

**Delta Science Program Independent Review Panel**  
**for the**  
**Feasibility Study of Shore-Based Ballast Water Reception and Treatment Facilities in**  
**California**  
**Report 1: Feedback on Literature Review and Case Study presentations**

## **1 Introduction**

In mid-2015, the Delta Stewardship Council (DSC) convened an independent review panel (Panel) to provide expert evaluation of a feasibility study of the potential use of shore-based ballast water reception and treatment facilities in California (CA) to meet CA's interim performance standards for the discharge of ballast water (Title 2 CA Code of Regulations Section 2293). The purpose of the feasibility study is to meet a mandate in the Marine Invasive Species Act for the State Lands Commission to identify and conduct research about the means by which to reduce or eliminate a release or establishment of nonindigenous species by shipping vessels. The study, initiated in mid-2015, will culminate in a report that is based on verified, substantiated publically-available data and documents and includes detailed analyses (cost, logistics, etc.). The report will detail the potential of shore-based ballast water treatment to enable regulated vessels to comply with CA's interim performance standards and will contribute to the understanding of a potentially broader and more effective range of treatment options.

### **1.1 Panel Membership<sup>1</sup>**

The five members of the interdisciplinary panel (listed below) bring together expertise in chemistry, ecology, fisheries and aquatic biology, natural resources economics, ship operations, environmental compliance, treatment technologies, and environmental engineering.

- William (Bill) J. Cooper, Ph.D., University of California, Irvine, (Panel Chair)
- Audrey D Levine, Ph.D., P.E., (Lead Author)
- Christine M Moffitt, Ph.D., University of Idaho
- Steven C. Hackett, Ph.D., Humboldt State University
- Rick Harkins, P.E.

### **1.2 Charge Questions**

The DSC Science Program asked the Panel to review materials and participate in three public meetings. The Panel was asked to consider thirteen charge questions:

1. Does the literature review report cover all pertinent information related to the feasibility of shore-based treatment facilities?

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<sup>1</sup> <http://deltacouncil.ca.gov/feasibility-study-shore-based-ballast-water-reception-and-treatment-facilities-california-0>

2. Do the findings render adequate insights to understanding vessel types, treatment plants and facilities?
3. Does the assessment of case studies provide adequate knowledge to assess feasibility of ballast water transfer, storage and treatment?
4. Are site descriptions complete, are they representative of the range of port facilities in California, and do they contain the necessary information from which to evaluate the application of a given engineering solution and their potential of meeting California's interim standards?
5. Are potential engineering solutions clearly defined and described?
6. Are the evaluation criteria clearly defined and described?
7. Are linkages between elements of the report clear?
8. Is the report of sufficient robustness and scientific quality that it appropriately identifies and considers applicable technologies, economic implications, and considers applicable solutions?
9. What, if any, additional engineering solutions should be considered?
10. What, if any, additional evaluation criteria should be considered?
11. Are the engineering solutions described in the report feasible to implement?
12. Do the recommendations and implications fully answer questions related to feasibility of shore-based treatment facilities?
13. If not, what needs to be considered to improve the feasibility analysis of the potential solutions?

### **1.3 Report context**

The initial public meeting for the feasibility study was held on October 6, 2015 in Sacramento, CA and focused on the literature review, the case study selection process, public comments, and next steps. Overall, the Panel is impressed with the activities that have been completed to date. This report summarizes the Panel's observations, findings, and recommendations. This report partially addresses charge questions 1 and 4.

## **2 Literature Review**

The draft literature review encompassed thirty documents that have been produced over the last ten years and provided a detailed summary of six studies. The Panel has several observations and recommendations regarding the literature review:

1. Scope: While the Panel understands the need to confine the review to a finite number of documents, ballast water issues have been investigated for decades. There are numerous studies that pre-date the ten-year time period and could offer insight specific to California. The Panel suggests that the literature review be expanded beyond the arbitrary cut-off of ten years. In addition, there are numerous references in the peer-reviewed literature that address specific ballast water components (e.g. capture, transport, pumping, treatment, vessel modifications, life cycle analysis, etc.). A more comprehensive review of the individual topics could yield relevant information.
2. Report organization/utility: Section 2 of the report, entitled "Feasibility Studies of Shore-Based Ballast Water Treatment" summarizes the six selected references one-by-one. However, the information is presented somewhat at "face-value" and lacks a critical review and analysis. The

level of detail in each of the sub-sections is inconsistent, making it difficult to locate specific information. It would be useful to organize this chapter around the main themes and provide a critical review of the state-of-knowledge around each theme. The report-specific information can be provided in an Appendix. The summary tables are useful, but also lack a critical review.

3. Specific questions: The Panel raised a number of specific questions related to the information presented in the literature review and recommends consideration of several key issues.
  - a. Terminology: The use of the term “filtrate” (page 3, 35, 56, 65) is incorrect. Filtrate commonly refers to the filter effluent and, as such, refers to the usable water, not the waste-stream or “reject” water.
  - b. Cross-contamination: Has any relevant information been reported in the literature on mitigating cross-contamination due to co-mingling of water from different ports in the ballast tank of a ship? Are there any data on cross-contamination that has stemmed from barge or truck transport of ballast water to/from shore-based treatment or other types of ballast water exchanges?
  - c. Salinity: From a California perspective, it would be useful to evaluate the range of salinity that needs to be accommodated by the ballast water systems that were reviewed. This topic was not addressed in the literature review.
  - d. Data analysis: Are there any data in the literature that describe logistical approaches to managing incompatibilities between ballast flowrates and loading capacities? These issues need to be considered in scenarios where discharges will be routed to a vessel or truck. Can any logistical guidance be gleaned from the literature?
  - e. Regulatory arena: A review of current and projected global regulations would be useful in framing policy-relevant questions for the case studies.
  - f. Monitoring and inspection: A review of methodologies that have been implemented for monitoring (compliance and performance), spill mitigation/response, and inspection would be useful for documenting feasibility and potential challenges.
  - g. Technology scale-up: A review of scale-up information on specific technologies would be useful, particularly with respect to the shore-based technologies that are the focus of this project.
  - h. Future directions: The literature review should also look at emerging directions in the shipping industry and not only focus on retrospective case studies. For example, how will the Panama Canal expansion impact the quantity and quality of ballast water? How will changes in vessel designs affect ballast water management? What about increases in LNG? What is potential for use of alternative water sources (e.g. stormwater, reclaimed water) for ballast water? Is there potential to recover water or resources from ballast water?

### 3 Case Studies

Five case study sites were downselected from an initial survey of thirty-five California seaports, six vessel types, and five treatment approaches (1050 combinations). The rationale for selecting the five case study sites included the cumulative volume of ballast water discharges (44% of all discharges in California), geographical distribution, representation of all six vessel types, and diversity of scale,

activity, discharge quantities, flowrates, water “type,” and ecology. The Panel supports the concept of conducting Case Studies and offers several recommendations about the site selection and scope.

1. Downselection methodology: Given the time and resource constraints, the Panel recognizes that the maximum feasible number of case studies is likely to be five. However, it is not clear that the selected five study sites will provide the specific information needed for this project. It is also not clear on how the percent of ballast ships was calculated and if future shipping projections were considered. It would be useful to define the specific questions that need to be answered and then determine which combination of case studies is best suited to answering the questions. The methodology and criteria used for selecting the five case study sites should be clarified, perhaps using a multi-criteria decision analysis process. Consider the feasibility of a tiered approach for the case studies instead of obtaining parallel data at each site.
2. Number of vessels: The case studies should be designed to consider 100% of the vessels that are handled by individual ports, to avoid introducing biases into the study results from skewed data. It is important to define the boundary conditions based on all of the vessels that call into individual ports to accommodate the role of other contamination sources (e.g. hull fouling) in mass balance calculations.
3. Meta-analysis: Details are needed on how the data from the case studies will be integrated to inform the final analysis
4. Types of vessels: The rationale for selecting the types of vessels needs to be clarified. How will the results be applicable to recreational vessels, seasonal influx of cruise ships, specialty or tramp ships?
5. Business or enterprise models: Frameworks for business or enterprise models should be incorporated into the case studies. Competition among ports can be an important factor in the case study analysis. Consider how the fee structure impacts port activity.
6. Versatility to address heterogeneous vessels: Case studies should address ballast water treatment solutions that have the versatility to work for the full range of relevant vessel types utilizing a given port.
7. Port idiosyncrasies: Each port has unique docking facilities and numerous specific environmental, physical, and geographic characteristics that need to be considered in framing the case study activities.
8. Risk assessment: The use of a risk assessment approach could be valuable in framing the case studies and enabling cross-comparisons of results. Risk assessments could also be useful in identifying and prioritizing vulnerable environments/habitats.

## **4 Conclusions and Recommendations**

The Panel commends the project team for the work that has been completed to date. The Panel looks forward to further progress.