Orange County Sanitation District

Research Strategic Plan

CS-2006-315BD

VOLUME 1
Overview

November 2008

carollo

Engineers...Working Wonders With Water™

Orange County Sanitation District

Strategic Research Plan

PROJECT OVERVIEW

FINAL
November 2008

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ORANGE COUNTY SANITATION DISTRICT

STRATEGIC RESEARCH PLAN

PROJECT OVERVIEW

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1.0 BACKGROUND

Research is an integral part of an organization's overall strategy to attain its goals. However, research and development (R&D) itself needs a strategic plan to be successful. The Orange County Sanitation District (OCSD) has a clear overall mission to collect, treat, and discharge wastewater, all in compliance with applicable regulations and at a fair cost. At the same time, it is faced by new challenges including a changing regulatory environment, new plant capacity construction, and changing operational needs at the treatment facilities. The need for changes in the wastewater industry can be driven by diverse factors including:

- Regulatory trends.
- New technology developments.
- The overall perception of the utility's practices by ratepayers, citizens, neighbors, and environmental organizations.
- Switching to technologies that are more efficient.
- Site constraints.

OCSD has a reputation for being proactive in R&D investment. As a result, the goal of this project was to focus OCSD's research efforts to enhance future planning needs, meet regulations, and to ultimately decrease the cost of operation while meeting the needs of the ratepayers and community at large.

Research activities are covered by a 5-year Research Strategic Plan, which will consider OCSD plans for expansion and process modifications, regulatory drivers, and general service requirements. The plan also recommends specific projects to be undertaken by OCSD or general knowledge or areas of technology that should be investigated.

The purpose of Volume 1 of the Research Strategic Plan is to present an overview of the project and to serve as a collection of data and information used to create the 5-year plan. Within this volume, the following items have been compiled to serve as a record of the project:

- Kick-off Meeting Presentation (Appendix A) - these presentations summarize the approach that was undertaken to develop the Research Strategic Plan.
- Technical Memorandum No. 1 (TM1) (Appendix B) - this memorandum summarizes the objectives of the Research Strategic plan and provided an overview of project

goals, OCSD treatment facilities, possible existing or upcoming technologies to be considered by outside experts and project teams, etc.

- Workshop No. 1 Presentations (Appendix C) - the presentations from Workshop No. 1 were created and presented to OCSD staff by a panel of outside experts (Carollo and others). These outside experts presented on a wide range of topics from treatment technologies to future trends in wastewater treatment.

- Workshop No. 2 Presentations (Appendix D) - the presentations from Workshop No. 1 cover potential research projects, which were developed though small group meetings. Each group included one or more outside expert and OCSD staff members.

- Final Projects for Ranking (Appendix E) - this presentation contains all research projects that were considered for ranking using decision matrix software. In some cases, research projects were removed from the list of projects to be ranked (recycle bin). Furthermore, some projects were also combined. Overall, 26 projects were considered for the ranking.

- Ranking Model (Criterium Decision Plus) and Results (Appendix F) - after the creation and consolidation of research projects, ranking was completed. This process began in Workshop No. 2 with the establishment of model criteria and attributes and finalized in a follow-up TAG meeting. In Appendix E, the final model framework is presented in addition to the final ranking of all projects, in both list and graphical form.

Overall, the top 11 projects were developed in more detail and constitute Volumes 2 to 12 of the 5-year plan. Additional detail was in the form of extended scope of work descriptions, cost estimates, and scheduling.

2.0 PROJECT WORKFLOW

The development of the Research Strategic Plan involved several sequential steps involving OCSD staff, Carollo Staff, and out side experts. The following sections briefly describe the workflow of this project, which lead to the ultimate development of the 5-year plan. The general approach is also shown in Appendix A.

2.1 OCSD Staff Interviews

One of the first tasks of this project was the development of a questionnaire for OCSD staff and subsequent interviews. Participants included members of the management, engineering, planning, and operations staff. Data colleted from the interviews were used to develop areas of research interest based on perceived OCSD needs. These groups were later called “bins” and formed the foundation of project development by small focus group meetings with OCSD, Carollo, and outside experts. In the end, nine research bins were identified.

2.2 Workshop No. 1

The purpose of Workshop No. 1 was to bring in outside experts and present material on a wide range of subject matter to OCSD staff. This included an overview on OCSD operations, the current OCSD CIP, and results from staff interviews. Prior to the workshop, a TM1 was distributed to outside experts to provide an overview of project goals, OCSD treatment facilities, possible existing or upcoming technologies to be considered by outside experts and project teams, etc., (see Appendix B). The following subjects were then discussed by outside experts at Workshop No. 1:

- Overview of Wastewater Treatment Drivers.
- Regulations and Emerging Issues (Sustainability, etc.).
- State-of-the-Art for Key Treatment Processes.
- Megatrends in the Wastewater Industry.
- Measuring and Minimizing the Carbon Footprint of Wastewater Treatment and Residuals Disposal.
- Air Quality Trends in Regulations and Technology.
- European Perspective.

The presentations for these subjects may be found in Appendix C of this technical memorandum. The following outside experts participated in this project:

- Dr. Marco Aieta (Carollo).
- Dr. Graham Juby (Carollo).
- Dr. Gil Crozes (Carollo).
- Dr. George Tchobanoglous (UC Davis).
- Mr. Steve McDonald (Carollo).
- Dr. B. Narayanan (Carollo).
- Mr. Allen Todd (Carollo).
- Dr. Rhodes Trussell (Trussell Tech., Inc.).
- Dr. Perry McCarty (Stanford).

- Dr. Julia Lester (Environ).
- Dr. Hallvard Odegaard (Norway).
- Dr. Paul Pitt.

2.3 Project Development

Based on OCSD staff interviews, developed research bins, and the presentations of outside experts, small group meetings were held between Workshop Nos. 1 and 2 to develop potential research projects. Nine group meetings were held based on the nine identified research bins. Each group contained one or more outside expert and OCSD staff member. After each meeting, the team leader summarized project concepts for presentation in Workshop No. 2. A total of 58 potential projects were developed from these group meetings.

2.4 Workshop No. 2

The purpose of Workshop No. 2 was for research bin group leaders to present potential research projects developed by their team to the overall project team. The presentations for the nine research bins may be found in Appendix D of this memorandum. In addition, the second half of the workshop was used to develop a decision model to be used for the final ranking of all proposed research projects. Model criteria and corresponding attributes were created and discussed with the group as a whole. The ultimate ranking of projects was not completed in the workshop due to time constraints.

2.5 Project Ranking

After Workshop No. 2, Carollo combined several of the original 58 projects in an effort to reduce the total number of projects to be ranked. New projects were then presented to the OCSD TAG for comments. After consolidation and the removal of projects that were determined not to be legitimate research projects, a total of 26 projects at an estimated cost of $11,450,000 remained. In addition, the ranking model criteria were adjusted and appropriate weights were assigned in a group meeting with the OCSD TAG. At this point, the projects were rated to determine the top 10 projects that would be included in the Research Strategic Plan. Ranking results and the final project decision model may be found in Appendices E and F, respectively.

2.6 Project Development

Once project were ranked, Carollo developed detailed write-ups of each project, which constitute Volumes 2 to 12 of the Research Strategic Plan. It is important to note than an eleventh project was later developed at the request of OCSD.

3.0 PROJECT SCOPES

As part of this project, the top 11 research projects were expanded upon from the original concepts developed as part of smaller group meetings to more detailed descriptions. For each project, a more extensive scope of work was developed to provide OCSD with a starting point for the development of a request for proposal (RFP) or internal development plan. It was assumed that the Project Scope would be developed further in consultation with the OCSD project manager and the TAG before a consultant (if required) is requested to provide a formal proposal and cost estimate for the work.

4.0 PROJECT SCHEDULE

Detailed project schedules were developed for each project. Originally, each project was assigned an estimated duration along with costs during smaller developmental group meetings. Figure 1 shows the complete, composite schedule for the 5-year Research Strategic Plan.

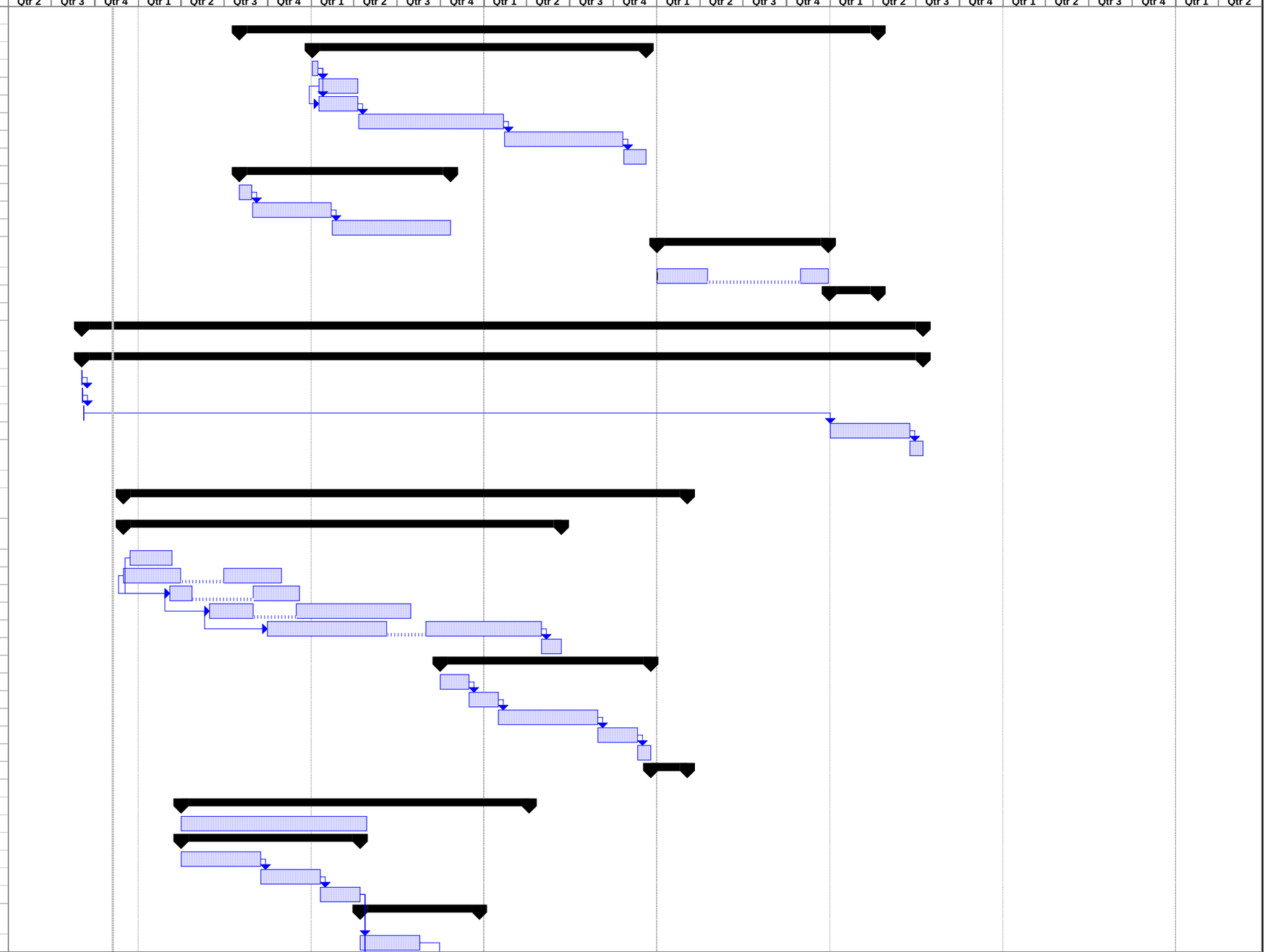
4.1 Schedule Assumptions and Notes

The Gantt chart in Figure 1 shows the overall Research Strategic Plan project. It has been assumed that the Research Strategic Plan will commence in January 2009 for an initial duration of 5-years, although some projects will extend beyond the initial 5-year window. Projects are listed below in ranking order (highest to lowest). The OCSD TAG extensively reviewed this project schedule prior to finalization. In general, projects are arranged within the 5-year schedule to evenly distribute workload, which leads to semi-linear expenditure of the Research Strategic Plan budget (See Figure 2).

Some cooperative research projects and studies that OCSD is currently participating in with other organizations are shown at the bottom of the plan schedule. These specific projects are not listed above in the individual research projects.

OCSD Strategic Research Plan
5-year Project Scheduling

ID	Rank	Task Name
1		
2	1	**Power Generation Project (5-2)**
3		Task 1: FOG Handling Study
4		Define project scope
5		Evaluate existing data
6		Evaluate FOG use options
7		Design and construct test facilities
8		Test FOG addition to digesters
9		FOG use assessment
10		Task 2: Fuel Cell Testing and Marketing
11		Evaluate sale of conditioned biogas
12		Design and construct test system
13		Test fuel cells
14		Task 3: Strategy for OCSD Vehicle Fleet and Renewable/Alternative Energy Sources
15		Evaluation - Economic
16		Task 4: Project Report
21		
22	2	**Sludge Disposal (Deep Well Injection) Project (2-3)**
23		Task 1: Sludge Disposal via Deep Well Injection
24		Preliminary assessment
25		Geotechnical assessment
26		Engineering assessment and predesign
27		Track Terminal Island demonstration project
28		Determine need for additional research (TS) or start implementation (Engr.)
29		
30	3	**Enhanced Gas Production and Solids Treatment Project (2-4)**
31		Task 1: Evaluation of Sludge Conditioning Technologies & Dewatering Improvements
32		Literature review
33		Technology evaluation
34		Cost analysis
35		Construct test facilities as needed
36		Test sludge conditioning technologies
37		Summary report
38		Task 2: Digester Mixing
39		Technology evaluation
40		Cost analysis
41		Construct test facilities as needed
42		Mixer pilot study
43		Digester mixing summary report
44		Task 3: Project Report
49		
50	4	**Environmental Footprint Project (5-1)**
51		Task 1: Investigate Green Technologies Applicable to OCSD
52		Task 2: Ecological and Carbon Equivalent Footprint
53		Compile and format data
54		Identify ecological footprint components
55		Estimate impacts (e.g., consumption area)
56		Task 3: Impacts of Climate Change on Plant Operations and Compliance Monitoring
57		Evaluate wet weather and dry weather pattern trends

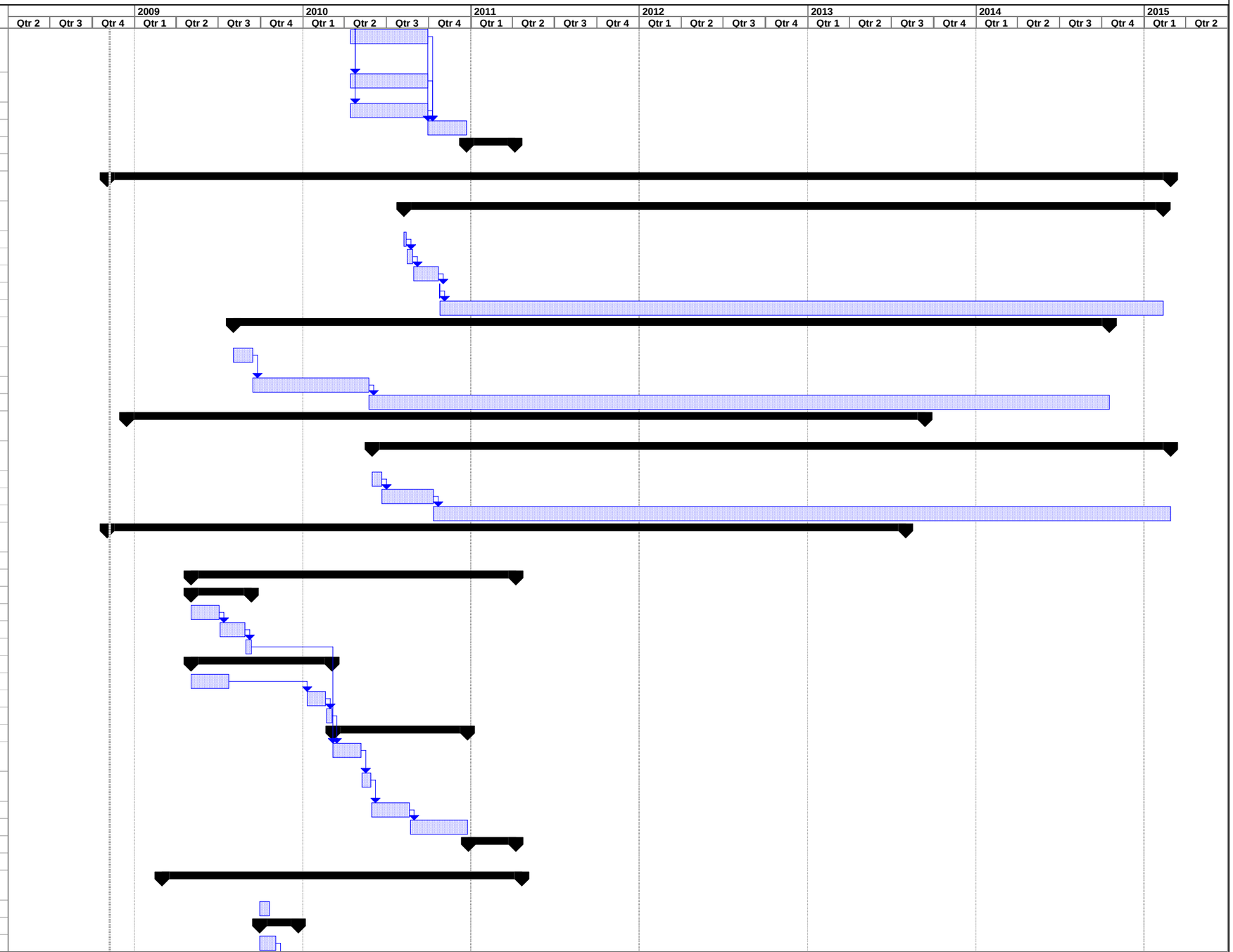


Project: Research Schedule
Date: 11/7/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

OCSD Strategic Research Plan
5-year Project Scheduling

ID	Rank	Task Name
58		Evaluate the impact of climate change on the wastewater influent loadings, infiltration, temperature, etc.
59		Evaluate the effect of climate change on ocean biota, chemistry, and water levels.
60		Review existing reports and data
61		Summarize findings
62		Task 4: Project Report
67		
68	5	**Organizational Cooperation and Outreach Project (7-1)**
69		Task 1: Website and Outreach Materials Development for the Board and Public
70		Brainstorm Website and brochure concepts
71		Coordinate with IT and PR staff
72		Development of website and brochures
73		Launch Website and print brochures
74		Operate Website
75		Task 2: Establish Regional Technology and Information Sharing Group
76		Develop a list of regional agencies and established groups for participation
77		Contact regional agencies and establish MOU's
78		Initiate and administer program
79		Task 3: Placeholder for Urgent Regulatory Analysis
81		Task 4: Develop Formal Program of Cooperation with Universities
82		Develop list of research partners
83		Establish Program
84		Initiate and administer program
85		Task 5 - Participate in Multi-agency Technology Review Group
87		
88	6	**Process Modeling Project (4-1)**
89		Task 1: Develop Biowin Models for OCSD Plants
90		Collect plant data
91		Develop and calibrate model
92		Train staff
93		Task 2: Develop Hydraulic Modeling of Plants
94		Collect Plant data
95		Develop and calibrate model
96		Train staff
97		Task 3: Liquid Stream Optimization
98		Review models and develop plant optimization strategies
99		Alter models based on optimization strategies
100		Implement single optimization concept
101		Monitor plant performance
102		Task 4: Project Report
107		
108	7	**Chemical Mixing Systems and Collection System Chemicals Evaluation Project (9-3)**
109		Task 1: Select Mixing Site
110		Task 2: Evaluate Mixing Alternatives
111		Evaluate potential mixing solutions

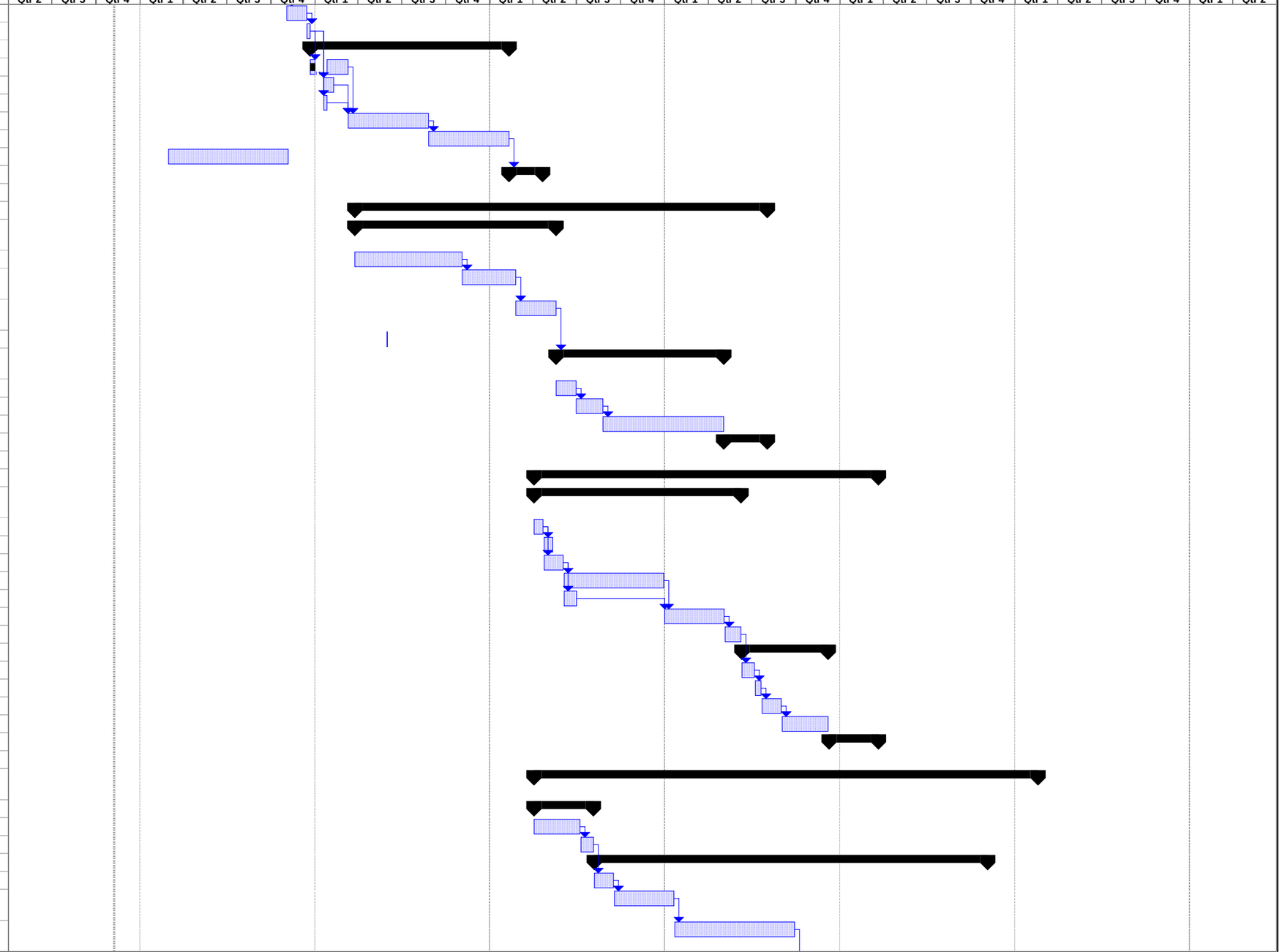


Project: Research Schedule
Date: 11/7/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

OCSD Strategic Research Plan
5-year Project Scheduling

ID	Rank	Task Name
112		Develop planning level cost estimates
113		Recommend mixing system for pilot testing
114		Task 3: Testing of Selected Mixing Technology
115		Design mixing system
116		Develop testing plan
117		Coordinate with Operations staff
118		Construct mixing system
119		Test mixing system
120		Task 4: Collection System Chemicals Evaluation
121		Task 5: Project Report
126		
127	8	**Odor Analysis Project (3-1)**
128		Task 1: Identify Specific Odor Problems by Odor Panels and Chemical Analysis
129		Odor Profile Analysis
130		Determine the primary chemicals associated with each odor source
131		Test Best Management Practice (BMP) to control odor problems
132		Task 2: (moved to end)
133		Task 3: Determine non-H2S Compounds in Collection System
134		Sample odor emissions and analyze
135		Collaborate with universities
136		Investigate pathways of odor formation
137		Task 4: Project Report
142		
143	9	**Odor Control Improvement Project (3-2)**
144		Task 1: Modifications of Biological/Chemical Scrubbers
145		Literature review
146		Conduct plant surveys
147		Evaluate treatment concepts
148		Design and construct modifications
149		Develop test plan
150		Test modifications
151		Analyze results and complete report
152		Task 2: Optimization of Chemical Scrubbers
153		Perform additional odor sampling and analysis
154		Select odor treatment site
155		Develop an optimized treatment approach
156		Implement and monitor optimization
157		Task 4: Project Report
162		
163	10	**WASAC Process Feasibility Study Project (4-3)**
164		Task 1: WASAC Process Evaluation
165		Process and Siting Evaluation
166		Cost Analysis
167		Task 2: Demonstration Testing
168		Develop a predesign report for demo project
169		Develop design drawings and equipment specifications
170		Obtain contractor and build plant modifications

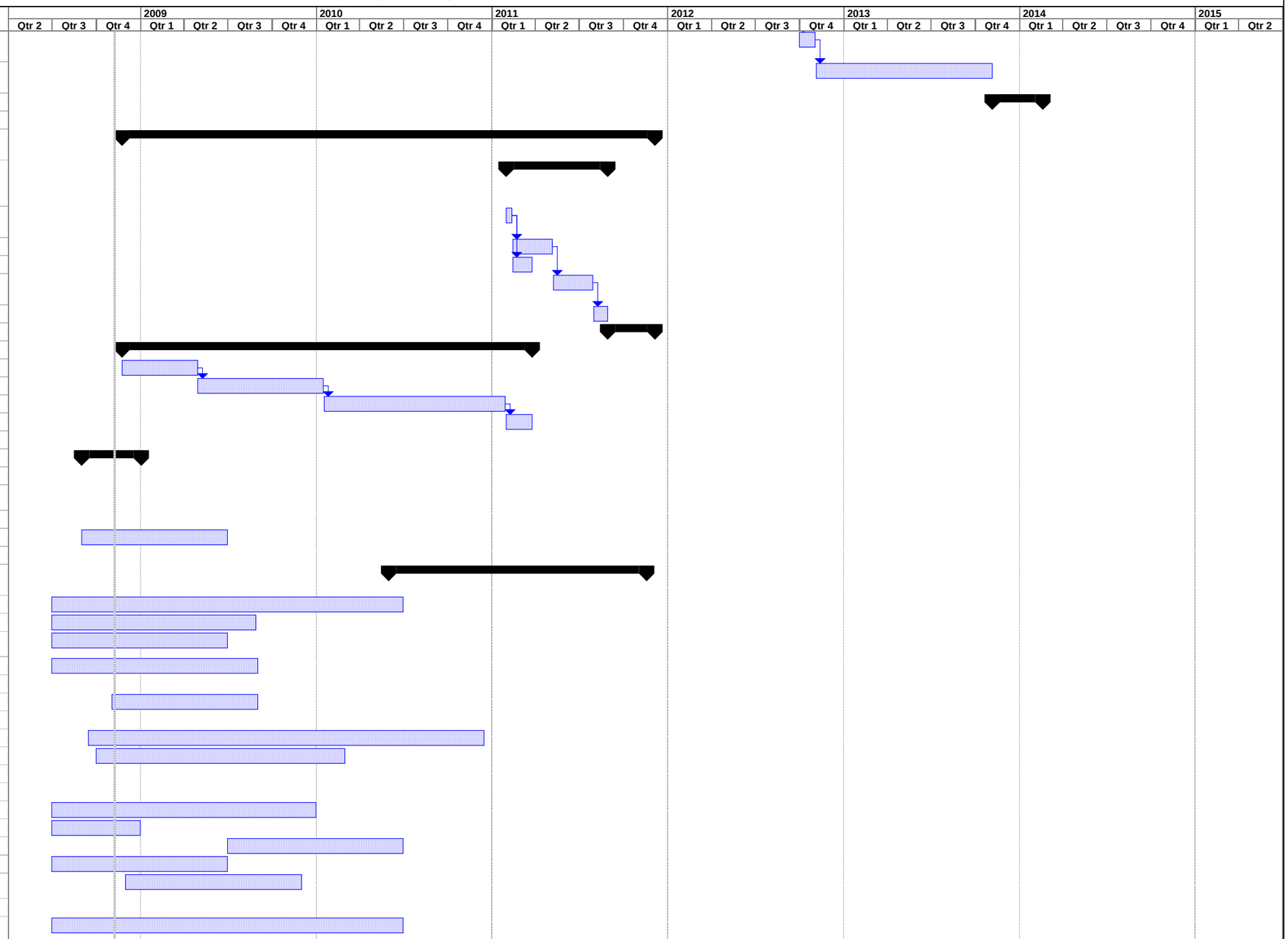


Project: Research Schedule
Date: 11/7/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

OCSD Strategic Research Plan
5-year Project Scheduling

ID	Rank	Task Name
171		Provide start-up services and construction overview
172		Oversee operation of the treatment plant (1-year)
173		Task 3: Project Report
178		
179	11	**Air Regulations (Combustion Sources) Project (3-4)**
180		Task 1: Evaluation of Regulated and Unregulated Particulate and Odorous Emissions from Combustion Sources
181		Determine future restriction on generator emission compounds
182		Perform generator emissions sampling
183		Evaluate fuel cell study results
184		Propose accepted mitigation alternatives for power generation
185		Review proposed alternatives
186		Task 2: Project Report
191		Task 3: J-79 Engine Emissions Control Catalyst Test (MPI)
192		Preliminary steps
193		Construction and startup
194		Testing
195		Reporting
196		
197		Superoxygenation Applications
199		
200		Cooperative Projects Not Included in Other Projects Above:
201		University of Arizona Water Quality Center (WQC)
202		WQC Biosolids Safety Studies
203		Water Environment Research Foundation (WERF) Support
204		WERF Cooperative Project: Model Development Linking Collection System Odor Generation and Corrosion
208		WERF Targeted Research (TCR): Pathogen Risk Assessment
209		WERF Targeted Research (TCR): Incident Response
210		WERF Targeted Research (TCR): Centrifuges & Pathogen Regrowth
211		WERF Epidemiological Study Advisory Committee
212		UC Irvine Urban Water Research Center (UWRC)
213		UWRC Projects TBD
214		So. Cal. Coastal Water Research Project (SCCWRP)
215		SCCWRP Endocrine Disruptor Study
216		SCCWRP So. Cal Bight Regional Study
217		American Water Works Assn. Research Foundation
218		WateReuse Foundation (WRF)
219		WRF: Identifying Health Effects Concerns of Water Reuse
220		WRF: Study of Advanced Oxidation Processes
221		WRF: Impacts of Nanoparticle Pollutants
222		WRF: Project Advisory Committee on UV Disinfection
223		WRF: Methods for Measuring Chemicals of Emerging Concern (CECs)
224		So. Cal. Assn. of Marine Invertebrate Taxonomist (SCAMIT)
225		SCAMIT: Developing On-line Tools for Ocean Organism Identification



Project: Research Schedule
Date: 11/7/08

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

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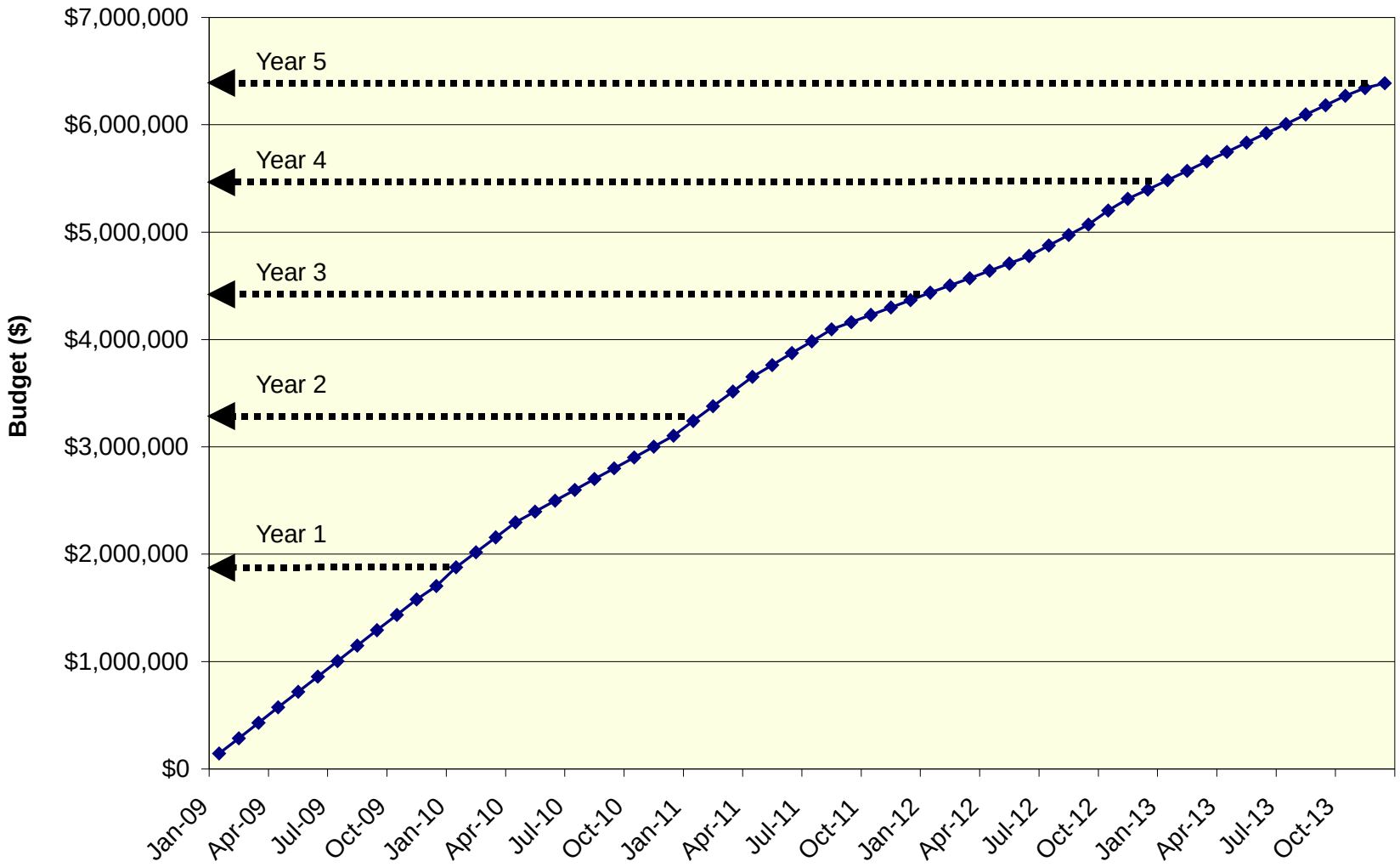

RESEARCH STRATEGIC PLAN EXPENDITURE RATE

FIGURE 2

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5.0 PROJECT COSTS

For each project, a detailed cost estimated was developed using the expanded scope of work. Table 1 outlines the assumed average billing rates that were used in order to calculate a fee based on estimated hours for each task.

Table 1 Hourly Rate Assumptions for Manpower Estimates
Research Strategic Plan
Orange County Sanitation District

Category	Average Hourly Rate ($/hr)
Consultant	165
OCSD PM	150
OCSD Engineering	150
OCSD Operations	140
OCSD Laboratory	140

Table 2 summarizes the cost estimate for each of the 11 research projects. The original estimate from smaller developmental group meetings is also noted.

Table 2 Summary of Project Costs
Research Strategic Plan
Orange County Sanitation District

Project Title	Cost	Original Estimated
Power Generation Project	$676,760	$500,000
Sludge Disposal Project	$895,560	$950,000
Enhanced Gas Production and Solids Treatment Project	$1,162,220	$1,250,000
Environmental Footprint Project	$508,560	$500,000
Organizational Cooperation and Outreach Project	$574,680	$500,000
Process Modeling Project	$514,740	$500,000
Chemical Mixing Systems and Collection System Chemicals Evaluation Project	$439,900	$275,000
Odor Analysis Project	$757,020	$750,000
Odor Control Improvement Project	$570,780	$500,000
WASAC Process Feasibility Study Project	$601,860	$500,000
Air Regulations for Combustion Sources Project	$411,800	$250,000
Total	**$7,113,880**	**$6,425,000**

This total estimate is within +/- 25 percent of the original project estimate developed throughout the project workshops and group meetings. Based on the above estimates, the total, yearly expenditure by the OCSD would be approximately $1.42 million/year. Figure 2 shows the expenditure rate based on project costs and schedules.