RECLAMATION & REUSE

AT THE CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT

by

Trille C. Mendenhall, Residuals Manager
Charlotte- Mecklenburg Utility Department

F. Stephen Swartz, PE
Senior Engineer
Boyle Engineering Corporation
Charlotte, North Carolina

INTRODUCTION AND BACKGROUND

Evolution of the concept at CMUD: - Discussion about the concept of reclaiming high quality wastewater treatment plant effluent began in the late 1980's at the Charlotte-Mecklenburg Utility Department (CMUD). This thinking was prompted by the large quantities of irrigation water needed at Charlotte's Renaissance and Freedom Parks, and their respective geographic nearness to CMUD's Irwin and Sugar Creek wastewater treatment plants. Although nothing immediately tangible came from these early discussions, the seed of an idea was planted.

Initial discussions with potential users: -It took some time for this seed to germinate, but it eventually did sprout - about five years later. Around 1992, it was announced that approximately 1700 acres directly across the creek from the McAlpine Creek Wastewater Management Facility (WWMF) was to be developed into a Planned Urban Development accompanied by an 18-hole golf course and associated residential complex. The CMUD Director at that time, Joe Stowe, initiated contact with the developer to introduce the concept of utilizing reclaimed water from the McAlpine WWMF as the source for irrigation water within the development.

The developer expressed interest and excitement at the concept, and indicated that he would be interested in using the reclaimed water exclusively as his irrigation water. By then, the golf course was being developed separately, and its developer also expressed interest in looking into the idea.

CMUD DECIDES TO STUDY THE FEASIBILITY OF RECLAMATION FOR REUSE

Feasibility in North Carolina unknown - Approximately eighteen states across the country permit and regulate water reclamation and reuse as a water resource it its own right. Although current North Carolina environmental regulations do address some types of irrigation with wastewater treatment plant

effluent, reclaimed water is not considered as a separate resource from wastewater. Therefore, CMUD recognized that the feasibility of its proposed concept within the state was unknown. Realizing this, CMUD sought independent expertise and issued a Request for Proposal to study the feasibility of reclamation & reuse (R/R) at McAlpine WWMF in April 1993.

Principal objectives of the feasibility study - In this study, CMUD principally sought to:

1) Evaluate the effluent from McAlpine WWMF to determine its suitability for irrigation

2) Evaluate the potential demand for reclaimed water within the proposed development

3) Develop a conceptual plan for delivering reclaimed water within the development, including a user fee structure

Feasibility study commissioned - CMUD engaged Boyle Engineering Corporation (BEC) to conduct the study. BEC had already assisted over 90 other municipalities around the U.S. on R/R projects, and CMUD considered it most important that many of these projects had resulted in the creation of functioning, independent R/R water utilities. This was not an academic exercise for CMUD, but a reasoned investment of its resources to test the implementability of a reclamation and reuse project in North Carolina.

Detailed objective of the study - The specific and detailed scope of the feasibility study commissioned by CMUD was to:

1) Evaluate and characterize the effluent from McAlpine WWMF to determine its suitability for irrigation purposes principally within the development, and also generally

2) Evaluate the potential demand for reclaimed water within the proposed development

3) Develop a conceptual plan for delivering reclaimed water within the development, including a user fee structure

4) Identify other potential uses within a 5-mile radius of the WWMF within Mecklenburg County

5) Identify and evaluate legal and public relations issues

6) Determine what other studies and permits may be required

Study Results - The results of BEC's feasibility study were published in a report on February 8, 1994. Some of the more fundamentally important aspects of that report are summarized below:

1) McAlpine WWMF effluent quality data was assessed to determine its applicability for use in irrigating landscaped areas where public access is not rigidly restricted. Exhibit 1, attached, summarizes the effluent quality data at the McAlpine Creek treatment facility. With two exceptions, effluent as currently discharged to McAlpine Creek is of a quality to be directly used for irrigation. The exceptions are fecal coliform, and the ratio of sodium, calcium and magnesium called Sodium

a) Potential immediate demand from the 1700 acre development was estimated at 580 million gallons per year (mgy). This translates into a 3.3 mgd design peak over a 9-month irrigation season. This demand included irrigation of roadway landscaping, commercial property landscaping and an 18-hole golf course. Calculations assumed that the landscape irrigation would be conducted during an eight hour night time period, and that the golf course would augment flow over twenty four hours into internal ponds with re-pumping for irrigation.

b) Potential future demand was estimated from irrigation meter data of existing CMUD customers, and acreage calculations of existing parks, athletic fields and golf courses within a 5-mile radius of the McAlpine plant. This potential demand was estimated at approximately 1,600 mgy over the same 9-month season.

c) Aggregate potential irrigation water demand within 5 miles of McAlpine Creek WWMF was estimated to be approximately 2,200 mgy, or 8.2 mgd average daily demand over a 9-month period.

6) Preliminary opinions of construction and operating costs were presented for five alternative scenarios for providing service to the 1700 acre development. Exhibit 4 is a reproduction of the study's 'Overview of Alternatives'.

a) Unit costs of providing reclaimed water for the five scenarios ranged from $0.68 to $1.26 per 1000 gallons.

b) Adjusted unit costs, taking into account the economic benefit of postponed additional water plant capacity construction, range from $0.41 to $0.78 per 1000 gallons.

7) Specific recommendations were given in the report. Some of the more important include:

a) It was recommended that CMUD undertake a R/R project to serve the 1700 acre development as a demonstration project. As such, several long-term advantages could be realized. CMUD could be involved in the first project in North Carolina that viewed Reclamation and Reuse as differentiated from wastewater treatment and disposal. An opportunity would then exist for specific data to be generated in a North Carolina application. Also, the state regulators would have the opportunity to gather data concerning the operation of a R/R facility to assist in its development of specific guidelines and regulations for reclamation and reuse.

b) A specific set of facilities was recommended for this demonstration project which included:

i) A pumping station utilizing dual, vertical turbine pumps mounted over the effluent weir box to utilize the nearly constant water level for suction hydraulics advantage

ii) Chlorination facilities to provide supplemental disinfection to address fecal coliform spikes

iii) Specially colored piping and fittings to distinguish reclaimed water from potable water facilities

c) CMUD should establish its reclaimed water service as a separate utility service, equal in status to potable water and wastewater services.

d) Education of the public about reclaimed water is absolutely essential. A public education program was outlined.

ONGOING DISCUSSIONS

N. C. Department of Environment, Health and Natural Resources - Discussions with the N. C. Department of Environment, Health and Natural Resources (DEHNR) have been ongoing since the report was published. These discussions have been aimed at coming to terms with the appropriate permitting and operating procedures for this demonstration project. One issue relates to the appropriate limit for fecal coliform to be maintained in irrigation water. A limit of 50 mg/l is being pursued for irrigation water in areas of limited public access.

Public health concerns over the control of viruses and bacteria that may be present in the reclaimed water pose operating challenges. Standard tests for viruses and bacteria require a number of days for results to be known. However, decisions whether to continue or to shut down reclamation and reuse operations require immediate availability of quality data for system operators. Appropriate surrogate virus and bacteria parameters that have a quicker analytical turn-around time are being investigated for use in operations control.

Ongoing testing and reporting requirements will also be defined during the final engineering design of the demonstration project facilities. Opportunities for shared research efforts are being sought.

Potential users - Discussions with potential users have also been ongoing since the publication of the feasibility report. Issues being discussed include:

1) What should be the delivery pressure for R/R water? One school of thought holds that R/R water delivery pressure should be less than potable water pressure to differentiate the two. Another school of thought maintains that similar delivery pressure should be maintained for both services in order for users to not perceive R/R water use as requiring additional pumping costs.

2) R/R water delivery points and metering requirements.

3) User contracts. Economic viability of any R/R project requires that the utility have the commitment of the user for long-term use. In addition, potential liability of the serving utility demands that it have certain guarantees and controls on use of the reclaimed water. And certainly, the customer needs protection against degradation of the reclaimed water quality.

4) Water quality from an agronomic perspective, especially related to the SAR. These discussions have led to the agreement that a detailed study be made prior to final construction of the system pumping station to determine what the site-specific, appropriate SAR needs to be. This study will

determine what quality amendment procedure is appropriate, and at what site it should be made, i.e., prior to pumping or at the planting bed. This study will also consider the agronomic requirements of the specific landscape species planned for this development.

5) Whether advisory signage is appropriate and, if so, what it should be.

CONCLUSIONS

CMUD has concluded that pursuing a project to demonstrate the feasibility of reclaiming and reusing the highly treated effluent of its McAlpine Creek WWMF for landscape irrigation is in its best interests.

NCDEHNR has concluded that a separate set of regulations and permitting procedures for water reclamation and reuse projects in this state appears to be needed. Further, through the CMUD demonstration project, DEHNR sees an opportunity to gather specific scientific data to use as the bases for developing such regulations and procedures.

CMUD and NCDEHNR are pursuing the implementation of the demonstration project recommended in the BEC Feasibility Study Report.

SUMMARY OF EFFLUENT QUALITY FROM McALPINE CREEK

CONSTITUENT	UNITS	RANGE OF RESULTS	AVERAGE
BOD	mg/l	1.0 - 11.2	4.2
Chlorine residual	mg/l	0.01 - 0.73	0.2
Total Suspended Residue	mg/l	1.0 - 12	4
Fecal coliform	**#/100 ml**	3 - 19,300	45
Calcium	mg/l	12.8, 12.9 (a)	12.8
Chloride	mg/l	55, 60 (a)	57.5
Magnesium	mg/l	3.06, 3.04 (a)	3.1
Nitrogen, total	mg/l	0.6 - 18.0	9.9
pH	-	6.1 - 7.3	6.8 mode
TDS	mg/l	434, 446, 471 (b)	450
ECw	dS/m	0.68 - 0.74	-
Sodium	mg/l	82, 161 (a)	121.5
Ammonia	mg/l	0.1 - 8.6	1.9
Phosphorus, total	mg/l	1.0 - 6.0	3.1
Dissolved Oxygen	mg/l	8.5 - 9.1	8.8
Chromium	ug/l	10.0 - 19.2	11.6
Lead	ug/l	15.0 - 18.8	16.5
Silver	ug/l	10.0 - 20.8	11.8
Zinc	ug/l	50 - 132	64.4
Alkalinity	mg/l	51 - 73	62
SAR	-	7.5, 8.1 (a)	-
Adjusted SAR	-	9.5 (c)	-

(a) Only two data points
(b) Only three data points
(c) Estimated

CMUD SYSTEM WATER DEMAND

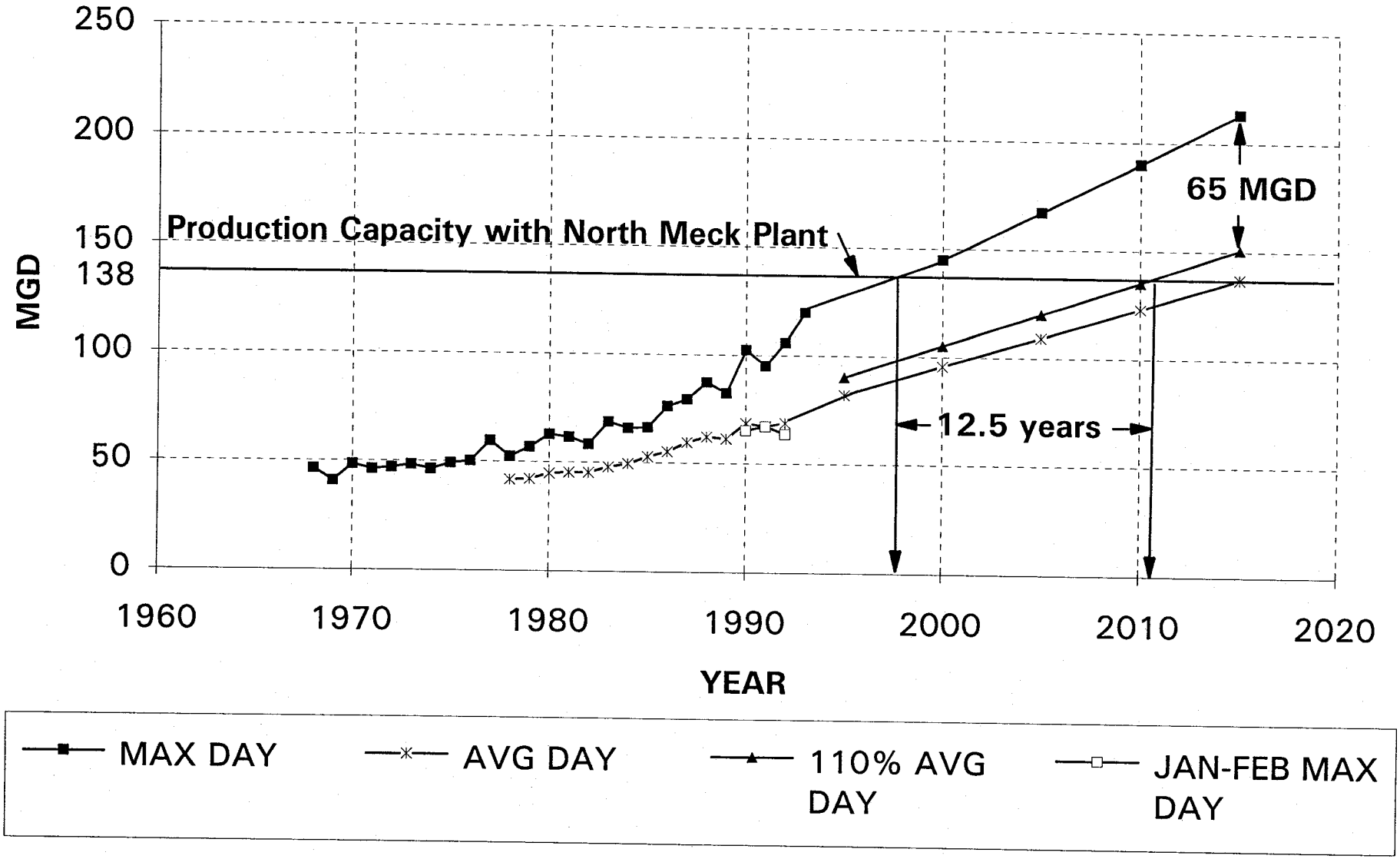

EXHIBIT 2

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT

MCALPINE WWMF EFFLUENT REUSE STUDY

COST OF POTABLE WATER TREATMENT CAPACITY

ASSET	CAPACITY (MGD)	CONSTRUCTION BID ($ x 1000)	COST per 18 MGD ($ x 1000)	UNIT COST ($ / 1000gpd)	UNIT COST ($ / hcfpd)
RAW WATER INTAKE	108	4,000	667	37.04	27.71
RAW WATER TRANSMISS. LINE	60	3,530	1,059	58.83	44.01
TREATMENT FACILITIES	18	27,250	27,250	1,513.89	1,132.54
TOTAL		34,780	28,976	1,609.76	1,204.26
YEARLY DEBT SERVICE @6% for 20 years			2,526.10	140.34	104.99

Assumptions:
The real value of treatment capacity is calculated at maximum efficiency.
Maximum efficiency is achieved when the plant is running at constant maximum production capacity.
Constant maximum production capacity must consider some 'down time' for cleaning and repair. Use 10% down time.
Construction of additional capacity must begin when plant reaches 90% capacity.

Maximum Production Capacity per yr : $0.9 \times 365 \times 0.9 \times \frac{18{,}000{,}000}{1000} = 5{,}321{,}700$ thousand gallons

Unit cost of debt service per 1000 gallons : $\frac{2{,}526{,}099}{5{,}321{,}700} = \$0.475$

EXHIBIT 3

OVERVIEW OF ALTERNATIVES

ITEM	ALTERNATIVE 1	2	3	4	5
DESCRIPTION	Provide all potential immediate demand delivered through pipe network.	Provide only golf course demand delivered to a point in Highway 521 relocated at the future club house.	Provide only non-golf course demand delivered through pipe network.	Provide only non-golf course demand delivered to a central point in the East-West Connector at the Six-mile outfall R/W.	Provide all potential Ballantyne demand delivered to two central points - E/W @ Hwy 521 & in Hwy 521 @ golf club.
FLOWS					
DESIGN FLOW (MGD)	9.0	2.0	7.0	7.0	9.0
AVG. DAILY FLOW (MGD)	3.3	1.0	2.2	2.2	3.3
ANNUAL USE (GALLONS)	588,700,000	287,400,000	301,200,222	301,200,000	588,700,000
ANNUAL USE (HCF)	786,927	384,173	402,620	402,620	786,927
EQUIPMENT					
PUMPS	3 @ 250 HP	2 @ 75 HP	3 @ 225 HP	3 @ 225 HP	3 @ 250 HP
PIPING	40,200 lf of 4" - 24" dia. pipe	13,600 lf of 12" dia. pipe	40,200 lf of 4: - 18" dia. pipe	7,000 lf of 18" dia. pipe	13,600 lf of 10" - 24" dia. pipe
PROBABLE PROJECT COST ($)					
Pumping Station	500,000	250,000	500,000	500,000	500,000
Distribution Piping Network	1,305,000	450,000	1,186,000	375,000	724,000
Legal, Tech., Admin., Cont.	795,000	308,000	742,000	385,000	539,000
Total Estimated Project Cost	2,600,000	1,008,000	2,428,000	1,260,000	1,763,000
ESTIMATED ANNUAL COSTS ($/yr)					
Administrative Overhead	70,644	34,488	36,144	36,144	70,644
Fixed Operations & Maintenance	22,000	22,000	22,000	22,000	22,000
Power	127,000	52,000	77,000	77,000	127,000
Debt Service	270,000	105,000	243,000	130,000	180,000
Total Estimated Annual Costs	489,644	213,488	378,144	265,144	399,644
INDICATED UNIT COST ($/1000 gal) •	0.83	0.74	1.26	0.88	0.68
ECONOMIC ADJUSTMENTS ($/1000 gal)**	0.25	0.00	0.48	0.48	0.25
POTENTIAL RATES ($/1000 gal)	0.58	0.74	0.78	0.41	0.43
POTENTIAL RATES ($/HCF)	0.44	0.56	0.58	0.30	0.32

• Does not include any adjustments for economic considerations

** Accounts for the fact that the golf course does not intend to irrigate with potable water; therefore, economic benefits do not accrue to this type use.

EXHIBIT 4