CAP Maintenance Organization Assessment Report

Submitted by

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Executive Summary

This Executive Summary provides an abbreviated description and overview of the Central Arizona Project (CAP) Maintenance Organization Assessment (MOA) conducted by CH2MILL. The CAP selected CH2MILL to assist the agency in accurately assessing its current strengths and capabilities with respect to industry best practices in maintenance and reliability, as well as to help prepare the Maintenance Organization in addressing challenges that lie ahead.

For this project, CH2MILL designed an evaluation utilizing methods and tools that have been employed with numerous water agencies and other industry sectors across North America. Upon initiation of the Assessment, it was apparent that the CAP Maintenance Program was fairly well advanced as a result of continuous internal development efforts over the past several years. Therefore, CH2MILL included evaluation methods typically associated with assessing organizations that perform at a “world class” level. Project efforts consisted of meetings, workshops, interviews, site visits, and included the following key activities:

- Process Benchmarking of the organization using the Aquamark Asset Management Framework developed by the Water Services Association of Australia (WSAA).
- A multi-step Maintenance Audit utilizing the existing maintenance best practice model; further evaluation after the integration of CH2MILL’s risk assessment methods; and, followed by field visits of representative CAP facilities.

Water Services Association of Australia Asset Management Process Benchmarking

CH2MILL applied a benchmarking methodology called Aquamark Asset Management Framework developed by the Water Services Association of Australia (WSAA) to compare with the CAP results. It is regarded as the preeminent asset management tool that is often applied to leading-edge organizations. For this project, only the maintenance function of the Framework was employed.

The WSAA Benchmarking approach was based on 41 water sector agencies from Australia, Canada, Hong Kong, New Zealand, Sultanate of Oman, United Arab Emirates, and the United States. The U.S. contingent included 14 utilities. For the purposes of the CAP review, CH2MILL divided the results into two comparison groups:

1. Overall Participant Group (International and North America participants)
2. North America Participant Group

As shown in exhibit ES-1, the CAP scored relatively high overall in this rigorous process at 72 percent. This placed CAP at a level completely above the North American Participant Group. Further, it placed CAP at a level well above the median when compared to the Overall Participant Group. This confirmed that CAP’s maintenance processes are advanced and the high score was likely a direct result of its existing comprehensive and highly effective Maintenance Excellence Program. Observing that some agencies in the Overall Participant
Group achieved scores above 80 percent indicates that there is room for improvement. The benchmarking exercise captured a variety of CAP’s strengths and improvement opportunities which are presented in the full report.

Closer review of the eight processes within the Maintenance function (1- Business Objective Knowledge; 2-Asset Technical Knowledge; 3-Business Based Maintenance Strategy; 4-Maintenance Procedure Documentation; 5-Work Practices; 6-Execution of the Maintenance Strategy; 7-Consumables and Spares Management; and, 8-Review and Improvement) shows CAP scored at or above the median in seven of the eight process areas compared with the Overall Participant Group, as shown in exhibit ES-2.

In conjunction with the WSAA evaluation, CH2MHILL also included a series of open-ended organizational interview questions for CAP maintenance managers. The team held individual, confidential interviews and discussions covering the following areas: a) General, b) People, c) Processes, and, d) Technology. Candid discussions revealed that CAP managers are very proud of their accomplishments and want to find more improvement opportunities in their organization. After completion of the interviews, CH2MHILL thoroughly analyzed the results. Detailed lists of “Strengths” and “Opportunities for Improvement” were identified and described in the report for further consideration by the CAP. Overall, the CAP Maintenance Organization has implemented significant organizational adjustments in recent years. Previous maintenance audits identified staffing level needs and CAP has since made appropriate adjustments for maintenance planners and engineers, an area typically understaffed in public sector water service organizations.

**Maintenance Audit**

CH2MHILL performed a maintenance audit consisting of three distinct steps, as described below:

**Step 1** – CH2MHILL maintenance specialists conducted a maintenance audit that consisted of a series of question-based interviews. The intent in performing the question-based maintenance audit was to provide CAP with an independent assessment of its maintenance program that could be compared to previous audits.

**Step 2** – A risk assessment of each audit category was performed within the question-based maintenance audit to prioritize and focus future improvements.
Step 3 – CH2MHILL performed a risk assessment of seven individual CAP facilities and subsequently visited each site to determine the effectiveness of overall maintenance practices. Each site was evaluated on five categories of maintenance activities.

Exhibit ES-3 displays the scores associated with each of 21 maintenance assessment categories as a result of the audit efforts during Step 1. This initial portion of the audit involved personal interviews of a representative cross-section of the maintenance organization which included maintenance engineers, maintenance planners, and trades. Each interview session was structured to include the discussion of over 600 questions regarding maintenance practices. The interview sessions were conducted in a concentrated effort over a period of two weeks in various locations such as Headquarters, the Hassayampa Pump Plant, the Little Harquahala Pump Plant, and the Tucson Field Office.

ES – 3
Maintenance Audit Processes Category Scores

An overall audit score of 82 percent (or 0.820) was achieved. This suggested that the CAP Maintenance Organization falls within the “Excellence” category of maintenance operations according to the standard industry model. This current CH2MHILL Assessment in 2010 has produced a result that is quite close to the performance measurement of 0.807 measured through the 2009 CAP internal audit effort. This corroborates the 2009 findings. Based on a combination of these results and the industry experience of the CH2MHILL project team, the CAP maintenance function appears to incorporate practices that are more characteristic of those associated with “world-class” operations. Acknowledgement of CAP’s high level of maintenance capabilities was gained through this process, however, as previously mentioned, room for improvement still exists.

The audit process continued with Step 2 by weighting the “risk” associated with all of the ingredients to the Maintenance Assessment Evaluation. CH2MHILL determined a more accurate picture of the true risk associated with the level of performance in each area of work. Through this method of risk-assessment, an additional dimension of analysis was provided. This resulted in the ability to re-prioritize where improvement efforts should be focused as displayed in Figure ES-4. The bar graph displays the highest priority items from left to right in order of highest to lowest risk.
Another important finding during this stage revealed that the organization is performing the “higher weighted” (i.e., more important) functions with a larger degree of consistency than other similar organizations. The following table presents a summary of this observed result.

### Question Answer Scores

<table>
<thead>
<tr>
<th>Condition Score</th>
<th>Condition Description</th>
<th>CAP Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Performing consistently</td>
<td>62.18%</td>
</tr>
<tr>
<td>2</td>
<td>Performing 80 to 90% of the time</td>
<td>22.09%</td>
</tr>
<tr>
<td>3</td>
<td>Performing most of the time</td>
<td>8.02%</td>
</tr>
<tr>
<td>4</td>
<td>Performing some</td>
<td>3.93%</td>
</tr>
<tr>
<td>5</td>
<td>Not performing</td>
<td>3.78%</td>
</tr>
</tbody>
</table>

During Step 3 of the audit process CH2MHILL conducted site visits of seven representative facilities to have an opportunity to confirm the level of maintenance performed and conduct additional interviews of site personnel. Site visits included: Mark Wilmer Pump Plant, Salt-Gila Pump Plant, Waddell Pump/Generating Plant, Hassayampa Pump Plant, Headquarters, Check Structure 21, and the Phoenix Turn Out.

CH2MHILL’s audit team performed a high-level review of the facilities with respect to five basic areas relating to: Structural, Mechanical, Electrical, I&C, and Process Control. In addition, a “Consequence and Likelihood” Matrix was developed for this effort which provided a framework for considerations such as cost, health & safety, public image/community impact, regulatory compliance, and service delivery/reliability. Detailed results are included in the report and associated appendices.

### General Observations

All facilities are clean and are operated and maintained well. Minor issues were observed with respect to some individual items such as the storm screens, and some remote signal bundling and annunciator panels. There also appeared to be an emerging awareness that certain equipment is becoming more difficult to replace as it ages due to lack of available replacement parts. Staffing appeared to be adequate, and distribution by West, Central (Headquarters), and
South is appropriate. CAP might find it beneficial to reevaluate the supervisor loading rates and travel distances to assigned pump plants. A formal, robust supervisor training program may mitigate some of the issues currently encountered.

Fleet and Headquarters staffing appeared to be at the appropriate levels. The shop area appeared to have the appropriate number and type of staffing. Heavy maintenance crew and trades staffing levels seemed appropriate. The Apprenticeship Program is an asset and a strong training program for trades personnel. There is also a need for a detailed O&M training system to fill the gap created by removing the Team Leader role.

It was evident throughout the Assessment that safety is the top priority for all aspects of the Maintenance Operations. Safety signage, eyewear, and hearing protection were available and observed utilized in all areas where they are required. All employees encountered during facility tours were observed utilizing the required personal protective equipment that was appropriate for the work being performed. During a field site visit, the staff at the Mark Wilmer Pump Plant were observed employing a comprehensive and impressive fall arrestor system while performing precarious work repairing the pump bearings. Safety is clearly ingrained in the CAP culture.

**Conclusion**

The CH2MILL Assessment Team conducted a detailed evaluation of the CAP Maintenance Program by incorporating methods designed to benchmark it against the performance of leading-edge organizations both nationally and internationally. The results of these efforts revealed that CAP has been systematically developing a Maintenance Excellence Program over the last several years which now ranks it as a leader among other major agencies within the United States and have brought it to the threshold of a “world class” level. In order to complete the progress toward achieving this objective, continued focus is needed on the more complex issues. An additional risk-assessment approach was introduced in order to highlight and prioritize strategic improvement areas. The CAP Maintenance Program should be acknowledged for its significant accomplishments and fully supported in its future development.