwash valves. The system all runs on reuse main line pressure so no additional pumping is required. The power demand is nominal to operate the irrigation controller and SCADA system. In general, the only operational requirement is a weekly inspection. As a result, the operation and maintenance costs are approximately half of that required for fixed gun or center pivot installations.

The relative present worth costs of traditional vs. airport subsurface irrigation are summarized in Table 1.

DEDICATED REUSE SITE COSTS PER GALLON
TABLE 1

	Airport Reuse	Agricultural Reuse
Irrigation system	$1.25	$ .75 to $1.00
Land	. 0	$.50 to $1.00
Operation and Maintenance (Present worth)	$ .20	$.35
Total p.w. Cost	$1.45	$1.60 to $2.35

p.w. = Cost worth for 20 yr.
period at 6%

MAINTENANCE

The cost to operate and maintain a subsurface reuse system is much less than a conventional irrigation system. Once a week maintenance personnel visit the site to visually inspect the irrigated area and equipment. The site is remotely monitored from the water reclamation facility so the visit is to ensure everything is operating correctly and that there are no problems the SCADA system may not detect.

Once a year the filter system and controller are taken off line so the components can be inspected and tested. Sand is added to the filter and control components replaced as needed. Spare emitter tubing couplings and relays are all that are required to be kept on hand for spare parts.

For purposes of comparison Ocala's "conventional system" is a mixed center pivot, fixed sprinkler irrigation site. The subsurface system per gallon uses approximately 1/2 of the operating manpower, 1/4 of the electric power, needs less than 1/4 of the maintenance effort, and requires less than 1/5 of the value of stocked parts.

Ocala's wastewater operators are "amazed" by how easy and inexpensive the site has been to maintain. Since setup the system has basically operated maintenance free without any problem significant enough to shut it down.

REUSE OR DISPOSAL

Many would contend that irrigation of an airport clear zone is not really "reuse". Limited constructive use is made of the heavy water use and groundwater withdrawal is not offset. The Ocala area, however, is the prime recharge area for the Floridian Aquifer providing drinking water for much of Florida so recharge is considered reuse.

One of the major challenges and expenses of reuse has proven to be the balance between reusers and storage or dedicated disposal sites. Airport systems provide dedicated wet weather disposal that can reduce expensive storage requirements. In Ocala's case, the dedicated sites have a peak capacity equal to plant flow eliminating the need for storage. In fair weather, the golf course and irrigation users draw up to 90% of the reclaimed water resting the dedicated sites for rainy days.

OCALA SYSTEM SPECIFICATIONS

Background

Soils coarse to fine sands	10 feet to 30 feet thick
Groundwater	25 feet to 40 feet below surface in fractured limerock
Site	48 acres
Wetted Area	44 acres

Flows

Design maximum	500 gpm,	720,000 gpd	4.2 in/wk
Permitted average		512,000 gpd	3.0 in/wk
Current loading		500,000 gpd	

System

- 2 - 1000 gpm sand media filters by **FLOW GUARD**
- TC-1800 LX II - irrigation controllers by **HARDIE**
- 475,000 LF OF ¾" **GEOFLOW** polyethylene tubing
- 160,000 **GEOFLOW** .75 gph emitters with **ROOT GUARD**
- **DATA FLOW SCADA** monitoring and control system
- 3 **ASCO** 6" MODEL 115-4 OCU control valves

GROUNDWATER DATA

No extensive analysis of nutrient loading was performed in permitting this project or drafting this paper. The reclaimed water applied at this site meets advanced secondary standards for public access reuse. The quality of effluent meets or exceeds the requirements for most groundwater monitoring criteria. The diluting effects of rainfall, groundwater flow and minor losses from nutrient breakdown combine to reduce applied concentrations to well below permitted levels.

NITRATES	- average loading	10 ppm reclaimed water
	background levels	2 ppm to 4 ppm
	average monitoring well levels	5 ppm to 6 ppm
TDS	- startup average	200 ppm
	current average less than	100 ppm
CHLORIDES	- startup average	10 ppm
	current average	15 ppm

Note: background well showing high concentrations, cause not identified.

PH	- startup range	5.2 to 11.7
	current range	5.4 to 10

FECAL COLIFORM - none detected for three years.
TOTAL COLIFORM - one hit of nine in three years.
TURBIDITY - no clear pattern.

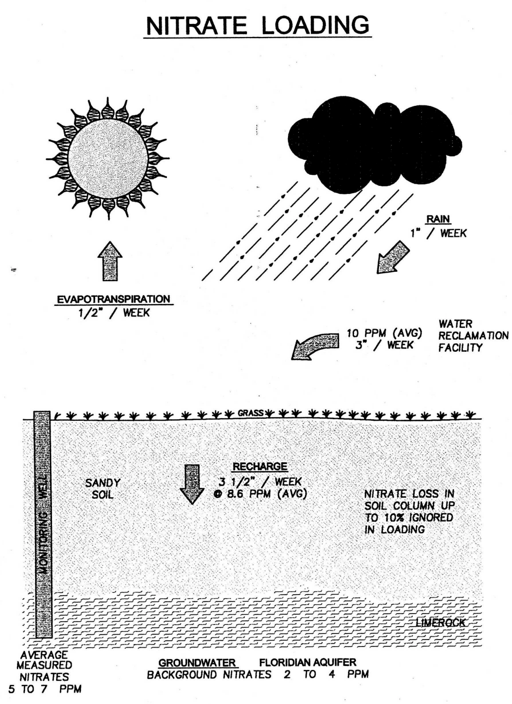


TABLE 2

DUST REDUCTION IRRIGATION PROJECT @ OCALA REGIONAL AIRPORT

	1996			1997				1998				1999		
	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR	4TH QTR	1ST QTR	2ND QTR	3RD QTR
FECAL COLIFORM														
BW/MW1D	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW2D	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW3D	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	7	DRY
MW4D	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OP1/MW5D	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MW6D	N/A	N/A	N/A	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	DRY
TOTAL DISSOLVED SOLIDS														
BW/MW1D	149	69	86	144	67	58	30	106	103	97	126	143	102	90
MW2D	460	305	377	420	216	131	100	103	120	329	182	121	85	89
MW3D	656	91	90	99	91	107	40	97	92	117	149	132	147	DRY
MW4D	53	34	35	56	38	33	40	22	33	43	43	51	42	34
OP1/MW5D	107	77	57	55	60	50	90	84	88	87	92	97	73	73
MW6D	N/A	N/A	N/A	139	129	118	130	112	79	121	112	109	92	DRY
NITRATES														
BW/MW1D	1.40	2.18	1.37	1.83	1.27	3.41	2.93	7.09	7.10	5.69	7.42	8.78	7.81	5.17
MW2D	5.31	5.40	5.31	5.72	6.31	6.57	6.04	7.63	3.42	6.81	6.75	7.09	7.37	8.13
MW3D	1.49	2.29	2.21	2.67	2.34	4.10	5.27	4.82	6.23	5.61	5.79	4.59	2.67	DRY
MW4D	4.50	4.25	4.23	4.28	3.76	4.52	3.68	3.07	3.08	2.84	2.61	3.77	2.69	5.13
OP1/MW5D	2.12	2.04	1.54	2.08	2.14	3.44	3.48	4.26	6.77	5.99	5.43	5.11	4.93	5.24
MW6D	N/A	N/A	N/A	1.04	1.28	2.04	2.02	3.11	2.86	2.23	2.76	3.26	1.58	DRY
pH														
BW/MW1D	10.96	9.5	10.4	10.9	9.5	8.5	8.9	7.2	7.2	9.3	7.5	7.3	7.3	7.6
MW2D	11.6	11.4	11.6	11.7	10.7	10.5	10.7	8.8	10.4	11.6	11.4	9.7	9.6	10
MW3D	11.74	7.8	7.8	7.9	8.9	8.2	9.1	7.9	8.1	7.8	8.1	7.8	8.4	DRY
MW4D	5.18	5.3	6.1	6.7	6.7	7.7	6.9	5.9	6.7	6.6	6.1	6.6	6.5	5.4
OP1/MW5D	8.67	11.5	9.6	9.4	8	8.1	8.2	6.8	7.4	7.7	8.4	7.8	7.9	7.7
MW6D	N/A	N/A	N/A	7.4	7.4	7.4	7.3	7.0	7.4	7.2	7.4	7.5	7.5	DRY

CONCLUSION

- Reclaimed water irrigation systems can be permitted with FAA on airport sites if properly packaged.
- Airport sites due to their large buffers and commercial nature are better suited to the permitting and construction of reuse projects than most other areas industrial.
- While subsurface reuse systems are more expensive up front than traditional irrigation, the savings in maintenance and operation costs make these systems economically viable.
- The low profile of subsurface reuse facilitates permitting, reduces public opposition and allows the site to be virtually invisible once in operation.