City of Hamilton
Trip Report for Membrane Facility Tours

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INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

The Woodward Avenue WWTP requires an upgrade and expansion of its facilities to meet the needs of the City of Hamilton with respect to population growth, management of wet weather flows, and increasingly stringent effluent criteria. During the Class EA for the expansion of the facility, a multi-criteria evaluation of wastewater technologies lead to the recommendation of membrane technology for implementation at the plant.

Membrane technology is now considered a proven technology for wastewater treatment; however, it has yet to be implemented at the scale of Woodward Avenue, which will have an average day flow capacity of 500 MLD. Site tours to membrane filtration and membrane bioreactor facilities were recommended, with the following objectives:

- To better understand the operational and maintenance requirements of membrane technologies
- To gain an appreciation of the scale of relatively large membrane installations
- To gather information from operations staff of these facilities of potential improvements to the design of membrane technologies and ancillary systems;

The tours of two facilities, the F. Wayne Hill WRC (Gwinnett County, Georgia) and the Redlands WWTP (California) were held on August 21st and 22nd respectively.

1.2 ATTENDEES

Attendees from the City of Hamilton included:

- **Mark Bainbridge** – Project manager for membrane pilot and alternate PM for Class EA
- **Dan Chauvin** – Manager of Capital Planning and PM for Class EA
- **Khalid Mehmood** – Operation Lead, Woodward Avenue WWTP
- **Plamen Nikolov** – Senior PM, Capital Works
- **Ian Routledge** – Manager of Operations, Woodward Avenue WWTP

Troy Briggs of KMK Consultants and Tim Constantine of CH2M HILL, who are both involved in the Class EA for the consultant team, also attended the site visits.
1.3 LOCATIONS

The F. Wayne Hill Water Reclamation Center is located in Gwinnett County, Georgia, which is approximately 30 minutes northeast of Atlanta. The Redlands WWTP is located in Redlands, California, which is approximately 1.5 hours due east of Los Angeles. These locations are shown in Figure 1.

Figure 1    Locations of Facility Tours
2. SUMMARY OF FINDINGS

2.1 CITY OF REDLANDS WWTP

The City of Redlands WWTP was upgraded in 2003 to include membrane bioreactor technology. The MBR facility was designed by CH2M HILL (membrane selection and sizing) and Carollo (overall process design and design of ancillary MBR facilities such as vacuum pumps, screens, etc.). An aerial view of the facility is provided in Figure 2.

![Aerial View of Redlands WWTP](image)

**Figure 2 Redlands WWTP**

The overall facility can be described as a blend of MBR and conventional activated sludge technology, in that theses two technologies are operated in parallel.

This facility was unique for its time as it operated a MBR facility in parallel with an activated sludge facility (i.e. a portion of the existing aeration tank was split to act as the bioreactor for the MBR, as shown in Figure 3). The overall goal of the MBR implementation was to improve
water quality. More specifically, the City of Redlands has an agreement with the local power company to provide 6,000 acre-feet per year (af/yr) of recycled water for cooling of the power generation facilities. The water for use by the power company is required to meet the State of California Title 22 requirements. Specific water quality requirements include: Turbidity less than 1 NTU, ammonia less than 2-3 mg/L, and silica less than 20 mg/L. The MBR facility has a capacity of 6 mgd (23 MLD) on a maximum month flow basis, which at the time (2003) was the largest in North America. It was surpassed shortly after started up (Traverse City, MI).

Figure 3 Close-up Aerial Showing MBR Facilities
Figure 4 Membrane Installation Photo at Redlands WWTP

Other pertinent information that was gleaned from the site tour included:

- The facility uses Zenon membrane equipment. The MBR facility includes 6 parallel membrane trains each housing 15 membrane cassettes for a total of 90 cassettes.

- The facility design included three process related deficiencies, namely:
  
  - **Anoxic Zone Design** – An anoxic zone was implemented in the bioreactor portion of the MBR to allow for some alkalinity recovery; however, it never worked very well as this basin includes the input of the membrane recycle stream, which has a very high DO (perhaps 5-6 mg/L), which “poisons” this zone with oxygen. The anoxic zone baffle design also does not allow for free passage of foam.

  - **MBR Screen** - Rather than installing the MBR screen on the inlet to the membrane zone, the lead process engineering firm decided to have it (drum screen) installed on the recycle line. In doing so, this allows hair and other trash to enter the membrane zone. However, this has not been seen by operations staff to create problems with maintenance on the membrane system.

  - **Foaming in Membrane Zone** – No positive foam removal system was provided in the process design of the membrane system.
Compared to the F. Wayne Hill facility, this plant would be considered much less sophisticated, from an ancillary process design as well as general O&M standpoint. The facility and its operators have relied heavily on support from the manufacturer.

The Owner likes the Zenotrac™ system and generally has had good experiences working with the manufacturer.

Given the choice of operating the MBR and the parallel activated sludge facility, operations and maintenance staff prefer the MBR system. It is easy to operate and the overall maintenance requirements are fairly routine.

2.2 F. WAYNE HILL WRC

The F. Wayne Hill Water Reclamation facility (WRC) is located in Gwinnett County and has the distinction of being the largest tertiary membrane filtration facility in the world, with a capacity of approximately 50 mgd (~190 MLD). The facility was started up in 2005 and uses Zenon membranes. Figures 5 and 6 provide aerial views of the plant and the membrane facility respectively.

Figure 5 Site Aerial of F. Wayne Hill WRC
Figure 6   Aerial Showing Membrane Filtration Facility

The plant discharges its flow to the Chattahoochee River (eventually Lake Lanier, the raw water source for the County), which is approximately 9 miles away. The facility uses 8 equalization tanks (20 million gallons each) to store secondary effluent prior to membrane filtration and effluent pumping. This EQ strategy provides significant power savings as the County purchases power on the spot market.

The following provides additional details on the membrane filtration facility and its operation:

♦ The plant is required to meet stringent limits for the indirect reuse. COD<25 mg/L, ammonia <0.5 mgN/L, faecal coliforms < 23 CFU/100 ml, TP < 0.1 mg/L.

♦ The facility operations and maintenance would be considered very sophisticated by industry standards and the design of the facility appeared to match this.

♦ The facility uses rotary drum screens for screening of secondary effluent prior to membrane filtration.

♦ The plant includes substantial redundancy (e.g. redundant permeate header), some of which is now considered excessive by operations staff. However, they defended the decision for this redundancy based on the overall scale of this installation.