Addressing Existing Noncompliance Issues and Future Wet-weather Flow Management Requirements for the South Wastewater Treatment Plant

Summary of Findings and Recommendations

Prepared for

City of Baton Rouge
Parish of East Baton Rouge

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Prepared by

CH2MHILL

304 Laurel St., Suite 2C

Baton Rouge, LA 70801

Addressing Existing Noncompliance Issues and Future Wet-weather Flow Management Requirements at the South Wastewater Treatment Plant

Summary of Findings Results and Recommendations

PREPARED FOR: Seema Alim, Ph.D., P.E.

PREPARED BY: Julian Sandino, Ph.D., P.E.
Joshua P. Boltz, Ph.D., P.E.
Lee Davis, P.E.

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1.0 Background and Introduction

In 2001, the City of Baton Rouge/Parish of East Baton Rouge (City / Parish) entered into a Consent Decree with the U.S. Environmental Protection Agency (EPA) and Louisiana Department of Environmental Quality (LDEQ) that outlined a program of wastewater treatment system improvements to correct overflow, bypass, and treated effluent discharge problems. The City / Parish initially selected a program of deep underground tunnels and related improvements but in April 2005, sought to amend the Consent Decree to proceed instead with an aggressive, comprehensive sewer rehabilitation program and targeted system capacity upgrades of lines, pumping stations, and wastewater treatment plants (WWTPs).

EPA agreed not to impose fine-related deadlines and to allow the City / Parish 90 days, beginning May 1, 2005, to verify and develop the proposed rehabilitation option. The City / Parish hired Camp Dresser & McKee, Inc. (CDM), to evaluate the sewer collection and treatment system and to develop a plan to address the causes of inflow and infiltration (I/I) and resulting system overflows, as well as the ongoing effluent compliance challenges related to the South WWTP. CDM submitted its draft report of the *Sewer System Model Verification and Revised Second Remedial Action Plan* (RMAP2) to the City / Parish on August 1, 2005. Subsequently, the City / Parish retained CH2M HILL to conduct a Peer Review of CDM's RMAP2 draft report. A preliminary process evaluation of the South WWTP facilities was conducted as part of the CH2M HILL Peer Review effort during the spring of 2006. This evaluation relied on information included in the RMAP2 report and additional information provided by the City / Parish.

The Peer Review Team endorsed the RMAP2 recommendation of providing a new combined headworks structure (with consolidated new screening and grit removal capabilities) and a new flow equalization basin as a top-priority improvement project. The Peer Review Team, however, did not endorse the RMAP2 recommendation of abandoning the trickling filters and replacing them with activated sludge basins. The Peer Review Team's evaluation concluded that the trickling filter process itself did not appear to be the cause of periodic noncompliance at the South WWTP. On the basis of generally accepted design criteria, the Team concluded that the existing trickling filter units and the accompanying secondary clarifiers should be able to meet the effluent requirements at its current rated loading conditions (45 million-gallons-per-day [mgd] annual average; 55-mgd maximum month; 120-mgd peak hour), provided that issues associated with inadequate interconnecting piping, flow distribution, and trickling filter effluent recirculation were addressed. This conclusion was supported by the fact that the City / Parish's North and the Central WWTPs, which rely on the trickling filter process, generally have been able to achieve compliance. The Team also concluded that two new 160-foot-diameter units, as defined in the RMAP2 report, are necessary to be able to handle the anticipated wet-weather flow of 200 mgd once improvements to the conveyance systems and the provision of plant influent flow equalization are implemented.

Subsequent to the Peer Review effort, the City / Parish hired a team led by CH2M HILL to serve as the Program Manager for the implementation of the Baton Rouge Sanitary Sewer Overflow (SSO) Control and Wastewater Facilities Program. One of the early tasks assigned to the Program Management Team was to conduct a detailed evaluation of the noncompliance issues at the South WWTP and to revisit the original findings and recommendations of RMAP2, as well as those from Peer Review effort. This report presents the key findings from this evaluation and summarizes the specific recommendations aimed at achieving compliance with existing National Pollutant

Discharge Elimination System (NPDES) and Louisiana Pollutant Discharge Elimination System (LPDES) requirements under the facility's current rated capacity, as well as those improvements necessary to manage the anticipated increased wet-weather flows resulting from the rehabilitation of the conveyance system.

2.0 Summary of Key Findings

The results of the in-depth evaluation of the South WWTP conducted by the Program Management Team support the findings and recommendations defined in the Peer Review Team Report, and further define plant improvement requirements and associated implementation plan details.

The South WWTP upgrade recommendations in RMAP2 did not consider alternatives that would maximize the use of existing facilities and accomplish the same objectives as its proposed approach of replacing the existing trickling filters with a new activated sludge process. This more recent and detailed evaluation indicates that the existing facilities at the South WWTP would adequately handle the existing rated treatment capacity loadings, provided that all units were operational and that several existing interconnecting piping and flow distribution limitations were resolved. This evaluation also indicated that a relatively simple conversion into a Tricking Filter/Solids Contact (TF/SC) process would allow this plant to handle the anticipated wet weather flow treatment requirements from the rehabilitated conveyance system. This conversion would be much simpler and less costly to implement than the RMAP2 recommendation of completely abandoning the trickling filter process and replacing it with activated sludge. Table 1 summarizes the plant improvement comparative analysis conducted for the South WWTP.

TABLE 1
Comparative Summary of South WWTP Improvement Alternatives

Criteria	Step-Feed Activated Sludge (RMAP2)	TF/SC Process Upgrade
Effluent Quality; Compliance Ability	Will meet existing limits; can provide higher quality effluent than existing TF process	TF configuration improvements will meet existing limits. TF/SC upgrade can provide even higher quality effluent
Wet Weather Flow Management	Feeding to last cell of step-feed aeration basin effective for high flow conditions	Feeding directly to solids contact basin provides effective biological treatment for high flow conditions
Compliance Schedule	Will take longer to demolish existing system and build new activated sludge process	Configuration improvements to existing TFs to meet current design basis will require less time
Operational Compatibility/ Complexity	Only activated sludge plant of all three large facilities, and will be more complex to operate. Maintaining compliance during construction will be a challenge	Most similar technology to other existing facilities; relatively simpler to operate. Easier to maintain compliance during construction
Odor Potential	Lower, however other sources (headworks, primary treatment, sludge processing) must be addressed as well	Higher, however TFs are a relatively minor source of odors as compared to other current sources in plant

TABLE 1
Comparative Summary of South WWTP Improvement Alternatives

Criteria	Step-Feed Activated Sludge (RMAP2)	TF/SC Process Upgrade
Sludge Processing Requirements	Considerably larger sludge yields will significantly increase associated O&M costs	Lower sludge yields, similar to current levels
Energy Requirements	Little difference in energy requirements between options	Little difference in energy requirements between options
Snail Control	No snails	Proposed improvements should result in effective snail control
Future Disinfection Implementability	High-quality effluent allows for UV implementation in the future if so desired.	High-quality effluent of TF/SC allows for UV implementation in the future if so desired
Implementation Costs	Existing facilities are demolished and replaced; higher construction costs	Maximizes use of existing assets; lower construction costs

3.0 Evaluation of Existing Facilities

The Program Management Team conducted a detailed process evaluation of the existing treatment facilities at the South WWTP. Figure 1 presents a simplified process schematic of the existing plant. A summary of the existing facilities is included in Appendix A. The South WWTP is configured in two process trains, which are generally referred to as the "gravity train" and the "force main train." Each of these trains provides pretreatment (screening and grit removal), primary settling, secondary treatment consisting of trickling filters and final settling tanks, and effluent disinfection. Sludge-handling processes include gravity thickeners, gravity belt thickeners, anaerobic digesters, and belt filter presses for dewatering digested sludge prior to biosolids cake is hauled for landfill disposal. Treated effluent is discharged to the Mississippi River. The WWTP currently is required to maintain a 30-million-gallon (mg) total suspended solids per liter (TSS/L) and 30-mg biochemical oxygen demand per liter (BOD/L) monthly average and 45-mg TSS/L and 45-mg BOD/L weekly average discharge standard, as well as a 200- and 400-fecal coliform per 100 milliliters (mL) for monthly and weekly geometric means, respectively.

Plant operating records for the past 3 years, as well as the results from a targeted sampling program conducted in November 2006, were used to define influent characteristics, performance of existing processes, and sludge yields and characteristics. Dimensions, configuration, and performance of existing facilities were derived from documentation provided by the City / Parish, from interviews and workshops conducted with plant operations and maintenance staff, from several visits to the treatment facility, and from the process modeling of existing facilities.

The Team considered three operational scenarios in the evaluation:

- Current Operations, assuming current loadings similar to those reflected in the recent historical data analyzed

Insert Figure 1 – Simplified PFD

- Rated Capacity Operation, assuming operation in the future once the plant reaches its current rated treatment capacity (45 mgd annual average; 55 mgd maximum month; 120 mgd peak hour).
- Rehabilitated Conveyance System Operation, assuming that improvements to the existing conveyance system would increase peak hour flow contributions from the service area to 300 mgd. Under this scenario, the peak hour flow to be treated by the South WWTP would be limited to 200 mgd by means of flow equalization.

3.1 Headworks and Preliminary Treatment

The general arrangement of the two headworks and the condition of the screening, grit removal, and flow measurement equipment are among the biggest challenges facing the South WWTP. These facilities have a rated capacity of 120 mgd. The existing bar screens on the gravity side of the plant are frequently out of service due to mechanical failure. The reduced preliminary treatment allows rags and other large material to accumulate in downstream treatment facilities such as the primary settling tanks, which then causes process mechanical equipment failure in the said processes. A significant amount of work would be required to bring these facilities into appropriate operating conditions and to provide the additional treatment capacity to handle larger flows in the future. A more desirable alternative scenario would be to replace the two headworks with a new single system, sized to handle the peak hour flow rate of almost 300 mgd anticipated from the future design storm event. Flows up to 200 mgd would be routed to the treatment plant, while flows in excess of this amount would be diverted to flow equalization facilities for storage until a later time, when they could be pumped back into the plant for treatment prior to discharge.

3.2 Primary Settling Tanks

The existing primary settling tanks are achieving relatively high removal rates (59 percent TSS and 39 percent 5-day biochemical oxygen demand [BOD_5]). The high BOD_5 removal rates imply that the raw sewage has a relatively high suspended organic matter fraction (approximately 39/59 = 66 percent). This high-suspended organic fraction is not typical of sewage that has undergone considerable degradation in the collection system. At the rated treatment capacity, the surface overflow rates (SORs) of the primary settling tanks will be somewhat high (1,225 gallons per day per square foot [gpd/sf] at 55 mgd MM flow), yet will still be within the range in which significant removals can be achieved. Adding primary settling tanks or diverting around these units would be required to handle the anticipated future 200-mgd equalized wet weather flow.

3.3 Trickling Filters

The primary effluent pumping facilities and the trickling filters are sized to handle a maximum flow of 120 mgd during wet weather events. During dry weather, it is estimated that the organic loading rates (OLRs) to the existing trickling filters will be 30 and 37 pounds per day of five-day biochemical oxygen demand per 1,000 cubic feet (ppd BOD_5/kcf) at the AA- and the MM-rated capacity conditions, respectively. At these relatively low loading rates, the existing facilities should be able to meet the 30/30 effluent requirements. Incorporating chemical feed capabilities to the primary settling tanks (such as ferric chloride as a coagulant and polymer as a flocculation aid) during maximum month conditions would further reduce the loadings to the trickling filters, and thus would further enable compliance with the effluent requirements without requiring additional trickling filters. Ferric chloride addition also will help reduce odors. Although the existing trickling filters have adequate media volume to treat the intended design BOD_5 loadings, they do have limitations in keeping minimum wetting rates, given the lack of suitable effluent recirculation capabilities. This insufficiency historically has limited the effectiveness of the biological treatment process, and probably has increased odor generation from the existing facilities.

3.4 Final Settling

The SOR of the existing final settling tanks operating at the AA-, MM-, and PH-rated capacity conditions will be 540, 650, and 1440 gpd/sf, respectively. These hydraulic loading rates are within the capabilities of the type of clarifiers currently operating at the South WWTP. Additional settling will be required to handle the anticipated equalized wet-weather flow rate of 200 mgd adequately. However, the biggest limitation of the existing final settling facilities at the plant is the inability to interconnect the clarifiers from the gravity and the force main trains. Providing an interconnecting pipe between these sets of clarifiers would greatly improve the operability and reliability of the South WWTP in meeting its effluent requirements.

3.5 Effluent Disinfection

Effluent disinfection at the South WWTP is provided via chlorination (chlorine gas and chlorine contact basins) and dechlorination with sodium bisulfite. The existing facilities are sized to handle up to 120 mgd during wet weather flow events. Chorine gas represents a safety and operational hazard, especially considering the encroachment of residential areas around the treatment facility. The Department of Public Works has considered eventually replacing this system with a safer alternative such as sodium hypochlorite, ultraviolet (UV) radiation, or a combination of both.

3.6 Snail Control

The existing snail shell screening system is designed to remove the shells from the secondary sludge before sludge processing and handling. This system is currently not in service due to what is believed to be an undersized pumping system. Inadequate snail removal results in frequent tearing of the belts in the belt filter press units. Rehabilitating the snail removal system would be a relatively simple matter and should increase the reliability of the sludge processing facilities at the plant.

3.7 Sludge Thickening

Currently, secondary solids are returned from the secondary settling tanks, along with sludge from the primary settling tanks, to the anaerobic digesters for stabilization without additional thickening. Gravity thickeners and subsequent gravity belts thickening infrastructure exist, but are not operational. Should these units be rehabilitated, they have sufficient capacity to handle the anticipated sludge production rates at the currently rated plant design conditions.

3.8 Anaerobic Digesters

The existing digester volume, if fully operational, should be able to handle the sludge production rates anticipated at the rated capacity loadings. This volume will result in AA and MM solids retention times in excess of the minimum 15-day recommended value for these types of systems. These values were calculated assuming continuing the practice of co-settling in the primary tanks and directly feeding the combined sludges to the digesters without additional thickening. In terms of organic loading, the calculations indicate that volatile solids loading rates would be within recommended values of 200 to 250 ppd/kcf.

3.9 Sludge Dewatering

The existing four, 2-meter-wide belt filter presses (BFPs) should be able to adequately handle the digested sludge production at the rated capacity conditions, provided, however, that some thickening of the raw sludges prior to digestion is accomplished.

3.10 Summary

The evaluation of the existing facilities indicates that the trickling filter process itself does not appear to be the cause of noncompliance at the South WWTP. On the basis of generally accepted design criteria, the Program Management Team has concluded that each of the unit processes at the plant should be able to meet the effluent requirements under the anticipated design conditions defined by its current rated capacity (45-mgd AA, 55-mgd MM, and 120-mgd PH). This conclusion is supported by the fact that the North and the Central WWTPs, which also rely on the trickling filter process, generally have been able to achieve compliance with similar treated effluent requirements.

It appears that the causes of noncompliance at the South WWTP are not related to the particular choices of unit processes that make up the plant (trickling filters), but rather to how they have been configured. Configuration limitations at the South WWTP include hydraulic surging due to complex and inadequate headworks configuration, poor flow distribution, inadequate recirculation to maintain minimum trickling filter wetting rates, inadequate provisions for snail control (flushing, chemical control, and screening facilities), lack of interconnecting capabilities between force main and gravity trains, and inadequate operational control systems. These physical limitations, although relatively simple to address, ultimately have resulted in a treatment facility that is unreliable and difficult to operate.

4.0 Improvement Alternatives for the South WWTP

The RMAP2 improvements for the South WWTP relied on totally replacing the trickling filter process with a much more complex activated sludge system, without considering an alternative that would address the configuration limitations of the existing plant. The following sections present the key features of the RMAP2 improvement alternative and a new proposed trickling filter improvement and upgrade alternative, as well as a discussion of the relative merits of these two options.

4.1 Activated Sludge Replacement Alternative (RMAP2)

Under RMAP2, improvements to the South WWTP were defined to handle the anticipated increased wet-weather flow (200 mgd after flow equalization) and to address the documented inability of this plant in consistently complying with the current NPDES and LPDES requirements. The following four basic components of improvements to the South WWTP were defined in the RMAP2:

- **Project WWTP 01–New Headworks and Flow Equalization.** A new plant Headworks (including screening and grit removal) and a new 19-mg flow equalization basin would be provided. These facilities would be able to handle an anticipated peak hourly flow rate of

300 mgd while producing an equalized flow of 200 mgd to the downstream treatment facilities.

- **Project WWTP 02–Pipeline Connection to New Headworks.** A new pipeline connecting the existing two headworks from the existing facility to the proposed new headwork would be provided.
- **Project WWTP 03–South WWTP Improvements.** This project considered maintaining the existing primary settling tanks and replacing the existing eight trickling filters with an activated sludge process composed of six new step-feed aeration basins. Two new 160-foot-diameter final clarifiers would be added to handle wet weather events.
- **Project WWTP 04–Pipeline to the Mississippi River**. This project would increase treated effluent conveyance capability to 200 mgd by providing a new parallel line to the existing discharge outfall, which would be required to handle the additional wet weather flows.

4.2 Trickling Filter Rehabilitation/Upgrade Alternative

Figure 2 presents a process schematic depicting a trickling filter rehabilitation and upgrade alternative. Figure 2 shows separately those improvements necessary to bring the plant into compliance under the existing rated capacity (i.e., 45-mgd AA; 55-mgd MM; and 120-mgd PH), and those required to adequately handle the increased wet weather flows, with peak hourly values close to 300 mgd, resulting from the future rehabilitation of the conveyance system. Following is a summary of these rehabilitation and upgrade features.

Improvements for Existing Rated Capacity. These modifications are less complicated and relatively inexpensive to implement and would achieve much faster compliance with existing effluent requirements at the current rated capacity conditions. Key improvements include the following:

- Incorporating chemical enhancement capabilities (ferric chloride as a coagulant and polymer as a flocculation aid) for the primary settling tanks to further reduce organic and suspended solids loadings to the subsequent trickling filter process.
- Providing a new trickling filter effluent recirculation pump station that would allow operating the trickling filters at optimum wetting rates to enhance BOD_5 removals and to reduce odor generation.
- Interconnecting the two trickling filter effluent lines feeding the final settling tank systems (force main and gravity sides of the plant). This would allow using all settling tanks independently of the number of trickling filters in service. This approach would reduce SORs, thus improving the capture of suspended particles, which is the main challenge in maintaining compliance in this plant.
- An assortment of relatively minor electro/mechanical improvements to other ancillary facilities such as screening, flow measurement/control, primary settling, sludge thickening, and snail control. None of these necessary improvements were addressed in the RMAP2 report and will have to be addressed, regardless of other alternatives, to maintain system reliability.

Insert Figure 2 - Wet Weather PFD

Improvements for Increased Wet Weather Flows. It is anticipated that the rehabilitation of the conveyance system will result in the increase of flows delivered to the South WWTP during wet weather events. It is anticipated that peak hourly flows close to 300 mgd would result. The Program Management Team concurs with the RMAP2 recommendation of providing new influent pump station, headworks (with screening and grit removal capabilities), and flow equalization facilities sized to delivered up to 200 mgd of equalized wet weather flows to the South WWTP for treatment. Under this scenario, up to 120 mgd of preliminary treated influent would be sent through the primary settling tanks, and the remaining flow (up to 80 mgd) would be diverted around primary treatment and sent directly to the secondary treatment process. The secondary treatment process would be upgraded into a TF/SC process by adding a small aeration basin aeration basin after the trickling filter and before the final clarifiers. Settled solids in the final settling tanks would be returned to the head of the solids contact basins. This solids contact stage would significantly improve the settleability of the biological process effluent. During wet weather events, flows up to 120 mgd would be pumped into the trickling filters and then flow into the solids contact basin. Flows in excess of this value and up to 80 mgd would be fed directly into the solids contact process. This concept of wet weather flow management is equivalent to that defined in RMAP2, in which wet weather flows would be fed only to the last stage of the proposed step-feed activated sludge basins before the separation of the biomass from the treated effluent in the final settling tanks. Table 2 compares the features of the aeration basins proposed under the RMAP2 Activated Sludge Replacement options, and those considered under the TF/SC upgrade alternative defined by the Program Management Team.

TABLE 2
Comparison of Aeration Basin Features

Features	Step-Feed Activated Sludge (RMAP2)	TF/SC Process Upgrade
Detention Time[1], hours	4	0.3
Volume, ft^3	1,242,000	95,000
Aeration, firm scfm	45,000	2,000

Notes:
[1] based on 55-mgd MM flow
TF/SC = trickling filter/solids contact
ft^3 = cubic feet
scfm = standard cubic feet per minute

As indicated by Table 2, the TF/SC process upgrade will require considerably fewer aeration basins than the RMAP2 proposed activated sludge complete process replacement. This means that in addition to substantial implementation cost savings, there are considerably fewer plant site requirements, which will facilitate implementation without the need to demolish facilities. Additional final settling capabilities must also be provided to manage the 200-mgd wet weather flow condition while providing biological treatment for all equalized flows. RMAP2 had recommended two additional 160-foot-diameter units. Given the space constraints at the current site, a much more compact alternative, such as a high-rate ballasted flocculation system, could be considered as an alternative. Either of these systems would only operate during storm events, when flows to the existing final settling tanks would exceed 120 mgd. In this proposed configuration, the ballasted flocculation system would be supplementing the existing final clarification capabilities of the plant during wet weather events, allowing all equalized flows to receive biological treatment prior to discharge. This contrasts earlier consideration of this technology at the South WWTP, when ballasted flocculation was intended to provide just primary treatment as part of a “Blending” strategy to manage wet weather flows.

4.3 Comparison of Alternatives

There are several key differences associated with the two improvement alternatives defined above for the South WWTP. In terms of implementation costs, the trickling filter upgrade option is considerably less expensive to implement, given the costs associated with demolishing the existing trickling filter, and the construction of new large aeration basins as required by the RMAP2 original recommendation. Regardless of these implementation costs differences, there is a need to consider non-economic factors, which are equally important in the establishment of a recommended improvement option for the plant. Following is a discussion of the relative merits of each of these alternatives.

Effluent Quality. Activated sludge has the potential to achieve better effluent quality compared to a trickling filter process. However, the current permit does not require the City / Parish to achieve higher treatment levels than those that can be expected from a well-configured and operated trickling filter facility. The North and Central WWTPs historically have demonstrated compliance, indicating that a properly configured trickling filter facility will solve the compliance issues at the South WWTP. Should the City / Parish in the future adopt the goal of achieving lower permit limits and/or further improving the likelihood of compliance, then other alternatives such as modifying the existing facilities to a TF/SC could be considered. Conversion to TF/SC is one of the most widely considered options for upgrading trickling filter facilities mainly due to its simplicity and relatively lower cost.

Wet Weather Flow Handling. Both treatment improvement alternatives considered herein have several features in common concerning wet weather flow management. Both assume new influent pumping, headworks, and flow equalization facilities to limit flows to the plant to 200 mgd during wet weather events. Both divert flows in excess of 120 mgd around primary treatment, and both only expose part of the biomass (the step feed cell in the activated sludge option and the solids contact basins in the TF/SC alternative) to the influent flows during wet weather events that exceed 120 mgd.

Accelerated Compliance. The trickling filter improvements alternative clearly has an advantage over the activated sludge replacement option in terms of shortening the schedule to achieve compliance with the Consent Decree requirements. Incorporating the identified TF recirculation capabilities and the final settling tank interconnectivity can be accomplished more quickly than demolishing the existing TF units and replacing them with activated sludge basins. This later option will also present considerably more challenges in terms of maintaining suitable treatment levels during its implementation. The recommended improvements to the TF facilities can be easily constructed and made operational once completed, without affecting the effluent quality.

Operational Compatibility. Another factor the City / Parish needs to consider in evaluating improvement alternatives is the impact its decision will have in terms of the compatibility with the overall treatment program. Activated sludge operational and control requirements are considerably more complex than those required to run a trickling filter facility. The City / Parish will have to retrain its operations and maintenance (O&M) staff to provide the additional knowledge required for the new system. This, in turn, will reduce the flexibility in allocating staff among all facilities, as only those who have the expertise to operate and maintain activated sludge can be assigned to the South WWTP. This also affects spare parts inventories and the need to maintain a different set of outside vendors and contractors to support the different systems.

Odor Potential. Activated sludge undoubtedly has a lower odor generation potential than trickling filters. However, abandoning the trickling filters and replacing them with activated sludge will not necessarily reduce the odor problems at the South WWTP, as perceived by the surrounding community. From several site visits, it is apparent that most of the significant and noticeable odors at the South WWTP are not generated by the trickling filters. In fact, most come from the headworks, the primary clarifiers, the dewatering building, and primarily from the anaerobic digester operation. None of these odor sources would be affected by incorporating activated sludge. Until these odor sources are addressed, the surrounding community will continue to perceive odor generation as a problem associated with the South WWTP. Addressing odor issues probably will be a much higher priority to the community than any other aesthetic concern, such as the visual high profile of a trickling filter facility. Keeping the community from further encroachment against the plant site is also an important strategy to mitigate impacts from treatment. It is recommended that the City / Parish purchase as much land as possible around the treatment plant for this purpose and to preserve long-term expansion options. This treatment plant is likely to be a part of the City / Parish infrastructure for the foreseeable future.

Sludge Processing Requirements. An important O&M component in wastewater treatment is the processing and ultimate disposal of residual sludge, corresponding in some cases to almost half the operational budget requirements of a treatment facility. One generally accepted principle is that trickling filter plants produce lower amounts of residual sludge as compared to activated sludge systems. In the RMAP2 study, it was predicted that the anticipated residual sludge yield factor assumed for the new activated sludge facility would be 0.94 pounds (lbs) of TSS per pound of BOD_5 stabilized. Analysis of plant data conducted as part of this evaluation indicates that the trickling filters at the South WWTP have a sludge yield factor of 0.66. This means that replacing the trickling filters with activated sludge could result in more than 40 percent additional sludge. It was not apparent that the RMAP2 plan considered the impact of this significant increase in sludge in terms of additional sludge pumping, thickening, digestion, and dewatering facilities and the corresponding increase in operational costs, including ultimate disposal at the landfill.

Energy Requirements. Trickling filters and activated sludge are both aerobic biological treatment processes. A basic difference between the two is the method employed to maintain the necessary aerobic conditions. In trickling filters, oxygen transfer occurs by pumping water to the top of the media and letting it cascade as it travels down through the media. In other words, oxygenation happens from adding water to the air. In contrast, activated sludge relies on adding air to the water by using diffusers within the aeration basin. In general terms for carbonaceous treatment (BOD_5 removal), both processes are considered to have equivalent energy consumption.

Snail Control. Snails are a common problem in trickling filter facilities, but design provisions can be made to control them. At many facilities, including ones also operated by the City / Parish, they are effectively controlled, provided the facilities are designed with the appropriate features. These features include flushing capabilities (typically through incorporating electric drives for the tricking filters), chemical control means, and snail removal components such as screens and gravity traps. From observations during plant visits and discussions with the plant staff, it is obvious that the City / Parish has been able to reduce the snail problems significantly in the South WWTP. The main reason is the recent incorporation of electric drives in all the trickling filters at the plant. This allows for the periodic flushing of the media, which in turn helps control the snail population. Implementing the relatively simple snail removal improvements identified in this report will further contribute to the mitigation of snail related problems at this plant.

Disinfection Issues. Many utilities around the world are replacing chlorine gas disinfection systems with UV radiation. This change is not always necessarily driven by economics but rather by the desire to eliminate the hazard potential associated with the storage and use of chlorine gas, in particular in urban applications such as is in Baton Rouge. It is well documented that trickling filter effluent is not as compatible with UV as activated sludge. Should the City / Parish decide to implement UV disinfection in its facilities, modifying the existing secondary process of its three plants to a TF/SC would result in the same compatibility benefits as those cited in the RMAP2 report for activated sludge, and at a much lower cost. It is also advisable that the City / Parish consider providing UV facilities sized to treat all the anticipated 200-mgd peak flow at South WWTP. Only about one-fourth of these expensive facilities would be required to operate most of the time. A more cost-effective approach commonly adopted in other utilities around the country would be to size the UV facility to treat only the rated dry-weather flows and to rely on sodium hypochlorite or another, safer chlorine alternative for disinfection of peak flows. The City / Parish might also consider starting its transition into UV disinfection in a smaller facility such as the Central Plant. This would solve the hazard issue for a much more densely populated area in the city, while allowing lessons be learned in terms of the design and O&M issues associated with this more complex replacement technology.

4.4 Recommendation

The evaluation conducted as part of this study indicates that the South WWTP would adequately handle the existing rated treatment capacity loadings, provided all units were operational and several existing interconnecting piping and flow distribution limitations were resolved. This evaluation also indicated that a relatively simple conversion into a TF/SC process would allow this plant to handle the anticipated wet weather flow treatment requirements from the rehabilitated conveyance system. This conversion would be much simpler and less costly, and have significantly greater benefits, compared to the RMAP2 recommendation of abandoning the trickling filter process and replacing it with activated sludge. As a result, it is recommended that the trickling filter rehabilitation and upgrade alternative defined herein be adopted by the City / Parish to address current noncompliance issues and future wet-weather flow management requirements at the South WWTP.

APPENDIX A

Summary of South WWTP Existing Facilities

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South WWTP Unit Process Summary and Description

The South wastewater treatment plant (WWTP) originally was constructed in the 1960s as an oxidation pond facility. The plant included primary clarification, oxidation ponds, and sludge digesters. Five major upgrades projects have been implemented during the past three decades. The first major upgrade occurred in 1985, and implemented the trickling filter (TF) process to meet secondary treatment standards. Subsequent improvements have been expansions to the TF process, and sludge management facilities.

Currently, raw sewage enters the South WWTP by a combination of gravity and pumped flow. The South WWTP is composed of two process trains that are generally referred to as the gravity train and the force-main train. These trains are interconnected at several points throughout the process. However, each of these trains allows for pretreatment (i.e., screening and grit removal), primary settling, secondary treatment consisting of TFs and final settling tanks, and effluent disinfection. Sludge handling processes include gravity thickeners, gravity belt thickeners, anaerobic digesters, and belt filter presses for dewatering of digested sludge. Stabilized and dewatered biosolids cake is hauled to a landfill for final disposal. Figure 2 presents a process flow diagram for the South WWTP. Each of the aforementioned unit processes, along with their operational strategy, is briefly described in the following sections.

Gravity Train Headworks - Preliminary Treatment and Conveyance

The gravity train receives raw sewage by 60-inch (in) gravity main. Although not combined into a single structure, the gravity train currently consists of (a) a screening facility with four, climber-type bar screens, (b) influent pump station, (c) wet-weather pump station, and (d) grit removal facility with four-centrifugal grit removal systems and auger-type grit classifiers. Influent gravity flow is initially discharged into the screen pits and subsequently passed through the screening equipment by differential hydraulic head. Under dry-weather flow conditions, which has been defined by the designer of the system as being less than or equal to 55 mgd, the influent pump station directs screened-raw sewage through the degritting facility to the gravity-train primary splitter box. This structure allows flow diversion to the force-main train prior to primary clarification. The volume of wastewater directed to the force-main train is controlled by a manually operated weir gate. Therefore, conditions that dictate interconnection are established by operation staff. Screened, degritted wastewater then flows by gravity to either the gravity or the force-main train primary clarifiers. During wet-weather conditions, screened wastewater in excess of 55 mgd (not to exceed 70 mgd) is diverted to a wet-weather pump station prior to degritting. In this scheme, both the influent pump stations' and the wet-weather pump stations' direct screened wastewater through the degritting facility to the gravity train primary splitter structure.

Force Main Train Headworks - Preliminary Treatment and Conveyance

The force-main train receives raw sewage by 48-in force main. This facility is combined into a single structure that consists of (a) screening facility with three-climber-type bar screens, and (b) grit removal facility with two-centrifugal grit removal systems and auger-type grit classifiers. Sufficient pressure is generated by off-site pump stations to direct raw sewage through both screening and degritting facilities to the force-main train primary splitter box. The influent force-main is connected to the gravity train headworks by means of a flow meter and control valve. South WWTP operation staff indicates that flows in the force main that exceed 55 mgd results in the valve automatically opening. Then, raw sewage from the force main is also directed to the gravity train bar-screen facility through the so-called junction-box number four.

Primary Treatment – Primary Settling

The South WWTP achieves primary treatment with six-rectangular primary settling tanks (PSTs). Screened and degritted raw sewage flows by gravity from either the gravity or force-main train primary splitter structures into one of three primary settling basins. Two primary settling basins are in the force-main train, while the other is a portion the gravity train. Nominally, the primary settling basins have a 10.25-foot (ft) side water depth (SWD) (the PSTs have a sloping bottom to a maximum SWD of approximately 11.5 ft) and 70-ft wide and 220-ft long plan dimensions.

Each basin contains a primary sludge pump station and two, 16-ft wide and 120-ft long PSTs. A 70-ft wide and 8.25-ft long stilling well is situated along each primary settling basin influent. The stilling wells are separated from the PSTs by rectangular partitioning baffles that have several circular orifices. Each of the PST's mechanism for collecting sludge is longitudinal-rectangular flights that continuously rotate along the length of each tank. The flights scrape settled primary sludge from each basin bottom and deposit the waste material in the stilling well. Primary sludge pumps withdraw waste solids from the stilling well and direct the material to gravity thickeners. Scum is also collected with longitudinal-rectangular flights that continuously rotate along the length of each tank, but on the water surface. Finally, each of the PSTs contains nominal 46.5-foot-long zones with U-shaped longitudinal troughs and V-notch weirs placed on 7.75-ft center.

PSTs one and two, and three and four, have a wet-well and pump station along the discharge of the unit process. The pump station for primary settling tanks one and two is referred to as primary effluent pump station number one, and the other is named primary effluent pump station number two. The primary effluent wet well is designed to handle a 120-mgd maximum flow during peak hydraulic flow events. PSTs five and six discharge clarified effluent into a collection channel. The channel conveys wastewater to the wet well along the discharge of PSTs three and four. A 48-inch interconnection, or cross-over, pipe links the primary basins' wet-wells in order to equalize flow between the primary effluent pump stations.

Secondary Treatment – Trickling Filters and Final Settling Tanks

Primary effluent pump stations number one and two discharge into a TF slitter box. The splitter structure is nominally 36-ft tall, and has a plan 17-ft wide and 17-ft long. Wastewater is divided amongst the gravity and force-main train TFs by 13-ft long weir gates. Primary effluent flows by gravity to a TF distribution box that serves as both a head box and isolation structure for the TFs. Each of the biofilters contains plastic cross-flow modules (XFM) and electrically driven distribution systems. The distribution systems are equipped with a speed modulating apparatus that is not controlled by a timer; rather there is local adjustable (variable frequency) control with an ON/OFF setting. Both the gravity and force-main train has a dedicated final settling tank complex. Each final settling tank at the South WWTP is a center-feed circular basin. Sludge is collected along a sloping bottom by a scraping mechanism. The mechanism is equipped with a flocculator-type energy-dissipating inlet. Settled effluent is allowed to flow over V-notch weirs into an intra-clarifier launder that also serves as a baffle to dispel density currents. Additionally, each final settling tank complex has a dedicated waste sludge pump station. However, waste sludge from each pump station is discharged into a common 8-inch diameter line. The primary sludge pump stations then contribute to the same 8-inch line prior to discharge at the gravity thickeners, or anaerobic digesters. It is possible that this line is undersized given all the flows being routed to it. Waste sludge can be routed through parallel static screens prior to receiving the primary sludge. Daily flushing, or sudden intense hydraulic loading, is used to avoid predator (specifically snails) accumulation in the biofilters. The static screens are used to filter snail shells prior to solids stabilization and dewatering facilities.

The gravity train contains four, 90-foot diameter biofilters with an 18-foot media depth, and four, 120-foot diameter final settling tanks with a 15-foot SWD. The force-main train contains four, 125-foot diameter biofilters with an 18-foot media depth, and four, 110-foot diameter final settling tanks with a 15-foot SWD.

Effluent Disinfection

Effluent disinfection at the South WWTP is provided by chlorination (chlorine gas and contact basins) and dechlorination by sodium bisulfite. The existing chlorine contact basin is separated into two tanks. Each tank is nominally 155-feet wide, 94-feet long, and 11-feet deep, and partitioned by baffles in order to create 15-foot wide sections that span the width of the basin. Each chlorine contact basin is approximately 1.2 million gallons in volume.

Sludge Management – Biosolids Thickening, Digestion, and Dewatering

Current practice at the South WWTP is to pump waste sludge (referring to both primary and biological sludge) directly to anaerobic digestion facilities. Despite being inoperable, both gravity-belt and gravity-thickening infrastructure exists. Two gravity belt thickeners exist that are capable of reaching between 6 and 8% solids content. However, this concentration leads to poor mixing in the anaerobic digesters. Therefore, the gravity belt thickeners are inoperable due to a lack of control over the effluent solids content. Alternatively, the gravity thickeners are inoperable due to damaged pumping facilities and deteriorated mechanisms. The gravity thickeners are adequately sized to produce a thickened sludge solids content that allows for an appropriate solids residence time (SRT) in the anaerobic digesters to meet pathogen and vector attraction reduction requirements. An ideal scenario is to use the gravity thickeners and anaerobic digesters for biosolids thickening and stabilization, respectively.

In the aforementioned scenario, waste sludge is pumped to a distribution structure, located in the center of the gravity thickener pump station, to divide waste sludge between four, 32-foot diameter gravity thickeners. The gravity thickeners have a 14-foot SWD, and are covered by aluminum-geodesic domes. Each gravity thickener at the South WWTP is a center-feed circular basin. Sludge is collected along a sloping bottom by a scraping mechanism. The mechanism is equipped with an inlet well, and supernatant is allowed to flow over V-notch weirs into an intra-gravity thickener launder before being directed to the head of the WWTP.

Thickened sludge is then pumped to one of four anaerobic digesters. The digesters have rigid covers and are mixed by an Atara (coarse bubble air injection into a mixing tube) system. Three digesters are 65-feet in diameter with a 29-foot sidewall sludge depth. The fourth is 90-feet in diameter with a 29-foot sidewall sludge depth. Stabilized biosolids are then pumped to a dewatering building where they are processed by a belt-filter press and loaded onto an open-trailer truck via conveyor. The stabilized and dewatered biosolids cake is hauled to a landfill for disposal. Methane produced during the anaerobic digestion process is ignited with a flare.