FINAL

Charge to Macrophyte Science Work Group

Background

In 2009 the California legislature passed the Delta Reform Act creating the Delta Stewardship Council. The mission of the Council is to implement the coequal goals of the Reform Act and provide a more reliable water supply for California while protecting, restoring, and enhancing the Delta ecosystem. The Council wrote and adopted a Delta Plan in 2013 to implement these goals. Chapter 6 of the Delta Plan deals with water quality and contains recommendations to implement the coequal goals of the Delta Reform Act. Recommendation # 8 states, in part,

> *"…the State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta … by January 1, 2014. Studies needed for development of Delta… nutrient objectives should be completed by January 1, 2016. The Water Boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, the Delta… by January 1, 2018.*

Potential nutrient related problems identified in the Delta Plan for evaluation are:

1. Decreases in algal abundance and shifts in algal species composition,
2. Increases in the abundance and distribution of macrophytes, including water hyacinth and Brazilian waterweed,
3. Increases in the magnitude and frequency of cyanobacteria blooms

This charge addresses issue #2, assessing whether the observed increase in the abundance and distribution of macrophytes in the Delta is the result of long term changes in nutrient concentrations and whether management of nutrient loads can remedy the problems associated with macrophytes.

In the spring of 2014 Water Board staff wrote a new five-year Delta Strategic Work Plan to help prioritize Delta activities. The five-year plan was presented as an information item at the February 2014 Board meeting. Item five in the Strategic Plan lays out tasks, schedule and deliverables to begin implementing the nutrient recommendations in the Delta Plan (Figure 1). The Strategic Plan included the formation of a Technical Advisory Committee and a Stakeholder Advisory Group (which was later combined into the Stakeholder and Technical Advisory Group

or STAG) to help respond to Delta Plan recommendations and to identify additional issues of concern. The Water Board is also forming several Science Work Groups to help develop white papers on the three potential nutrient related problems. White papers from these groups may include recommendations for research to resolve outstanding questions about the efficacy of nutrient management to control macrophytes. These recommendations will be incorporated into a Nutrient Research Plan. Draft white papers and a draft Nutrient Research Plan will be available for review by the STAG and the State Board's Independent Science Review Panel in 2015. A final Nutrient Research Plan addressing all review comments is anticipated to be completed and presented as an information item to the Central Valley Regional Water Board and, if requested, the Delta Stewardship Council in 2015.

The State Water Resources Control Board contracted through the Southern California Coastal Water Research Project with Dr. Katharyn Boyer, San Francisco State University, to write the macrophyte white paper. A draft outline of the white paper is included as Appendix A. Dr. Boyer is scheduled to complete a first draft of the paper in early 2015 and be available to discuss it shortly thereafter.

Charge to Science Work Group

The charge to the Science Work Group is to review and comment on the draft white paper. The Work Group is intended to be a group of experts who will vet the conclusions of the white paper and bring to the attention of Water Board staff and to Dr. Boyer any peer reviewed or grey literature that either contradicts or extends the conclusions in the white paper. The Science Work Group is also charged with preparing a prioritized list of recommendations for future research addressing whether ambient nutrient concentrations contribute to the present macrophyte problem and whether nutrient management will reduce the severity of the aquatic weed problem. The prioritized list of recommendations for future research from this and other Science Work Groups will be included in the Nutrient Research Plan. The White Paper and Research Plan are intended to provide the rationale and roadmap for future research to resolve outstanding issues about the need for nutrient management to control the abundance and distribution of Water Hyacinths and Brazilian Waterweed.

Evaluation Process

Three sessions are envisioned for the Macrophyte Work Group. It is hoped that all members will be able to participate in person at all meetings. However, if not, a Web Ex will be arranged.

First Meeting The primary purpose of the first meeting is for the Macrophyte Science Work Group to review and provide comments on the white paper. At least two weeks prior to the first meeting, Dr. Boyer will circulate a draft of her paper and make available in PDF format all key references in the report. At the meeting Dr. Boyer will summarize her findings in an oral report. The presentation will include a conceptual model of factors controlling macrophytes in

the Delta and a list of information gaps and recommendations for future research. The Work Group will evaluate these findings and determine whether:

(1) All the major water quality problems caused by the proliferation of Water Hyacinth and Brazilian Waterweed in the Delta have been identified.
(2) All physical and biological factors that influence the abundance and distribution of these invasive aquatic weeds have been identified.
(3) Review the evidence that these aquatic weeds are sensitive to changes in nutrient concentrations. In particular, document the results of studies demonstrating that changes in ambient nutrient levels either decrease or do not decrease the abundance and distribution of these aquatic weeds.
(4) The white paper findings are fully supported by the literature and that there is no additional unreferenced information that either supports or refutes the findings.
(5) The prioritized list of nutrient recommendations include all questions that need to be resolved before it can be concluded that nutrient management will reduce the severity of the invasive aquatic weed problem in the Delta.

At the last STAG meeting Stakeholders reviewed the charge and suggested changes in the charge and additional questions for the Science Work Group. The Science Work Group should, to the maximum extent possible, address these concerns while still answering the basic charge to the group. One stakeholder commented:

> "*The charge to identify "future research addressing whether ambient nutrient concentrations contribute to the present macrophyte problem and whether nutrient management will reduce the severity of the aquatic weed problem" needs to be sharpened. The question is not whether nutrient concentrations "contribute" and whether management can "reduce the severity"; instead, the management-relevant questions are:*
>
> 1) *Is nutrient management necessary for successful management of macrophytes (i.e. can macrophyte management be successful without nutrient management)? If "yes" what level of nutrient management is the minimum needed for success?*
> 2) *If the answer to 1 is "yes", then is nutrient management alone sufficient to control macrophytes?*
> 3) *What combinations of management actions (including different levels of nutrient management and non-nutrient management strategies) are likely to achieve equal levels of benefit with regard to macrophyte management? What are the likelihoods, costs, and potential unintended consequences of these different strategies?*
>
> *#3 is particular important for developing risk/reward and cost/benefit analysis of different approaches.*
>
> *All of the above, I suspect, will require development in advance of goals and objectives (specific, measureable, achievable, relevant, and time-bound targets; S.M.A.R.T.) for*

macrophyte management so that we can evaluate which strategies are likely to succeed".

Another Stakeholder noted that in 2009 CALFED convened an Independent External Review Panel to prepare a framework for research to address the role of Ammonia/um in the Bay Delta Estuary[1]. Study topics #3 and #5 dealt with macrophytes. Topic #3 recommended research to determine how stands of macrophytes affect nutrient dynamics in surrounding waters. Topic #5 suggested that research be conducted to determine how stands of macrophytes affect higher trophic level organisms, including POD species. The Stakeholder asked what is now known about these issues and should their evaluation remain a high priority research topic.

A modelling work group is also being formed to provide advice on development of coupled hydrodynamic water quality models to better inform future water quality in the Delta. The Macrophyte Work Group is asked to review the charge to the Modeling Group and provide modelling related questions to help inform the understanding of how nutrients and other physical and biological factors influence the abundance and distribution of macrophytes. These questions will be forwarded to the Modelling Group and are intended to help them recommend the best suite of models for use in the Delta.

Second Meeting The purpose of the second meeting is to continue the discussion of the white paper with an emphasis on the review and prioritization of a list of recommendations for follow up studies. Comments from the Macrophyte Work Group may be provided orally or in writing to Dr. Boyer and to Regional Board staff. These comments along with those of the STAG and the State Board Independent Science Review Panel will be addressed in the final white paper.

Third Meeting Comments on the White paper and on the list of recommendations for future research are expected from the Macrophyte Science Work Group, STAG and State Board Independent Science Review Panel. A final session may be scheduled, at the discretion of the work group, to review how all the suggested changes have been addressed in the White Paper.

Products of the work group process will include:

- Science Work Group white paper and prioritized research recommendations.
- STAG comments and recommendations.
- State Board Independent Science Panel comments and recommendations
- Final white paper and research plan after comments from the State Board Independent Science Panel and STAG have been received and addressed.

This package is intended to support the transparency of the process and ensure that Regional Water Board staff and other interested parties have a complete suite of information needed for their considerations and decision making.

[1] http://www.science.calwater.ca.gov/events/workshops/workshop_ammonia.html

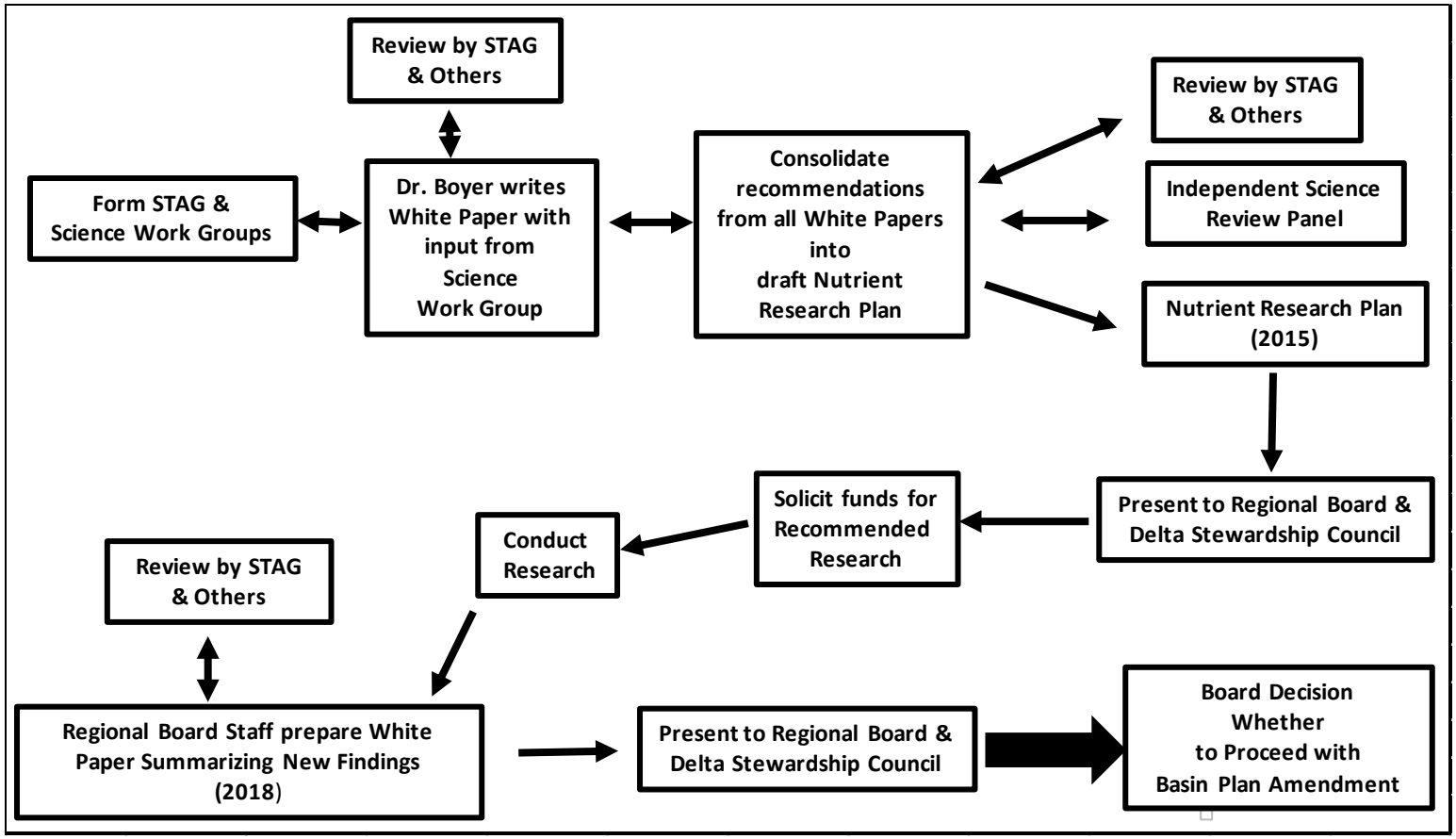

Figure 1. Tasks and schedule for developing and implementing the Nutrient Research Plan outlined in the 2014 Delta Strategic Work Plan. Staff will solicit input at a 2018 Regional Board meeting whether nutrient objectives are needed for the Delta and whether staff should begin their development.

Table 1 List of individuals for the Macrophyte Science Work Group

Individual	Agency	Macrophyte Work Group
Louise Conrad	Department of Water Resources	X
Shruti Khanna	LAWR, U C Davis	X
Patrick Moran	USDA, Agricultural Research Service	X
John Madsen	U C Davis/USDA, Agricultural Research Service	X
Kathy Boyer	San Francisco State University	X
Martha Sutula (Facilitator)	Southern California Coastal Water Research Project	X
John Durand	U C Davis	X
Diana Engle	Larry Walker Associates	X
Jeff Cornwell	Horn Point Laboratory, U Maryland	X

Key: X= Individual has agreed to participate in the work group.

Appendix A

Rooted and Floating Macrophyte Review Outline

05-21-2014 Draft

Katharyn Boyer (SFSU) and Martha Sutula (SCCWRP)

Questions to address in the review:

1. What are the general conceptual models of rooted or floating aquatic vegetation in relation to both impacts to and support of beneficial uses?
2. What is known about the spatial and temporal trends in floating and rooted aquatic vegetation in the Delta?
3. What is the relative importance of nutrients and organic matter accumulation versus other factors in promoting observed trends in floating and rooted aquatic vegetation in the Delta?
4. What are the key data gaps and recommended future studies?

Review Outline

1. Executive Summary
2. Introduction, Purpose of Review, and Key Questions
3. General Ecology and Trends in the Distribution of Floating and Rooted Aquatic Vegetation in the Delta
    a. Definitions
    b. Overview of genus/species found in the Delta
    c. Habitat types in which they are characteristically found
    d. Spatial and Temporal trends in their distribution and abundance
4. Conceptual models of linkage with beneficial uses (if there is a problem—what is it?)
    a. General conceptual model
        i. Organic matter subsidy/accumulation
        ii. Limitation of phytoplankton and native SAV
        iii. Trophic support
        iv. Habitat alteration
        v. Navigation and industry
        vi. Aesthetics
    b. Documentation of adverse effects in the Delta
5. Factors contributing to spread of floating and rooted aquatic vegetation in the San Francisco Estuary-Delta region
    a. Conceptual models of growth, propagation and environmental characteristics that enhance or limit growth
    b. Relative importance of nutrient subsidies versus other factors in promoting observed trends
6. Summary of key data gaps and research needs