FY 22-31 PROGRAM PROPOSAL
DATA MANAGEMENT

Proposals requesting FY22 - 31 funding are due to shiway.wang@alaska.gov and elise.hsieh@alaska.gov by March 29, 2021. Please note that the information in your proposal and budget form will be used for funding review. Please refer to the Invitation for the specific proposal requirements for each Focus Area. The information requested in this form is in addition to the information requested in each Focus Area and by the Invitation. We may make inquiries regarding the project and proposer(s), including consulting with agencies or other parties that may be interested in this work. Please indicate below if your proposal contains confidential information.

Does this proposal contain confidential information? ☐Yes ☒No

Project Number* and Title

23120113 EVOSTC Data Management Program

Primary Investigator(s) and Affiliation(s)

Carol Janzen, Alaska Ocean Observing System

Rob Bochenek, Axiom Data Science

Date Proposal Submitted

Initial submission as part of the GWA LTRM Data Management Project, March 29, 2021;

Revised submission as a Data Management Program to include data management support for the GWA LTRM Program, continuing Non-Program Projects, and newly funded projects, September 7, 2021

Revised submission to reduce the Data Management Program budget relative to project funding recommendations following the October 13, 2021 Trustee Council meeting

Revised final submission to increase the Data Management Program budget in FY22 for the addition of one year for GWA-LTRM Project 22120114-N Long-term killer whale monitoring project following recommendations for the January 18, 2022 Trustee Council meeting

Nov 7, 2022: Revised final submission to increase the Data Management Program budget in FY23 for the addition of a second year for GWA-LTRM Project 22120114-N Long-term killer whale monitoring project following recommendations from the October 5, 2022 Trustee Council meeting

Project Abstract (maximum 300 words)

The abstract should provide a brief and concise overview of the overall goals of the project and provide sufficient information for a summary review as this is the text that will be used in the public work plan and may be relied upon by the EVOSTC Public Advisory Committee and other parties.

The *Exxon Valdez* Oil Spill Trustee EVOSTC (EVOSTC) requires a data management approach composed of methods covering the entire data lifecycle, from immediately after data collection, to long-term preservation, to discovery and reuse. Since 2012, the Alaska Ocean Observing System (AOOS) and its

technical partner, Axiom Data Science (Axiom), have provided data management services for both the "Long-Term Monitoring of Marine Conditions and Injured Resources and Services" Program (i.e., Gulf Watch Alaska (GWA)) and the "Herring Research and Monitoring" (HRM) Program. These two programs have leveraged the existing data management capacity of AOOS, and have also helped inform and improve the overall AOOS data management, access, and visualization tools. Beginning in FY20, AOOS and Axiom also began providing data management services for individual EVOSTC-funded Non-Program Projects (NPP) using the same approach and infrastructure that leverages the existing data management capacity of AOOS. Going forward in 2022-2031, the EVOSTC requested that a single program proposal be submitted for data management services to support the GWA and HRM Programs (now combined into a single program - the Gulf Watch of Alaska Long-term Research and Monitoring (GWA LTRM) Program), the continuing NPPs, and any newly-funded NPPs funded under the FY22-31 Invitation for Proposals. The AOOS-Axiom team and mature infrastructure remain best situated to continue providing data services to EVOSTC-funded programs and projects to maintain continuity and build upon the ongoing data management efforts. AOOS and Axiom Data Science propose to continue providing access to the tools and services for which the principal investigators (PIs) of the GWA LTRM Program and the continuing NPPs depend. Among these are the Research Workspace, a web-based data management platform; the AOOS Gulf of Alaska (GOA) Data Portal, where project data will be shared publicly; and the DataONE Member Node where final data sets will be archived for long-term preservation and broad access across multiple data repositories. Building upon these prior efforts, the AOOS-Axiom team is well poised to deliver continued success in facilitating the access and curation of EVOSTC data to support decision-making related to Spill affected ecosystems.

EVOSTC Funding Requested: Data Management Program* (round to the nearest hundred, must include 9% GA)

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$379,716	$394,207	$411,819	$401,524	$373,476	$1,960,742
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$328,449	$335,485	$344,195	$351,708	$360,903	$1,720,740
				FY22-31 Total	*$3,681,482*

**If the amount requested here does not match the amount on the budget form, the request on the budget form will considered to be correct.*

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$0	$0	$0	$0	$0	$0
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$0	$0	$0	$0	$0	$0

FY22-31 Total	*$0*

1. EXECUTIVE SUMMARY

Please provide a summary of the program including overall goals and program history if this is a continuing project.

Following the 1989 *Exxon Valdez* oil spill ('Spill'), several decades of scientific research has occurred to monitor the impacts and recovery to the Gulf of Alaska region and its resources. As time has lapsed, ecosystem impacts directly related to the Spill have become more challenging to detect due to regime shifts, natural variability, climate change, and other anthropogenic changes. Data collected through long-term observations and focused research are fundamental to inform management decision-making, to help with determination whether changes are related to natural or Spill-related factors, and to indicate what potential recovery actions may be needed. To address these challenges and facilitate the recovery of injured resources, scientific and resource management communities need access to the most current scientific information and environmental intelligence tools to help make sound decisions.

In 2012, EVOSTC awarded the Alaska Ocean Observing System (AOOS), with support from the National Center for Ecological Analysis and Synthesis (NCEAS), a data management contract entitled "Collaborative Data Management and Holistic Synthesis of Impacts and Recovery Status Associated with the *Exxon Valdez* Oil Spill." In that project, AOOS and its partners successfully designed, developed and maintained an interactive web-based data management system to support the data management needs of the Gulf Watch Alaska (GWA) and Herring Research Monitoring (HRM) Programs and the EVOSTC. Building upon the prior data management success, AOOS and its technical partner Axiom Data Science (Axiom) were again selected as the Data Management Program provider from 2017-2021 to support continued data management activities for the GWA and HRM Programs, which included maintaining and enhancing the data management framework in response to the relative maturity of the GWA and HRM Program data sets. Starting in FY20, the Data Management Program was further expanded to provide data sharing and archiving support and services to additional EVOSTC-funded science and technical projects that were not part of the GWA or HRM Programs. Three such projects, referred to as continuing "Non-Program" Projects (NPPs), are currently managed by the AOOS-Axiom team and will continue through FY25. Those projects include the FY21 projects 21110853 Pigeon Guillemot restoration project (2012-2019 legacy data 5-years new data; FY2020-2024); 21200127 Gulf Watch ocean acidification monitoring (FY2020-2022); and 21210128 Status and trends of EVOS injured seabirds in the Kenai Peninsula coast and Kachemak Bay (FY2021-2025). These same services for data management support will be extended to newly-funded science and technical programs and projects that were successfully awarded under the FY22-31 Invitation for Proposals.

The FY22-31 Data Management Program proposal responds to the EVOSTC's continued need for a cost-effective data management program that maintains continuity and builds upon the efforts of the prior EVOSTC data management investments. AOOS and Axiom are best situated to provide that continuity to all EVOSTC-funded programs and projects by leveraging the data management system that was instituted over the prior 10-year efforts. In this proposed work, this data management system will be

maintained and augmented to enhance the accessibility of data and products generated by the EVOSTC-funded GWA LTRM Program and continuing and new NPPs to ensure they are readily available to general science and natural resource management communities, both now and into the future. Refer to Attachment 1 for a list of LTRM Program and continuing and new NPPs that are supported by the Data Management Program. This list may be subject to change relative to future Council funding decisions.

The goal of the 2022-2031 Data Management Program is to provide critical data management to support all GWA LTRM Program projects and the individual NNPs in order to assist study teams in efficiently meeting their objectives and ensuring data collected or consolidated through the effort is organized, documented, and available for their use and for future use by the larger scientific community. The AOOS-Axiom team proposes to be successful in meeting the goal of this project by leveraging the extensive cyberinfrastructure and data management capacities of both Axiom and AOOS, and utilizing the existing, collaborative relationships with the GWA LTRM Program and NPP PIs to ensure continuity in the data collected across all efforts. Specifically, this goal will be achieved with the following objectives:

Objective 1. Initiate data management services and oversight for the GWA LTRM Program and Non-Program projects.

Objective 2. Standardize and provide access to data sets from the prior EVOSTC-funded efforts for continuity and integration.

Objective 3. Facilitate, monitor and evaluate regular data submissions and metadata generation in the Research Workspace.

Objective 4. Provide, maintain and modify technical infrastructure for user groups to access information produced or processed by the GWA LTRM Program and Non-Program projects.

Objective 5. Publish and promote data collected by the GWA LTRM Program and Non-Program projects, making them available for research, management and general audiences.

Objective 6. Execute management, user feedback and internal and external communications related to the GWA LTRM Program and Non-Program project data and data products.

Objective 7. Ensure long-term preservation and dissemination into publicly accessible repositories at the term completion.

The Data Management Program prioritizes data preservation and accessibility to scientific and resource management communities. This will be achieved through support for data submission and organization, metadata generation, and data transfer among study teams to assist with cross-project analysis and synthesis. Axiom data analysts and domain experts will continue to review metadata and data structure formats produced from project data collection activities and advise study team members in best practices for archive-ready data formats, as well as metadata authoring. Axiom software engineers will also maintain and enhance, as necessary, existing web-based tools to improve the discoverability of EVOSTC-funded project data both internally within the Research Workspace and externally through

publicly-accessible data repositories, including the AOOS Gulf of Alaska (GOA) Data Portal and the DataONE archive. This data curation process has been designed to meet the requirements of the EVOSTC as specified in the Data Management sections in the EVOSTC Invitation for Proposals 2022-2031. This includes the transfer of EVOSTC-funded project data to the EVOSTC storage resources at the completion of this funding term. While these tools will build upon existing systems that were developed with previous funding from multiple sources (including the EVOSTC), they are sufficiently scalable to address any new developments within the GWA LTRM and NPP Programs and the other focus areas, and to meet the environmental intelligence needs of researchers and resource managers required for an effective understanding of ecosystems affected by the Spill.

The partners in the Data Management Program include: 1) the Alaska Ocean Observing System (AOOS), which will serve as the overall program management lead and will contribute its extensive data resources and infrastructure; and 2) Axiom Data Science, which will serve as the technical data management lead and provide data management support for individual GWA LTRM and Non-Program projects. The project PI (Dr. Carol Janzen, AOOS) will serve as the liaison for direct communications with the GWA LTRM Program and project lead(s) and the EVOSTC. She will work closely with the Axiom lead (Mr. Bochenek) to ensure reporting and meeting requirements occur on-time and as per instructed in the Program Invitation. The entire data management team will work to serve a diverse group of the GWA LTRM Program and NPP PIs as they contribute scientific data and information to support decision-making related to Spill affected ecosystems.

2. RELEVANCE TO THE INVITATION

Discuss how the proposed project addresses the overall project goals and objectives. Does this project address the purpose of the EVOSTC data policy, which is to facilitate full and open access to, and confident use of, the data and information used in and produced by programs of the Exxon Valdez Oil Spill Trustee EVOSTC. Describe the results you expect to achieve, the benefits of success as they relate to the Invitation Focus Areas, and the potential recipients of these benefits.

The work planned in this Data Management Program proposal is relevant to the EVOSTC 1994 Restoration Plan priorities for "strategies that involve multidisciplinary, interagency, or collaborative partnerships" and for efforts that will "include a synthesis of findings and results, and will also provide an indication of important remaining issues or gaps in knowledge" (Restoration Plan p. 16).

With a rapidly changing ecosystem in Alaska, new challenges exist for gaining an effective understanding of the effect of the Spill and the recovery status of affected ecosystems. Ready access to up-to-date scientific information is critical for detecting and understanding ecosystem changes to facilitate the recovery of injured resources and services. Researchers, resource managers, and restoration workers are among those needing this information to aid their decision-making, and will benefit from the ongoing success of this Data Management Program. Through extending the capacity of the AOOS data management system, we aim to meet the needs of the EVOSTC-funded researchers as well as other stakeholders, including agency managers, policy makers, and local communities, thereby enhancing the value of the EVOSTC's investment in research and monitoring.

This project will provide critical data management support to PIs of GWA LTRM Program and NPPs to assist study teams in efficiently meeting their objectives and ensuring data collected is organized, documented, and available for their use and for future use by general science and natural resource management communities. Using the significant data management experience of AOOS and Axiom, these objectives will be addressed through a combination of advanced cyberinfrastructure, human expertise, and collaborations developed over the previous ten years supporting EVOSTC data management activities. This work will continue to implement a full-lifecycle data management system that replicates and enhances a technical infrastructure system that has been successfully used by study teams. The ultimate outcome is a public archive of organized, documented EVOSTC-funded scientific data sets from the Gulf of Alaska ecosystem that can be used in perpetuity by future generations of scientists and resource managers.

In the Data Management section of the 2022-2031 Proposal invitation, the stated EVOSTC goal for Data Management is to ensure that critical data and products for all EVOSTC-funded programs and projects are available to the scientific and natural resource management communities, both now and into the future. This goal aligns well with the AOOS mission to address regional and national needs for ocean information by gathering specific data on key coastal and ocean variables, and ensuring timely and sustained dissemination and availability of data to stakeholders that include scientists, natural resource managers, and the public. AOOS is the recognized Alaska regional component of the national Integrated Ocean Observing System (IOOS), a program within NOAA's National Ocean Service, and AOOS serves as the regional Data Assembly Center (DAC) for oceanographic and coastal data and information products in Alaska waters. Effective 2017, AOOS received national certification as a Regional Information Coordination Entity (RICE) for meeting federal standards for data gathering and management. Being certified by NOAA as meeting federal standards for data gathering and management means that ocean, coastal, and Great Lakes data and information from the non-federal IOOS Regional Association System partners can now be used with the same confidence and assurances as federal data. The data management standards upheld by AOOS as a regional DAC and certified RICE align with the EVOSTC data policy to facilitate full and open access and confident use of the data and information used in and produced by programs of the EVOSTC.

Within the scope of the invitation, multiple reasons exist for sharing and archiving data, including reuse of historical data for new research, data synthesis for long time series analyses, reproducibility of results to validate research findings, as well as improved discovery through greater reliance on scientific information. The proposed continuance of this Data Management Program will provide benefit to GWA LTRM and NPP researchers through access to intuitive tools and accessible staff to support the ingestion, organization, sharing, documentation, discovery, access, and reuse of a complex array of data types related to the Spill-affected ecosystem.

Through the data management approach detailed in this proposal, we expect to achieve: 1) a continued successful track record making all EVOSTC-funded data publicly-accessible through AOOS data discovery portals and federated repositories; 2) ongoing engagement with researchers and other stakeholders that will facilitate an expansion of the user context of data sets collected by EVOSTC-funded programs and projects; and 3) sustained data management efficiencies based on nearly two decades of developing

expertise managing and curating data collected by large, multidisciplinary research and monitoring programs.

3. PROJECT PERSONNEL

*Provide the names of key personnel involved and their role(s) in the program including their roles as they relate to the program and the percentage of their time that will be dedicated to the program. Attach CVs to the end of the proposal. Each CV is limited to **two** consecutively numbered pages and must include the following information:*

- *A list of professional and academic credentials, mailing address, and other contact information (including e-mail address)*
- *A list of all persons (including their organizational affiliations) in alphabetical order with whom you have collaborated on a project or publication within the last four years. If there have been no collaborators, this should be indicated.*

Given the increasing scope of the Data Management Program there are two contractual Data Management Program leads sharing the respective oversight responsibilities for the 2022-2031 EVOSTC Data Management Program. The organizational and respective roles of the leads are 1) AOOS – to provide overall coordination and communications for the Data Management Program with the EVOSTC and data management coordination for the GWA LTRM Program; 2) Axiom Data Science - to provide technical day-to-day data management of all EVOSTC-funded programs and projects, and data management coordination for the NPPs.

The AOOS lead for the Data Management Program will be Dr. Carol Janzen, Director of Operations and Development at AOOS. Dr. Janzen served as the Data Management Program PI during the previous GWA and HRM Program and NPP five-year efforts, and will continue to serve as the Data Management Program team liaison with the EVOSTC and the GWA LTRM Program leads. She will also be responsible for contractual reporting of the GWA LTRM Program data management and oversee that the GWA LTRM data management objectives are being met. Though Dr. Janzen will not be directly responsible for the NPPs data management component coordination and contractual reporting, she will continue to provide updates on the NPPs progress (both continuing and new) through the life of each project for the annual Data Management Program reports, work plans, and activities. Dr. Janzen will coordinate closely with the Axiom Data Management Program lead PI (Rob Bochenek) and staff, as well as with the leads from the GWA LTRM Program. Dr. Janzen has her Ph.D. in Oceanography and over three decades of experience in this field, including managing environmental monitoring programs for private industry and State agencies, and serving as a lead PI, research coordinator, and project manager in the academic and private industry sectors. She has extensive internal and external communications and customer liaison experience, both nationally and internationally. In her current position, Dr. Janzen reports directly to the AOOS Executive Director, and is responsible for administrative oversight of AOOS program objectives and activities, as well as serving as the Program Manager and lead PI on multiple external grants. We are requesting salary for 8% of Dr. Janzen's time for this effort, which amounts to about 4 weeks annually.

The Axiom co-lead for the Data Management Program will be Axiom's Information Architect and CEO, Rob Bochenek. Mr. Bochenek will provide the day-to-day technical data management oversight of the EVOSTC-funded-programs and projects, supervising Axiom's data management activities, infrastructure, and staff.

He will also be responsible for coordination with the new EVOSTC NPP PIs on EVOSTC data management requirements, which mirror those for the GWA LTRM Program. Mr. Bochenek will oversee and report out on each NPP project's data management objectives to ensure they are being met. He will communicate all EVOSTC-funded project data management updates directly to the AOOS lead Dr. Janzen for inclusion in EVOSTC Data Management Program reports, workplans, presentations, and communications. He will also communicate directly with EVOSTC staff as needed on NPP data management issues, and will be responsible for contractual reporting on the NPPs. Mr. Bochenek has 20 years of data management experience and 15 years of experience managing the company, staff, and projects, and maintains the vision and direction of Axiom's technical developments as per the project scope and according to EVOSTC data requirements. We are requesting salary for 8% of Mr. Bochenek's time for this effort, which amounts to about 4 weeks annually. A list of the data management team involved in this project is provided in Table 1. The CVs for senior personnel are in Attachment 2.

Table 1. The Data Management Program key personnel listed by name, organization, title, program duties, and percent of time dedicated to the program.

Name	**Duties**	**% FTE**
Carol Janzen, AOOS, Director of Operations and Development	Provide primary coordination for EVOSTC Data Management Program; ensure objectives of the GWA LTRM data management component are being met; oversee data management coordination and contractual reporting for the EVOSTC GWA LTRM Program; prepare, review and submit reports, workplans and funding requests for the EVOSTC Data Management Program; primary liaison and spokesperson to communicate, work with and respond to data management requirements of the EVOSTC; represent the Data Management Program at meetings; inform EVOSTC and GWA LTRM leads on NPPs data management efforts; facilitate cost-effective technically supportive funding required by project team	8.0
Rob Bochenek, Axiom, Information Architect	Provide technical oversight for EVOSTC Data Management Program; ensure objectives of the NPPs data management components are being met; oversee data management coordination and contractual reporting for the EVOSTC NPPs; work closely with AOOS to provide data management progress updates for all EVOSTC-funded projects; support reporting, workplan and funding request activities; facilitate cost-effective technically supportive funding required by project team; facilitate EVOSTC data management activities with AOOS	8.0

Name	Duties	% FTE
Stacey Buckelew, Axiom, Data Coordinator	Interface with Program Managers and PIs; track data submissions and metadata authoring; provide Research Workspace and metadata support; curate final data sets; write reports and participate in meetings; participate in meetings; coordinate EVOSTC data management activities with AOOS	30.0
Chris Turner, Axiom, Data Librarian	Interface with project PIs; facilitate curation of data sets and provide guidance on data structures; track data submissions and metadata authoring; provide Research Workspace and metadata support; maintain Axiom's metadata editor tool; manage data curation process with DataONE and issuance of digital object identifier (DOIs); participate in meetings	30.0
Adrienne Canino, Axiom, Data Librarian	Interface with project PIs; facilitate curation of data sets and provide guidance on data structures; track data submissions and metadata authoring; provide Research Workspace and metadata support; maintain Axiom's metadata editor tool; manage data curation process with DataONE and issuance of digital object identifier (DOIs); participate in meetings	30.0
Shane St. Savage, Axiom, Software Architect	Maintain and enhance the GOA Data Portal to support continuity of data sets, including historical data and data collected during the previous efforts; enable automation of data audits and submission pathways	12.0
Karl Hiner, Axiom, Senior Software Engineer	Maintain and enhance the Research Workspace to meet needs of the GWA LTRM Program and projects; enable automation of data audits and submission pathways; expose DOIs in the GOA Data Portal	18.0

4. PROJECT ADMINISTRATION

Provide an administrative plan for overall program management including an organizational chart. At a minimum the plan should include a list of what services are covered by your indirect rate (clearly report what this rate is); a schedule for the production and implementation of data and reporting policies which must include a plan for addressing non-compliant PIs and programs; and a listing of any costs and staff time associated with meetings.

Administrative Plan

Both AOOS and Axiom Data Management Program leads will be responsible for responding to data management requirements of the EVOSTC. An organization chart summarizing the project management structure is shown in Figure 1 and described below.

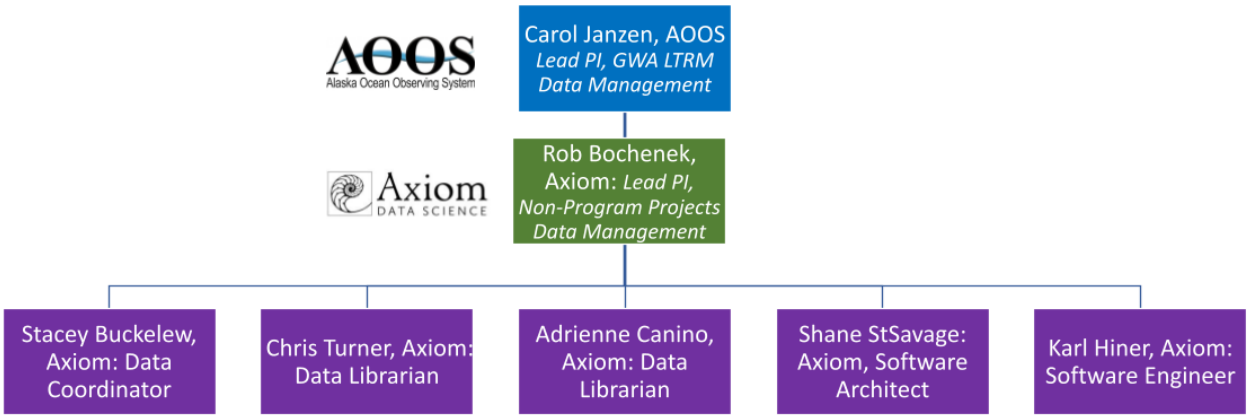


Figure 1. An organizational chart of the Data Management Program management structure.

AOOS is the logical entity to head this program since its mission is to address regional and national needs for ocean information, gather specific data on key coastal and ocean variables, and ensure timely and sustained dissemination and availability of these data to stakeholders that include scientists, natural resource managers, and the public. AOOS is governed by a board made up of federal and state agency and academic and research institution leads in Alaska, as well as representatives of tribal entities, NGOs and the private sector.

Axiom Data Science serves as the technical manager of the AOOS data management system. Axiom is mission-oriented and focused on developing scalable cyberinfrastructure which can be leveraged across a variety of users, clients, and institutions. Axiom team is comprised of 22 members, including data librarians, data coordinators, data analysts, data ingestion experts, full-stack software engineers, system architects, and user experience and visualization experts. Axiom's focuses include developing the cyberinfrastructure necessary to integrate and provide access to real-time, modeled, GIS and remote sensing data; making data publicly-available through web-based interfaces; and providing data management support to marine research programs. Information about Axiom's infrastructure and ability to archive data at multiple offsite locations can be found in Section 5.B.

AOOS and Axiom will provide access to existing cyberinfrastructure as well as a myriad of stakeholder networks for which information collected through the GWA LTRM Program and NPPs will be disseminated. The AOOS lead (Dr. Janzen) will be responsible for ensuring coordination among the data management team, the EVOSTC and with the GWA LTRM Program leads and projects. She will have oversight authority to ensure data accessibility and preservation needs of the GWA LTRM Program are being met, and she will ensure data management programmatic reports are accurate, complete, and submitted on schedule per stated in the proposal invitation. She will continue to serve as the primary spokesperson to communicate with the EVOSTC and the GWA LTRM Program leads on the overall Data Management Program. The Axiom lead (Mr. Bochenek) will oversee the technical data management aspects for all EVOSTC-funded projects, and will administer the NPP data management component of the program. He will be responsible for ensuring coordination among the Axiom data management

team, the NPPs and the Data Management Program liaison to the EVOSTC, Dr. Janzen (AOOS). Mr. Bochenek will have oversight authority to ensure data accessibility and preservation needs of the NPPs are being met. He will coordinate with the Dr. Janzen on data management programmatic reports to ensure they are accurate, complete, and submitted on schedule per stated in the proposal invitation.

Axiom staff will actively facilitate data management activities directly with the GWA LTRM Program leads and project PIs and NPP PIs. They will focus on the day-to-day operations of data management, including the responsibility for engaging with PIs, tracking data submissions, supporting metadata documentation, and curating data and data products to make them publicly accessible. All data, documents, annual, and final reports will be made available electronically to both researchers and the public based on the timeline for deliverables.

Contract Administration and Rates

The Data Management Program contract to AOOS will be administered through the AOOS fiscal agent, the Alaska SeaLife Center (ASLC). The Data Management Program contract to Axiom Data Science will be administered through the Prince William Sound Science Center (PWSSC).

AOOS salary fringe benefits are charged as actual expenses (Direct Costs) and estimated at 28% of salary. Fringe includes the cost of accrued leave, employer contributions to health insurance, required payroll taxes (social security, Medicare, and unemployment), and employer contributions to retirement plans (401K), long-term disability, workers compensation and other insurance programs.

AOOS does not charge indirect costs on grants it manages, hence all costs for the contract budget are shown as direct costs. AOOS pays ASLC an overall fiscal sponsor fee of 10% for administration of contracts less than $100,000, which covers the following administrative duties:

- Accounting Services: Accounts payable, accounts receivable including invoicing of grant receivables.
- Audit services: Retain auditor and oversee annual audit per federal audit requirements. Provide auditor with information needed to conduct audit. Respond to any audit issues. Oversee compliance with federal award conditions, federal and state laws, and audit requirements. Maintain complete set of grant files.
- Grant Services: Assist with development of grant proposals and budgets, and submit on AOOS behalf. Review drafts and assist with preparation of subawards and contracts. Monitor administrative and compliance aspects of subawards and contracts. Provide overall grant financial tracking, monitoring and reporting. Assist with award changes and special requests (e.g., international travel, no cost extensions). Prepare and submit financial reports per grant requirements. Review financial transfers or budget amendments.

- Office Space: Maintain official equipment inventory records. Review draft contracts (e.g., for rent, parking). Ensure physical equipment inventories are completed in accordance with grant requirements.

- Human Resources Support: Provide payroll administration, timesheets and process payment. Prepare W-2 forms, benefit package paperwork and assistance. Obtain and oversee worker's compensation, D&O and liability insurance policies, and processes claims on insurance policies. Provide training and guidance on any personnel issues.

Axiom Data Science salary fringe benefits are calculated at 25% to cover 401K, health insurance, and paid leave for staff salaries. Axiom has a federally approved indirect cost rate of 45%. This is a modified total direct cost rate that excludes direct costs, equipment, supplies, and subcontracts in excess of $25,000. Many of Axiom's services intricately overlap outside of the direct scope of work for our partners. Thus, Axiom's partners benefit from a much more comprehensive suite of services and systems than is written into our contracts. The indirect cost rate covers the expense of operating Axiom's data center and other utilities, as well as administration and indirect project personnel such as software engineers who may be responsible for a component in the Axiom suite that supports the project but is not directly included in the scope of work. Administration includes accounting services, audit services, grant services, office space, and human resources support. Indirect project personnel may include data analysts, data coordinators, data scientists, software engineers, and senior software engineers.

The PWSSC has a contract administration fee for the Data Management Program contract to Axiom, which includes a 10% administrative fee on continuing NPPs, new NPPs, and any new LTRM projects that are not an integrated part of the GWA LTRM Program. The 10% fee is not applied to the GWA LTRM Program data management component or the Mariculture ReCON NPP because those administrative costs are covered under the PWSSC's role as the Administrative lead. The PWSSC administrative fee covers salary for administrative staff, contractual items for operating PWSSC, audit services for administered contracts, and supplies to support contract administration.

Meeting and Travel Costs

A total of four weeks of Dr. Janzen's time has been budgeted per year for project management and administration activities. Dr. Janzen's budgeted time includes attendance at various EVOSTC Program meetings (annual EVOS GWA LTRM Program PI meetings, three quarterly PI meetings, EVOSTC Science Panel and Public Advisory Committee meetings as needed, and EVOSTC meetings). The majority of these meetings will be held in Anchorage, and up to five will be held in Spill-affected communities, such as Cordova, Homer, or Kodiak. Travel for one annual PI meeting every other year is budgeted to include round-trip airfare ($350) and per diem ($125 per day for two days). Two of the Axiom data management team members (Stacey Buckelew and Chris Turner) will also participate in the annual PI meetings and one-on-one PI meetings during the Alaska Marine Science Symposium. Six days per year have been budgeted per person each year for meeting attendance. Axiom will cover Axiom staff travel costs for meeting attendance.

Reporting Policies and Schedule

Dr. Janzen will work with the Axiom lead PI Mr. Bochenek and data management team members in advance of the report deadline to ensure adequate preparation of annual reports and budgets. AOOS will be responsible for the overall Data Management Program annual report submittal on March 1 each fiscal year, which will include a completed Program Reporting form and correlated Budget Form. As a courtesy Dr. Janzen will provide the GWA LTRM Program leads a draft of the Data Management Program report by mid-February for inclusion in the Program Summary Status Form, also due March 1. To assist with the preparation of these reports, Dr. Janzen will review each quarter with Rob Bochenek (Axiom) the data management team's progress, and will help to facilitate the budget planning required by the project team. Dr. Janzen will also work with Mr. Bochenek and Axiom staff on preparing semi-annual contractual subaward reports from both AOOS and Axiom (to PWSSC), which carry NOAA reporting requirements due every 6 months during the contract. Both Dr. Janzen and Mr. Bochenek will be responsible for submitting separate contractual reports as needed to PWSSC that satisfy their subaward reporting requirements.

The annual report will adhere to the following policies for the duration of this program:

- Ensure adequate resources are available for preparing and disseminating the report: The Data Management Program PIs have budgeted a minimum of two weeks for reporting activities, and the Axiom Data Coordinator has also sufficiently budgeted for reporting.

- Ensure that realistic timeframes are set for producing the report: The data management team will have a draft report prepared no later than mid-February to provide adequate time for GWA LTRM Programmatic review and inclusion in the Program Summary Status Report due annually on March 1.

- Include information about data management services that is accurate, complete, easy to interpret, and addresses only issues that relate to the data and data product(s) being reported: The data management team has successfully provided accurate and complete, easy to interpret data and data product reports for 10 years, and has improved efficiency at reporting out data submission and publication inventories for all EVOSTC Programs during the past five-year effort.

- Include special notification of non-compliant data submissions (following the procedures listed below).

- Include additional information as requested by the EVOSTC directly and/or within the report template.

Plan for Addressing Non-Compliant PI's and Programs

During the past five-years, the Data Management Program team provided the GWA and HRM Program leads with quarterly project data submission inventory status reports. The data management team will continue this practice for the GWA LTRM during the next 10-years, to facilitate punctual tracking of data submissions as well as to identify any delays that may need to be addressed or reported to the EVOSTC

(e.g., as with COVID-19). NPPs will also be tracked using the same data submission inventory status reports, for sharing with EVOSTC staff as needed. These status reports also facilitate reporting activities, and provide updates of prior year data archival and publication progress.

During the previous Data Management Program, a compliance plan was developed to help ensure project PIs were submitting data and metadata for publishing, archiving, and public access as directed by an agreed upon GWA and HRM Program data submission schedule. Consistent with this plan and based on the previous track record of timely data submissions and public access, we propose adopting the same data compliance plan used in the prior five-year effort for all EVOSTC-funded projects, as shown below:

1. Project PIs that fail to submit timely data and metadata in accordance with the above procedures are subject to corrective action, including recommendation to withhold a portion of the funds until compliance is met. An administrative file and metadata inventory tool within the Research Workspace (described in the Technical Infrastructure section below) will be used to identify potential PI non-compliance with data submission. At the annual one-on-one PI meetings (scheduled six months prior to annual report submission) the PI will be notified by the data management team of any shortfalls to their data submission and metadata authoring. Thereafter, the PI must correct any shortfalls within three months and steps must be taken to ensure future timeliness of submissions.

2. Following a failure to correct these submissions within three months, an Out of Compliance notification will be submitted by the Data Management Program team to the GWA LTRM Program leads and the relevant NPP PIs. Clear documentation will be provided of what is required to correct any non-compliance. Together with the notification, internal controls will be discussed within the data management team and with the GWA LTRM Program leads when applicable to determine root causes of non-compliance and to adjust expected timetables or help ensure the PI maintains compliance in the future. Internal controls may include updates to the Research Workspace organization, ongoing training of the PIs, and/or additional data management support (e.g., metadata or database templates, one-on-one meetings, etc.). Thereafter, with additional oversight, the PI must correct any non-compliance within three months and steps must be demonstrated to ensure future compliance.

3. After these corrective actions, if the PI still fails to submit data, a Non-Compliance report will be submitted by the data management team to the EVOSTC during the annual report cycle. The Non-Compliance report will detail the nature of the non-compliance and corrective action steps taken by the data management team and by the relevant PI(s). The report may also include a recommendation for financial withholdings until compliance has been achieved.

5. PROJECT TECHNICAL DESIGN

Describe the plan for the development and maintenance of the infrastructure required to achieve the goals of the program. At minimum, the plan should include:

A. **QA/QC methods, data and metadata policies/standards**

Are the proposed methods consistent with prior data archiving methods and standards? Metadata must follow the FGDC (Federal Geographic Data Committee) metadata standards.

The EVOSTC requires data sharing among all EVOSTC-funded projects. To accommodate data sharing among GWA LTRM projects before they are ready for public release, the Research Workspace enables secure data sharing among project PIs while being password-protected to the public until data are in their final quality assurance/quality control (QA/QC) state.

The Data Management Program will require all PIs to adhere to the data management policies listed below. The exact data management procedures for EVOSTC-funded projects using the Research Workspace are in Attachment 3. These procedures were adopted by the GWA and HRM Programs during the first five-year phase (2012-16) and adapted in the second five-year phase (2017-2021), including newly funded NPPs, relative to the maturation of the data management needs. This document provides a data management framework for all projects with defined procedures for the collection, quality, storage, maintenance, and dissemination of project data.

- All data are to be posted on the EVOSTC Research Workspace groups as soon after collection as is possible in order to promote internal integration and data sharing within the project.
- Final QA/QC versions of data are to be added to the Research Workspace alongside the initial (raw) versions.
- Comprehensive standards-compliant metadata will be required for each final dataset.
- Metadata shall be authored by the PIs iteratively throughout the data workflow process using the Research Workspace metadata editor, unless individual agencies provide or require other means of creating metadata and provide a standards-compliant metadata record to be uploaded into the Research Workspace.
- Data from monitoring studies will be made available to the public as soon as they have been QA/QC'd, or within one year following collection, whichever is sooner. Data from process studies, which are research-oriented in nature and do not have an annual component, will be made available at the end of the project.
- Anyone making public use of another team member's data should contact the collector of the data and provide appropriate attribution and credit.

All PIs and program and project managers are expected to adhere to EVOSTC policies regarding retention of all documents, correspondence (electronic and paper), samples, and data per the terms of the EVOSTC court settlement.

B. **Existing infrastructure available for the implementation of the project**

The AOOS Data System is the backbone of the cyberinfrastructure that will be leveraged to support end-to-end data management. This infrastructure has been developed to meet the guidelines and specifications recommended by the NOAA-NOS Integrated Ocean Observing System (IOOS) and endorsed by the federal Interagency Ocean Observation Committee and Global Earth Observation

Program. The data system is built using several mature, open-source interoperability and data stewardship systems to provide full cycle data management services, including: data ingestion, metadata, data aggregation and assembly, data catalogue and discovery, QA/QC, data access and transport, data storage, and end-user input and feedback.

The system is divided into four logical tiers, which separate the suite of technologies composing the system. Tier 1 is the source data produced by researchers, instruments, models, and remote sensing platforms, which are stored as files or loaded within geospatial databases (Figure 2). Interoperability systems in Tier 2, such as Web Map Services (WMS) and Web Coverage Services (WCS), are then implemented and connected to these underlying data sources. The asset catalogue, Tier 3, connects to internal interoperability systems in Tier 2, and to known external sources of interoperable data that populate a database describing the dimensional characteristics (space, time, measured parameter, and taxonomy) of each data resource. Web services in Tier 3 provide access to the descriptive metadata contained in the asset catalogue database for applications to more easily utilize data from multiple sources, formats, and types. The final technical level, Tier 4, is composed of the web-based applications and tools, which allow users to discover and explore the data resources in the system. From the top of the pyramid, users have a powerful and intuitive experience of the underlying systems working together to facilitate rapid data discovery, improved data accessibility and understandability, and the potential to develop knowledge about the physical and biological environment.

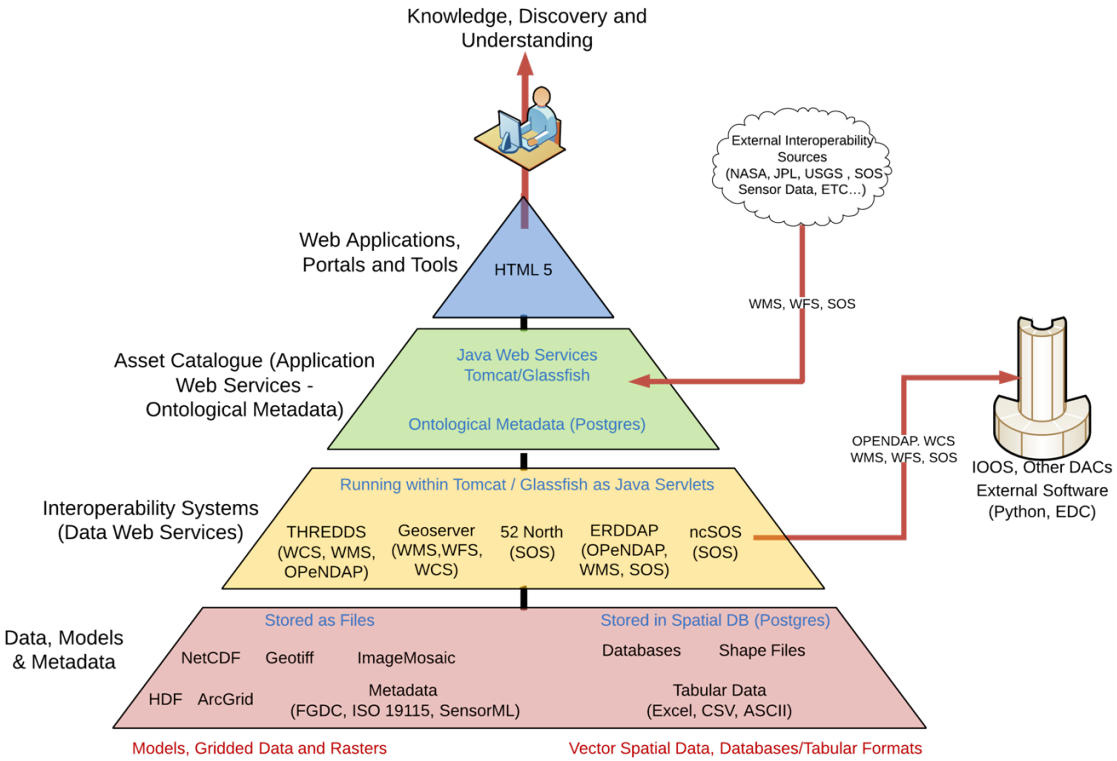


Figure 2. A schematic of the AOOS Data System that details the flow of data through logical technology tiers so that it can be consumed by users to enable discovery and understanding of EVOSTC-funded data and products.

AOOS Data System: Tier 1 (Data, Models and Metadata)

At the base of the data system framework are the data sets, metadata, and model outputs that provide the foundation for applications and user tools. These resources can be stored either in native formats or spatially enabled databases. The decision to choose one method over the other is dictated by the requirements of the interoperability system serving the data. Data which have a tabular or vector form (Shapefiles, databases, Excel spreadsheets, comma separated values (CSV) text files, etc.) will be converted into netCDF files when appropriate, and will be loaded into a PostgreSQL database and spatially indexed. When possible, GeoServer, an open-source geospatial data server, will then connect to the database and serve the data through WFS and WMS protocols. Imagery, raster, and model data will be stored in a file server in their native file formats. The ncWMS web map service is used for displaying environmental data that are stored in CF-complaint netCDF Files. THREDDS and/or ncWMS will be used to serve NetCDF and HDF files, which may contain two, three, four or higher dimensional gridded data sets. GeoServer or other OGC compliant mapping servers will be utilized to serve GeoTIFF, ArcGrid, or other two-dimensional imagery/raster data.

AOOS Data System: Tier 2 (Interoperability Systems)

Various interoperability servers (GeoServer, THREDDS, ncWMS, ERDDAP, etc.) are implemented on top of source data to expose a powerful set of interfaces for other computing systems and humans to extract, query, and visualize the underlying source data. These systems will facilitate all aspects of data delivery to users in addition to providing the muscle for the machine-to-machine data transfer to national data assembly systems as required. These systems have been developed using the Java programming language and run within Tomcat servlet containers.

AOOS Data System: Tier 3 (Asset Catalogue, Ontological Metadata and Services)

The asset catalogue provides a description of known internally and externally available data resources, access protocols for these resources (interoperability services, raw file download, etc.), and directives on how to ultimately utilize these data resources in applications. Documentation and access methods vary widely between data sources, therefore a system which catalogues data sources and reconciles these inconsistencies is essential if the data are to be used in an efficient manner. In addition to managing information about data availability and access methods, the asset catalogue also contains ancillary data such as geographic locations, spatial and temporal resolution, units, source location, and CF parameter.

AOOS Data System: Tier 4 (User Applications)

Web services written in Java connect to the asset catalogue and provide applications with access to the underlying descriptions of AOOS data assets and sources. The asset catalogue contains relationally-structured maps between data types, sources and a controlled set of definitions in order that user interface applications can connect users to vast arrays of data through simple but powerful interfaces. These interfaces include the following:

- A public-facing data catalog showing data assets that is updated automatically when new data are published into the system.
- A powerful, prioritized, Google-like search interface that allows users to search by geography, time, access method, or words contained in metadata descriptions.
- A secure method to share project-and file level metadata and data files with the public
- Interactive maps that allow users to explore other related data sets relevant to the Gulf of Alaska.
- User interfaces comprised of web-based applications and tools to provide users access to all the data and products within the data management system.

AOOS Data Management Infrastructure

In addition to the cyberinfrastructure that powers the underlying AOOS Data System, the Research Workspace, the metadata editor, the Research Workspace DataONE Member Node, and the AOOS Gulf of Alaska (GOA) Data Portal will be immediately available to support data sharing, access, and use by the EVOSTC-funded programs and projects. While these tools are in a state that is sufficient for effective management and publication of EVOSTC project data, Axiom will implement planned enhancements to these components. These components and the intended enhancements are further described below.

C. **Infrastructure needed for implementation of this project**

As is stated in the EVOSTC Invitation for Proposals, the existing AOOS-Axiom data system is sufficient to meet the needs of the GWA LTRM Program and NPPs and no funds will be required to further develop these tools. However, as the data system and its constituent tools are highly leveraged for other projects and partners, several significant improvements are already funded or are being planned. These improvements will be made to the technical infrastructure, including the Research Workspace, metadata editor, and public GOA Data Portal, and will build upon both the data manager and user experiences gained during the previous decade of EVOSTC data management support, as well as that from a variety of other large research and monitoring programs and projects. With these enhancements, we aim to streamline and improve the performance of these systems to meet the data management needs of the GWA LTRM Program and NPPs, and to make data and metadata more FAIR (Findable, Accessible, Interoperable, and Reusable) in order to increase their value to a broader community of scientists, researchers, and decision-makers now and in the future. Some of these planned enhancements are described below:

- Continued revision of the newly incorporated ISO-compliant metadata editor based on usability feedback. Planned improvements include export to a newer, simpler version of the ISO standard, and additional and easier to use metadata templates.
- The launch of a custom, EVOSTC -themed DataONE portal to make searching for and locating data from EVOSTC-funded projects easier and less ambiguous.

- Enhanced internal Axiom-system metadata to better document relationships between data resources and dataset provenance to improve dataset discovery in the GOA Data Portal.
- Continued improvement to the Research Workspace system architecture and user experience based on feedback from stakeholders in a variety of programs, including any future EVOSTC programs or projects.
-

D. **Plan for data archiving at multiple independent off-site locations**

Data and any associated infrastructure must be archived at a minimum of two independent off-site locations. The locations of the archives must be geographically distributed to guard against data loss from natural disasters or technical failure.

Axiom designed and maintains its own data center, co-located with the Pittock Internet Exchange in Portland, OR, part of the West Coast US internet backbone. There, the data center benefits from the low-latency, high-bandwidth internet connection, and network and power reliability. All data center resources are protected by several levels of onsite redundancy and backup, with offsite backup through Amazon Glacier. This design ensures that multiple redundant copies of data exist in addition to web application servers. Several layers of physical hardware (enterprise-level firewalls) and system monitoring software (NAGIOS) are also in place to provide hardened cyber security.

All data stored within Axiom cyberinfrastructure have multiple redundant copies existing within internal and external systems. Data stored internally at the Axiom data center are replicated over a Gluster storage cluster where each node runs a RAID 10 disk array. This approach ensures that there are four redundant copies of each granule of data existing on four different hard drives on two physical computer systems at all times. Axiom also backs up all data granules to Backblaze (https://www.backblaze.com/), an external cloud-based backup and storage service, to guard against a data-loss catastrophe (e.g., fire, building collapse, or other natural disaster). Furthermore, all code repositories are also backed up to cloud services using this same approach. All critical components of the technical system have more than one redundant node built in as a failover mechanism.

As an additional data recovery mechanism, all Axiom software systems are containerized and easily deployable to other third-party cloud systems, such as Amazon Web Services (AWS) or Google Cloud, to ensure continuity of services and protected data resources. Further, in 2018, Axiom implemented a data monitoring system with alert capabilities that is exposed to both Axiom software engineers and to the AOOS staff. This platform has the ability to readily diagnose data interruptions and is a critical component of the AOOS data management system to ensure a high-level of uptime and trust in the system. Since August 2018, Axiom has maintained a 99.92% uptime of the AOOS Data System.

6. COORDINATION AND COLLABORATION

A. **With the Alaska SeaLife Center or Prince William Sound Science Center**

A preferred requirement for all proposals is to partner with the ASLC, PWSSC, or both Centers. If not collaborating with either of these Centers, please provide information as to the inquiries and efforts extended to ASLC and PWSSC researchers and/or administrators.

The subcontract from Prince William Sound Science Center to AOOS for the PI (Janzen) for overall coordination of the Data Management Program and oversight of the GWA LTRM data management component will be administered through the AOOS fiscal agent, the Alaska SeaLife Center (ASLC). A separate subcontract will go directly to Axiom Data Science (PI Bochenek) from the Prince William Sound Science Center for their oversight of the NPP data management component and their technical role in the overall Data Management Program.

B. **With other EVOSTC programs and projects**

For this Invitation, the Data Management project will include oversight of individual EVOSTC projects which will ensure that data from all EVOSTC projects are consistently maintained, archived and made publicly available through the Alaska Ocean Observing System and DataOne data portals. Provide a list and clearly describe the functional and operational relationships with the other EVOSTC proposed projects in the Long-term Research and Monitoring Program, Mariculture Focus Area projects (if applicable), Education and Outreach Focus Area projects (if applicable), and existing individual projects (not part of this Invitation; Anticipated continuing individual projects for FY22 include project numbers 21210128, 21200127, and 21110853. Use the project search function for project details). This includes any coordination that has taken or will take place and what form the coordination will take. Describe how the proposed program will communicate and collaborate with the Programs to ensure compliance with data and reporting policies.

Building upon previous experiences, we propose to continue our success by strengthening the existing collaborative relationship with the GWA LTRM Program and individual EVOSTC-funded projects to most effectively meet their data management needs. By its very nature, AOOS's technical infrastructure (described in this proposal) is collaborative in the sense that the Research Workspace is designed to give open-access across program teams for file sharing and transparency of data progress. Backing this infrastructure is a data management team that is well-coordinated with GWA LTRM Program Managers and science teams (including NPP PIs) for timely data submissions and accuracy of metadata authoring, and to ensure data and products are available to general science and resource management communities.

The coordination within the GWA LTRM Program and across individual EVOSTC -funded programs and projects will be achieved through the activities listed below.

- Coordination with GWA LTRM Program: Overall coordination of the Data Management Program effort will be provided by Dr. Janzen, the AOOS GWA LTRM data management lead, who will be responsible for ensuring coordination with the GWA LTRM Program leads. As such, nearly half of Dr. Janzen's time on the project is dedicated to coordination and communication to ensure integration within the GWA LTRM Program and the data management services. Coordination within the GWA LTRM Program will occur through email, phone communications, and regularly scheduled in-person meetings. Dr. Janzen and representatives from Axiom will attend annual and semi-annual PI meetings and regularly scheduled program management team phone calls, as needed, to ensure a seamless response to data management and decision-support needs.

- Coordination across projects (including NPPs): The data managers will maintain regular communications with GWA LTRM Program leads and project PIs, NPP PIs, and EVOSTC staff as needed through participation at annual PI meetings and through regular program-wide email correspondence. At meetings, the Axiom data management team will communicate to all PIs about data submission progress and procedures through presentations and group discussions. Using emails, PIs will be notified of program data inventories and the submission timelines to help encourage compliance. These communications are a continuation of effective working relationships developed with the science teams in the prior five-year efforts.

- Coordination with individual projects: Regular communications will also be maintained to individual PIs through annual one-on-one meetings and regular email and/or phone conversations. One-on-one meetings will be held at the start of the program to develop a project-level data management plan, and then annually thereafter to track project progress and provide hands-on support for data organization, formatting, and metadata authoring. The data managers will also use email to inform individual PIs of their data submission progress using the data submission inventory tool, and to respond to PIs inquiries and/or requests for additional assistance. Depending on the location of individual PIs, this assistance will be provided through the most practical communication method (e.g., email, phone correspondence, scheduled meetings).

C. **With Trustee or Management Agencies**

If the proposed team has experience coordinating with state or federal agencies, organizations or scientists provide a description of the level and type of coordination and the names of agency or organization representatives involved in the project. If your proposal is in conflict with another project or program, note this and explain why.

AOOS brings a significant level of leveraged resources, infrastructure, regional data management projects and partnerships to the proposed effort. The EVOSTC data management services could not be accomplished for the funds available within this proposed Data Management Program without these existing and leveraged resources. The project team provides data management visualizations, and preservation services, including providing access to and facilitating the use of the Research Workspace, to a number of other programs that receive funding from or are administered or are overseen by representatives from the trustee agencies. None of the programs or projects listed above conflict with this proposal. Some of these programs and their associated trustee agencies are given below:

Group Agency	**Level and Type of Coordination and How the Project Assisted EVOSTC Trust or Agency Work**	**Representative**
Regional Coastal Ocean Observing System: Alaska Ocean Observing System (AOOS). Integrated Ocean Observing System (IOOS), National	Develop the integration of ocean and coastal observing capabilities, in collaboration with Federal and non-Federal partners, to maximize access to data and generation of information products, inform decision making, and promote economic, environmental, and social benefits Through the IOOS grant, AOOS provides partial support on a few GWA LTRM supported projects (e.g, Seward Line environmental drivers ship time support, Kachemak Bay	Carl Gouldman, Director, IOOS Dave Easter, Division Chief, IOOS

Group Agency	Level and Type of Coordination and How the Project Assisted EVOSTC Trust or Agency Work	Representative
Ocean and Atmospheric Administration (NOAA)	environmental drivers project support, the Ocean Tracking Network Herring acoustic tracking arrays in PWS). AOOS has invested a significant portion of their IOOS support to host the regions most sophisticated data acquisition system, which hosts the GWA Website and the GOA Data Portal as subsystem. This data system is highly leveraged by other large research and ecosystem-based programs (listed here). AOOS supports all the related EVOSTC and management agency projects by providing the backbone and base support to keep this data system operational, and also by providing data management services to all these groups and their projects.	
Integrated Ocean Observing System (IOOS), National Ocean and Atmospheric Administration (NOAA)	Develop community standards for sensor observations; make regional data nationally accessible. This supports all the data management activities for the prior GWA and HRM Programs and will for the LRTM GWA Program, as well as other projects listed here, and provides data in the correct formats to meet national and international data archival requirements and standards.	Derrick Snowden, Data Management and Coordination (DMAC) System Architect, IOOS
Alaska Ocean Observing System (AOOS) Data Management, (AOOS grants support funded through NOAA's IOOS Program)	Provide data management; cyberinfrastructure support. Works directly with member and non-member organizations to ingest and document new data sets as well as historical data assets that might not be available elsewhere or in a consistent useful format; data visualizations and product development Support data collection, data sharing and acquisition for the entire region of Alaska, including the GOA. These data are provided to the public and all interested users free of charge via the AOOS Data System. The AOOS Data System leverages their own data portal system to support other programs listed in this table.	Sheyna Wisdom, Executive Director, AOOS
Central and Northern California Ocean Observing System (CeNCOOS) Data Management, NOAA	Provide data management; cyberinfrastructure. Works directly with member and non-member organizations to ingest and document new data sets; visualizations Tools developed for CeNCOOS can be leveraged for other projects listed on this table, as well as ingestion capability of new data types. Activities undertaken for CeNCOOS can be leveraged across the national IOOS data system and other regions using the AOOS Data System platform.	Henry Ruhl, Executive Director, CeNCOOS
Southeast Coastal Ocean Observing Regional	Provide data management; cyberinfrastructure. Works directly with member and non-member organizations to ingest and document new data sets; visualizations	Debra Hernandez, Executive Director, SECOORA

Group Agency	Level and Type of Coordination and How the Project Assisted EVOSTC Trust or Agency Work	Representative
Association (SECOORA) Data Management, NOAA	Tools developed for SECOORA can be leveraged for other projects listed on this table. as well as ingestion capability of new data types. Activities undertaken for SECOORA can be leveraged across the national IOOS data system and other regions using the AOOS Data System platform.	
Beluga Sightings Database Visualization, NOAA-National Marine Fisheries Service (NMFS)	Produces visualizations, guidance on building community standards for submitting marine mammal stranding observations. AOOS hosts The Cook Inlet Beluga Whale Ecosystem Portal.	Mandy Migura, Marine Mammal Specialist, NOAA (2018) (Current position, Broad Conservation LLC)
Building coupled storm surge and wave operational forecasting capacity for Western Alaska, NOAA- IOOS Program - OTT (Ocean Technology Transition)	Provide data management and outreach support for transitional project that is developing a multi-scale, multi-process integrally coupled wave-surge forecast modeling system, refined and validated with a focus on transition to operations while resolving key issues that presently limit forecast reliability in western Alaska. The system will be designed to fit into the NOAA ESTOFS Pacific Storm Surge Guidance System framework. The specific goal is to enable significant advancement of NOAA's high-fidelity operational surge and wave models, ADCIRC and WAVEWATCH III, within the northern Pacific Ocean, Bering, Chukchi and Arctic Seas.	Joannes Westerink, Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, IN
Core Program, North Pacific Research Board (NPRB)	Provide guidance given on data and metadata best practices; access to and facilitation of the Workspace; organization and archiving of historical projects; Now the data management team for NPRB. NPRB funds are administered through the EVOSTC. Data management from the NPRB Programs is being managed by Axiom Data Science, and is leveraging the Research Workspace and the data system developed by AOOS to make data public and available for sharing, and standardized for long-term, national archival.	Matthew Baker, Science Director, NPRB Jo-Ann Mellish, Program Manager, NPRB
Arctic Integrated Ecological Research Program (AIERP), NPRB	Fully facilitate data and metadata management working directly with PIs, from initial sharing within the group to long-term archiving at NPRB	Danielle Dickson, Program Manager, NPRB
Arctic Marine Biological Observation Network (AMBON), Bureau of Ocean Management (BOEM)	Coordinate all data management activities for AMBON using the Workspace	Katrin Iken, Lead Principal Investigator, Professor, College of Fisheries and Ocean Sciences, University of Alaska, Fairbanks

Group Agency	Level and Type of Coordination and How the Project Assisted EVOSTC Trust or Agency Work	Representative
Arctic Ecosystem Integrated Synthesis (Arctic EIS), BOEM	Provide guidance to program management on data and metadata best practices; access to and facilitation of the Workspace; organization and archiving of completed projects	Franz Mueter, Lead Principal Investigator, Associate Professor, College of Fisheries and Ocean Sciences, University of Alaska, Fairbanks
Marine Arctic Ecosystem Study (MARES), BOEM	Develop data management plans for each sampling effort; access to and facilitation of the Workspace; acquire and ingest into AOOS Arctic Data Portal environmental data sets identified by program PIs as important context for MARES program; facilitate conversion of data into long-term preservation-ready formats; submission of data sets to long-term archives	Francis Wiese, Lead Project Manager, Stantec
Central Beaufort Sea Wave and Hydrodynamic Modeling Study (BOEM)	Provide data management and outreach support for a joint data synthesis and modeling effort between the University of Alaska, Fairbanks (UAF), the University of Alaska Anchorage (UAA), and the U.S. Geological Survey (USGS) Coastal & Marine Geology Program-Pacific Coastal & Marine Science Center (PCMSC). The Alaska Ocean Observing System (AOOS) and the AOOS data management contractor Axiom Data Science are providing data management services and outreach for this project. Through field observations, historical and new, the goal is to adequately document wave and sediment transport conditions within Stefansson Sound/Foggy Island observationally and provide input data assimilation and validation support for project modeling activities.	Jeremy Kasper, Lead Principal Investigator, University of Alaska, Institute of Northern Engineering
Alaska Data Integration working group (ADIwg), U.S. Geological Survey (USGS)	Generate community standards for project data; advise on translation from ADIwg metadata content profile into suite of ISO geospatial metadata of standards The mission of the Arctic LCC is to identify and provide information needed to conserve natural and cultural resources in the face of landscape scale stressors, focusing on climate change, through a multidisciplinary program that supports coordinated actions among management agencies, conservation organizations, communities, and other stakeholders. The conservation goals of the Arctic LCC are: to provide information on, and predict the effects of climate- driven changes and other landscape stressors; determine how climate driven changes affect subsistence users; and provide improved data and information access to managers and policy makers.	Josh Bradley, Data Manager, Arctic Landscape Conservation Cooperative (LLC), US Fish and Wildlife Service

7. PROJECT SCHEDULE

Specify when critical program tasks will be completed including data management, meetings, and reporting. C = completed, X = planned or not completed. For multi-year projects, reviewers will use this information in conjunction with project reports to assess whether the project is meeting its objectives and is suitable for continued funding.

This proposed Data Management Program is focused around the following objectives:

Objective 1. Initiate data management services and oversight for the GWA LTRM Program and Non-Program projects.

Objective 2. Standardize and provide access to data sets from the prior EVOSTC-funded efforts for continuity and integration.

Objective 3. Facilitate, monitor and evaluate regular data submissions and metadata generation in the Research Workspace.

Objective 4. Provide, maintain and modify technical infrastructure for user groups to access information produced or processed by the GWA LTRM Program and Non-Program projects.

Objective 5. Publish and promote data collected by the GWA LTRM Program and Non-Program projects, making them available for research, management and general audiences.

Objective 6. Execute management, user feedback and internal and external communications related to the GWA LTRM Program and Non-Program project data and data products.

Objective 7. Ensure long-term preservation and dissemination into publicly accessible repositories at the term completion.

The milestones related to achieving each of these objectives are described below.

Objective 1. *Initiate data management services and oversight for the GWA LTRM Program and Non-Program projects*. A standardized data management approach is necessary to provide fundamental data management support for the GWA LTRM Program and NPPs in sharing data sets and authoring metadata records, and for a data management system to handle many diverse data types and facilitate integration and long-term preservation. Such an approach requires the data management staff and PIs have a mutual understanding of when and what data are expected to be collected, how data can be best organized and formatted for sharing, and the expectations and goals for metadata.

Milestone 1. Convene data management meeting with GWA LTRM Program Managers - At the start of the program, Axiom will convene data management meetings with GWA LTRM Program leads to make explicit the expectations for data management staff and project PIs, and to verify the list of funded research projects, data collection periods, documentation of data quality control procedures, submission timelines, program outputs, and the production of any derived data products.

Milestone 2. Convene data scoping meetings with individual PIs to develop project data management plans (DMPs) - Axiom data management team members will meet with all

EVOSTC-funded project PIs (in person, online or by phone) to share expectations regarding what data types will be collected and delivered, timelines for data submission and metadata generation, and expected and appropriate data and file formats and naming conventions. Following these meetings, data management plans (DMPs) for each of the projects will be established, which detail how data will be handled throughout that project's lifecycle, from collection to preservation. Agreeing to a plan at the start of the project will ensure that, from the beginning, the data are organized, well-documented and appropriately formatted for discovery, preservation, and ultimate data use for restoration and management purposes.

Milestone 3. Maintain up-to-date inventory of expected and submitted data - Using information generated during the DMP scoping, an inventory of data expected to be generated by all funded projects will be created. This inventory will describe the data sets, indicate the PI responsible for the data, and note the status of metadata for each dataset. It will be used throughout the life of the project to track the status of data sets and their metadata.

Milestone 4. Institutionalize metadata authoring - Descriptively-robust and standards-compliant metadata records are critical for long-term data access and reuse. To ensure accurate and consistent metadata authoring, Axiom will leverage procedures used for the prior GWA and HRM Programs to encourage frequent, incremental updates by project PIs to their metadata as part of their normal workflows. Specifically, Axiom will continue to use and modify, as necessary, the program-specific metadata templates used in the prior five-year effort. These templates help to inform PIs about which metadata fields are mandatory, mandatory if applicable, or optional. Additionally, the templates include boilerplate information for fields that must contain program-wide metadata (e.g., access constraints, use constraints, programmatic contact information). This approach is intended to make metadata creation less cumbersome for PIs, meanwhile ensuring sufficiently robust, standards-compliant metadata are generated to ensure data are findable for re-use purposes. Throughout the project, GWA LTRM Program Managers and PIs and NPP PIs will receive training and regular communications (via email, in person, and at annual meetings) about the metadata procedures and authoring workflow.

Objective 2. *Standardize and provide access to data sets from the prior EVOSTC-funded efforts for continuity and integration.* This objective will maintain data continuity and build upon data management services from the previous ten-year efforts. Early in the first quarter, Axiom will engage with individual PIs to identify whether data to be collected will be a continuation of an existing time series or a new project. Data sets that are a continuum will be updated to reference the archive(s) from the previously-funded efforts. These references are important to integrate related but independent data sets across funded periods in a clear, organized manner. Further, this mapping encourages discovery of the entire time series (e.g., across multiple ten-year funding periods) though project titles and lead PIs may have changed over time.

Milestone 1. Connect data and metadata to any previous data instances - For projects that are a continuation of a time series collected under the previous efforts, metadata in both the Workspace and DataONE archives will be updated to document the chronology of data

ownership, any DOI and/or national archive accession number, and the location of any historical dataset(s). This includes the previously-funded NCEAS historical plus GWA or HRM Program projects, as well as continuing NPPs.

Objective 3. *Facilitate, monitor and evaluate regular data submissions and metadata generation in the Research Workspace.* Project PIs and Program administrators will use the Research Workspace as a web-based platform to upload, share and discover data sets and supporting documents, and to rapidly author metadata. The system is enabled with security authentication in order to limit access to PIs, project managers, and Program administrators. Throughout the life of the project, Axiom staff will maintain oversight of timely and organized data, metadata documentation, and other program documents to the Research Workspace using a combination of data management personnel and technical infrastructure.

Milestone 1. Support and provide training for data transfer and metadata production using the Research Workspace - Experience with the use of the Research Workspace by 25 other research programs over the past six years has resulted in a system that is intuitive, easy to use, and designed to meet researcher needs. To enhance use of this system by project PIs, Axiom will host in-person and web-based training sessions in Year 1. These trainings will be scheduled as soon as possible after the funding award. Throughout the life of the program, Axiom will continue to provide training and one-on-one assistance, as needed, to support PIs and Program Managers.

Milestone 2. Track regular data and metadata submissions - The data inventory (Obj. 1, M. 3) will be used to track data and metadata submissions to the Research Workspace against data that were expected to be generated by individual projects. On a semi-annual basis, the data management team will update the data submission records to this inventory to reflect changes in dataset and metadata status. Further, Axiom will audit the organization of data intended for publication by ensuring the types of data submitted are appropriate for long-term preservation and consistent conventions are used for naming files. This will be achieved by working directly with the PIs to implement any recommended changes identified during the audits.

Indication of any data submission delays and formatting delinquencies will be identified and communicated following the procedures for addressing data non-compliance (see “Plan for Addressing Non-Compliant PIs and Programs” in Section 4). The corrective actions to address non-compliance will be implemented by the PIs with support from the Axiom data management team members.

Milestone 3. Hold annual data progress meetings with individual PIs - To facilitate timely data submission and metadata authoring, Axiom will meet annually with individual PIs to discuss progress. Based on previous experiences, one-on-one meetings are an effective way to address individual metadata authoring questions, create accountability for data submissions, and strengthen relationships between PIs and data management staff. During these meetings, data management staff will revisit and make any changes necessary to the DMPs to ensure the

documents are responsive to any changes or unexpected issues that arise in data collection or processing.

Milestone 4. Provide supplemental data and metadata quality control - It is the purview of the project PIs to conduct quality assurance on data collection procedures and quality control of the data themselves. Quality control by the data managers will be focused on data file formatting and on metadata documentation to ensure authoring adheres to known best practices and accurately reflects data captured within individual data files. This process will include an automated completeness check for required metadata fields; a secondary quality control check by Axiom data management staff for accuracy and consistency of metadata resulting in a list of any issues in the metadata that will be delivered to the PI; and a final check for ISO-format validation after metadata quality issues have been addressed and before submitting the dataset to national archives.

Objective 4. *Provide, maintain and modify technical infrastructure for user groups to access information produced or processed by GWA LTRM Program and Non-Program projects*. The ultimate goal of the Data Management Program is to provide technological and staff services to assist in the organization, documentation, and structuring of data collected by GWA LTRM projects and NPPs in order that they can be transferred efficiently to long-term data archive and storage centers for future use by researchers and other user groups. This project leverages cyberinfrastructure, long-term funding, and other active data management projects previously and currently undertaken by AOOS. Project data sets will be shared with each other, documented, and shared with the public by extending and enhancing an existing technological infrastructure (see "Existing Infrastructure" above). These systems have capabilities to share, ingest, document, and archive project data and related documentation to ensure its long-term security and use.

Milestone 1. Create Research Workspace groups - At the onset of this program, new Research Workspace groups will be created for any newly-funded projects in order to organize project-level data captured under this funding period effort. In cases of continuing projects, existing Research Workspace instances will persist to provide continuity across previously funded efforts.

Milestone 2. Maintain automated submission pathways to national archives - The Research Workspace is connected to the DataONE Network for long-term preservation of data in the most contextually relevant environment. The intent of this capability is to ease the ingestion of data collections to national archives by simplifying the submission and upload of content and metadata. The archive pathway includes automated QA steps for preservation-ready data and metadata formats, publication agreement approval by PIs, access control to data products, services for replication and preservation of data, and DOI generation and data set citation. Throughout the life of this project, the submission pathway to DataONE will be maintained as a solution for providing long-term preservation of EVOSTC-funded project data.

Milestone 3. Provide scheduled and unscheduled maintenance to the system infrastructure – The Axiom data management team members will perform scheduled and as-necessary maintenance to the data management system infrastructure, including the Research Workspace and GOA Data Portal, to ensure continuous operation and reliability. This may involve tasks such as applying security updates, monitoring for hardware failures, and upgrades to improve performance and capacity.

Objective 5. *Publish and promote data collected by GWA LTRM and Non-Program projects, making them available for research, management and general audiences.* To maximize data use for analysis, synthesis, review, and application, and to support the restoration and management of Spill injured resources, data from EVOSTC-funded projects will be made widely available through multiple pathways. During the research phase of this funding cycle, data will be securely available for internal use through the Research Workspace. When data are ready to be published, they will be made available through the existing, public-facing AOOS GOA Data Portal (https://gulf-of-alaska.portal.aoos.org/) for exploration and discovery. At the end of the fifth and 10th years (2026 and 2031), final data will be archived through DataONE for long-term preservation, noting that research or process studies will likely occur at the 10-year project term submission. National repositories have the advantage of reaching wider audiences, thus expanding the access, discoverability, and active management of data collections generated through EVOSTC-funded efforts.

Milestone 1. Prepare data and metadata into preservation-ready file formats - File formats play a key role in the ability for data access and reuse in the future. As opposed to proprietary or product-specific formats, open file formats are necessary for long-term preservation and storage, particularly in data repositories. Examples of preferred formats for different types of data include: ASCII formats (TXT, CSV, XML), NetCDF, and PDF. Ultimately, it is the responsibility of the data providers to generate and document preservation-ready data formats. However, Axiom data analysts will help convert data from agreed-upon formats (used by the PIs) into preservation-ready file formats when necessary. For data sets that may stray from format standardization, Axiom data analysts will work with PIs to determine the best option for dataset preservation. Any custom scripts that are developed to convert between formats and visualize the data will be saved to streamline conversion of similar data types in the future. To ease file use and analysis by PIs that prefer proprietary or product-specific formats, the original files will be retained.

Milestone 2. Publish data and relevant program documents through the AOOS GOA Data Portal - After metadata that complies with content and quality requirements are completed, the Research Workspace will be used as a gateway to publish data and associated metadata to the AOOS GOA Data Portal, which is publicly-available for discovery by researchers, managers and general audiences. As data providers, PIs have ultimate control for managing which data are made publicly available. Within projects, PIs can individually elect to publish data folders to the portal using a simple, clearly marked checkbox. At the annual one-on-one meetings with PIs, Axiom will review the published data files with PIs to ensure no unintended publication occurs (e.g., if data have been published by another project collaborator before they are finalized).

Milestone 3. Submit all final data and metadata documents to a national archive – At the end of the fifth year (2026) and tenth year (2031), completed data and metadata from the GWA LTRM projects and NPPs will be submitted to DataONE, a nationally recognized long-term archive for scientific data. Research or process studies may not be ready for submission at the 5-year DataONE submission. However, by the end of the 10-year project term, all final data and metadata will be submitted to DataONE. Submissions will occur by initiating finalized data sets from the Research Workspace, having a final metadata review check by data management staff, and then using an automated submission process into the DataONE data federation. Research Workspace project metadata will be updated to include any identifiers associated with the data once they have been ingested into DataONE (e.g., DOI, archival accession numbers). This pathway will simplify preservation and publication for PIs while providing transparency to the data managers, program managers, and funders. Access to project data sets within DataONE and the associated data set DOIs will be exposed in the GOA Data Portal to facilitate the citation of data sets that are reused for research and management purposes.

Objective 6. *Execute management, user feedback and internal and external communications related to GWA LTRM Program and Non-Program project data and data products*. The data management team will participate in GWA LTRM Program and other project meetings, respond to user feedback, and maintain regular communication about project progress with the EVOSTC staff.

Milestone 1. Participate in regular project and project meetings - At the initial program and project kick-off meetings, the data management team will give an overview of the data management system and procedures to EVOSTC staff and project PIs. This presentation will specifically focus on a high-level description of the tools to be used and any procedural updates from the previous ten-year effort. These procedures will also be provided in writing for reference by project PIs. Thereafter, the data management team will attend scheduled PI meetings and EVOSTC meetings (on request) to present on data management progress and receive feedback on any recommended modifications. Presentations may include topics such as the percentage of data submissions and metadata generation completed on time, new features or process updates in the data management system, and progress towards publishing data and data products. Axiom staff will also be available at PI meetings to give one-on-one training, hands-on assistance, or to answer questions about data management practices. The Axiom data management team members will maintain regular contact with PIs throughout the year to ensure they have the technical support needed for the Research Workspace and their data management activities. These communications will entail notification of approaching deadlines for data or metadata submission, questions related to these submissions, and/or response to PIs about data management procedures and responsibilities questions.

Milestone 2. Continually evaluate progress and new technologies to keep pace with data management needs - Implementing a system to serve the EVOSTC-funded project data management needs is a core component of this proposed work. To ensure progress of the data management team in meeting these needs, regular and structured feedback is required from data management system users, i.e., the Program Managers and PIs. User feedback through

surveys, group discussions, and one-on-one meetings will be gathered. The feedback will be synthesized to identify what data management methods are working well and what procedural modifications or including new technologies could be made to improve the performance of the data management system. Improvements will be prioritized based on feasibility within project funding levels and implemented as is possible.

Milestone 3. Report progress annually to the EVOSTC – The data management team will submit annual reports as required by the EVOSTC. These reports will document progress on objectives and milestones, as well as overall progress on project data submission and metadata generation. Reporting will also include a final report at the conclusion of the ten-year funding term.

Objective 7. *Ensure long-term preservation and dissemination into publicly accessible repositories at the term completion.* In the final year of this ten-year effort, Axiom data management team members will ensure the completeness of all data and metadata records in the project collections. Upon request, Axiom will work with EVOSTC to develop and implement a plan to transfer all data and metadata from the data management system to EVOSTC.

Milestone 1. Ensure the existence and completeness of all data in the data inventory - In the final year of this ten-year effort, the data management team will revisit the DMP data inventory to ensure it is complete and representative of the entire legacy of data collected across projects. Using this inventory, Axiom will ensure that data and metadata generated across all years of the GWA LTRM Program and NPP activities are present, accurate, and complete. At the conclusion of this funded term, this process will provide verification of the submission of all data as a guarantee of completeness for each dataset. Any discrepancies in data and metadata completeness will be resolved between the data management team and individual PIs.

Milestone 2. Identify appropriate method of transfer for metadata and data from Axiom infrastructure to other storage resources - Upon request, in the final year of this ten-year effort, Axiom data management team leads and the EVOSTC will convene to discuss the total volume of data, metadata, and derived data products; the resources necessary to securely and usefully store the data and metadata; and a path forward for system transfer. Because the proposed data management system uses Axiom's significant, leveraged, and cloud-based cyberinfrastructure, it will not be feasible to transfer the entire functionality of the data management system to local EVOSTC storage and compute resources. Similarly, with the publication of all finalized GWA LTRM and NPP data to DataONE (a fully replicated archive) and the AOOS GOA Data Portal, duplicating the data to EVOSTC servers may not be necessary. The outcome from the meeting will determine if a complete, local replicate is necessary, and if so, where data should be relocated, and the timelines and procedures for transfer.

Project milestone and task progress by fiscal year and quarter, beginning February 1, 2022. C = completed, X = planned or not completed. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31. (see table next page)

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Objective 1. Initiate data management services and oversight for the GWA LTRM Program and Non-Program projects.																				
1.1 Schedule & complete initial data management meeting with Program leads	X																			
1.2 Schedule & complete data management meetings with individual PIs		X																		
1.3 Complete & disseminate DMPs for GWA LTRM Program & Non-Program projects; maintain inventory of data submissions		X																		
1.4 Develop & disseminate metadata templates		X																		
Objective 2. Standardize and provide access to data sets from the prior EVOSTC-funded efforts for continuity and integration.																				
2.1 Connect data and metadata to any previous data instances				X																
Objective 3. Facilitate, monitor and evaluate regular data submissions and metadata generation in the Research Workspace.																				
3.1 Provide Workspace and metadata training to PIs			X			X				X				X				X		
3.2 Semi-annual update to data submission inventory table		X		X	X		X		X		X		X		X		X		X	
3.3 Hold one-on-one meetings with PIs			X			X				X				X				X		
3.4 Complete QC of data formats and completed metadata				X			X				X				X				X	
Objective 4. Provide, maintain and modify technical infrastructure for user groups to access information produced or processed by GWA LTRM Program and Non-Program projects.																				
4.1 Set-up new Workspace groups, as needed	X																			
4.2 Serve existing infrastructure to GWA LTRM Program & Non-Program projects, maintaining automated submission pathways to national archives	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.3 Provide scheduled and unscheduled maintenance.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Objective 5. Publish and promote data collected by GWA LTRM Program and Non-Program projects, making them available for research, management and general audiences.																				

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
5.1 Prepare data into preservation formats				X				X				X				X				X
5.2 Publish data and data products through the AOOS GOA Portal				X				X				X				X				X
5.3 Final data collections submitted to DataONE																			X	X
Objective 6. Execute management, user feedback and internal and external communications related to GWA LTRM Program and Non-Program project data and data products.																				
6.1 Present data management procedures & progress at annual meetings			X				X				X				X				X	
6.2 Provide ongoing data and metadata support to PIs, evaluating progress and new technologies for data management as needed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.3 Report progress annually to the EVOSTC					X				X				X				X			
Objective 7. Ensure long-term preservation and dissemination into publicly accessible repositories at the term completion.																				
7.1 Verify data and metadata completeness for GWA LTRM Program & Non-Program projects																				
7.2 Implement, as necessary, final transfer and storage of data to EVOSTC																				
Reporting																				
*Annual reports					X				X				X				X			
Deliverables																				
Data uploaded to Research Workspace				X				X				X				X				X
Data posted on GOA Data Portal				X				X				X				X				X
Data archived in Data ONE																			X	X

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Objective3. Facilitate, monitor and evaluate regular data submissions and metadata generation in the Research Workspace.																				
3.1 Provide Workspace and metadata training to PIs			X			X				X				X				X		
3.2 Semi-annual update to data inventory table		X		X	X		X		X		X		X		X		X		X	

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
3.3 Hold one-on-one meetings with PIs			X			X				X				X				X		
3.4 Complete QC of data formats and completed metadata				X			X				X				X				X	
Objective 4. Provide, maintain and modify technical infrastructure for user groups to access information produced or processed by GWA LTRM Program and Non-Program projects.																				
4.1 Set-up new Workspace groups, as needed	X																			
4.2 Serve existing infrastructure to GWA LTRM Program & Non-Program projects	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4.3 Provide scheduled and unscheduled maintenance.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Objective 5. Publish and promote data collected by GWA LTRM Program and Non-Program projects, making them available for research, management and general audiences.																				
5.1 Prepare data into preservation formats				X				X				X				X				X
5.2 Publish data and data products through the GOA Portal				X				X				X				X				X
5.3 Final data collections submitted to DataONE																			X	X
Objective 6. Execute management, user feedback and internal and external communications related to GWA LTRM Program and Non-Program project data and data products.																				
6.1 Present data management procedures & progress at annual meetings			X				X				X				X				X	
6.2 Provide ongoing data and metadata support to PIs, as needed	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6.3 Report progress annually to the EVOSTC	X				X				X				X				X			X
Objective 7. Ensure long-term preservation and dissemination into publicly accessible repositories at the term completion.																				
7.1 Verify data and metadata completeness for GWA LTRM Program & Non-Program projects																			X	X
7.2 Implement, as necessary, final transfer and storage of data to EVOSTC																				X
Reporting																				
*Annual reports	X				X				X				X				X			X
Final report																				X

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Deliverables																				
Data uploaded to Research Workspace				X				X				X				X				X
Data posted on GOA Data Portal				X				X				X				X				X
Data archived in DataONE																			X	X

8. Budget

A. Budget Forms (Attach)

Please provide completed budget forms (Excel workbook). Please note that costs associated with international travel for meetings, symposia, or presentations will not be considered for funding. Costs associated with outreach or education should be included in the Program budget. Include a screen shot of the "Summary" worksheet (example below).

Data Management Program (Years 1-10)

Budget Category:	Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$237,237	$245,619	$255,956	$249,977	$234,556	$1,223,345	
Travel	$0	$600	$0	$600	$0	$1,200	
Contractual	$1,247	$1,345	$1,323	$1,423	$1,404	$6,742	
Commodities	$0	$0	$0	$0	$0	$0	
Equipment	$0	$0	$0	$0	$0	$0	
Indirect Costs Rate = 45%	$101,144	$104,748	$109,226	$106,357	$99,233	$520,708	
SUBTOTAL	$339,628	$352,311	$366,505	$358,357	$335,193	$1,751,994	
General Administration (9% of certain projects)	$30,567	$31,708	$32,985	$32,252	$30,167	$157,679	N/A
PWSSC Fiscal Administration (10% of certain projects)	$9,522	$10,188	$12,328	$10,915	$8,116	$51,068	
PROJECT TOTAL	$379,716	$394,207	$411,819	$401,524	$373,476	$1,960,742	$1,960,742
Other Resources (In-Kind Funds)						$0	

Budget Category:	Proposed FY 27	Proposed FY 28	Proposed FY 29	Proposed FY 30	Proposed FY 31	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE	TEN YEAR TOTAL
Personnel	$208,473	$213,410	$218,496	$223,736	$229,131	$1,093,246		$2,316,591
Travel	$600	$0	$600	$0	$600	$1,800		$3,000
Contractual	$1,506	$1,489	$1,594	$1,580	$1,687	$7,856		$14,598
Commodities	$0	$0	$0	$0	$0	$0		$0
Equipment	$0	$0	$0	$0	$0	$0		$0
Indirect Costs Rate = 45%	$87,306	$89,333	$91,421	$93,571	$95,786	$457,417		$978,125
SUBTOTAL	$297,885	$304,232	$312,111	$318,887	$327,204	$1,560,320		$3,312,314
General Administration (9% of certain projects)	$26,810	$27,381	$28,090	$28,700	$29,448	$140,429	N/A	$298,108
PWSSC Fiscal Administration (10% certain projects)	$3,754	$3,872	$3,995	$4,121	$4,250	$19,991		$71,060
PROJECT TOTAL	$328,449	$335,485	$344,195	$351,708	$360,903	$1,720,740	$1,720,740	$3,681,482
Other Resources (In-Kind Funds)						$0		$0

B. **Sources of Additional Funding**

Fill out the summary table below (should match the table on page 2). Provide a narrative that Identifies non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal. Please attach documentation from additional project funding sources which confirms and describes matching funds, including date(s) the matching funds are/will be authorized.

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	**FY23**	**FY24**	**FY25**	**FY26**	**FY22-26 Total**
$0	$0	$0	$0	$0	$0
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$0	$0	$0	$0	$0	$0
				FY22-31 Total	*$0*

Attachment 1 – EVOSTC funded project listings within each program component that will have data managed by the FY22-31 Data Management Program

Program: GulfWatch Alaska Long-Term Research and Monitoring Program (GWA LTRM)

roject Number	incipal Investigator	Project Title	Years Funded
2222LTRM	Lindeberg & Hoffman	Long-Term Research and Monitoring Program (LTRM)	FY22-31
22120111-C	Branch	Modeling and stock assessment of PWS herring	FY22-31
22120111-E	Hershberger	Herring disease program	FY22-31
22160111-F	Haught	Herring surveys and age, sex, and size collection and processing	FY22-31
22220111-I	Rand et al.	Ecological interactions between Pacific herring and Pacific salmon in Prince William Sound, Alaska	FY22-29
22120114-C	Arimitsu & Piatt	Forage Fish Distribution, Abundance, and Body Condition	FY22-31
22120114-D	Ostle & Batten	Continuous Plankton Recorders	FY22-31
22120114-G	Campbell	Oceanographic Conditions in PWS	FY22-31
22120114-H	Coletti	Nearshore ecosystems the Gulf of AK	FY22-31
22120114-I	Danielson	GAK1 Monitoring	FY22-31
22120114-L	Hopcroft	Seward Line Monitoring	FY22-31
22120114-M	Kuletz & Kaler	PWS Marine Bird Surveys	FY22-31
22120114-N	Matkin	ong-term Killer Whale Monitoring	FY22-23
22120114-O	Moran & Straley	Humpback Whale Predation on Herring	FY22-31
22200114-P	Esler & Lindeberg	Lingering Oil Component Project	FY22-23

Program: Continuing LTRM Non-Program Projects

roject Number	incipal Investigator	Project Title	Years Funded
22200127	Hetrick, Campbell, Baird, Evans	Ocean acidification sampling	FY22 (original FY20-22)
22110853	Kuletz, Kaler, Irons	Pigeon guillemot restoration	FY22-24 (original FY20-24)
22210128	Hollmen, Labunski et al.	Status and trends of EVOS injured seabirds	FY22-25 (original FY21-25)

Program: New LTRM, General Restoration, and Mariculture Non-Program Projects

roject Number	incipal Investigator	Project Title	Years Funded
22220201	Branson & Hetrick-Price	Chugach Regional Ocean Monitoring Program	FY22-31
22220202	Hauri	Continuation and expansion of ocean acidification monitoring	FY22-31
22220203	Rhea-Fournier et al.	Walleye pollock-Pacific herring interactions	FY22-31
22220300	Hetrick-Price	PWS kelp mariculture development for habitat restoration and local economy	FY22-26
22220301	Poe et al.	Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone	FY22-26
22220302	Hoffman et al.	Sustainable mariculture development for restoration and economic benefit in the EVOS spill area	FY22-31
22220502	Lomax	Clean Water Act assessment of beaches with lingering oil	FY22-25
22220507	Moonin	Port Graham Corporation general restoration and habitat protection	FY22-26

22220508	Thielke	Geospatial wetlands and hydrography data across the EVOS region	FY22-25

Attachment 2 - Curriculum Vitae for Data Management Team

EVOSTC DATA MANAGEMENT PROGRAM LEAD

CAROL D. JANZEN, Ph.D.

Alaska Ocean Observing System
1007 W. 3rd Ave, Suite 100
Anchorage, AK 99501
Phone: (907) 644-6752
janzen@aoos.org

RELEVANT PROFESSIONAL EXPERIENCE

Director of Operations and Development for the Alaska Ocean Observing System (AOOS) (2015-present): Works closely with the Executive Director and a statewide Board of Directors to plan, execute and manage Alaska coastal and oceanographic monitoring and research programs. Provides subject matter expertise in marine observing, technologies and data, data quality assurance and control, and develops the AOOS program through research grants and observing initiatives. Manages and oversees AOOS external grants, as well as internal AOOS programs and subawards worth over $4 million in 2019-20. Provides logistical and operational oversight of AOOS owned and operated ocean observing assets. Prepares technical reports, publications, proposals, budgets, outreach materials, and presentations and represents AOOS nationally.

Data Management Program Lead for the EVOSTC (2015-present): Provides primary data management coordination for the EVOSTC-funded 2016-2021 GWA and HRM Programs and three Non-Program projects. Principal liaison to communicate work with and respond to requirements of the EVOSTC Programs, and responsible for completing annual reports, workplans, budgets, and responding to project data management support requests from the EVOSTC.

Professional Positions

06/2015-present	Director of Operations and Development, Alaska Ocean Observing System (AOOS), Anchorage, AK, USA
06/2006-06/2015	Senior Oceanographer, Sea-Bird Scientific, Inc., Bellevue, WA, USA
11/2002–08/2006	Research Scientist-Physical Oceanographer, School of Marine Sciences, University of Maine, ME, USA
09/2000–10/2002	Physical Oceanographer (Post-Doctoral Researcher), School of Ocean Sciences, University of Wales (Bangor), UK
06/1993–08/2000	Research Assistant-Graduate Student (M.S. 1996, Ph.D. 2000), Graduate College of Marine Studies, University of Delaware, DE, USA
01/1989-06/1993	Ecology Supervisor, Washington State Dept. of Ecology, WA, USA
05/1985-12/1988	Assistant Scientist-Oceanographer, Envirosphere Company, WA, USA

RELEVANT PUBLICATIONS

Janzen C., M. McCammon, T. Weingartner, H. Statscewich, P. Winsor, S. Danielson and R. Heim, 2019. Innovative Real-Time Observing Capabilities for Remote Coastal Regions. Front. Mar. Sci. 6:176. DOI: 10.3389/fmars.2019.00176, Report Link

McArthur, S., K. Bailey, **C. Janzen**, R. Morrison, T. Murphy, J. Newton, S. Ruberg, U. Send, 2017. The National Strategy for a Sustained Network of Coastal Moorings. U.S. IOOS Office and National Weather Service Office of Observations Approved Document, January 2017, Report Link

Murphy, D., **C. Janzen**, 2017. Advances in In-Situ Ocean Measurements. In: Observing the Oceans in Real Time, Ed: R. Venkatesan, A. Tandon, E. D'Asaro, M.A. Atmanand. SPRINGEROCEAN, pp.141-162, https://doi.org/10.1007/978-3-319-66493-4

Janzen, C.D., M. McCammon, H. Kent, D. Dugan, R. Bochenek, W. Koeppen, 2016. The Alaska Ocean Observing System Past and Future Presence in the Arctic. IEEE Conference Publication, Oceans 2016 MTS/IEEE, Monterey, CA, USA, September 19-22, 2016

Murphy, D., and **C. D. Janzen**, 2015. Designing CTDs to meet the challenges of monitoring Climate Change in the Ocean. Marine Technology Society Journal, Vol 49, no. 3, pp. 50-55

OTHER SIGNIFICANT PUBLICATIONS

Wright, D., **C. Janzen**, R. Bochenek, J. Austin, E. Page, 2019. Marine observing applications using AIS: Automatic Identification System. Front. Mar. Sci. 6:537. DOI 103389/fmars.2019.00537, Report Link

Janzen, C.D., Jim Churchill, Neal Pettigrew, 2005. Observations of bay/shelf exchange between eastern Casco Bay and the western Gulf of Maine. Deep-Sea Research Part II: Special Issue: The Ecology and Oceanography of Toxic Alexandrium funyense Blooms in the Gulf of Maine, Ed. D.M Anderson, D.W. Townsend, D.J. McGillicuddy, and J.T. Turner, Vol. 52, Issue 19-21 September-October 2005, pp. 2411-2429. DOI 10.1016/j.dsr2.2005.06.032

Janzen, C.D., K.-C. Wong, 2002. Wind forced dynamics at the estuary-shelf interface of a large coastal plain estuary. Journal of Geophysical Research, Vol. 107, No.C10.

Short, K.S., **C.D. Janzen**, C.J. Van Zee, and D.J. Hanzlick, 1991.Oceanography. In: 1987 Final Report for the Endicott Environmental Monitoring Program, Volume 3, Part II, Chapter 3. Prepared for by Envirosphere Company for the U.S. Army Corps of Engineers, Alaska District, Anchorage, AK.

EDUCATION

University of Washington, Seattle	Oceanography, B.S.	1986
University of Delaware, Newark	Marine Studies, M.S.	1996
University of Delaware, Newark	Physical Oceanography, Ph.D.	2000
University of Wales, Bangor, UK	Physical Oceanography, Post Doc	2002

COLLABORATIONS

James Behrens (Coastal Data Information Program (CDIP) – University of Southern CA, San Diego); Robert Bochenek (Axiom Data Science); Heather Crowley (Bureau of Ocean Energy Management (BOEM)); Geoff Crowley (ASTRA, LLC); Seth Danielson (University of AK, Fairbanks (UAF)); Li Erikson (USGS); Jeremy Kasper (UAF); Randy Key (University of Alaska, Anchorage (UAA)-ADAC); Jacquelyn Overbeck (AK DNR-DGGS); Ed Page (Marine Exchange of Alaska); Nathan Wardwell (JOA Surveys); Joannes Westerink (University of Notre Dame)

EVOSTC DATA MANAGEMENT PROGRAM co-LEAD

ROBERT BOCHENEK

INFORMATION ARCHITECT, CEO

Axiom Data Science, LLC
1016 W 6th Ave Anchorage, AK 99501
Phone: 907.230.0304 Email: rob@axiomdatascience.com

RELEVANT PROFESSIONAL EXPERIENCE

2012 – Present	Develop and maintain AOOS Data Assembly Center, CeNCOOS Data Assembly Center, SECOORA Data Assembly Center, IOOS Environmental Sensor Map, Marine Biodiversity Observation Network Portal, Animal Telemetry Data Assembly Center, and other association products
2012 – Present	Funded under the NOAA High Performance Computing program for exploratory research in applying HPC concepts to serving and visualizing gridded multidimensional models and observational data sets
2011 – Present	Member of the IOOS Sensor Observation Service Standardization Committee
2010 – Present	Member of the Alaska Data integration Working Group (ADIWG) focused on developing frameworks for interchange of scientific information across Alaskan Agencies.
2008 – 2010	Development of the Prince William Sound Data Portal, a tool for scientists, educators and the public to visualize four-dimensional fisheries data

Professional Positions

2019- Present	Cyberinfrastructure Lead, National Science Foundation, Ocean Observatories Initiative
2018– Present	Technical Lead for Office of Naval Research Animal Telemetry Network DAC
2017– Present	Information Manager, National Science Foundation, North Gulf of Alaska LTER Site
2015– Present	Technical Lead, Southeast Coastal Ocean Observing Regional Association, Charleston, SC
2013 – Present	Technical Lead, Central and Northern California Ocean Observing System, Moss Landing, CA
2010 – Present	Technical Lead, Alaska Ocean Observing System, Anchorage, AK
2006 – Present	Information Architect and CEO, Axiom Data Science, Anchorage, AK
2003 – 2006	Data Systems Manager, Exxon Valdez Oil Spill Trustee Council (EVOSTC), Anchorage, AK
2001 – 2002	Analyst Programmer, Alaska Department of Fish & Game, Anchorage, AK

RELEVANT PUBLICATIONS & PRODUCTS

Bochenek, R.B., McCammon, M., Stone, B.J. (2019). AOOS Ocean Data Explorer. https://portal.aoos.org; 10+ regional data portals: http://www.aoos.org/aoos-data-resources/.

Bochenek R.B., Vance, T., Stone, B.J. (2019). IOOS Environmental Sensor Map. https://sensors.ioos.us/

Bochenek R.B., Canonico, G.., Stone, B.J. (2019). Marine Biodiversity Observation Network (MBON) and Arctic MBON. https://mbon.ioos.us/

Lopez, J., Austin, J., Koeppen, W. and **Bochenek, R.B.** (2018). AIS Vessel Traffic Data Products and Arctic Oil Spill Risk Assessment (OSRA) Products. http://ais.axds.co. and https://osra.axds.co/.

Turner, C. and **Bochenek, R.** (2017). "Cyberinfrastructure to support data management," in OCEANS Anchorage, 2017., 2017, Anchorage, AK, [Online]. Available: http://ieeexplore.ieee.org/document/8232392/

Bochenek, R.B., R. Martin (2017), Research Workspace. https://researchworkspace.com.

Bochenek, R.B., Baker, B. (2019). North Pacific Research Board. Project Search & Database. http://projects.nprb.org

EDUCATION

University of Michigan Ann Arbor, MI Aerospace Engineering, B.S.E. 2001

COLLABORATIONS

Anderson, Clarissa (Scripps Institution of Oceanography); Arp, Christopher (University of Alaska Fairbanks); Baker, Matthew (North Pacific Research Boar (NPRB)); Bailey, Kathleen (Integrated Ocean Observing System (IOOS)); Beaulieu, Stace (Woods Hole Oceanographic Institute (WHOI)); Biddle, Matthew, (IOOS); Bresnahan, Phillip (Scripps Institution of Oceanography); Broderson, Dayne (University of Alaska, Alaska Center for Energy and Power); Burger, Eugene (NOAA Pacific Marine Environmental Laboratory (PMEL)); Canonico, Gabrielle (IOOS); Chavez, Fransisco (Monterey Bay Aquarium Research Institute); Crowley, Heather (Bureau Ocean Energy Management); Daniel, Patrick (Central and Northern California Ocean Observing System (CeNCOOS)); Danielson, Seth (University of Alaska Fairbanks (UAF)); Davis, Nolan (LEIDOS); Decker, Julie (Alaska Fisheries Development Fund); Dickson, Danielle (NPRB); Dorton, Jennifer (Southeast Coastal and Ocean Observing Regional Association (SECOORA)); Dugan, Darcy (AOOS); Glastein, Jeffrey (WHOI); Goldmann, Maxwell, Audubon Alaska; Harper, Alex (CeNCOOS); Hatch, Leila (NOAA); Hernandez, Debra (SECOORA); Hoffman, Katrina (Prince William Sound Science Center); Holderied, Kris (NOAA National Centers for Coastal Ocean Science); Hopcroft, Russell (UAF); Howard, Katherine (Alaska Department of Fish and Game); Iken, Katrin (UAF); Janzen, Carol (AOOS); Jones, Benjamin (UAF); Jones, Matthew (National Center for Ecological Analysis and Synthesis); Jones, Tahzay (National Park Service); Kaczmarek, Michael (Carnival Corporation); Kasper, Jeremy (UAF); Kee, Randy (ADAC-University of Alaska, Anchorage); Kent, Holly (AOOS); Konar, Brenda (UAF); Knutson, David (Olgoonik Corporation); Lindeberg, Mandy (NOAA National Marine Fisheries Service); Merkel, Heike (University of Alaska, Alaska Center for Energy and Power); McCammon, Molly (AOOS); Mellish, Joann (NPRB); Morse, Laura (ORSTED); Migurra, Mandy (NOAA National Marine Fisheries Service); Mueter, Franz (UAF); Muller-Karger, Frank (University of Florida); Mundy, Phillip (Alaska Fisheries Science Center); O'Brien, Margaret (University of California Santa Barbara); Palenski, Lynn (NPRB); Pegau, Scott, Oil Spill Recovery Institute

EVOSTC DATA MANAGEMENT PROGRAM DATA COORDINATOR
STACEY BUCKELEW

DIRECTOR OF PROGRAMS

Axiom Data Science, LLC.
1016 W 6th Ave #105
Anchorage, AK 99501
Phone: 907.717.4583 ; Email: stacey@axiomdatascience.com

RELEVANT PROFESSIONAL EXPERIENCE

- Interface with external partners, funders, and clients on project management, budgetary and reporting activities, in addition to leading internal project management and task coordination across the Axiom enterprise.
- Maintain stewardship responsibility for all aspects of the project during the execution and has overall responsibility for subaward management, schedule, and cost compliance.
- Provide primary coordination, for subaward activities, and facilitate cost-effective technical support by the Axiom team in compliance with the project budget and statement of work.
- Maintain oversight of the entire life-cycle of subawards including pre-award activities, negotiations, post-award activities, financial reporting, and closeout. Plan, organize and supervise the activities of assigned project staff, and facilitate relationships between partner/awarding institutions and appropriate offices.
- Serve as Project Manager for data management activities for the following marine research programs: IOOS Animal Telemetry Network, Data Assembly Center; National Science Foundation's Ocean Observatories Initiative (OOI) data discovery user interface; Central and Northern California Ocean Observing System and Southeast Coastal and Ocean Observing Regional Association, Data Management and Communications; Alaska Ocean Observing System, Data Management and Communications; IOOS Environmental Sensor Map; *Exxon Valdez* Oil Spill Trustee Council, Data Management Program.
- As Coastal Training Program Coordinator, deliver science-based information to coastal decision-makers to promote informed decisions about coastal resources through meetings, workshops, and training events. Outreach science and research about coastal ecosystems and management issues through training programs and products. Establish and maintain effective working relationships with government agencies, partners, and the public. (2012 – 2015)

Professional Positions

2015 – Present	Director of Programs, Axiom Data Science, Anchorage, AK
2012 – 2015	Coastal Training Program Coordinator, Kachemak Bay Research Reserve, Homer, AK
2011 – 2012	Program Manager, Saltwater Inc, Anchorage, AK
2010 – 2011	Alaska Dept of Fish & Game, Div of Commercial Fisheries, Anchorage, AK
2005 – 2010	Project Manager, Island Conservation, Santa Cruz, CA
2002 - 2005	Field Biologist, US Antarctic Marine Living Resources Program
2000 – 2002	Research Technician, University of California Santa Cruz

RELEVANT PUBLICATIONS & PRODUCTS

Croll, D.A., M. MacKown, K. Newton, N. Holmes, J. Williams, H. Young, **S. Buckelew**, C. Wolf, M. Bock, B. Tershy. 2016. Passive recovery of an island bird community after rodent eradication. *Biological Invasions 18:703-715.*

Doroff, A, Baird, S., Freymueller, J., **Buckelew, S**., Murphy, M. Assessing coastal habitat changes in a glacially influenced estuary system: Kachemak Bay, Alaska. *In review*.

Buckelew, S. 2014**.** Bivalves in Kachemak Bay: Applying Lessons Learned from Restoration along the Pacific Coast. Kachemak Bay Research Reserve, *Workshop Proceedings.*

Buckelew, S. 2013**.** Oyster Population Resiliency: Situation Assessment Report. Kachemak Bay Research Reserve, Homer, Alaska.

Buckelew, S., V. Byrd, G. Howald, S. MacLean, and J. Sheppard. 2011. Preliminary ecosystem response following invasive Norway rat eradication on Rat Island, Aleutian Islands, Alaska. *Island invasives: eradication and management. IUCN, Gland, Switzerland.*

Buckelew, S., G. Howald, S. Maclean, G. Siekaniec. 2009. Conservation in action: restoring habitat and protecting seabirds in the Aleutian Islands. *Oryx. 43(2).*

Trivelpiece, W.Z., **S. Buckelew**, C. Reiss, and S.G. Trivelpiece. 2007. The winter distribution of chinstrap penguins from two breeding sites in the South Shetland Islands of Antarctica. *Polar Biology. 30(10).*

Maron, J. L., J. A. Estes, D. A. Croll, E. M. Danner, S. C. Elmendorf, & **S. L. Buckelew.** 2006. An introduced predator transforms Aleutian Island plant communities by disrupting spatial subsidies. *Ecological Monographs. 76*.

EDUCATION

University of California, Santa Cruz; Marine Biology; B.S., 2000

University of California, Santa Cruz; Ecology and Evolutionary Biology; M.S., 2007

COLLABORATIONS

Aderhold, Donna (PWSSC); Arimitsu, Mayumi (USGS); Baird, Steve (KBNERR); Batchelder, Hal (PICES); Batten, Sonia (PICES); Bishop, Mary Anne (PWSSC); Branch, Trevor (UW); Brenner, Rich (ADF&G); Campbell, Robert (PWSSC); Danielson, Seth (UAF); Coletti, Heather (NPS); Esler, Daniel (USGS); Haught, Stormy (ADF&G); Heintz, Ron (SSSC); Hershberger, Paul (USGS); Hoffman, Katrina (PWSSC); Holderied, Kris (NOAA); Hopcroft, Russell (UAF); Iken, Katrin (UAF); Janzen, Carol (AOOS); Kaler, Robert (USFWS); Klinger, Terrie (UW); Konar, Brenda (UAF); Kuletz, Kathy (USFWS); Lindeberg, Mandy (NOAA); Matkin, Craig (NGOS); Moran, John (NOAA); Ostle, Clare (MBA); Pegau, Scott (PWSSC); Rand, Pete (PWSSC); Rice, Stanley (Jeep) (NOAA, retired); Straley, Jan (UAS); Whitehead, Andrew (UC Davis)

EVOSTC DATA MANAGEMENT PROGRAM DATA LIBRARIAN

ADRIENNE CANINO

DATA LIBRARIAN

Axiom Data Science, LLC.
1016 W 6th Ave #105
Anchorage, AK 99501
(315) 886-1322 (Mobile); adrienne@axiomdatascience.com

RELEVANT PROFESSIONAL EXPERIENCE

- Data Coordinator for Gulf Watch Alaska program responsible for data management planning and metadata creation for scientific research projects engaged by the Exxon Valdez Oil Spill Trustee Council (2020- present).
- Data Coordinator for Arctic Marine Biodiversity Observation Network responsible for data management planning and metadata creation for scientific research projects across a network of partnership MBON programs (2020 - present)
- Data Coordinator for Arctic Integrated Ecosystem Research Program responsible for data management planning and metadata creation for scientific research projects (2020-present).
- Data Coordinator for North Pacific Research Board Core program, responsible for data management planning and metadata creation for scientific research projects funded through NPRB's annual grants (2020-present).
- DMPTool Administrator and data management planning consultant, University of Rochester Libraries- point of contact for researchers, office of sponsored programs, and graduate students (2018-2020).
- NYDCLC Fellow - Institute of Museum and Library Services funded consortium of academic and public institutes supporting data, software and library carpentry workshops and instructors in a community of practice in upstate New York (2019).
- Official Representative, University of Rochester Membership, Inter-university Consortium for Political and Social Research, social and behavioral science data archive. Primary point of contact for access, voting, and communications (2018-2020).

Professional Positions

2020 – Present	Data Librarian, Axiom Data Science, Anchorage, AK
2018 – 2020	Science & Data Outreach Librarian, River Campus Libraries, University of Rochester, NY
2017– 2018	Graduate Student Employee, Carnegie Library, Syracuse University, Syracuse, NY
2013 – 2017	Program Coordinator, Onondaga Earth Corps, Syracuse, NY

RELEVANT PUBLICATIONS

Canino, A. (Pending). Getting messy for ourselves: An experiential learning curriculum for subject librarians to engage with data literacy. In K. Getz and M. Brodsky (Eds.), *ACRL's Data Literacy Cookbook*. Association of College and Research Libraries.

Canino, A. (2019), Deconstructing Google Dataset Search, *Public Services Quarterly* 15:3, doi: https://doi.org/10.1080/15228959.2019.1621793

EDUCATION

Syracuse University; Syracuse, NY; Library and Information Science; M.S., 2018

Syracuse University; Syracuse, NY; Data Science; C.A.S., 2018
State University of New York College of Environmental Science and Forestry; Syracuse, MY; Environmental Studies; M.P.S., 2014
Le Moyne College; Syracuse, NY; Environmental Studies; B.S., 2011

COLLABORATIONS

Haught, Stormy (ADF&G); Kaler, Robert (USFWS); Kuletz, Kathy (USFWS); Baird, Steve (KBNERR);

EVOSTC DATA MANAGEMENT PROGRAM DATA LIBRARIAN

CHRIS TURNER

DATA LIBRARIAN

Axiom Data Science, LLC
1015 W 6th Ave, Anchorage, AK 99503
907.306.8663; chris@axiomdatascience.com

RELEVANT PROFESSIONAL EXPERIENCE

- Site information manager for the Northern Gulf of Alaska Long-term Ecological Research site (NGA LTER), responsible for site data management policies and deliverables implemented according to best practices and to ensure compliance with NSF and LTER requirements.
- Participated in an advisory role on the Alaska Data Integration Work Group (ADIwg) to inform about the structure and content of ISO 19115 metadata and to guide translation from ADIwg content standard to ISO metadata
- Provided data management services and best practice guidance to a variety of ecological research programs, including EVOSTC's Gulf Watch Alaska and Herring programs, as well as NPRB's GOAIERP, BOEM's ArcticEIS and MARES programs, and NSF's NGA LTER site, and the IOOS Animal Telemetry Network Data Assembly Center (at Axiom Data Science).
- Presenter and facilitator of hands-on workshops and trainings at Gulf of Alaska and Arctic focused data management meetings and workshops including: Alaska Marine Science Symposium (Jan. 2017-2020); NGA LTER site kick-off (Nov. 2017) and annual PI meetings; MTS Oceans NOAA Digital Showcase and Data Management in the Ocean Sciences tutorial (Sept. 2017); Marine Arctic Ecosystem Study kick off meeting (Aug. 2015); Distributed Biological Observatory and Pacific Arctic Group meeting and data management breakout (Oct. 2014); Arctic Ecosystem Integrated Survey PI meeting (June 2014); Exxon Valdez Oil Spill Trustees Council Long-Term Monitoring Program Data Meeting (Jan. 2014) and Annual PI meetings (Nov. 2013-2018), and Public Outreach and Science Panel Meeting (Feb. 2015).
- As data management consultant for the Thermochronology and Tectonics Research Group at Syracuse University, research experimental procedures and data generation pathways for thermochronology research to develop plans for data and sample management.
- As data management consultant for Human Migration Research Group at Syracuse University, designed metadata profile, data management plans, and database structure to be used for management of migrant and refugee data

Professional Positions

2012 – Present	Data Librarian, Axiom Data Science, Anchorage, AK
2011	Polar Profile Intern, National Snow and Ice Data Center, Boulder, CO
2010 – 2012	eScience Graduate Fellow, Syracuse University, Syracuse, NY
2008 – 2010	Serials Cataloger, Consortium Library, University of Alaska, Anchorage, AK

RELEVANT PUBLICATIONS & PRODUCTS

Wiese, F.K., Pickart, R., Fissel, D.B., Ross, E., Nelson, J., Ashjian, C., Gryba, R., Lin, P., Torres, D., Bahr, F., Monacci, N., Kasper, J., Stafford, K., Fabijan, M., and **Turner, C.** (2019). Marine ARctic Ecosystem Study

(MARES): Moorings on the Beaufort Sea shelf 2016-2017 - Year 1 Highlights. Poster presented at the Alaska Marine Science Symposium, Anchorage, AK.

Turner, C. and I. Gill. (2018) Developing a data management platform for the ocean science community. *Marine Technology Society Journal*, 52(3), 28-32. https://doi.org/10.4031/MTSJ.52.3.8.

Bochenek, R. and **C. Turner**. (2017) Cyberinfrastructure to support data management. *OCEANS 2017 - Anchorage*, Anchorage AK, 2017, pp. 1-9. https://ieeexplore.ieee.org/abstract/document/8232392.

Turner, C., Stone, B., and StSavage, S. (2016). Research Workspace Metadata Editor. Web-based scientific metadata editor for authoring ISO 19115/19110 compliant metadata records. Available at: https://researchworkspace.com

EDUCATION

B.S., Mathematics; B.S., University of Alaska Anchorage, 2007
M.S., Library & Information Science, Syracuse University, 2012

COLLABORATIONS

Arimitsu, Mayumi (USGS); Ashjian, Carin (WHOI); Bahr, Frank (WHOI); Baird, Steve (KBNERR); Batchelder, Hal (PICES); Batten, Sonia (PICES); Matthew Biddle (NOS); Bishop, Mary Anne (PWSSC); Julie Bosch (NCEI); Branch, Trevor (UW); Brenner, Rich (ADF&G); Buckelew, Stacey (Axiom); Campbell, Robert (PWSSC); Danielson, Seth (UAF); Coletti, Heather (NPS); Esler, Daniel (USGS); Fabijan, Michael (Kavik-Stantec); Fissel, David (ASL); Gryba, Rowenna (Stantec); Haught, Stormy (ADF&G); Heintz, Ron (SSSC); Hershberger, Paul (USGS); Hoffman, Katrina (PWSSC); Holderied, Kris (NOAA); Hopcroft, Russell (UAF); Iken, Katrin (UAF); Janzen, Carol (AOOS); Kaler, Robert (USFWS); Kasper, Jeremy (UAF), ; Kent, Holly (AOOS); Klinger, Terrie (UW); Konar, Brenda (UAF); Kuletz, Kathy (USFWS); Lin, Peigin (WHOI); Lindeberg, Mandy (NOAA); Matkin, Craig (NGOS); McCammon, Molly (AOOS); Megan McKenzie (MBARI); Moran, John (NOAA); Monacci, Natalie (UAF); Nelson, John (VIMS); Ostle, Clare (MBA); Pegau, Scott (PWSSC); Pickard, Robert (WHOI); Rand, Pete (PWSSC); Rice, Stanley (Jeep) (NOAA, retired); Ross, Ed (Trailmark Systems); Stafford, Kate (UAF),; Straley, Jan (UAS); Torres, Daniel (WHOI); Tiffany Vance (IOOS); Wiese, Francis (Stantec); Whitehead, Andrew (UC Davis)

Data Management Procedures Using the Research Workspace for *Exxon Valdez* Oil Spill Trustee Council-funded Programs and Projects

Prepared by Axiom Data Science
on behalf of Alaska Ocean Observing System,
as the Data Management Provider to the *Exxon Valdez* Oil Spill Trustee Council
October 2017

Data Management Timeline for Council-funded Programs and Projects

To keep data organized and meet the data management requirements, PIs should follow these timelines throughout the life of their projects. Items marked with an asterisk(*) are required. The remaining items are guidelines to help you stay on track

Upon award	● Log in to the AOOS Workspace and update your contact information ● Update project SOPs to include data QA/QC procedures*
Within 6 months of data collection	● Review data management best practices ● Load preliminary data to the Workspace under the Data folder for the current funding term* ● Create preliminary metadata record using metadata best practices* ● Meet annually with Axiom to discuss data management plan specific to your project
Within 1 year of data collection	● Complete data QA/QC ● Load final QA/QC data to the Workspace under the Data folder for the current funding term* ● Revise preliminary metadata record* ● For monitoring studies, publish data and metadata to the GOA data portal*. Otherwise for process studies that are research-oriented, data and metadata will be published within 1 year after study completion.
Within 6 months of project completion	● Compile final project data and metadata* ● Work with Axiom to review and edit final project data and metadata for archive in DataONE Search via the DataONE Research Workspace Member Node* ● Approve publication agreement for Axiom to archive final data in DataONE*

TABLE OF CONTENTS

1. Purpose

The goal of the Long-Term Research and Monitoring Program (LTRM) is to provide sound scientific information on biological resources and environmental conditions to management agencies, the scientific research community and the general public; and to identify and help understand the impacts of multiple factors on recovery of resources injured by the 1989 oil spill. The data generated by LTRM funded projects are key assets to realizing this vision that must be managed correctly to support management decision-making, scientific integrity, and enhanced information availability. This document provides a data management framework for the LTRM program with defined procedures for the collection, quality, storage, maintenance, and dissemination of project data. Procedures may be followed at any time during the preparation of your dataset, but are most useful when considered at the onset of project planning and implemented during data collection. The intent of this framework is to improve the accessibility and long-term usability of Council-funded data.

2. EVOSTC Information and Data Sharing Policy

The EVOSTC data sharing policy is as follows:

- All data is posted on the Research Workspace as they become available following collection in order to promote internal integration and sharing within the project.
- These data are replaced with QA/QC'd data when available.
- Comprehensive metadata using FGDC (or ISO) standards accompany each dataset.
- Monitoring data is made available to the public as soon as it has been QA/QC'd or within 1 year following collection, whichever is sooner.
- Anyone making public use of another team's data contacts the data collector and provides appropriate attribution and credit.
- The Science Coordinating Committee must agree to any deviations from these policies in advance.

3. Definitions

For the purposes of this document, the following definitions apply:

Data: Data are distinct units of information, such as numbers, model code base, research outputs, usually formatted in a specific way stored within a database or file and suitable for processing by a computer.

Data storage: Data files uploaded and stored in the Research Workspace, a secure, web-based scientific collaboration and data management tool used to centralize and share Council-funded program or project information. Data files are stored for long-term access exclusively by project PIs, EVOSTC staff, and invited project collaborators.

Data transfer: Data files that are submitted either by upload to the Research Workspace or other means, such as email or physical copy (e.g. hard drive).

Data shared with the public: Project data and data products made available publicly through the Gulf of Alaska data portal one year after collection. The GOA portal provides the public with scientific information about the Council-funded programs and projects.

Archived: Final data and data products are stored in a data repository for long-term preservation. At the time of writing, the Research Workspace supports an automated pathway to submit project data to the Research Workspace Member Node in the DataONE network where it is discoverable and accessible through the DataONE Search catalog. The final data package is

assigned a digital object identifier (DOI) or accession number to facilitate the citation of project data.

4. Data Management Procedures

All PIs shall follow the procedures listed below for managing and submitting project data and data products. Further, it is recommended to follow the common data management guidelines for the Research Workspace. The rationale for these procedures is to save PIs time by ensuring data is well-organized and documented and, ultimately, to increase access by the broader community to research outputs.

4.1 Data Management Plan

Data management plans are the best way to ensure that your data are well-organized, managed, and prepared for preservation into the future. Preparing a data management plan before data collection is recommended to document the planned research effort, the expected outputs, and the plan for documenting and archiving your data.

As you and your collaborators begin to implement the best practices outlined in this document, make an effort to record these plans and who is responsible for each task within your team, including:

- Folder structure
- File naming
- File versioning
- Metadata documentation
- Final dataset preparation for publication and archiving

Project PIs should complete the LTRM Project Data Management questionnaire at the onset of their project to clearly document and record a data management plan specific to their project. This plan will be reviewed by the data management team at Axiom Data Science to assist the PI with specific data management needs relative to their project requirements. Additionally, the plan will be revisited annually in a one-on-one meeting with the PI and Axiom Data Science to check progress and make adaptation, as needed, to ensure timely data and metadata submissions.

4.2 Data Submission

Following data sharing policies, the PI(s) agree to transfer all monitoring data as they become available using the Research Workspace (https://workspace.aoos.org). These data shall be replaced in the Workspace with QA/QC'd when available. Final QA/QC'd data and metadata shall be made publicaly available through the GOA data portal within 1 year after collection. The Workspace is the gateway for PIs to elect and publish data and metadata to the GOA data portal. The exception is for process studies which are research-oriented in nature and do not have annual timeseries data. Process studies requires data and metadata to be made publicly available through the GOA data portal by the end of the project.

While the minimum requirement is for intermediary and final monitoring data to be stored in the Workspace, PIs are encouraged to use the Workspace to store provisional versions of both monitoring and process study data throughout the life of the project. The Workspace is an effective tool to help PIs centralize project information, securely store data files, and share project data with collaborators. Detailed information on how to use the Workspace can be found in the help documentation.

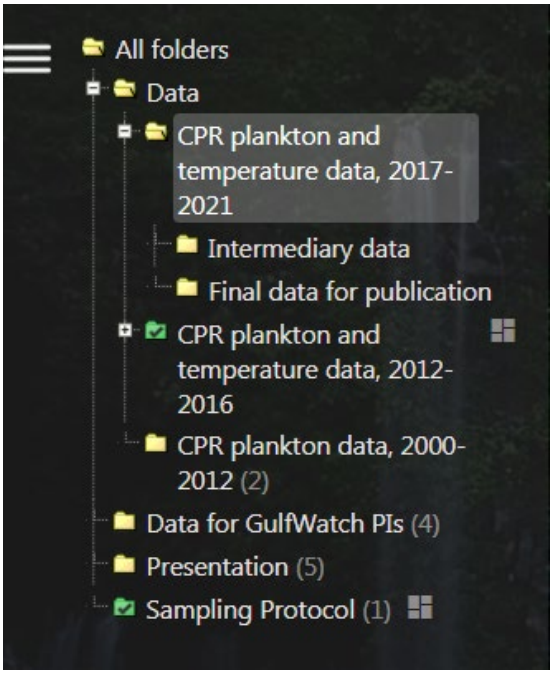
4.3 Data Organization

Project information stored in the Research Workspace shall adhere to the below data guidelines. Refer to Axiom's documentation for more detailed recommendations about best practices for managing your data.

Folder Structure

Folders are important for breaking down project files into smaller, easier-to-manage and identifiable units. By default, projects in the Research Workspace contain a pre-existing folder named "Data". PIs are encouraged to use and/or build a unique folder structure within this folder to help stay organized and easily retrieve data files. This folder also serves to differentiate project data from one program funding cycle to another (e.g. 2012-16 from 2017-21).

Finalized files shall be stored in separate and clearly-marked folder(s) from intermediary or raw data files. This will expedite preparation of your final dataset for archive. Below is an example folder structure for storing intermediary and final 2017-21 project data in the Research Workspace.



Refer to the best practices documentation for guidance on creating and naming new folders.

Folder and File Naming

How you name folders and files added to your projects will have an impact on you and your collaborator's ability to find and understand the project's data. Naming consistently and descriptively will help users identify records at a glance, and will help to facilitate the storage and retrieval of data. Final data files shall follow these naming guidelines to ensure they are consistently formatted and informative.

4.4 Data Formats

For data-based projects, final data files shall be stored in non-proprietary formats to help ensure they are usable, open, and readable into the future. Refer to the best practices documentation for data formats appropriate for long-term preservation.

4.5 Data Quality

Beyond scientific quality assurance, basic quality reviews shall be performed to your data throughout its lifecycle, from collection through submission of final data files in the Research Workspace. To meet AOOS's mandates as a Regional Information Coordination Entity (RICE) under the authority of the Integrated Coastal and Ocean Observation System Act of 2009 (ICOOS Act), detailed quality assessment and control procedures shall be written into the projects sampling SOPs. These procedures used during your project can be later copied into the metadata documentation to indicate to future users the quality and accuracy of your data. Refer to the best practices documentation for the data quality guidelines.

4.6 Prepare Metadata and Data Documentation

Metadata

Metadata are required for all project datasets or data products submitted to the Workspace and made publically available through the GOA portal. Metadata must be in a standards-compliant format suitable for long-term archive. The Research Workspace includes an integrated metadata editor that the PIs shall use to generate FGDC-endorsed ISO 19110 and 19115-2 standards metadata.

A new metadata record should be created using the LTRM Program template available through Workspace metadata editor. Follow these steps for how to copy a whole record from a metadata template. The name of the existing template record to be used in step 2 is the LTRM (*or Gulf Watch or HRM) metadata template*. New content about your project data can be added to your metadata record after the template is copied.

Depending on the project, more than one metadata record may be required to sufficiently describe the data. Metadata should be created at the final data folder to describe the file or files contained within the folder. The intent of folder metadata is to reduce the burden upon the creator for constructing the metadata and resource archive.

- Depending on the nature of the data, groups of files of the same format or sharing similar characteristics or methods can be documented by a single metadata record. Examples that require one metadata record include: single data collection methods resulting in one data file; a single instrument or sensor type (e.g. CTD); or single data collection methods repeated at more than one location resulting in one or more data files.

- If there are project datasets that contain distinct characteristics or were generated using different methods, then more than one metadata record should be created to describe each unique dataset. Examples that require more than one metadata record are projects organized with distinct sub-projects (e,g, Nearshore: Ecological trends in Kachemak Bay intertidal surveys vs. sea otter diet study); projects using more than one instrument or sensor type that are not associated (e.g. ADCP, CTD, etc); or projects having generated more than one distinct model or data product.

Refer to the Best Practices for Scientific Metadata document for guidance in assembling the final data package and creating scientific metadata using the metadata editor. This document provides field-by-field guidance on how to write high-quality metadata.

If you have questions about how to structure your metadata record(s) relative to your project data, please contact Axiom Data Science at metadata@axiomdatascience.com.

Data Documentation

Beyond standardized metadata, additional documentation about your dataset may be useful to further describe the actions taken to the data. Examples of data documentation include standard operations procedures, field notes, QA/QC manuals, and other associated readme files.

4.7 Annual Data and Metadata Quality Review

Once QA/QC'd data has been submitted, Axiom Data Science will perform reviews of the data formats and metadata record(s) to help ensure accuracy, consistency, and completeness of the content. Any recommended edits or additions to the metadata will be communicated directly from Axiom Data Science to the PI. After which, Axiom will perform the final review of any modified metadata prior to publishing the data and metadata to the GOA data portal. The PI will give written approval to Axiom prior to the publication of any project datasets.

4.8 GOA Data Portal and DataONE Archive

As stated for monitoring studies, within one year of data collection QA/QC'd data and metadata will be made available publicly through the GOA data portal through the Workspace gateway.

At the end of the LTRM funding cycle, all final project data and metadata (from both monitoring and process studies) will be archived in the DataONE network through the Research Workspace Member Node to be discoverable and accessible through the DataONE Search catalog. The final data package will be assigned a digital object identifier (DOI) or accession number to facilitate the citation of project data. The DOI and dataset citation will be accessible through the project Research Workspace, in addition be exposed in the GOA data portal for public access and discovery.

Data may be submitted to DataONE at a sooner interval than the end of the project term, as requested by the project PI. At the time of writing, the Research Workspace supports an automated pathway to submit data to DataONE through its member node. In the future, data archive and/or replication from DataONE to NCEI may be supported.

Project PIs will receive and provide written acknowledgement of the Agreement to Archive to Axiom Data Science prior to submission of final data to the repository. At which time, any updates to the dataset or metadata content may be made or requested by the PI, including: updating PI contact information; any new changes to the data content; and referencing project-related publications.This Agreement to Archive constitutes agreement between the dataset creator or custodian (the "Provider"). The "Provider" attests that they give permission to Axiom Data Science to submit, on their behalf, the Provider's data and metadata for long-term preservation, and that the Provider has the responsibility to do so.

4.9 Maintenance and Updates to Project Data and Metadata

Publicly-available and archived metadata are living documents that need regular review and maintenance. Routine reviews to the technical metadata structure will be made by Axiom Data Science. It is the responsibility of the PI to notify Axiom of any substantial changes to the dataset or metadata to ensure currency, accuracy, and completeness. Changes may include updating of the data contents, contact information, or publications. Axiom Data Science will work with PIs to reflect these changes within the published or archived metadata records.

5. Technical Support

Project PIs are responsible for reading and adhering to the principles and guidelines written or referenced in this document. For additional questions on using the Research Workspace or creating metadata for your project, contact Axiom Data Science at metadata@axiomdatascience.com. Questions asked early in the project can save time and frustration when preparing your final dataset and metadata documentation!

5.1 Resolving Data Issues

Any user of publicly-available or archived data may question the accuracy of any data element. The user is responsible for helping to correct the problem by supplying as much detailed information as possible about the nature of the problem to Carol Janzen, AOOS (907-644-6752 janzen@aoos.org). AOOS will respond to questions about the accuracy of data, and work with the project PI and/or Axiom Data Science, as necessary, to correct inconsistencies in the published or archived resource.