

The Engineering Society of Detroit Consensus Action Report

DETROIT WATER & SEWERAGE DEPARTMENT WASTE WATER TREATMENT PLANT: THE ROAD TO COMPLIANCE AND BEYOND



Submitted to the City of Detroit

July 26, 2010



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ACKNOWLEDGEMENTS

Just over a month ago, The Engineering Society of Detroit (ESD), through its Institute (ESDI), was asked to assess and identify immediate emergency corrective steps and a sustainable, long-term remediation strategy relating to certain NPDES Violations described in Jonathan W. Bulkley, PE's June 3, 2010, Preliminary Report, correspondence from the Michigan Department of Environmental Quality (MDEQ) dated October 3, 2007; November 12, 2009; and April 14, 2010; and recent pleadings relating to such NPDES Violations as filed under Civil Action No. 77-71100 in the United States District Court, Eastern District of Michigan, Southern Division.

Fortunately, a crisis is a terrible thing to waste. It is Detroit's opportunity for transformation and today's enabler and unifier for the City and the Detroit Water & Sewerage Department (DWSD) and the Detroit Waste Water Treatment Plant (WWTP). In a word, it is the engine for global breakthrough solutions.

This Report represents the work of the ESD Institute Blue Ribbon Panel, which is made up of volunteers individually selected for their expertise, hands-on subject matter knowledge and experience to serve as a forum catalyst for change enabling the City of Detroit WWTP to become a sustainable entity.¹ The Panel represents a neutral and independent voice taking a fresh look at a long-standing, often intractable set of issues. This Report spells out specific actions that immediately need to be taken and lays out the implementation steps needed to break the sine curve of past cycles of success and failure. It lays out a process to move from reactive to proactive decision-making.

With the end in mind, the Panel has sought to understand the root causes of how today's noncompliance occurred, learning from the fine people who work with dedication at the City, DWSD and WWTP. The cooperation and value everyone has brought are the reason the present crisis will not be wasted, the patterns of noncompliance will end and Detroit will not only have one of the world's largest treatment plants, but one of the best. WWTP will be a gem in the City of Detroit and a key factor in our region's economic turnaround.

Our Report also puts a fence around a multifaceted set of problems that requires solutions based on people, process and procurement. There is no silver bullet answer due to the interdependencies in the management and successful operation of a \$5-billion facility. That said, however, we have now constructed a perimeter around the challenges before us. We have begun an inclusive, transparent process with key stakeholders who care deeply about the fate of WWTP. This collaboration constitutes the foundation for consensual action. Our desired outcomes include an effective City Integrated Enterprise Agency (CIEA) based upon visionary management, best operating practices, financial sustainability, smart capital expenditures, reduced maintenance risk, optimum staffing and skills, competitive treatment rates and zero noncompliance.

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1 Appendix A contains the biographical information of the ESD Institute Blue Ribbon Panel and staff.



ABOUT THE ENGINEERING SOCIETY OF DETROIT

The Engineering Society of Detroit (ESD) was founded in 1895. Its membership consists of over 6,500 individuals and 3,000 corporate members. With its 83 affiliated technical societies, 34 construction associations and over 52 unions, ESD's reach extends to over 60,000 technical and scientific professionals. ESD's Board of Directors includes diverse leaders in business, labor, government, manufacturing, engineering and design, academia and health care.²

ESD collaborates with nearly 100 nonprofit organizations, including: Automation Alley, Detroit Regional Chamber, Business Leaders of Michigan, Michigan Chamber of Commerce, Michigan Economic Development Corporation, NextEnergy, Oakland County, Oakland County Michigan Works!, Society of Automotive Engineers, City of Southfield and Wayne County. ESD provides professional training, certification and accreditation programs in conjunction with the majority of Michigan's universities and community colleges.³



² Appendix B is a complete listing of The Engineering Society of Detroit and ESD Institute Board of Directors.
³ Additional information regarding The Engineering Society of Detroit is available at www.esd.org.

ABOUT THE ESD INSTITUTE

The ESD Institute was formed through unanimous approval of the Board of Directors of The Engineering Society of Detroit through “Mega-Question” facilitation in December 2008 and benefits from seed and continuing funding from the Rackham Engineering Foundation.⁴ The ESD Board of Directors established the charter of the Institute as follows:

- **ESD Institute Vision:** Finding a sustainable tomorrow with integrity that serves our members and society.
- **ESD Institute Mission:** Fostering greater unity, focus, and choice for the implementation of innovation, maintenance, and attraction of investment capital and the betterment of society.

The charge of the Institute is to advance, through excellence and collaboration, the successful implementation of innovation by bridging creative and independent thought with concrete and meaningful action with an emphasis on the needs of Michigan.

Based on the process model of the National Academy of Science in Washington, D.C., the Institute’s goal is to establish and safeguard a productive problem-solving environment that encourages creativity and open dialogue in workgroups that are tasked to achieve new solutions that can be implemented by policy makers. The Institute’s overall focus is to find socioeconomic unifiers and enablers to propel Michigan’s economic and employment turnaround building from the grassroots level.



⁴ Additional information regarding The ESD Institute and its process is available at www.esdinstitute.net. The Institute is served by volunteer Co-Directors David A. Skiven, PE, FESD, and Christopher J. Webb, J.D., FESD.

CURRENT STATE CONDITION

BACKGROUND

The ESD Institute Panel emphasized that its assignment was designed to gather information and not conduct an audit. Our task was geared to one key principal: seek to understand, through an inclusive process, the many challenges faced daily in operating the largest, single-site waste water treatment plant in the world that serves over three million residential, commercial and industrial customers and storm flow averaging a rate of 750 million gallons per day. In moving forward, we hoped to establish meaningful communication to get the facts and find solutions that would work in practice leading to predictable compliance and beyond.

To accomplish this, our Panel kicked off its work with a debriefing meeting with the staff of the Court. We then met with key individuals at WWTP, the leadership of DWSD and critical City of Detroit departments. In preparing this Report, multiple visits occurred with DWSD and WWTP representatives, including maintenance and engineering. A series of one-on-one meetings were held with city department representatives from Purchasing, Human Resources, and Legal. Sessions were then jointly held with representatives having operational and support responsibilities. These joint sessions engaged in transparent dialogue regarding the strengths and weaknesses of DWSD and WWTP. These efforts helped each attendee to understand the challenges faced by communication issues and collaborative problem-solving. Everyone wanted to see WWTP succeed. No one was without frustration in trying to carry out these duties. What follows is largely how those people helped the Panel prepare this Report.



VIOLATIONS & RESPONSE HISTORY

Between August 1997 and 1999, there were significant violations of the NPDES Discharge Permit limitations for effluent and non-effluent requirements. Corrective actions were incorporated in the Second Amended Consent Judgment (SACJ) issued by the U.S. District Court, with the appointment of Mayor Dennis Archer as Special Administrator, whose status was terminated in 2008. On November 6, 2000, DWSD entered into a Program Management Contract (PC-744) to rehabilitate and upgrade the facility and return it to compliance under the NPDES Permit and Michigan Department of Environmental Quality (MDEQ)–MIOSHA–Clean Air Act requirements.

The major elements of the solids processing equipment are sludge dewatering, incineration and disposal to landfill. Additional belt filter presses were installed to address sludge dewatering in 2000. The original design life of these presses is 7 years under normal



operations. In May 2004, centrifuges were installed to increase capacity and the solids content of the sludge. These distinct units require major overhaul at 1- to 2-year intervals. Efforts including major construction work achieved substantial compliance by December 2005. This Program Management Contract ended in 2006, although work under PC-744 had not resulted in a complete upgrade and rebuild of the WWTP's dewatering operations.

After the conclusion of PC-744, responsibility for plant maintenance rested solely with WWTP, and in the years following, WWTP began to experience a decline in staff trained under PC-744. The decline in the condition and operability of the solids processing equipment coincides with a decline in fiscal and personnel resources.

RECENT DEGRADATION CONDITION

In 2008, the aging condition and operability of the belt filter presses was evident. The presses were in their replacement stage life cycle. Overhaul of centrifuges had not occurred as required at 1½- to 2-year intervals. In 2009 and 2010, sporadic outages in the PC-774 incinerators chiefly occurred due to age and deferred maintenance in anticipation of a Synagro sludge disposal contract. Conveyor and other conveyance equipment critical to the movement of solids within WWTP were near or past useful life. Maintenance alone will not result in consistent operation of the conveyors. Unlike other workarounds available in the event of down equipment, conveyors are often operational bottlenecks if equipment fails.

To create a perfect storm for noncompliance, WWTP staff losses through attrition and retirement were not offset by either promotions from within, hiring new employees or the retention of outside contract staff, although it should be noted that permit violations have in fact occurred when staffing levels were higher than they are today. The salient factor is quality of staff and not necessarily quantity.

The lack of timely approvals to fund skilled trade contracts and parts, maintenance and other subcontracts for the dewatering area caused at a minimum a 5-month delay in the implementation of corrective measures. The inefficient processes for the purchase of critical parts over \$25,000 stretches the procurement timeline to a period of 8 months or more.

All of the above contributed to a real-world reduction in WWTP's capability to dewater and dispose of solids. The results were predictable: WWTP continued to face the dangers of an ever-increasing high-solids inventory, pushing its management, staff, contractors and equipment beyond their limits. For short-term relief, DWSD recently issued a contract for landfill services for solids disposal, bringing the total landfill capacity to 2,000 wet tons per day. Outsourcing services continues to be an expedient response to a chronic condition.

While reporting has been an important tool to measure compliance, it too often has lacked credibility. Metrics alone will not solve underlying problems. It will merely measure past performance, and such measurement would always be after the fact, especially when



a rain event outside the control of WWTP occurs. Noncompliance became a symptom of the underlying deficiencies of process, people and equipment and would repeat itself until addressed. Ironically, it was easy to label WWTP performance as subpar, but, in fact, it was beyond the call of duty given reality.

COURT STAFF ASSESSMENT

After our review and meeting, the reports and observations of the Court Monitor and Staff speak for themselves and come as no surprise to this Panel. Like the years preceding the year 2000 violations, history repeated itself and the sine curve of compliance and violation continues. And, once again, the City of Detroit and DWSD find themselves in a reactive mode using their best efforts to respond to the Court and MDNRE. It is our intention that the findings of this Report will complement those parallel efforts and provide the solutions that will break this pernicious cycle. Only a unified approach will make the strategic changes in direction contained in this Report a reality. Specifically, this Report augments, from a technical point of view, the findings of the Court Monitor and staff.

ROOT CAUSES

This section of our Report breaks down salient root causes behind today's noncompliance. By understanding these causes from both an internal (within WWTP) and external perspective (city-wide and others), solutions for corrective action can be identified and then implemented through consensus-based action.



WWTP Practices

Operating Practices

Numbers and data often provide a false level of comfort and can become an end instead of a means. Soon it can become impossible to sort out what numbers are important and what are not. To put this into context, the daily solids inventory numbers at WWTP tell the story of that day's operations. Most, if not all, of the conditions preceding a noncompliance event shared a common backdrop: the solids inventory was too high for the plant to handle. The solids inventory numbers to WWTP are like a blood pressure readings. We can get away with our blood pressure numbers being too high once in a while, but at the end of the day systematic high blood pressure will endanger your health as it quietly overtaxes your body. As the inventory numbers climb, WWTP cranks up its aging equipment on a 24/7 basis if possible to address it. The blood pumps as fast as it can until it unfortunately comes to a terrible stop, or, to say it another way, solids go into the Detroit River.

To put it in a nutshell and perhaps put all metrics into perspective, when the inventory number exceeds 1,000 tons, clarifiers are filling up. The belt filter presses are running up



to capacity. Conveyors are starting to run full out. Centrifuges are spinning at their design parameters. Incinerators lose any margin for failure. Staff goes on alert and morale suffers. In short, people and system begin to strain. Any snag becomes the chance for a catastrophic failure resulting in noncompliance. The replacement for the non-stock broken part that is no longer available from today's suppliers could break the camel's back. When the solid inventory exceeds 3,000 tons, the risk of noncompliance is unacceptable. Above 3,000 tons, no report—accurate or otherwise—will soften the likelihood that on a long, rainy, holiday weekend, WWTP may be unable to meet the effluent NPDES Discharge Permit limitation.

Personnel & Maintenance Practices

A critical problem facing DWSD and WWTP is the lack of sufficient qualified personnel and, in particular, maintenance staff. When the Panel was introduced to the 8 key leaders at WWTP, we were informed that losing anyone could jeopardize the successful operations at the facility due to their collective institutional knowledge that had not been shared with others coming up the ranks. This stark reality drives home the importance of addressing the people need on a fast-track basis.

That said, there is a difference between quality and quantity. For example, little, if any, ongoing training of operators and maintenance providers takes place. There is no succession planning for plant supervision personnel. The number of maintenance personnel has decreased from 250 in 2000 to 150 today. Further, the plant's overall workforce is aging. Through normal attrition, approximately 60 to 80 employees leave the plant each year. Worse, 118 of the 539 existing employees have more than 25 years of service. Housekeeping practices reflect the morale of the facility and are consistently a low priority. Poor practices can be the source of significant safety concerns as well as the cause of maintenance issues threatening a noncompliance event.

Aging filter belt presses, centrifuges, conveyor belts and incineration equipment result in 350 to 400 new maintenance work orders each week. Staff can only complete approximately 50% of these work orders, often due to lack of parts. As a result, little maintenance work is routine or without risk of adverse consequences to operations. To make matters worse, the plant's preventive maintenance system is in need of upgrading to be an effective tool.

WWTP has multiple job classifications for its skilled trades personnel with each only responsible for what is in their job description. Delays in maintenance service occur when a service crew is short a particular trade. At times, the maintenance event requires the assistance of engineering talent. Often the engineering personnel are not available to make decisions that first must go through channels. The plant does not or simply cannot assign an engineer to every failure and therefore needed engineering expertise cannot be used to resolve design-related or complex maintenance problems.



Capital Practices

Despite good intentions and outside expertise, capital expenditure practices have been reactive and have not been undertaken with the end in mind. Currently, a consensus on what the Panel would call an End State is sorely lacking. Worse, if done in a reactive or piecemeal fashion, the likelihood of a repeat of the Year 2000 initiative will occur. Sooner or later the sine curve will collapse into noncompliance.

Today, capital decisions are usually made without meaningful consultation with DWSD management. Engineering is consulted in a bureaucratic fashion through a system that has well-established channels of avoiding blame or placing blame for poor performance or failure. No internal capital planning process for the rehabilitation and replacement of equipment based upon on the ground realities at the plant is in place. The result is a foregone conclusion: little or no capital essential to WWTP's compliant operations has been spent over the past 5 years. Drawing on our earlier metaphor, the patient is ready for its next heart attack.

As a stopgap measure, WWTP has retained a recognized outside consultant to examine its capital needs. This 2010 Needs Assessment Report & Capital Expenditure Plan is in its final drafting stages and is based upon current thinking at the plant level that may not have the optimum end in mind. If adopted, expenditures may then close off critical options for DWSD and WWTP needed to break the sine curve of noncompliance and move from a reactive to proactive, sustainable and inclusive entity.

City of Detroit Practices

Human Resources Practices

The City's Human Resource Department would be the first to acknowledge that it should be a service provider to DWSD as an Enterprise Agency of the City of Detroit and that it has provided inconsistent or nonexistent services to DWSD in the past.

Faced with its own staff reductions of over 34%, Human Resources fully understands the challenges. The current process barriers driven by real or perceived requirements due to city ordinances, civil service rules and procedures, requisition practices and collective bargaining agreements have impacted the ability of the Human Resources Department to fill the personnel needs of DWSD and WWTP. Workings between DWSD and HR are bureaucratic in nature and the process challenges each face in carrying out their responsibilities with the other have not been fully shared. Each has legitimate reasons why the process has not been successful, but joint problem-solving efforts have not yet occurred.

Putting any fault assessment aside, the lack of an effective succession planning process has again resulted in workarounds that increase the risk of noncompliance due to lack of qualified personnel. All of this has led to considerable mistrust between DWSD and the City Human Resources Department. Dealing with each other via email or hardcopy deliveries has become the rule with little face-to-face communication. As a result, needs are left unaddressed and solutions are not consensus-driven.



Purchasing and Budget Practices

First, it should be emphasized that like Human Resources, the City's Purchasing Department has a healthy sense of the work ahead needed to transform its processes and practices into a value-added service provider to an Enterprise Agency like DWSD. Frequently the department shared with the Panel its internal goal of finding the optimum balance between centralization and co-located services to streamline purchasing to become an effective service provider to DWSD.

Discussions with the Purchasing Department were candid and to the point. Business as usual was going to change in the City's Purchasing Department. The often needless labyrinth of process and procedures required to award a significant contract were well understood and a determined effort was underway to transform the process into an efficient and electronic one.

Clearly workarounds had sprung up in different location of the City that resulted in silos of purchasing activities that failed to maximize the buying clout of the City and reduced accountability. That said, it was understood that the purchasing services located at DWSD were authorized by City ordinance, although within DWSD itself there were buying units engaged in significant purchases from construction contracts to stock items with little communication or interface with the City's Purchasing Department. In a word, the City's Purchasing Department was in the dark, after the fact and out of the loop regarding much of DWSD's purchasing activities leading to formalistic and bureaucratic procedures that treated symptoms and not causes.

At times, bidding procedures introduce problems, as well. There are significant difficulties in obtaining clearances and certifications, and the number of levels of management approval needlessly burdens the process. What appeared missing was a management communication and process linkage that could address the inefficiencies and hurdles to the timely and cost-effective purchase of the staffing, parts and capital needs of DWSD and WWTP.

All of this is compounded by the overarching approval process relating to purchases over \$25,000. Essential DWSD purchases often exceed this amount. The process requirement sometimes results in over 17 steps with a resulting 6- to 12-month delay in the delivery of goods and services. The sequential processing of contracts with original documents transferred from office to office exacerbates this condition. With the likelihood that a part or piece of equipment over \$25,000 would fail at any time and shut down WWTP, it is no wonder that outsourcing under approved existing subcontracts has become the rule instead of the exception. And, ironically, despite this dollar approval limitation, no WWTP purchasing request has, at least in collective recent memory of plant personnel, ever been rejected.

Finally, annual budget approval has been relatively meaningless since the Budget Department was a required approval process step for purchases already approved in DWSD and WWTP's budget. This redundancy again created a roadblock to an effective and timely purchasing process.



CUSTOMER RELATIONS

As residents, businesses and local governmental units throughout Michigan carry the weight of our current economic distress, pressure will only build on DWSD and WWTP to offer their services at competitive rates with accountability as to capital expenditures in compliance with applicable rules and regulations. Missteps are commercially and politically charged events that drive the real and perceived view of DWSD's competence in serving its customers and serving as an asset for Michigan's economic recovery.

Permit violations clearly represent backward steps, however accidental in nature. Bluntly speaking, WWTP has no control over what or how much comes into its facility. For example, stormwater surges can cause a threefold increase in the quantity of wastewater to be processed. This in turn increases the solids load on the dewatering process and so on. Also, toxic dumps into the collection system can inhibit biological activities and shut down or cripple the plant.

All of these uncontrollables call for proactive leadership. Customers today believe that nothing will change at DWSD and that they are captive due to the cost of any alternative local or regional treatment facility. Resentment and cynicism become the order of the day and legitimate explanations are ignored. Customers think only one thing: their rates will only go up due to DWSD's blunders. To restore confidence and credibility, DWSD must take a new tack, one that is a consensual and transparent road map, that is technically the best, that is cost competitive and, importantly, one that is implementable. Once in place, stakeholder support will build and become a demonstrable reality.



FUTURE CONSIDERATIONS

The United States wants to be green and it is a relentless tide. Green is also a moving target that can quickly change direction. No utility can avoid this ever-changing environment, driven in large part by legal and regulatory requirements. We can only plan that it will be the constant for years to come. As a result, every strategic decision taken today needs to recognize this force and preserve a utility's ability to constructively and competitively respond to these pressures. Understanding core competency is key. Options based upon existing and new technologies are essential to avoid a defensive and reactive response.

For example, last April the U.S. Environmental Protection Agency (EPA) launched a rule-making initiative regarding proposed new air emission, monitoring and reporting requirements relating to new and existing nonresidential boilers, including those fired by biomass. In addition, the EPA is considering the redefinition of which units should be considered biomass incinerators, which would be subject to even more stringent requirements. Simply put, the definition of sewage sludge generated at a wastewater treatment facility that was destined for incineration as solid waste would be regulated under Section 129 of the Clean Air Act. And, worse, existing incinerator facilities are not intended to be grandfathered. Incineration may, in fact, go the way of the dinosaur. Conventional thinking is not enough in this kind of tough environment in which change is the only constant.



RECOMMENDATIONS OF THE ESD INSTITUTE

AN OVERVIEW

The recommendations that follow represent a road map in the time frames of *Now* (0 to 6 months), *New* (0 to 3 years) and *Next* (0 to 5 years). The common start date is intentional. For Detroit to arrive at its destination, work must concurrently start on all activities, even though the tasks have different durations and complexities. By using this timeline-based approach, seemingly impossible challenges are broken down and solved while at the same time building an atmosphere of trust and communication essential for the accomplishment and successful implementation of the needed solutions. Importantly, the interdependency of actions taken now and their consequences—for better or worse—on downstream desired outcomes is then highlighted.

THE “NOW” CONDITION (0 TO 6 MONTHS)

Operating Practices

First and foremost, at the end of this July, DWSD will lose its Director. Regardless of anyone’s opinion of this departure, no one can argue that a significant institutional knowledge loss will occur and another of the many managerial positions at DWSD will either be vacant or have an interim representative sending signals to all internal and external stakeholders that the jury is out as to what will happen at DWSD. With a new DWSD Director soon in place, however, an operational objective of DWSD and the City should be to create a City Integrated Enterprise Agency (CIEA).

Staffing is a priority going forward. Today, WWTP will say that it needs people. DWSD management will say it has not been in the loop as to who is needed and why. This is a gulf between management and operational staff that needs to be promptly and correctly reconciled. The ongoing DWSD Staff Assessment Report through the outside consultant IMG is a start. At the end of the day, however, the application of the expertise gained from the work of IMG must be successfully applied. This is the missing link in the execution of most outside consulting efforts. Solid and cogent work is frequently handed off to the client without stakeholder consensus. Otherwise, long-standing institutional barriers will prevent implementation.

Accordingly, the Panel recommends the immediate formation of an internal steering facilitation team, ProActive CIEA Enabler (PACE), to bring together all internal



stakeholders enabling transparent communication and needs, as well as trust-based collaboration from the bottom up instead of top down to avoid traditional barriers to change. **PACE** would report directly to the Chief Operating Officer of the City of Detroit.

The mission of **PACE** will be twofold: break the sine curve of noncompliance and create the operating structure of a consensual-based CIEA. Accordingly, “**PACE to GREEN**” should consist of an outside facilitative organization (1 member); DWSD management and staff representatives (2 members); WWTP management and staff representatives (2 members); City Department representatives from Law, Human Resources, Purchasing and Engineering (with 1 member from each entity) and outside technical subject matter consultants with no conflict of interest due to representation of others (2 members).

Without this steering group, the many initiatives recommended by the many consultants now retained by DWSD, WWTP and the City along with those contained in this Report will likely remain on the shelf. Worse, given the financially distressed nature of the City and our economy, those initiatives may only be partially implemented or in piecemeal fashion to the detriment of WWTP. All initiatives should be considered through the lens of whether or not the chances of future noncompliance are increased or reduced. Specifically, **PACE** should undertake an immediate review of the IMG staff assessment and reach consensus on action to be taken going forward. Accordingly, immediate action should be approved for the implementation of the following operational recommendations:



1. **PACE** should be established immediately, reporting directly to the Chief Operating Officer of the City of Detroit and with members serving at his/her discretion with the charge to examine all facets of the WWTP. Members not already employed by DWSD or the City should serve as volunteers.
2. Collocation of two Human Resources staff to assist in creating job descriptions, establishing appropriate salaries and hiring operating and maintenance personnel to meet the staffing requirements set forth by the DWSD management.
3. Collocation of two Purchasing Department staff to order additional dewatering equipment for immediate installation to increase the ability of the system to manage solids loading and reduce the solids inventory consisting of either belt filter presses or centrifuges, opting for earliest delivery.
4. WWTP should immediately take advantage of the additional landfill contract for solids disposal.
5. The department should initiate dialogue with Skilled Trades to investigate possible reductions in the number of job classifications, as well as allowing represented persons to perform multiple job functions.
6. DWSD’s capital budget should be resubmitted for expedited approval. Upon approval, the department must be empowered to make purchases without additional approvals.

Maintenance Practices

In addition to the recommendations contained in the preceding Operating Practices section of this Report relating to staff issues, the Panel recommends that DWSD immediately undertake the following action items:

1. DWSD should retain an independent subject matter expert(s) to oversee a comprehensive umbrella contract for implementation of procurement maintenance and off-site biosolids disposal with no preexisting interest in a specific outcome or determination based upon other interests. The expert(s) should have specific professional experience based upon actual work in a wastewater treatment facility with an actual working knowledge of its operations and challenges.
2. Critical incinerator repairs should be completed as soon as possible.
3. Rental equipment should be brought in if plant equipment is unable to bring the solids inventory down to 1,000 tons.
4. WWTP should de-rate the equipment to reasonable levels, thereby allowing for maintenance outages and to reflect equipment age and condition realities.
5. Engineering should begin to work with plant maintenance staff to initiate a study of the conveyor systems. The study should include an analysis of present conveyor reliability, as well as a plan to increase the number of belts serving the dewatering equipment.
6. Training programs for operations and maintenance personnel need to be initiated to reflect present practices. Training should begin by October 2010. The syllabus should include detailed presentations on use of the Enterprise Maintenance Action Planning software program (EMPAC) for maintenance work orders. EMPAC will also require updating.



Capital Practices

Due to the burdensome processes relating to capital expenditure approvals, it is critical that DWSD not undertake capital expenditures that may have to be reversed or abandoned. Much is at stake, including the risk of future noncompliance and precious funding availability either internally or externally.

Importantly, capital expenditures need to begin with the end in mind. An overall endgame is essential to make every dollar count in both the short and long term. Accordingly, the Panel recommends the following immediate action items for implementation:

1. An independent subject matter expert with a working knowledge of the operations of wastewater treatment facilities should be retained to review and evaluate with DWSD its 2010 Needs Assessment Report & Capital Expenditure Plan currently in the final drafting stages. Needs capital should not be initiated without this assessment.



2. Any capital expenditures should be reviewed by **PACE** in order to maximize consensus building within DWSD, WWTP and the City and to minimize unnecessary roadblocks to responsive implementation.
3. Capital should be expended on optimizing short-term rehabilitation needs for dewatering equipment and existing multiple hearth incinerators with a priority given only to the equipment necessary for the near term.
4. Capital should be expended on three new pieces of dewatering equipment (belt filter press or centrifuge) within six months to augment availability as a part of the immediate dewatering rehabilitation plan.
5. Capital should be expended to rehabilitate and, as required, replace existing conveyor and conveyance equipment critical to the movement of solids within the facility with short-term redundancy taken into account to minimize the risk of noncompliance.

THE “NEW” CONDITION (0 TO 3 YEARS)

Building to the End State by Consensus

Building to an End State that allows for flexibility based upon a changing political, commercial, technical and regulatory environment requires both short- and long-range vision. As **PACE** tackles this challenge, its facilitative and inclusive process will create a solid foundation for moving forward. With the destination in mind, recommendations by **PACE** *should* be implementable due to the consensus reached in the steering group. By constituting **PACE** with both internal and external members, fresh ideas will have a fair hearing.

Importantly, the external members will have no vested interest in any specific outcome other than best professional practices to optimize WWTP for the benefit of the DWSD, the City and those it serves. The Panel recommends that **PACE** has no binding decision-making authority so that its role as a collaborative advisory group can be maintained based upon candor and the highest level of integrity. As such, **PACE** can serve as the neutral hub for implementation of the outline contained in this Report. What follows in this section is a suggested roadmap over the next three years relating to operations, maintenance and capital practices as identified in the listed recommendations below. That said, a fundamental crossroads must initially be faced.

The task before DWSD, WWTP and the City is whether or not its treatment facility should become incineration free. The answer to this question is necessary to guide staffing, equipment and capital needs now and in the future. Importantly, however, the Panel believes that tackling this question is key to achieving a sustainable entity for all interested stakeholders and the environment. To break the pernicious sine curve, the solution for an integrated enterprise agency that optimizes the service and support providers of the City



and achieves an End State in which no biosolids are incinerated needs to be evaluated by independent experts as well as those with internal expertise. During this same period, alternative dewatering sludge wastewater technologies such as low pressure air vortex systems should be evaluated. **PACE** may determine that the retention of an outside expert with no financial or contingent gain in its work product makes the most sense.

In sum, and at this point in its review, the Panel believes that the fluidized-bed incineration (FBI) option is problematic because of the extensive and advanced operational and maintenance requirements. Simply put, if mechanical and electrical maintenance is difficult under today's conditions, what hurdles will DWSD face if the scope of its maintenance responsibilities extends to chemical engineering and other disciplines? In addition, the FBI and other public options face permitting challenges that will increase cost and uncertainty. New source requirements will be burdensome and costly. Anticipating the likelihood of future CO₂ regulations that could put DWSD and the City at compliance risk only points toward a green solution that is cost-effective and implementable now.

Once consensus can be reached on this critical point, the sine curve will be broken, staff will be optimized, equipment will be purchased wisely, capital will be spent prudently and competitive wastewater rates will be achieved over the long haul.

To get there is not an easy task. We have chosen not to divide up these recommendations into subcategories since each are interdependent and represent a cohesive whole necessary for a facility that is proactive and not reactive, although each item is labeled for ease of reference. As an overall goal, during this period, the CIEA begins to take form and perform as a cohesive unit. Here, then, are the Panel's recommendations for the NEW time frame of 0 to 3 years:



1. **Operations:** Integration of City operational support should continue to optimize the CIEA.
2. **Operations:** Staffing needs should be fully assessed in the implementation stages.
3. **Operations:** Engineering should be aligned to provide on-the-ground support to maintenance to avoid mistakes and improve performance.
4. **Operations:** Streamlined procurement processes should be in place and gaining traction, working in harmony with facility personnel on site as needed.
5. **Operations:** Skill-based learning should be the rule and not the exception.
6. **Operations:** Stock and customer parts are appropriately available based upon preventive maintenance systems and staff awareness.
7. **Operations:** On-site teams consisting of operations, maintenance and engineering staff members with expertise specific to each critical area of the plant's treatment are in place.
8. **Operations:** At regular intervals, the heads of CIEA and Human Resources work together to reduce the shortfall in operations and maintenance staff anticipating upcoming retirements and agreeing on proactive steps required to replace staff to anticipate present and future needs.

9. **Operations:** CIEA invites personnel from other wastewater treatment plants to attend one of the programs and provide an independent critique of its operations seeking a reciprocal agreement, as well.
10. **Operations:** Engineering undertakes an examination of optimizing the automation of equipment at the plant. This design work should be compatible with the future installation of a state-of-the-art, plant-wide control system keeping in mind the need for flexibility to adapt to new technologies.
11. **Maintenance:** Engineering personnel are working side by side in real time with plant personnel to reduce miscommunications and proactively getting it right the first time instead of reactively the last time. They will use their expertise to prepare necessary technical scopes of work or other descriptions for quotation purposes with contractors approved by Purchasing and the plant.
12. **Maintenance:** Operating personnel are ahead of the curve in terms of monitoring and taking necessary maintenance and corrective rehabilitation and replacement action of key equipment, such as the plant's dewatering, incineration and conveyance equipment and systems.
13. **Maintenance:** Equipment failures are analyzed to conduct predictive maintenance routines.
14. **Maintenance:** The training programs for operations and maintenance personnel routinely repeat at agreed upon levels to meet the continuing needs of the facility.
15. **Capital:** A 3-year rolling capital budget is prepared and approved in principle and in advance of an emergency to cover replacement of equipment that has exceeded its 7-year life. This should include a solids storage facility and conveyor equipment.
16. **Capital:** Expenditures are directed to the consensus-based End State and are not divisive, nor a surprise to those in the approval process.



THE "NEXT" CONDITION (0 TO 5 YEARS)

The End State Achieved

Within this concluding window of time extending to 5 years and beyond, we expect to achieve not only an incinerator-free operation, but one that is also compliant. To put it another way, CIEA will be a vision come true based upon a green and sustainable operation serving the needs of its employees, the City and its customers for years to come. Through proactive decision-making, CIEA will in turn steer efficient and uncontroversial capital spending through approval processes that make sense and work with the appropriate checks and balances to ensure that expenditures are without question and both technically and financially on the mark.

By now, the struggle regarding incineration or not is over. Some of the benefits include a lean and efficient operation focusing on its core competence of dewatering. Figures 1



and 2 below dramatically show the reduction in space and building requirements with the Green Option. Space for conveyance will now be available. Budget needs are no longer driven by the uncertainties of regulatory requirements. Complex and unproven technologies are rejected and the CIEA is not dependent upon these risks. Current and new technologies can then be evaluated in light of predictable and successful operations. With operational risks reduced, maintenance risks are, too. Controls will be upgraded to provide centralized command with state-of-the-art technology allowing early problem identification and clear and concise reports with meaningful data. Morale, critical to any organization, improves, as do workplace conditions and stress. Overall capital expenditures decline and treatment costs are no longer viewed with suspicion. Rate increases are explainable on the basis of performance and not failure or noncompliance issues.

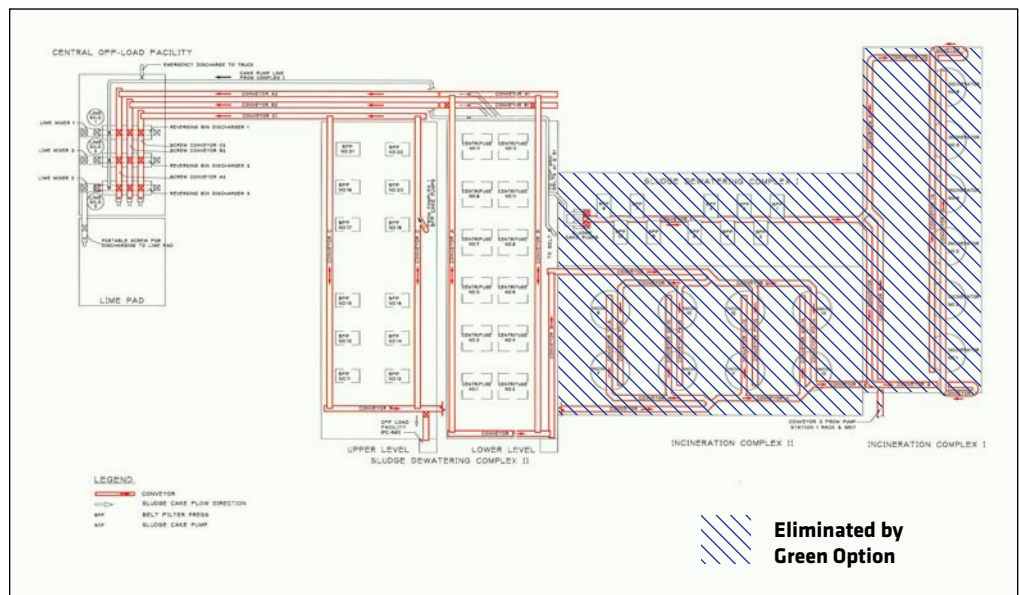


Figure 1: Conveyor system schematic at the Detroit WWTP

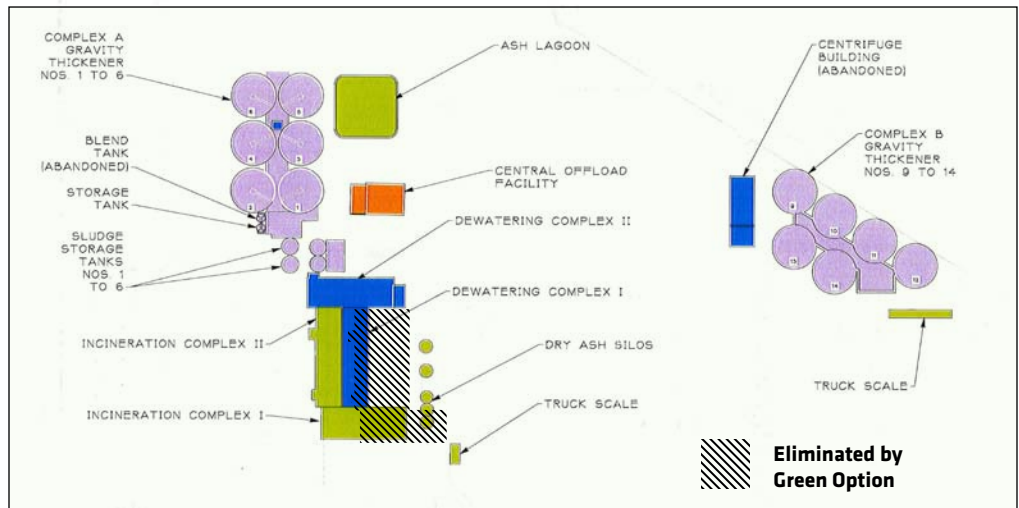


Figure 2: Solids handling facilities at the Detroit WWTP



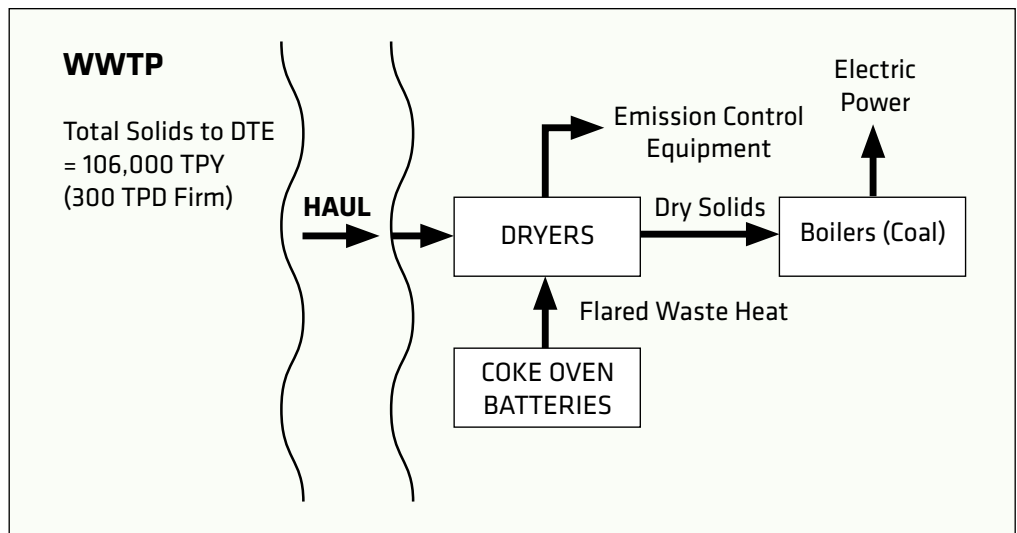


Figure 3: Green/Off-Site Drying Option

By way of example only, the Panel offers a representative sample of this outcome as shown in Figure 3. Here is a truly green option that makes sense in terms of operations and cost using proven technology (dryers are common technology in the fertilizer industry). Off-Site drying of solids followed by beneficial use in a coal-fired boiler provide unique advantages over on-site fluidized-bed incineration. Some of these advantages as shown in Figure 4 include lower risk of noncompliance, use of waste energy from coke oven batteries, application of federal tax credits and state incentives for biomass-generated electricity, simplified permitting and regulatory compliance, lower carbon footprint and revenue from displaced coal up to 60,000 tons per year.

- **Lowers capital O&M cost**
- **Uses coke oven gas waste heat for drying**
- **Dry solids cogenerated with coal**
- **Generates carbon credits**
- **Generates green credit for electricity**
- **Lowers carbon footprint**

Figure 4: Green/Off-Site Drying Option Benefits

The Panel therefore recommends that the End State achieves the long-term goals set forth in Table 1. A calculation of comparative carbon footprint of the FBI and Green/Off-Site Options is contained on Table 2 with the FBI Option at a net CO₂ of 243,000 MTeCO₂/yr and the Green/Off-Site Option at a net CO₂ of 80,000 MTeCO₂/yr. Finally, the Panel offers Table 3, which depicts the costs savings of an incineration-free operation as conclusive support for its End State recommendation. In dollars and cents, the Green/Off-Site Option has a net present value of \$200 million.



Table 1. Capital Improvement Initiatives & Total Savings Comparison

	Current Plan (Data from biosolids disposal study June 2010)	Potential Savings Green/Off-Site Option
5. Rehabilitation optimized dewatering equipment with 75% firm capacity (possible elimination of Complex I)—includes storage	34 units @ \$70 million	<ul style="list-style-type: none"> ■ <22 units @ <\$50 million capital ■ Reduced manpower for O&M (20)
6. System-wide central monitoring control system	Limited	<ul style="list-style-type: none"> ■ \$5–8 million ■ Reduced manpower (10-20)
7. Conveyor optimized and rehabilitation	Limited	<ul style="list-style-type: none"> ■ TBD
8. Primary disposal		
A. FBI—at ash lagoon	Capital: \$275 million O&M: \$26 million/yr	<ul style="list-style-type: none"> ■ NA
B. No incineration—beneficiation of sludge for use in boilers	NA	<ul style="list-style-type: none"> ■ <\$100 million capital (DTE) ■ Estimated \$10 million/yr O&M ■ Manpower reduced (50)
9. Summary		
A. Potential capital savings to City	Base	<ul style="list-style-type: none"> ■ \$300 million
B. Manpower reduction	Base	<ul style="list-style-type: none"> ■ (80-100)
C. Operating cost (net)	\$40.1 million	<ul style="list-style-type: none"> ■ 24.6 million (estimated)
D. Manpower savings		<ul style="list-style-type: none"> ■ \$6 million
E. NPV 20 year savings		<ul style="list-style-type: none"> ■ \$240 million
10. Carbon foot print MTeCO ₂ (Table 2)	243,000	<ul style="list-style-type: none"> ■ 80,000

Table 2. CO₂ Footprint in MTeCO₂/yr

	Fluidized-Bed Incinerators Option	Green/Off-Site Option
Total Solids	165,000 TPY	165,000 TPY
Solids Processed	106,000 TPY	106,000 TPY
Natural gas	11,800 MTeCO ₂ /yr	Natural Gas Minimum
Electricity	13,000 MTeCO ₂ /yr	Electricity TBD
Biomass	148,000 MTeCO ₂ /yr	Flare gas (used for drying) = 0 *From biomass/coal displacement = 0 Handling = 400 MTeCO ₂ /yr
Total for Disposal	173,000 MTeCO ₂ /yr	<10,000 MTeCO ₂ /yr
Landfill	70,000 MTeCO ₂ /yr	70,000 MTeCO ₂ /yr
Net CO₂	243,000 MTeCO ₂ /yr	80,000 MTeCO ₂ /yr

MTeCO₂/yr = Metric Tons Equivalent Carbon Dioxide per Year

Based on sludge 70% volatile @ 10,000 BTU/lb of VS

VS ≈ C₈H₇O₂N

1 Ton of Vs ≈ 2 tons of CO₂

1 Ton of solids = 1.4 tons of CO₂

1 Ton of solids = 15.4 million BTU
= 0.6 ton of coal

Table 3. Comparison of No-Incineration Option

	Fluidized-Bed Incineration (FBI) Option 2a	Green/Off-Site Option
Total Solids	165,000 TPY	165,000 TPY
Solids Processed	106,000 TPY	106,000 TPY
Firm Cap	300 TPD	300 TPD
Capital	\$263 million	\$100 million (estimated)
O&M	\$7.5 million/yr	TBD—Assume \$6 million/yr
Annualized Capital Cost	\$18.7 million/yr	\$7.2 million/yr
Fuel Value Coal	NA	\$6 million/yr
Green Electric Credit (REC)	NA	\$1 million/yr
Total Cost	\$26.2 million/yr	\$7 million/yr (assume \$10 million/yr)
Cost Per Ton	\$260/ton	\$100/ton
Secondary Disposal (Land Fill/Land Application)	59,000 TPY	59,000 TPY
Total Cost	\$14.6 million/yr	\$14.6 million/yr
Cost Per Ton	\$240/ton	\$240/ton
Carbon Foot Print	MTeCO ₂ /yr	MTeCO ₂ /yr
Combustion	173,000	10,000
Landfill	70,000	70,000
Total	243,000 MTeCO ₂ /yr	80,000 MTeCO ₂ /yr credit
Manpower	60	10
Space	Base	Less
NPV—savings 20 years	Base	\$200 million



CONCLUSION

The Panel concludes this Report with four End State recommendations as a roadmap to compliance and beyond:

1. **Achieve an effective, consensus-based City Integrated Enterprise Agency (CIEA).**
2. **Achieve a sustainable green operation by implementing the Off-Site “No Biosolids Incineration” Option.**
3. **Rationalize capital planning for the “NEW” and “NEXT,” with a consensus-based implementation forum.**
4. **Develop a roadmap for zero emissions and the elimination of landfill biosolids.**

We wish to thank DWSD, WWTP and the City of Detroit for this opportunity and extend a special note of appreciation to all of the fine representatives who worked with the Panel in preparing this Report.



APPENDIX A:

ESD INSTITUTE PANEL AND STAFF BIOGRAPHICAL INFORMATION

DENNIS D. COX, PE, has over 40 years in engineering and planning of environmental protection projects that involve 25 municipal and industrial wastewater and potable water plants in the U.S. and Mexico. He is currently the Vice President of JA Lombardo and Associates, Inc.

THOMAS M. DORAN, PE, Director of ESD and Vice President of Hubbell, Roth & Clark, Inc., has been practicing civil/environmental engineering for over 33 years. He has been a Principal with two of the most prominent civil engineering firms in Michigan, an adjunct professor at the University of Detroit, and earned the Purdue Alumni Achievement Award in 2008.

F. MICHAEL FAUBERT, PHD, PE, FESD, upon retirement from the electric utility industry, began serving as an independent consultant focusing on novel and advanced energy conversion systems.

KAMESH GUPTA, PE, CEM, is recently retired from GM after 36 years of service. His most recent assignment was Manager of Strategic Planning and Programs in GM's Energy & Utility Services Group, a business unit of GM responsible for Global energy business. He has led GM in solar technology with two 1 MW projects in California and a 12 MW system in Europe, which is the world's largest rooftop PV system. Before GM, Mr. Gupta worked at DWSD as an Associate Engineer for four years. Currently, he is working as an independent consultant with expertise in energy efficiency, renewable solar systems and water treatment.

DARCY HOLLON, MS, has 16 years of environmental consulting experience. Her responsibilities included information investigations, field remediation activities, data compilation and organization, and report and figure preparation.

JAMES G. MEENAHAN, PE, FESD, has over 49 years of experience in a wide variety of environmental and energy projects. He was responsible for the design and start-up of 28 wastewater treatment plants; feasibility analysis of 12 solid waste recycling and waste-to energy facilities; design and start-up of five utility complexes (steam, electricity, cogeneration, compressed air, chilled water); and preparation of infrastructure feasibility analyses. Currently, he serves as Chair of the ESD College of Fellows.

DAVID A. SKIVEN, PE, FESD, is the ESD Institute Co-Director. He has over 42 years of experience at General Motors Corporation. He was responsible for providing management in the facilities management, utilities, capital construction and environmental segments. He has a Bachelor of Science degree in mechanical engineering and a Masters of Science degree. He has been an advisor to the U.S. Navy, the U.S. Air Force and the General Services Administration. He is currently consulting in facilities-related fields. He is a member of the Board of Infrastructure and the Constructed Environment (a National Committee of the National Academy of Science) and a member of the Board of Directors of BioReaction, Inc., a pollution-control technology company.

CHRISTOPHER J. WEBB, JD, FESD, was Vice-President and General Counsel for the Jervis B. Webb Company, a global materials handling engineering, manufacturing and construction firm for over 25 years. He currently serves as a Co-Director of The Engineering Society of Detroit Institute (www.esdinstitute.net) and is a mediator and arbitrator with the American Arbitration Association and a member of the Panel of Neutrals of the International Institute of Conflict Prevention and Resolution.



APPENDIX B: LEADERSHIP OF THE ENGINEERING SOCIETY OF DETROIT AND THE ESD INSTITUTE

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