As explained in CWQMC 2008, not all aspects of all monitoring programs require statewide coordination. The Monitoring Council will therefore work with each workgroup to identify program elements that require larger-scale statewide coordination to support comprehensive assessments and those that can vary regionally to support local needs. Where national or state guidelines already exist, the Monitoring Council will encourage adoption of the highest-level guidelines available. In all cases, however, the Monitoring Council's philosophy (see Sections 1.1 and 2.1) is to present available information in a web portal as soon as some useful statewide information is available, even if it contains data gaps and/or inconsistencies. As explained above, this approach creates the structure and motivation for a transparent process of continual improvement of monitoring data, methods, and assessment products (see Figure 2).

2.2.5 Improved data management

The Monitoring Council's approach to improving data access is premised on providing a global point of access to a series of theme-based web portals. These in turn enable access to a wide range of other data sources as needed to fulfill the web portals' analysis, assessment, and reporting functions. This will require comparable monitoring data statewide, technical support for infrastructure and tool development, and the ability for users to query and download a variety of data and assessment products.

Work on the prototype web portals to date has demonstrated both the potential for and the challenges of this goal. Fully implementing the set of web portals envisioned will require finding, accessing, and integrating many different data types from a large number of sources, and providing monitoring data and products to users with valid, often wide, differences in needs and perspectives. These challenges are not limited to the Monitoring Council's efforts, and are in fact an important issue for the State as a whole. The Office of the Chief Information Officer recently released its *Statewide Data Strategy Report* (OCIO 2009), which describes the State's approach to overcoming widespread problems related to data access and integration. While it lays out basic principles for the design, functioning, and integration of the State's data management systems, it also allows for needed flexibility as each agency develops its own solutions and strategies. The Monitoring Council's approach is compatible with the State's strategy and is based on two key elements.

The first element involves implementing a distributed data management strategy by establishing locally centralized access and data input points at regional data centers, which are then linked with an exchange network to bring data together as needed. The State Water Board's Surface Water Ambient Monitoring Program has implemented the distributed CEDEN network (Figure 6) which may evolve into the primary source of data to the Monitoring Council's web portals. CEDEN relies on the California Environmental Resources Evaluation System (CERES) metadata catalog and is a distributed enterprise system intended to be flexible enough to accommodate multiple requirements. The CEDEN regional data center nodes fulfill the role of intermediary between larger state systems and small to medium data providers. CEDEN's architecture has been designed to create a long-term solution for delivering complex, scalable, user-friendly applications and information to a wide variety of users.

CEDEN is committed to participating in the USEPA's National Environmental Information Exchange Network (NEIEN) and in implementing their standards for service oriented architecture (SOA) and web services. These frameworks structured the initial design and implementation of CEDEN, which became operational in 2010. However, the system still requires a substantial amount of development, both of its basic infrastructure and of applications
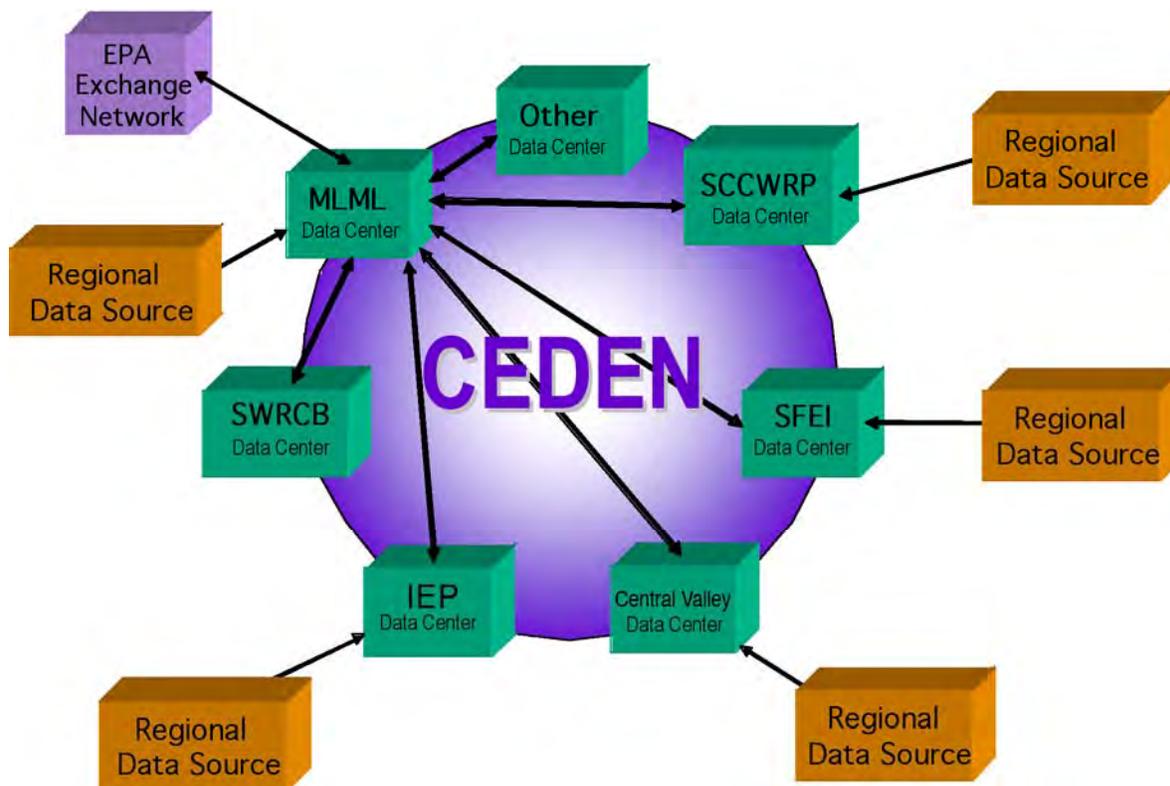
Figure 6. *Schematic depiction of the CEDEN network, illustrating the relationships of the regional data centers to each other, to regional data sources, and to the external EPA Exchange Network.*

needed to support the theme-based web portals, and this effort is outlined in the workplan in Chapter 3.

The second element of the Monitoring Council's data management approach is a data management workgroup that will play a critical coordinating role to ensure that the theme-specific workgroups:

- Meticulously define their data requirements
- Identify data requirements that cut across multiple themes and that therefore should be coordinated
- Employ data management strategies that comply with appropriate national and state guidelines
- Have a well-established mechanism for communicating data management issues to a body with overall responsibility for oversight and support of individual themes' data management efforts

These functions are illustrated in Figure 7, which shows the Monitoring Council's data management workgroup interacting with the theme-specific workgroups at critical points and supporting needed coordination across workgroups.
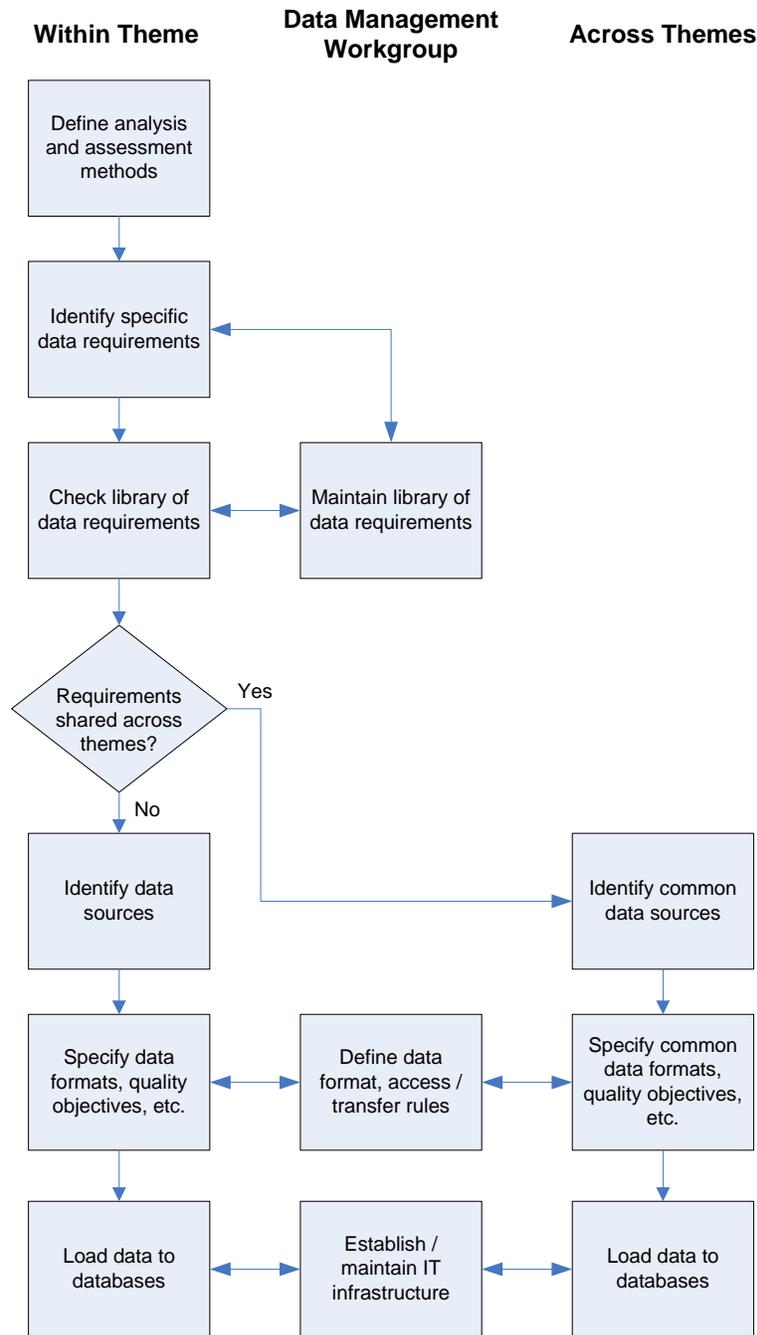
Within Theme   **Data Management Workgroup**   **Across Themes**

Figure 7. *The Monitoring Council's data management workgroup will support data management efforts of each theme-specific workgroup, as well as playing a coordinating role where data requirements cut across multiple themes.*

In addition to looking inward toward the theme-specific workgroups, the Monitoring Council's data management workgroup will look outward to other partners within and outside of state government to ensure that the Monitoring Council's data management strategy remains aligned

with State and federal initiatives and takes advantage of opportunities to utilize useful tools and approaches developed elsewhere.

2.2.6 Monitoring of state financed water quality improvement projects

The State of California provides millions of dollars of funding for water quality and associated ecosystem improvement projects. For a number of reasons, most of these projects do not generate monitoring data sufficient to document the success or failure of these projects. In response, SB 1070 required that the MOU between Cal/EPA and the Natural Resources Agency "shall describe the means by which the monitoring council shall formulate recommendations to … [e]nsure that water quality improvement projects financed by the state provide specific information necessary to track project effectiveness with regard to achieving clean water and healthy ecosystems." The MOU reiterates this mandate in describing the Monitoring Council's responsibilities.

Others have made recommendations to improve monitoring of state financed water quality improvement projects. The Natural Water Quality Committee (NWQC) was formed at the direction of the State Water Resources Control Board to define natural water quality based on a review of monitoring data in Areas of Special Biological Significance (ASBS). Some of their recommendations focused on monitoring of water quality improvement projects funded by Proposition 84 grants. The following is excerpted from the NWQC's *Initial Recommendations for Monitoring ASBS Implementation Projects* from *Summation of Findings, 2006-2009*.

> After discussions with [State and Regional Water Board] staff, task force members from other grant programs…, and the grantees themselves, the NWQC came to three conclusions regarding the successes and failures of previous grant programs. Frequently in the past, grant programs were incapable of assessing the success/failure of their program for either removal of pollutants or improvements to receiving waters. Inadequate guidance was provided to the grantees on the specific goals of the monitoring programs employed, especially to those grantees that lacked capabilities and experience with monitoring. Specifically, grantees rarely had a vision of the State's monitoring objectives such as cumulative pollutant removal. Even for those grantees with experience and capability, the timeline of the grant programs (typically two to three years) were inconsistent with adequately quantifying the goal of measuring pollutant reductions.
>
> The NWQC discussed several important elements to enhance the Proposition 84 grant program monitoring components. These elements included: 1) a cohesive, question-driven monitoring program; 2) a unified monitoring design that ensures comparability in sampling, data analysis, and information management; and 3) a person or group responsible for coordinating, collating, assessing and reporting on the Proposition 84 monitoring effort. A clear statement of objectives needs to be composed so as to provide a vision for the Proposition 84 monitoring program. Monitoring experts universally agree that this is best achieved through the use of a well-formed and unambiguous monitoring question, much akin to a hypothesis for testing. This question should be crafted with care and agreed to by the Proposition 84 Task Force or other governing body.
>
> A centralized monitoring design should be created with sufficient scientific rigor that the monitoring question can be answered with a specified level of confidence. It is impossible to describe what this design may look like until the monitoring question is created, but there are certain elements that must be included. The first element should be some level of standardized sampling. Standardized sampling approaches ensure representativeness and reduce bias in data collection. For example, flow weighted composite sampling during wet weather runoff can produce very different results than grab sampling, even during the same storm event at the same site. Comparing data from different sampling approaches is inappropriate and could lead to faulty conclusions. Similarly, standardized quality assurance should be achieved through the laboratory analysis portion of a large-

Single, global point of entry: The Monitoring Council will maintain its main *My Water Quality web site*, complete the initial phase of development for the first three prototype portals, identify and begin needed enhancements to the prototype portals, and begin development of the next set of web portals. This will involve establishing and tasking workgroups, developing core management questions, and embarking on the other tasks described in Section 3.1 and Figure 9.

Coordination: Based on its experience with the three prototype portals, the Monitoring Council will develop a more detailed approach to coordination of those aspects of monitoring programs needed to support statewide assessments of the core management questions for each web portal. This will involve developing procedures to assist workgroups in using the monitoring program performance measures to identify data gaps and methods inconsistencies that undermine the breadth and comparability of monitoring data and assessment results. It will also require the Monitoring Council to develop procedures for resolving these issues and tracking workgroups' progress toward such resolution. At another level, the Monitoring Council will identify other sources of inconsistency that cut across individual web portals and that will require more direct involvement by the Monitoring Council to address.

Data management: The Monitoring Council will stay abreast of the State's developing data management policies and ensure adequate channels of communication are in place. The Monitoring Council will also use development of the prototype web portals to identify data management issues that must be resolved at a higher level, implement the initial phase of CEDEN, and identify policies and procedures needed to ensure that data management methods and the reporting web portals are both compatible with CEDEN and make effective use of its capabilities. In particular, the Monitoring Council will establish a data management workgroup with appropriate representation to achieve the goals outlined in Section 2.2.5. As with the theme-specific workgroups, the data management workgroup will operate under a charge established by the Monitoring Council.

3.2.2 Development: Years 2 – 8

The development phase will encompass 2010 to 2016 and will focus on fully implementing the policies and procedures defined in the Start-up phase, revising them as experience dictates, and moving into the routine development and publication of the series of theme-based web portals. An important function for the Monitoring Council during this phase will be to identify funding sources and obtain needed funding.

Organizational structure: The Monitoring Council will fully implement all policies and procedures developed during the Start-up phase, including establishing more formal working arrangements with the theme-specific workgroups, conducting routine outreach and relationship building/maintenance with existing and potential partners, and formalizing mechanisms for ensuring that coordination policies are fully implemented and complied with.

Monitoring program performance measures: The Monitoring Council will implement regular assessments of its web portals and their related monitoring and assessment programs and report the results to program staff, partners, and audiences. In addition, the Monitoring Council will routinely apply the performance measures to high priority themes and subthemes as they are being considered for development, in order to produce more detailed and accurate estimates of effort required for web portal development.

Single, global point of entry: The Monitoring Council will stabilize the design of its *My Water Quality* main portal entry website and complete the full implementation of all features intended to support data access, analysis, visualization, downloading, and other assessment applications. The second set of web portals will be completed and a series of workgroups established to continue the regular production, maintenance, and enhancement of additional web portals.

Coordination: The Monitoring Council will make the use of the performance measures to identify inconsistencies at the level of individual themes and web portals a standard workgroup practice, and will support, encourage, and require workgroups to resolve inconsistencies and will track each workgroup's progress toward needed coordination. The Monitoring Council will also work with its partners to develop more global monitoring guidelines that cut across multiple themes and will publish these standards to all workgroups and incorporate them into the performance measures.

Data management: In coordination with the Monitoring Council, SWAMP will complete the implementation of CEDEN, including the regional data centers and will publish documentation, policies, and procedures necessary for maintaining the system. The Monitoring Council will also ensure that the data management workgroup stays abreast of new directions in the State's data management policies, as well as of evolving monitoring requirements and users' needs that call for new system capabilities.

3.2.3 Long-term maintenance: Years 9 – 10 (and beyond)

The long-term maintenance phase will extend from 2017 forward and will focus on maintaining and adapting the policies, procedures, funding, and the technical infrastructure needed to ensure the web portals and theme-specific workgroups remain both operational and relevant. This will involve periodically reevaluating all aspects of the Monitoring Council's five-part solution to assess their continued relevance and performance.

3.3 Budget

Accomplishing the goals and activities outlined in Sections 3.1 and 3.2 will require funding at both the Monitoring Council and the theme-specific workgroup levels, that is, for both the left- and right-hand sides of Figure 8. The Monitoring Council's funding strategy is based on its experience with the three prototype portals as well as experience gained by other monitoring and assessment programs that have promoted coordination at regional and statewide scales.

3.3.1. Funding strategy

The Monitoring Council assumes that the bulk of funding for work on individual themes and subthemes (the left-hand side of Figure 8) will come from the participating entities. This bottom-up support will involve varying combinations of ongoing monitoring efforts, in-kind support, outside grants, offsets to existing monitoring requirements, and savings over time from improved coordination and efficiency. Funding for Monitoring Council activities represented on the right-hand side of Figure 8, namely coordinating across themes, developing and maintaining infrastructure, and catalyzing start-up efforts, could come from the budgets of Cal/EPA and the Natural Resources Agency, contributions or grants from other agencies, a portion of monitoring funds allocated to meet grant or regulatory requirements, and/or new fee structures intended to directly support the Council's activities. An important aspect of the Monitoring Council's role will be to ensure that theme-specific workgroups identify and achieve the cost savings possible through increased coordination, efficiency, and access to data.