ORANGE COUNTY SANITATION DISTRICT
BIOSOLIDS MASTER PLAN

EXECUTIVE SUMMARY

OCSD PROJECT NO. PS15-01

Orange County Sanitation District

9 MAY 2017

In association with
EXECUTIVE SUMMARY
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Acronym and Abbreviations List

The following acronyms and abbreviations are used in this document.

- °: degrees
- %: percent
- 503 Rule: 40 CFR Part 503, USEPA Standards for the Use and Disposal of Sewage Sludge
- AB: Assembly Bill
- ADC: alternative daily cover
- ADP: Aquacritox Demonstration Project
- AZ: Arizona
- BAB2E: Bay Area Biosolids to Energy
- BFPs: belt filter presses
- BMP: Biosolids Master Plan
- BV/BC: Black & Veatch Corporation/Brown and Caldwell
- CA: California
- CARB: California Air Resources Board
- CASA: California Association of Sanitation Agencies
- CDFA: California Department of Food and Agriculture
- CDP: Criterium Decision Plus
- CENG: Central Energy Generation
- CEPT: chemically-enhanced primary treatment
- CEQA: California Environmental Quality Act
- CFDA: California Department of Food and Agriculture
- CFR: Code of Federal Regulations
- CIP: Capital Improvements Program
- CMAD: conventional mesophilic anaerobic digestion
- CO2: carbon dioxide
- consultant team: BV/BC team
- CUP: Conditional Use Permit
- DAF: dissolved air flotation
- DAFT: dissolved air flotation thickening
- DFF: digester feed facility
- District: Orange County Sanitation District
- DT: dry ton(s)
- EBMUD: East Bay Municipal Utility District
- EIR: Environmental Impact Report
- EMS: environmental management system
- EQ: exceptional quality
- F: Fahrenheit
- FBO: fluidized bed incinerator
- FMP: 2009 OCSD Facilities Master Plan
- FOG: fats, oil, and grease
- GHG: greenhouse gas
- GWRS: Groundwater Replenishment System
- HSW: high-strength organic waste
Executive Summary

OVERVIEW

The Orange County Sanitation District (District, OCSD) is implementing Project No. PS15-01, Biosolids Master Plan (BMP). The purpose of the project is to develop a BMP that provides a roadmap and framework for sustainable and cost-effective biosolids management options over a 20-year planning period. The options must comprise facilities improvements that align with the appropriate biosolids product(s), market(s), and level of treatment. OCSD authorized Black & Veatch in association with Brown and Caldwell (BV/BC, consultant team) to develop the BMP. The charge to the consultant team was to evaluate existing OCSD solids handling facilities, assess solids treatment alternatives, and make recommendations for future capital facilities improvements. Tasks also included identifying offsite biosolids management alternatives for OCSD to generate biosolids products that meet a sustainable biosolids beneficial reuse market, conducting a high strength waste co-digestion evaluation, developing a public outreach program to facilitate public involvement, and preparing an Environmental Impact Report (EIR) and supporting documents for the construction projects recommended by the BMP in order to comply with the California Environmental Quality Act (CEQA). This Biosolids Master Plan Report is comprised of the nine Technical Memoranda (TMs) listed in Table ES-1. Figure ES-1 also highlights the key areas of BMP development, as described in this Executive Summary.

Table ES-1. Summary of Biosolids Master Plan Documents

<table>
<thead>
<tr>
<th>SUMMARY OF BIOSOLIDS MASTER PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Collection and Review</strong></td>
</tr>
<tr>
<td>□ TM-1 – OCSD Solids Facilities and Design Basis</td>
</tr>
<tr>
<td>□ TM-2 – Review of OCSD’s Biosolids Program and Summarize the Current State, Trends, and Outlook for Biosolids Management</td>
</tr>
<tr>
<td><strong>Technologies Assessment and Alternatives Development and Evaluation</strong></td>
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<tr>
<td>□ TM-3 – Offsite Biosolids Management Alternatives Evaluation</td>
</tr>
<tr>
<td>□ TM-4 – Sludge Digestion and Post Dewatering Technologies Evaluation</td>
</tr>
<tr>
<td>□ TM-5 – High Strength and Organic Waste Co-digestion Evaluation</td>
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<tr>
<td><strong>Capital Improvement Program (CIP) Project Development</strong></td>
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<tr>
<td>□ TM-6 – CIP Project Development for Plant No. 2 Solids Handling Facilities</td>
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<td>□ TM-7 – CIP Project Development for Plant No. 1 Solids Handling Facilities</td>
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<tr>
<td><strong>Biosolids Management Plan</strong></td>
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<tr>
<td>□ TM-8 – Biosolids Management Plan</td>
</tr>
<tr>
<td><strong>Innovative Technology Review</strong></td>
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<td>□ TM-9 – AquaCritox Report Review</td>
</tr>
</tbody>
</table>

Figure ES-1. Task Flow for BMP
INFORMATION COLLECTION AND REVIEW

OCSD's Reclamation Plant No. 1 (Plant No. 1) and Treatment Plant No. 2 (Plant No. 2) provide the facilities needed to treat wastewater from OCSD's service area. Figure ES-2 shows an aerial photo of the two plants. One of the first tasks of the consultant team was reviewing and verifying compiled information for existing solids handling and gas treatment facilities at Plant No. 1 and Plant No. 2, as well as current and future solids handling trends. A key source of information was planning documents developed by the District such as the 2009 Facilities Master Plan (FMP), the 2003 Long-Range Biosolids Master Plan (LRBMP), and the 2015-16 OCSD Solids Loading Projections White Paper (White Paper). The consultant team also reviewed studies related to the rehabilitation, repair, and replacement of solids handling and gas treatment facilities at Plant No. 1 and Plant No. 2 and visited both of these facilities to review the facilities' functions and design parameters and to talk with operations staff about current and anticipated performance.

In addition to reviewing OCSD operations, the consultant team reviewed biosolids management programs for selected agencies in Northern and Southern California. Programs in the Pacific Northwest (including Canada), Arizona, and Nevada were reviewed as well.

OCSD Solids Facilities

Wastewater solids at both Plant No. 1 and Plant No. 2 are separated from the liquid stream by various unit processes and are thickened prior to further treatment. The sludge is then stabilized through a digestion process to create a product referred to as biosolids. Following digestion, the biosolids are dewatered and transported to management sites. OCSD currently maximizes beneficial reuse of all the biosolids produced in the treatment process. The current daily digested and dewatered biosolids production is around 780 wet tons per day (wtpd). Biosolids management options include composting, land application, and landfilling.

Plant No. 1. Plant No. 1 is located in the City of Fountain Valley, California. The plant receives flow primarily from the eastern and inland parts of the service area, which consist of residential, commercial, and industrial users. In 2015, the average Plant No. 1 influent flow rate was 103 million gallons per day (mgd). The processes at Plant No. 1 include preliminary, chemically-enhanced primary treatment (CEPT), and secondary treatment (activated sludge and trickling filters) as well as biosolids treatment and digester gas recovery. A portion of the normal flow tributary to Plant No. 2 can be diverted to Plant No. 1 using the Steve Anderson Lift Station (SALS) located at Plant No. 1.

Plant No. 2. Plant No. 2 is located in the City of Huntington Beach. The plant receives flow primarily from the western and coastal parts of the service area, which consist of residential, commercial, and industrial users. In 2015, the average Plant No. 2 influent flow rate was 85 mgd. The processes at Plant No. 2 include preliminary, CEPT, and secondary treatment (high purity oxygen waste-activated sludge and trickling filters/ solids contact) as well as biosolids treatment and gas recovery.

Similar solids processing operations are in place at both plants (see Figure ES-3), using the following solids handling and processing approach:

- Primary sludge is collected from primary sedimentation/clarifier basins and pumped to the digesters. At Plant No. 1, thickening centrifuges are currently under construction to further thicken the primary sludge.
- Waste activated sludge (WAS) from the secondary clarifiers is currently thickened in dissolved air flotation (DAF) thickeners. At Plant No. 1, WAS thickening centrifuges are under construction to replace the DAF thickeners. The thickened WAS is pumped to the digesters.

- Each plant digests combined primary sludge and WAS using mesophilic digestion. The digesters at both plants meet U. S. Environmental Protection Agency (USEPA) requirements for Class B land application of biosolids, which include a minimum 15-day detention time, temperature of 95 degrees Fahrenheit (°F), and 38 percent volatile solids reduction.

- Digester gas is collected at each plant in a storage tank, compressed, and discharged into a high-pressure gas line, which connects the two plants. The digester gas is used as fuel in the Central Generation Systems (CENGEN) facilities and heating boilers at both plants; any excess gas is flared. The CENGEN facilities produce electricity that is used in the two plants. After digestion, the stabilized liquid biosolids are transferred to digesters used as holding tanks.

- From the holding tanks, the biosolids are currently pumped to belt filter presses (BFPs) for dewatering. At both plants, dewatering centrifuges are under construction to replace the BFPs.

- Dewatered biosolids cake is transferred to holding bins using a combination of conveyors and cake pumps at Plant No. 1 and cake pumps at Plant No. 2.

- Biosolids cake is transferred to truck loading hoppers prior to truck pickup.

- OCSD prepared a White Paper in 2016 to project solids loading from the raw sewage influent to the OCSD Plants, establish methods to project the solids loadings to the major treatment processes, and set the loading criteria for future solids handling facilities that were recommended by the BMP. This document was jointly reviewed and confirmed by OCSD and the consultant team. The White Paper and solids mass balance diagrams ensure that a consistent process design approach will be taken to multiple OCSD projects over time.
OCSD Biosolids Program

OCSD began recycling of biosolids for beneficial use in 1971. Since that time, the District’s biosolids program has focused on continual improvement and has evolved to incorporate a mix of flexible options. Goals are to implement sustainable, cost-effective long-term options for beneficial use through the diversification of biosolids products, contractors, and markets and use of an environmental management system (EMS). Maintaining compliance with continually evolving state and federal requirements is another objective of OCSD’s program. The history of biosolids production at OCSD is given in Figure ES-4. Key features of the existing biosolids management program are as follows, the latter three having been developed from OCSD’s LRBMP:

- **Regulations, Policies, Guidelines, and Drivers.** USEPA’s Standards for the Use and Disposal of Sewage Sludge (503 rule) regulates the use of biosolids in land application, land disposal, and landfill disposal is the key regulation governing OCSD’s biosolids program.

  Another important driver is OCSD Board Resolution 13-03, which defines the District’s commitment to implementing a sustainable biosolids management program. Since its inception, OCSD’s biosolids management program has been in full compliance with the 503 rule requirements.

- **Diverse Biosolids Management Portfolio.** OCSD’s biosolids management practices have historically included Class B Land Application at Tule Ranch’s Yuma, Arizona, facility; composting through Synagro’ composting facilities in Kern County, California (SKCMF) and La Paz County, Arizona; composting through a cooperative agreement with Inland Empire Utilities Agency (IEUA) and the County Sanitation Districts of Los Angeles County (LACSD);
composting at Nursery Products’ Helendale facility; composting at Liberty Composting in Lost Hills and landfill through an agreement with Orange County Waste and Recycling (OCWR). The current Contractor facility allocations are shown in Figure ES-5.

- **Pursuit of Innovative Options.** OCSD is pursuing other developments to improve its program, such as exploring potential agreements with OCWR and Irvine Ranch Water District (IRWD), as well as conducting a feasibility study of AquaCritox, a potentially promising new technology. An evaluation of an AquaCritox Report by a vendor recommending a demonstration facility at OCSD is given in TM-9 AquaCritox Report Review.

- **Biosolids Management Cost/Benefits.** OCSD balances costs with environmental and societal considerations. OCSD maximizes the use of low-cost options such as land application and balances these financial considerations with those of using its biosolids locally, reducing hauling distances and increasing program diversity.

Figure ES-4. Annual Biosolids Production History from January 1992–December 2015
Other Relevant Programs

The consultant team reviewed the biosolids management programs of agencies of similar size in both Southern and Northern California. The team also evaluated programs in Washington, Oregon, Nevada, and Arizona, as well as British Columbia, because it encompasses a large area of the Pacific Northwest region and is comprised of some agencies that have operated successful biosolids reuse programs for more than 20 years. Table ES-2 summarizes programs for other California agencies, and Figure ES-6 presents a statewide comparison of biosolids management options and OCSD’s end programs. In general, OCSD relies more on land application and composting and less on landfilling than typical California agencies.
Table ES-2. Summary of Biosolids Programs of Selected California Agencies

<table>
<thead>
<tr>
<th>LOCATION/AGENCIES REVIEWED</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southern California</strong></td>
<td></td>
</tr>
<tr>
<td>• City of Los Angeles (City of L.A.)</td>
<td>• Outlets and Technologies/Product Types. Agencies produce a wide range of biosolids that are used in agriculture, landfill daily cover, horticulture and as fertilizer.</td>
</tr>
<tr>
<td>• Sanitation Districts of Los Angeles County (LACSD)</td>
<td></td>
</tr>
<tr>
<td>• City of San Diego</td>
<td>• Composting. Many utilities generate Class B biosolids of which all or a portion are then further processed in regional compost facilities. The composting infrastructure in Southern California is extensive and can accommodate the majority of the biosolids produced within the region.</td>
</tr>
<tr>
<td>• Medium-Sized Agencies (City of Riverside, Inland Empire Utilities Association, City of San Bernardino Municipal Water District, and Eastern Municipal Water District)</td>
<td>• Hauling Distances. Hauling distances range from 23 miles to 290 miles with land application averaging the farthest average hauling distances.</td>
</tr>
<tr>
<td><strong>Northern California</strong></td>
<td>• Unique Developments and Features. Many activities are underway as agencies seek to improve biosolids management programs and new companies seek to provide better biosolids management options.</td>
</tr>
<tr>
<td>• East Bay Municipal Utility District (EBMUD)</td>
<td></td>
</tr>
<tr>
<td>• San Francisco Public Utilities Commission (SFPUC)</td>
<td>• Outlets and Technologies/Product Types. The area is dominated by the production of Class B dewatered biosolids generated from anaerobic digestion. There is only one generator of dried granules and two compost facilities, one of which is utility owned and operated.</td>
</tr>
<tr>
<td>• San Jose-Santa Clara Regional Wastewater Facility (WRF)</td>
<td>• Hauling Distances. Most agencies haul biosolids within a 50-80 mile radius.</td>
</tr>
<tr>
<td>• Sacramento Regional Wastewater Treatment Plant (SRWTP)</td>
<td>• Unique Developments and Features. SFPUC is poised to become the first California installation of the thermal hydrolysis process (THP). In addition, a 19-agency coalition is working towards advancing biosolids to energy solutions within the San Francisco Bay Area.</td>
</tr>
<tr>
<td>• Fresno-Clovis Wastewater Reclamation Facility</td>
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</tbody>
</table>

Figure ES-6. 2015 Statewide Overview of Biosolids Management Options Compared to OCSD’s
Biosolids Management Trends and Future Outlook

As part of the evaluation of California’s program, several issues were identified that could impact biosolids management. Each of these issues was evaluated against regulatory, environmental, social, and financial criteria. The current condition, trend, and outlook for OCSD were described, and the overall impact was rated as positive, negative, or neutral. The evaluation results are summarized below:

- **County Biosolids Ordinances.** POSITIVE trend. More land application opportunities, closer biosolids recycling sites, and shorter truck hauls and lower transportation costs.

- **Arizona Regulations.** POSITIVE trend. Reliable water supplies and favorable regulations, where about 50 percent of OCSD’s biosolids are recycled.

- **Air Regulations for Composting (California Air Resources Board [CARB] and local air boards).** NEGATIVE trend in Southern California, which currently has some of the most stringent air quality regulations in the country and requires a more complicated environmental permitting process. Higher prices for facilities built closer to OCSD. POSITIVE trend in Mohave Air District and Arizona, which provides better opportunities.

- **Health Soils Initiative (California Department of Food and Agriculture [CDFA]).** POSITIVE trend in that new initiatives provide opportunities for environmental stewardship.

- **Landfilling (CARB).** NEUTRAL because California landfills will not be a future option but more opportunities for organics recycling are emerging.

- **Organics Recycling (Cal Recycle).** NEGATIVE impact on biosolids compost facilities/offsite market, but POSITIVE trend on biogas – onsite treatment plant options.

- **Cap and Trade Program.** POSITIVE trend due to the potential increased demand for biosolids compost and Class A products for land reclamation projects in California. Additional funding possible for codigestion and other organics recycling projects.
TECHNOLOGIES ASSESSMENT AND ALTERNATIVES DEVELOPMENT AND EVALUATION

This portion of BMP development included Offsite Biosolids Management Alternatives, Plant No. 2 Digestion and Post-Dewatering Alternatives, and High Strength Organic Waste Co-Digestion Evaluations. Throughout the process, OCSD staff and the consultant team worked closely together to assure conformance with OCSD objectives, policies and goals.

Offsite Biosolids Management Alternatives Evaluation Overall Approach

Planning efforts under the BMP began with the biosolids end use in mind to research potential markets for any product generated, whether on or offsite. Early in the process, the consultant team recommended extending the evaluation to biosolids products in addition to end use markets. In doing so, onsite management alternatives, such as thermal drying, were included in the analysis. Products and markets were screened using evaluation criteria tailored to OCSD’s goals. The screened products and markets were later paired with onsite processing technologies. The process is illustrated in Figure ES-7. The consultant team identified a full range of potential products that may be offered to the marketplace and prepared physical samples of those products for meetings with end users. This included both Class A and Class B biosolids quality and the full range of products for onsite digestion and post-dewatering technologies that were evaluated later in the study.

Figure ES-7. Market-based Approach for Evaluation of Biosolids End-use Alternatives
Surveys and Site Visits

Market research on the regional horticultural (i.e., lawn/garden), agricultural, and fertilizer industries was completed to better define available markets for the potential biosolids products and—therefore—processing options, as well as determine the products’ value and marketability (see Figure ES-8). Demographic data indicate that significant regional capacity exists within these markets. A review of emerging markets for environmentally beneficial applications (e.g., dewatered cake for land reclamation, compost for erosion control, etc.) was also conducted, although these markets are considered to be less developed with respect to biosolids products. Market surveying was initially completed via telephone by staff experienced in data collection and/or biosolids product sales. Then, a series of face-to-face meetings occurred. Generally speaking, it was determined that experience with biosolids products in the agricultural and horticultural markets is strong in the region, which encompasses Southern California and the westernmost part of Arizona. Agriculture can absorb large volumes of fertilizer-type products, whether thermally dried biosolids or compost. Use of biosolids in agriculture is expected to continue. Interest in use of biosolids for land reclamation can further expand available acreage. Marketing and outreach by either OCSD or its contractors will help support regional use of biosolids products.

Selected Alternatives

Alternatives were considered both for end use markets and product markets. Two sets of evaluation criteria were developed—one market-based set for evaluation of the product/market pairs and a second set for evaluation of the products and associated processing technologies.

End-use markets were scored in accordance with the following criteria developed by the consultant team:

- **Realistic, proven market**: The market for a given biosolids product is well established and understood within the region.

- **Market size**: The market has capacity to absorb biosolids volumes on the scale of OCSD’s production.

- **Proven value**: The alternatives have a cost associated with managing a given biosolids product and a varying end use willingness to pay for the biosolids product and transportation.

- **Future market capacity**: The market is predicted to be stable or expanding over the life of the project.

- **Resiliency to regulatory change**: The market is expected to provide flexibility for beneficial reuse over the life of the project, based on current regulatory trends in the region.

- **Year-round dependability**: The market provides a reliable, year-round outlet for OCSD’s biosolids.
OCSD staff and the consultant team jointly developed the following triple-bottom-line criteria to help assess potential biosolids products:

- **Minimize life-cycle management costs:** This criterion represented a metric of OCSD’s life-cycle biosolids management costs including factors such as hauling cost, cost to process/ manufacture, marketing fees, and revenues, where applicable.

- **Provide broad marketability:** This criterion addressed the market versatility associated with a given product. A product with access to multiple markets helps support a number of OCSD’s programmatic goals, including diversification.

- **Provide proven, safe, and reliable technology:** OCSD must implement biosolids-processing technologies that are dependable. Some newer processes employ features such as high pressure, high temperature, or chemicals that may be of concern with respect to worker safety and process reliability. The reliability of some biosolids-processing technologies is well-established by decades of experience, while others have been executed only at a pilot or demonstration scale.

- **Support OCSD’s biosolids management goals, policy, and operations:** The product should support OCSD’s goals and policies including resource recovery (which in itself includes beneficial use of biosolids), application of biosolids in-region, and balanced triple-bottom-line concerns.

- **Provide regulatory resilience:** Drawing from the findings of TM-2, this criterion assesses whether the generation or use of the product will trigger significant regulatory requirements.

- **Minimize net carbon footprint:** This criterion represented a qualitative metric of the life-cycle greenhouse gas (GHG) impacts resulting from the product generation and end use.

- **Minimize impacts from negative sidestreams and emissions:** The generation of wastewater sidestreams or emissions that are difficult to treat can create a host of issues including increased regulatory oversight, operational restrictions, and public opposition.

- **Enhance community relationships:** Generation of the product and its end use minimizes nuisance impacts such as dust, odors, vectors, aesthetics, noise, and traffic. Consideration was given for features that are typically mitigated (e.g., features associated with typical locations/installations).

The consultant team evaluated the product/market pairs based on the market research conducted. Then, OCSD staff collaborated with the consultant team on an evaluation of the products and their associated processes. Products and markets were assigned a score for each criterion from 1.0 to 5.0. Products receiving a score below 3.0 were eliminated from further consideration. Products receiving a score of 3.0 or higher were paired with their most promising markets (i.e., those receiving a score of 3.5 or higher). It should be noted that other markets could be developed with appropriate marketing, education, and outreach; however, for the purposes of further analysis, only the most likely markets were selected. The resulting scores were presented and refined in a workshop held on May 17, 2016, at OCSD’s Plant 1. The highest scoring product/market pairs selected for further evaluation are presented in Table ES-3. It should be noted that all of the
available markets for the selected on site processing alternative were revisited in Task 8; thus, some of the end use markets discussed later in this report may not appear in Table ES-3.

Table ES-3. Final Selected Products and Best Ranked Markets

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>SOIL BLENDING</th>
<th>BULK AGRICULTURE, CALIFORNIA</th>
<th>BULK AGRICULTURE, ARIZONA</th>
<th>BULK HORTICULTURE, LANDSCAPING</th>
<th>DISTRIBUTION OF BASED PRODUCT</th>
<th>GOLF COURSE AND OTHER SPECIALTY</th>
<th>LAND RECLAMATION</th>
<th>FERTILIZER BLENDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A Compost</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Class B Cake</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Class A Cake</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Class A THP Soil Blend</td>
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<td></td>
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<tr>
<td>Class A THP Cake</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Class A Soil Blend</td>
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<tr>
<td>Class A High Quality Granule</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Class B Partially Dried Cake</td>
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<td></td>
<td></td>
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<tr>
<td>Class A Partially Dried Cake</td>
<td>✓</td>
<td>✓</td>
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<td></td>
</tr>
<tr>
<td>Class A THP Partially Dried Product</td>
<td>✓</td>
<td>✓</td>
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Note: THP = thermal hydrolysis process
Plant No. 2 Digestion and Post-Dewatering Alternative Evaluation

The OCSD BMP encompasses both Plant No. 1 and Plant No. 2. However, due to structural integrity issues with existing anaerobic digesters at Plant No. 2, there is a need to replace these structures over time. Since Plant No. 1 anaerobic digesters do not have structural integrity issues that require replacement, no new digestion alternatives were evaluated at that plant, and the digestion and post-dewatering alternatives evaluation focused on identifying the new preferred digestion and/or post-dewatering facilities to be recommended for Plant No. 2.

Structured Decision-Making Process. The most viable product and market pairings established in the technologies assessment were coupled with preferred onsite treatment technologies for the creation of “end-to-end alternatives.” The methodology for evaluation of future alternatives included both cost and non-cost comparison. Initially, the alternative were screened to select the most feasible technology for OCSD given a number of related criteria. The remaining alternatives were then evaluated on a life-cycle cost basis Solids-Water-Energy-Evaluation Tool (SWEET Tool), and the most cost effective alternatives were further evaluated followed by a triple-bottom-line analysis of a smaller subset of non-cost alternatives Criterium Decision Plus (CDP Tool). The outcome of this multi-step methodology was to select the best end to end alternative for OCSD Plant No. 2, meeting both technical considerations and non-cost criteria. This process is depicted in Figure ES-9.

![Structured Decision Making Process Diagram](image)

Figure ES-9. Structured Decision Making Process
Identification of Onsite Processing Technologies. Constructing alternatives for onsite processing technologies began with identifying the general processing options capable of producing biosolids products recommended in the technologies assessment evaluation. Table ES-4 lists the technologies that were presented in a May 24, 2016, workshop held with OCSD. These were used as the starting point for identifying specific technologies that could be implemented at Plant No. 2.

Table ES-4. Processes to Produce End-use Product Alternatives

<table>
<thead>
<tr>
<th>TASK 3 PRODUCT ALTERNATIVES</th>
<th>TASK 4 PROCESS TECHNOLOGY OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A Compost (current product)</td>
<td>Class A or B digestion + composting</td>
</tr>
<tr>
<td>Class B Cake (current product)</td>
<td>Class B digestion</td>
</tr>
<tr>
<td>Class A Cake</td>
<td>Class A digestion</td>
</tr>
<tr>
<td>Class A THP Soil Blend</td>
<td>THP/digestion + soil blending</td>
</tr>
<tr>
<td>Class A THP Cake</td>
<td>THP/digestion</td>
</tr>
<tr>
<td>Class A Soil Blend</td>
<td>Class A digestion + soil blending</td>
</tr>
<tr>
<td>Class A Dried Granule</td>
<td>Class A or B digestion + drying</td>
</tr>
<tr>
<td>Partially Dried Class B Cake</td>
<td>Class B digestion + partial drying</td>
</tr>
<tr>
<td>Partially Dried Class A Cake</td>
<td>Class A digestion + partial drying</td>
</tr>
<tr>
<td>Partially Dried Class A THP Cake</td>
<td>THP/digestion + partial drying</td>
</tr>
</tbody>
</table>

Initial Screening of Technologies. A list of eight preliminary screening criteria was developed and presented during the May 2016 Workshop. The criteria were: end use market compatibility, proven technology performance, minimization of life cycle costs, energy/resource recovery, operations and maintenance (O&M) impacts, environmental impacts, community impacts, and project site compatibility. The following technologies were selected for further evaluation:

- **Thickening technologies:**
  - Primary clarifier thickening (for primary sludge only)
  - DAF thickening (for secondary sludge only)
  - Centrifuge thickening (combined sludge)

- **Digestion technologies:**
  - Class B Conventional mesophilic anaerobic digestion (CMAD)
  - Class B Staged MAD (SMAD)
  - Class A or B thermophilic anaerobic digestion (TAD)
• Class A or B temperature phased anaerobic digestion (TPAD)
• Class A THP

**Post-dewatering technologies:**

- Thermal drying – Rotary drum drying with high quality Class A granules
- Partial drying – Paddle or belt dryer with cake blending to yield partially dried Class A or B product

These technologies were then combined into complete end-to-end alternatives for concept design development in order to define capital and operating costs, feasibility to fit on the plant site, process flow configuration, equipment, and mass balance information. The developed alternatives were then paired with their appropriate products and markets, as determined under the technologies assessment task. These end-to-end alternatives were then evaluated on a net present value (NPV) basis using both capital and operational costs using a model of Plant No. 2.

The majority of the NPV results from the alternatives considered in this study were similar. In order to better assess the results, the NPV from various end-to-end alternatives was isolated to determine the impact of changes to thickening and use of drying following dewatering. Based on that analysis, it was concluded that centrifuge thickening does not provide any significantly economic payback relative to continued operation of the existing DAF thickeners (DAFT). In addition, alternatives with centrifuge thickening represent a higher initial capital project and would require abandoning the existing, newly retrofitted DAFTs.

**CDP Evaluation.** Several drying alternatives were identified as having higher NPV relative to other alternatives. However, they were carried forward for a triple-bottom-line evaluation using CDP due to the unique market opportunities associated with the high quality product. The alternatives carried forward are shown in Figure ES-10. The CDP tool for this project used a suite of evaluation criteria which were scored in a workshop on October 4, 2016 with OCSD. The evaluation criteria used also are shown in Figure ES-10.
Figure ES-10. CDP Model Scoring Breakdown

As depicted on the figure, mesophilic digestion, TAD, and TPAD included high scores related to operability, maintainability, and reliability and safety. Class A technologies, especially thermal drying, provided high scores related to end use market diversity and resiliency. When considering non-cost scoring, mesophilic digestion, TAD, and TPAD are very similar. However, the scoring for thermal drying alternatives was considered significantly lower than the other alternatives. Based on the CDP evaluation, it was decided that the thermal drying alternatives, both partial drying and thermal drying, would be removed from further consideration. The CDP results were not sufficiently different for the remaining alternatives to enable recommendation of a preferred process selection. Thus, a tie breaker category of criteria specific to Plant No. 2 was developed to compare the technology to facilitate a decision on a preferred digestion technology. Criteria included: seismic risk mitigation, diversity for the biosolids program, maximized use of existing infrastructure, minimized odor impacts to neighbors and end use sites and low initial capital cost.

Based on this comparison, TPAD provided a clear advantage relative to the other alternatives and was selected for implementation; however, the digestion process may be designed to accommodate operation in either mesophilic or TPAD mode, with the understanding that these processes generate different biosolids quality. The TPAD digestion process would include six new thermophilic digesters and batch tanks for the production of Class A biosolids. This approach provides the greatest degree of reliability and flexibility. Should process drivers change in the future, the six new digesters could be easily retrofitted to adopt other process technologies.
High Strength Organic Waste Co-Digestion Evaluation

The high strength organic waste co-digestion evaluated assessed the feasibility and economic justification for food waste co-digestion at one or both of OCSD’s plants. TPAD was assumed as the co-digestion process. Regulations and other market drivers were reviewed, and sources and characteristics for food waste were identified. Early in the evaluation, it was determined that Plant No. 1 does not have excess digestion capacity for co-digestion, and the focus turned to Plant No. 2.

A Significant Opportunity. A significant change in the regulatory landscape in California has occurred around the diversion of organics from landfills. Currently, much of the state’s diverted organics are being composted or used as alternative daily cover (ADC) on landfills. With the phase-out of organics as ADC, the regulatory shift around organics should generally benefit the wastewater sector by making organic feedstocks available for co-digestion, as well as generating funding opportunities for wastewater treatment plants (WWTPs) through cap and trade and other programs. Existing WWTPs are uniquely positioned to play a role in the new organics marketplace. Many WWTPs are already using available digestion and energy capacity for co-digestion of fats, oil and grease (FOG) and liquid high strength organic waste (HSW) from industry. Tipping fees for waste acceptance and increased digester gas production for energy generation make co-digestion economically viable and potentially attractive. Acceptance of organics diverted from landfill would follow the same model, but perhaps with improved economies of scale due to the large and steady demand created by the landfill/organics regulations. For the purposes of the BMP evaluation, high strength organic waste received at OCSD’s plants was assumed to largely comprise pre-processed commercial and/or residential source separated organics (SSO).

Capacity and Constraints. Available capacity to receive pre-processed SSO at Plant No. 1 and/or Plant No. 2 was examined. An important factor was to ensure that the receipt of pre-processed SSO would not compromise the ability of the digestion system to achieve pathogen reduction or any other metrics of quality for beneficial use of biosolids. In addition, the system should not generate more biogas than what the onsite combined heat and power system can manage. As mentioned above, the capacity analysis for Plant No. 1 indicated that a co-digestion program is not feasible there. At Plant No. 2, however, firm capacity exists today to accommodate pre-processed SSO. Thus, OCSD could opt to build a temporary SSO receiving station immediately and then construct a more permanent facility in the future, in conjunction with the larger digester project.

Potential Teaming Partners. As shown in Figure ES-11, several large municipal solid waste haulers within Orange County have the ability to provide SSO to OCSD. OCSD has met with these haulers to discuss potential partnerships. Republic Services and Waste Management, two of the largest entities, have expressed a willingness to partner with OCSD. Another important partner is OCWR. Although OCWR does not directly collect or haul waste, it does serve as the intermediary between the waste haulers and the county-owned landfills. In addition, OCWR is in the process of exploring the development of a compost site within Orange County.
**Economic Analysis.** The consultant team took a preliminary look at the feasibility of constructing both an interim (temporary) and ultimate (permanent) receiving station for pre-processed SSO. Based on the analysis and after discussions with OCSD staff, the consultant team recommended an interim SSO receiving facility capacity of 250 wtpd and an ultimate SSO receiving facility capacity of 500 wtpd. The interim facility will allow OCSD to enter the food waste market quickly to meet the urgent needs of waste hauler that is driven by pending regulatory requirement over the next few years. The ultimate facility will be fully integrated with the planned new digester facilities.

While co-digestion projects carry the benefit of additional gas production, this is an ancillary benefit that is offset by generator O&M costs. Typically, such projects are justified through the inclusion of tipping fees which help to recover, in part or in whole, the project costs. The consultant team examined a simple, preliminary tipping fee structure for OCSD based on the amount of food waste imported and the estimated capital and O&M costs for receiving facilities. The results of the analysis are presented in Figures ES-10 and ES-11, respectively. The figures highlight the estimated tipping fees versus food waste received in wet tons to obtain a payback period of 5, 10, and 20 years. Table ES-5 summarizes the tipping fees to achieve the same payback periods. For the Interim Food Waste Facility a tipping fee of approximately $40 per wet ton is projected to result in a five year payback for OCSD at 150 wet tons per day. For the Ultimate Food Waste Facility the projected tipping fee to achieve a five year payback is approximately $38 per wet ton at $300 wet tons per day. These tipping fees are within current industry values. Implementing food waste receiving has many environmental benefits and is cost effective.
Figure ES-12. Interim Pre-processed SSO Receiving Facility Tipping Fee Summary

Figure ES-13. Permanent Pre-processed SSO Tipping Fee and Resultant Return on Investment Summary
Table ES-5. Tipping Fee Required for Given Payback Period

<table>
<thead>
<tr>
<th>PAYBACK PERIOD</th>
<th>INTERIM FACILITY</th>
<th>PERMANENT FACILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 wet tons</td>
<td>150 wet tons</td>
</tr>
<tr>
<td>5</td>
<td>$52</td>
<td>$41</td>
</tr>
<tr>
<td>10</td>
<td>$42</td>
<td>$35</td>
</tr>
<tr>
<td>20</td>
<td>$38</td>
<td>$31</td>
</tr>
</tbody>
</table>

A consultant team analysis indicated that there is substantial Plant No. 2 digester capacity to add pre-processed SSO for co-digestion upon completion of P1-101 and the end of primary sludge diversions to Plant No. 2 in 2018. An interim SSO receiving facility capacity of 250 wtpd was recommended through 2028 (equivalent to approximately eleven (11) trucks per day). Such a project would allow OCSD to build partnerships and gain familiarity with food waste receiving and the co-digestion process at an interim location on the plant site.

OCSD staff and the consultant examined the Plant No. 2 site for the purpose of identifying potential locations for the Interim Food Waste Receiving Facility. Four potential sites were identified and subsequently evaluated, and two of the sites were selected for further evaluation. A site adjacent to Digester S appears to offer greater space and a larger capacity for the interim facility and is recommended.

**Next Steps.** An expedited project delivery of an interim food waste receiving facility was recommended. This interim facility should target operational completion in January 2019 to coincide with a significant increase in state regulatory requirements. With the interim facility receiving approximately 150-250 wtpd of pre-processed SSO, it will greatly help in the organics from landfill diversion effort. This temporary facility would operate until the ultimate facility is operational (estimated to be 2028). The increase in pre-processed SSO to 300-500 wtpd for the permanent facility would significantly aid OCSD’s partners in meeting regulatory requirements.
CAPITAL IMPROVEMENT PROGRAM PROJECT DEVELOPMENT

Identification of CIP projects for Plant No. 1 and Plant No. 2 built on information collection and review and technologies assessment/alternatives development; and evaluation activities performed as part of BMP development.

Plant No. 2

The purpose of PS15-01 is to evaluate and select the future digestion process and associated new infrastructure to mitigate the seismic risk through a holistic, end-to-end evaluation approach. The data assessment and alternatives evaluations conducted for the BMP led to the selection of co-digestion projects to be included in the CIP.

Overall Approach. Initial tasks investigated the biosolids management opportunities and defined the financial and operational considerations related to different end use alternatives. Subsequent tasks involved evaluation, definition, and selection of the major solids handling processes for Plant No. 2 in combination with associated end use opportunities, as well as a separate assessment of the feasibility of co-digestion facilities at Plant No. 2. These facilities were developed into discrete projects for inclusion under the CIP.

CIP Facilities. Table ES-6 summarizes the projects to be constructed under the CIP. These projects are also depicted graphically on Figure ES-14 as a site plan.

- New Facilities. Seven new projects were identified as necessary to upgrade the Plant No. 2 solids handling facilities in alignment with OSD's goals and objectives: P2-501 through P2-504C.

- Other Projects Integral to Implementation of the Full Program. Three of these projects were previously identified by OCSD: P2-500 Interim Digester Repairs (formerly P2-91-1), rehabilitation of the sludge dewatering truck loadout, and J-124 Digester Gas Handling Facilities. In order to maintain the integrity of the existing solids handling facilities during planning, design, and construction of the solids handling facilities upgrades, OCSD has a routine maintenance program. To ensure that this program is funded to support activities associated with digester maintenance, including cleaning, at Plant No. 2, the consultant team identified this as P2-500 for capital planning purposes. Project X-032 is the project developed by OCSD Planning Staff to improve the condition of the sludge dewatering truck loadout to address aging equipment. J-124 was an existing project for OCSD, but will require a modification in scope following the selection of TPAD and food waste digestion.

- Projects Involving Digesters. The consultant team also identified three projects impacting existing digesters: P2-505, P2-507, and P2-508.

CIP Implementation Schedule. In order to ensure continued operation of all of OCSD’s major facilities, the consultant team provided information regarding logical construction sequencing of the projects associated with the Plant No. 2 CIP. Figure ES-15 presents the overall schedule, along with critical path items and sequencing of major construction.
# Table ES-6. CIP Development for New Digestion and Food Waste Facilities

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>DESCRIPTION</th>
<th>CONSTRUCTION COST ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2-500 Digester Repairs</td>
<td>Support for activities associated with digester maintenance</td>
<td>$32,700,000</td>
</tr>
<tr>
<td>P2-501 Perimeter Screening</td>
<td>A visual buffer to provide perimeter screening of new facilities from Brookhurst Street and Talbert March</td>
<td>$1,300,000</td>
</tr>
<tr>
<td>P2-502 Interim Food Waste Receiving Facility</td>
<td>An interim facility with up to 100 wtpd capacity to allow OCSD to assess food waste market and process impacts</td>
<td>$2,600,000</td>
</tr>
<tr>
<td>P2-503 Relocate and Demo Warehouse and Collections Parking Area</td>
<td>Facilities demolition to free up site for construction staging and laydown area for TPAD project (P2-504)</td>
<td>$5,200,000</td>
</tr>
<tr>
<td>J-124 Digester Gas Handling Facilities</td>
<td>New digester gas vents, compressors, dryer, treatment, and flare facilities</td>
<td>$23,500,000</td>
</tr>
<tr>
<td>X-032 Dewatered Sludge Storage and Truck Loading</td>
<td>Rehabilitation of the sludge cake silos and truck loading facility (capacity is adequate)</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>P2-504 TPAD Project</td>
<td>Construction of six 110-ft diameter digesters to operate in either mesophilic or thermophilic operation</td>
<td>$154,100,000</td>
</tr>
<tr>
<td>P2-504A Class A Batch Tanks</td>
<td>Addition of batch tanks to allow OCSD to produce Class A biosolids</td>
<td>$26,300,000</td>
</tr>
<tr>
<td>P2-504B Thickened Sludge Feed Facility (Digester Feed Facility DFF)</td>
<td>Replace existing SBF with new facility to allow blending of PS and TWAS for continuous feed to digester</td>
<td>$12,600,000</td>
</tr>
<tr>
<td>P2-504C Ferric Chloride Facility</td>
<td>Relocate existing facility to free up space allocated for other treatment processes</td>
<td>$1,400,000</td>
</tr>
<tr>
<td>P2-505 Replace Digesters P, Q, R, S</td>
<td>Replace four aging digesters in need of extensive modifications and ground improvements to mitigate seismic risks</td>
<td>$56,800,000</td>
</tr>
<tr>
<td>P2-506 Ultimate Food Waste Receiving Facility</td>
<td>Replace interim facility that can receive a greater capacity of pre-processed SSO</td>
<td>$5,900,000</td>
</tr>
<tr>
<td>P2-507 Replace Digesters I, J, K (Relocate Digester Holders)</td>
<td>Demolition of seven existing digesters and rebuilding three existing digester to function as either digesters or digested sludge holders</td>
<td>$39,300,000</td>
</tr>
<tr>
<td>P2-508 Digester Demolition</td>
<td>Demolish six existing digesters</td>
<td>$7,400,000</td>
</tr>
</tbody>
</table>

**TOTAL CIP = $371,600,000**

Note: Construction cost estimates are AACE Class 4 which may vary from shown (low = -30%, high = +50%). Estimate for J-124 is based on February 2015 dollars. Estimate for X-032 is based on February 2016 dollars. All other estimates are based on December 2016 dollars.
Figure ES-14. Site Layout
Figure ES-15. Plant No. 2 CIP Implementation Schedule
Plant No. 1
Based on evaluations conducted by the consultant team, no changes to the current digestion technology are recommended. Also, based on the current capacity of the digesters, no HSW receiving facilities are recommended. The consultant team did evaluate potential post-dewatering facilities at Plant No. 1.

Plant No. 1 Capacity Analysis. A major rehabilitation of digesters at Plant No. 1 was completed in 2016 under project P1-100. The project improved reliability and increased existing treatment capacity, but facilities at Plant No. 1 will be at or close to design loading rates after 2018. Thus, excess capacity will not be available for SSO alternatives. An evaluation of the existing cake storage capacity was also conducted. The consultant team concluded that there is sufficient storage capacity for operations, both now and throughout the planning period.

Plant No. 1 Post-Dewatering Facilities Evaluation. For purposes of the BMP, a post-dewatering facilities analysis was performed at Plant No. 1. The Plant No. 1 dryer system design criteria capital and operating costs were input into the SWEET model to determine the NPV for a thermal drying option and a no drying option. The results of the SWEET model output are shown in Figure ES-16.

![Figure ES-16. Plant No. 1 Drying NPV Cost Evaluation](image)
The SWEET evaluation of post-dewatering alternatives for Plant No. 1 was presented to OCSD at a workshop on December 20, 2016. As shown in the figure, the NVP for the Thermal Drying Option is approximately $14.2M higher than the NPV for the No Drying Option. While thermal drying has a lower O&M cost due to reduced hauling, the capital cost of the facilities increases the NPV above that of the No Drying Option. Although thermal drying would increase product diversity, there are several non-economic disadvantages associated with thermal drying such as increased maintenance, equipment complexity, and safety concerns, which make this option less desirable.

Finally, it is challenging to find sufficient site area in close proximity to the existing solids dewatering facilities, and the new building would eliminate valuable space for potential future facilities. Since there was not an economic incentive and there are several non-economic disadvantages, thermal drying was not recommended by the consultant team for Plant No. 1, and OCSD concurred with this recommendation.

**CIP Implementation Schedule.** Potential Plant No. 1 solids handling facilities evaluations were identified and developed in discussions with OCSD staff. These are listed in Table ES-7. It is recommended that the evaluations be performed to determine if future Plant No. 1 CIP projects are warranted. The evaluations may be implemented based on priority and any predecessor activities. The evaluations with the highest priority that can be started immediately should take precedence.

**Table ES-7. Implementation Schedule and Sequencing**

<table>
<thead>
<tr>
<th>EVALUATION</th>
<th>PREDECESSOR ACTIVITIES</th>
<th>EARLY START</th>
<th>PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digester Solids Screening</td>
<td>None</td>
<td>Immediately</td>
<td>High</td>
</tr>
<tr>
<td>Digester Capacity</td>
<td>Completion of P1-100 and P1-101 projects and 1 year of operational data</td>
<td>JAN 2020</td>
<td>High</td>
</tr>
<tr>
<td>Sludge Diversion to Plant No. 2</td>
<td>None</td>
<td>Immediately</td>
<td>Medium</td>
</tr>
<tr>
<td>Existing Drying Bed Modifications</td>
<td>Identifying a project that would require removal of existing drying beds</td>
<td>Unknown</td>
<td>Low</td>
</tr>
</tbody>
</table>
BIOSOLIDS MANAGEMENT PLAN

The recommended BMP for OCSD’s biosolids end use portfolio corresponds to planned capital improvements at Plant No. 1 and Plant No. 2. In developing the recommended biosolids program, the consultant team worked with OCSD staff to establish the biosolids management framework including future biosolids products, potential end uses, and other program elements such as research and participation in trade organizations. Core elements of the future program were defined, and an implementation plan was developed.

Biosolids Management Framework Core Elements of the Future Plan

The development of a capital improvement plan for Plant No. 2 will result in a major change to OCSD’s biosolids program, namely, the generation of Class A biosolids beginning in 2030. Currently, OCSD’s biosolids program is shaped by three major factors: 1) federal, state and local regulations, 2) OCSD’s biosolids policy, and 3) guiding principles set forth in the LRBMP. This framework has led to diverse biosolids management as described previously.

While Plant No. 1 will continue to produce Class B biosolids, Plant No. 2 will begin producing Class A biosolids in 2030. The end use portfolio for Plant No. 1 is expected to remain much as it is today, with the majority of the annual production going to contract composting and a small percentage going to Class B land application in Arizona. With the proposed changes at Plant No. 2, new markets for OCSD would be Class A land application in California and soil blending within the region.

Core Elements of the Future Plan

OCSD’s biosolids management will be comprised of individual end uses, as well as market development, research, advocacy, and monitoring. These core elements are summarized in Table ES-8. As shown in the table, soil blending represents a market sector that can be developed once Class A biosolids are produced. Soil blending is a low-technology, low capital end use that allows generation of a product that is desirable in urban and suburban markets, particularly landscaping. A more in-depth market analysis of use of Class A cake in the soil blending market was performed prior to including this recommendation in the overall management plan. Blenders were shown representative TPAD cake and several expressed interest in working with the material either in their existing blend operation or at a new site developed for that purpose.

At a workshop on January 24, 2017, OCSD evaluated options for implementation, agreeing that small scale implementation would allow OCSD to evaluate a previously untested market. Such small scale implementation would likely consist of OCSD shipping its Class A biosolids to existing soil blending sites. If successful, OCSD could then pursue other methods of expanding its soil blending operation. The most likely scenario for such an expansion was determined to be partnering with an existing soil blender to develop a new site for blending and marketing OCSD’s biosolids-based soil blend. Land application is still expected to play a significant role in OCSD’s biosolids program in the future. Two additional emerging markets of interest are biosolids to energy and land reclamation. OCSD will monitor and participate in these markets as they develop.

Guiding Principles

OCSD’s current biosolids program is guided by regulatory requirements, OCSD’s biosolids policy, and guiding principles set forth in the LRBMP. During a workshop with OCSD, the BV/BC Team
reviewed those guiding principles and established those that were still valid, determined those that could be eliminated (e.g., because of changes in regulations, markets, or contractors), and identified several new or modified principles for inclusion. The guiding principles are intended to support OCSD's biosolids policy by minimizing risk within the beneficial use of biosolids. The 10 tenets of OCSD's biosolids management plan are as follows:

1. Allocate up to 50 percent of biosolids per biosolids contractor.
2. Allocate up to 50 percent of biosolids per geographic end-use market.
3. Maintain at least three different biosolids management facilities at any time.
4. Maintain at least two different biosolids management practices at any time.
5. Maintain at least two different hauling companies within the biosolids management portfolio.
6. Maintain at least 100% percent contingency capacity in at least two different off-site management options.
7. Maintain 20 percent failsafe hauling capacity.
8. Track and encourage development of emerging markets and/or end uses for biosolids, especially for local end-use options.
9. Allocate up to 10 percent of total biosolids production for participation in emerging markets, including participation in pilot or demonstration projects.
10. Explore partnerships with area soil blenders to allow incorporation of OCSD's Class A product into local markets.

Implementation Schedule

The new guiding principles for OCSD's biosolids management plan were established in the January 2017 workshop and finalized at a meeting on February 14, 2017. These principles support OCSD’s existing biosolids framework and help determine the direction for the future program. This includes shaping a roadmap for the future program, for which specific triggers were established that could cause OCSD to change the direction of its end use program. The roadmap is presented in Figure ES-17.
Table ES-8. Core Elements of the Future Program

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Application</td>
<td>It is expected that biosolids generated by OCSD, including Plant No. 2, will continue to go to Arizona land application. If California markets open, OCSD could leverage lessons learned in Arizona and through historic land application practices here.</td>
</tr>
<tr>
<td>Soil Blending</td>
<td>Soil blending represents a new end use for OCSD. Very little new infrastructure would be required. Information from successful applications in Washington State and British Columbia provides valuable production and market/sales data. The regional market within a 100-mile radius of OCSD is strong, representing a large potential market, but also competition from other products.</td>
</tr>
<tr>
<td>Emerging Markets</td>
<td>Emerging market projects that coincide with OCSD’s guiding principles may be considered for inclusion in the future programs. Two emerging markets with great potential are biosolids to energy (OCSD has already begun investigating AquaCritox supercritical water oxidation) and land reclamation, where Southern California opportunities include fire ravaged lands, overgrazed rangelands, abandoned mine sites, and brownfields. A number of grants are available for brownfield assessment, clean-up, and planning.</td>
</tr>
<tr>
<td>Market Development</td>
<td>Because of the potential for soil blending in the region, many operational options are possible: (1) OCSD operating at an OCSD-owned site, (2) a private company operating at a jointly-developed site, and (3) companies accepting biosolids at their sites. The most promising option that allows management of a large portion of OCSD’s biosolids appears to be partnership with an area soil blender to develop a new site (Option 2).</td>
</tr>
<tr>
<td>Research and Trade Organizations</td>
<td>Supplementary aspects of the biosolids management program include partnering with research institutions and participating in relevant trade organizations. A number of research partners are available including the California Association of Sanitation Agencies (CASA), the Water Environment and Research Foundation (WE&amp;RF), the University of California (Riverside, Irvine, and/or Davis programs), Pacific Northwest Universities (Washington, Washington State, and Oregon State), the ReNUWit Research Center at Stanford University, the Water and Environmental Technology Center (WET) at the University of Arizona. Participation and/or relationship building with relevant trade and other organizations will also support biosolids program goals and activities.</td>
</tr>
<tr>
<td>Regulatory Considerations</td>
<td>Management of OCSD’s biosolids requires compliance with regulations at the federal, state, and local level. This may include engagement with new regulatory entities, such as the CDFA.</td>
</tr>
</tbody>
</table>

**AQUACRITOX REPORT REVIEW**

OCSD is considering implementation of a demonstration scale super critical water oxidation (SCWO) plant for treatment of wastewater biosolids at one of their existing wastewater treatment facilities. A review was conducted of a specific proposal by SCFI for an AquaCritox A30 SCWO demonstration facility and included a literature review, technology evaluation, operational review, and a net present value (NPV) cost assessment. It was intended to visit an operating SCFI AquaCritox pilot plant facility in Valencia, Spain; however, that facility was not operating as intended and the site visit was therefore cancelled. Proceeding with a demonstration scale project is not recommended until OCSD are able to witness real, long term operating data of a pilot facility successfully operating on wastewater sludge.
IMPLEMENTATION PLAN

Figure ES-17. OCSD’s End Use Roadmap for Plant No. 2