DIVER Application: Environmental Data Specification

v. 2.0

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The **Data Integration Visualization Exploration and Reporting (DIVER) application**[1] is an online data warehouse and set of query tools containing environmental and project data, primarily collected to support the National Oceanic and Atmospheric Administration's (NOAA's) role as a trustee for natural resources on cases and projects nationwide.[2] In addition to standardizing and integrating environmental data from many sources and providers, DIVER serves as NOAA's primary tool for managing environmental data related to Natural Resource Damage Assessments (NRDAs), including data collected and analyzed during the Response and NRDA for the 2010 *Deepwater Horizon* oil spill in the Gulf of America.

This document serves as an environmental data specification with details on the data categories, fields, and valid values for the DIVER application. It details highlights of the DIVER common data models and data exchange methods, including the DIVER templates for data exchange. Additional information on data templates and documentation are available at: **https://www.diver.orr.noaa.gov/data-overview**.

[1] DIVER website: https://www.diver.orr.noaa.gov

[2] DIVER was developed by NOAA's Office of Response and Restoration in partnership with NOAA's Restoration Center.

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1. Data Access

The **DIVER website** provides access to data organized by region through the **DIVER Explorer query tool**. Users can search, filter, and download data using the DIVER Explorer query tool or view maps and spatial data in **ERMA**, NOAA's mapping and visualization application. Some activities and cases NOAA works on are highlighted in the **Recent Datasets of Interest** section of the DIVER website. The **help** materials on the website provide guidance and examples for using the DIVER Explorer query tool.

Query results are provided with information across multiple tabs (Figure 1): Summary, Data and Export, Charts, Metadata, and Study Notes. DIVER Explorer provides three primary export options for a query under the Data and Export tab:

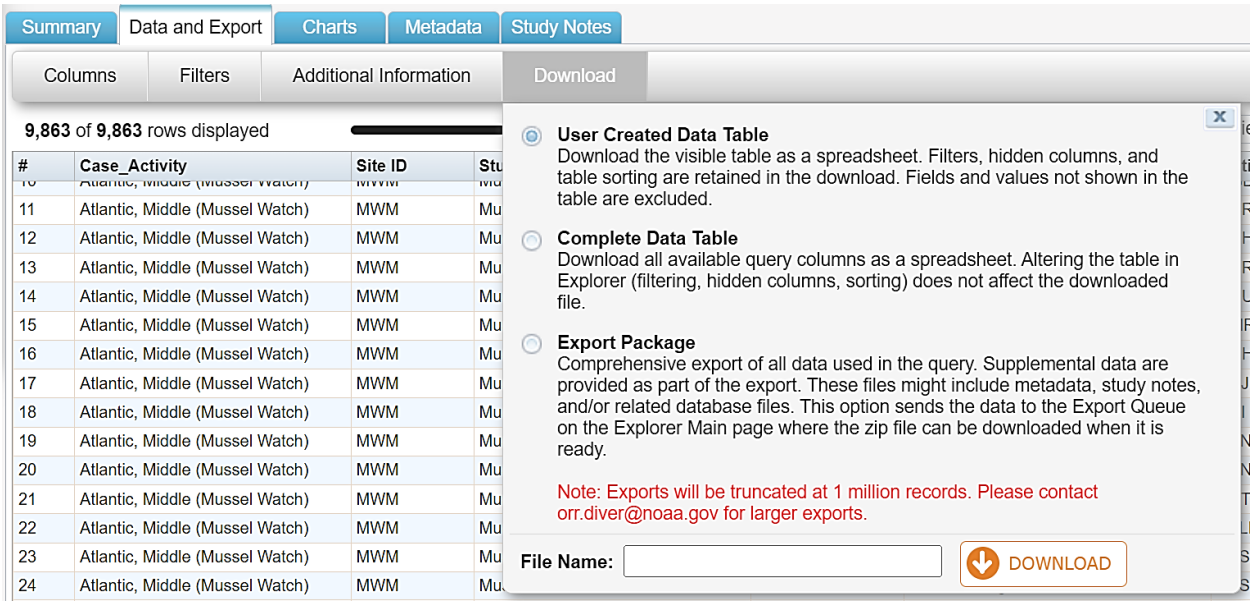
(1) the user created data table (which displays the columns and filters the user has chosen to display in the data table),

(2) the complete data table with all fields available for that query, and

(3) the full export package, which contains the complete data table including additional related fields, a readme file, and related supplemental files.

All downloads include a machine-readable, ISO19115 XML metadata file which contains information on the selected query, the exported fields, and the DIVER database overall. Data can also be accessed through DIVER's Data Services,[3] which leverage ERDDAP to present machine-readable data.

Figure 1. Example Query Results Window (Map Excluded)



[3] High-volume data users can directly access the public data stored in DIVER via ERDDAP (the Environmental Research Division's Data Access Program), an open-source data server program developed by NOAA's Southwest Fisheries Science Center that gives users a simple, consistent way to download scientific data in common file formats.

2. Data Categories

The DIVER data warehouse contains six "Data Categories" for integrated and standardized environmental data. Data Categories are overarching data models or database schemas for specialized environmental data types. Data categories are described in Table 1, with additional information in Appendix 1 under the "Field_Definitions" tab. The remainder of this section summarizes the Data Categories and specifies the primary keys used in DIVER to ensure unique records within each Data Category.

Table 1. Data Categories Description

DATA CATEGORY	DESCRIPTION
Samples	Environmental data typically from field collected samples and results from laboratory experiments, including contaminant chemistry, biological, and compositional analyses.
Field Observations	Observational and ecological/biological monitoring and field measurements.
Photos	Images and their keywords and metadata, which may include geographic location.
Telemetry	Spatial/geographic tracking data on the movement of tagged animal species (e.g., fish, marine turtles, and marine mammals).
Instruments	Information about devices (e.g., Conductivity-Temperature-Depth Rosette, remotely operated vehicle, etc.) used to collect environmental data during a field study.
Bioassay	Toxicity data from studies conducted in a laboratory to determine the effects of contaminants or other stressors on specific species. DIVER contains toxicity data on field collected material and laboratory-only toxicity tests.

2.1. Samples

The Samples Data Category is primarily for environmental data from field-collected samples that are analyzed for contaminant chemistry, biological metrics, and/or compositional analyses in a laboratory setting. For example, much of the data within the Samples Data Category is related to sediment collected in the field and then analyzed in a laboratory using industry standard methods to determine the concentrations of chemicals in that particular sample. Analyses may also determine the sediment's composition, including physical analyses such as grain size, organic carbon content, and dry weight. The primary environmental matrices represented in the Samples Data Category are sediment, water, oil, and biological tissue samples, which have been collected and managed using techniques and protocols that meet the quality objectives of the lead sampling organization.

The fields in the Samples Data Category are listed in Appendix 1 under the "Field_Definitions" tab. These fields describe how and when the sample was collected in the field and analyzed in the laboratory, and they provide details about the analysis result. A major source of contaminant chemistry data in the Samples Data Category is records that were migrated from NOAA's legacy Query Manager database.[4]

In addition to analytical chemistry and composition data, biological metrics or analyses are stored in the Samples Data Category, with an Analysis Category of "Biological". Examples include taxonomic

[4] https://response.restoration.noaa.gov/query-manager

identification in the laboratory, biochemical assays (e.g., measurements of stress hormones), and histopathology findings. In DIVER Explorer, these results are available under "Lab Results and Field Observations" and under "Build a New Environmental Data Query" for Samples.

Key fields for chemistry samples:
Site ID + Study ID + Station + SmpCode + Lab Replicate + Analysis.

Key fields for biological laboratory samples:
Site ID + Study ID + Station + SmpCode + Lab Replicate + Analysis + Reported Taxon.

Several fields in the Samples Data Category including chemical codes (ChemCode) and validation codes (Validation Level) are standardized to valid values in DIVER. Values for these fields and for additional fields including Collection Matrix, Analysis Matrix, and more are presented in Appendix 1 ("Valid_Value_Definitions" and "Chemical_Codes" tabs). Dynamic valid values lists for chemical codes and qualifier codes are also available for download for each region at https://www.diver.orr.noaa.gov/web/guest/data-service-regional-datasets.

2.2. Field Observations

The Field Observations Data Category organizes observational data and measurements that are primarily collected from field work. Much of the data incorporated into the Field Observations Data Category is ecological data recorded to assess or evaluate the biological health of a specific habitat or ecosystem. The Field Observations Data Category was originally designed to organize and manage field observations and measurements gathered under the *Deepwater Horizon* NRDA, but has been redeveloped to serve as a foundation for a broad range of observational data including data collected for restoration monitoring. Recent updates have improved the standardization and management of restoration monitoring data collected by Federal and State Trustees to track the recovery of Gulf of America ecosystems following the *Deepwater Horizon* oil spill. These improvements also apply to biological data collected in support of long-term cleanup efforts in the Great Lakes and other NOAA case-related work around the country.

The fields that are part of the Field Observations Data Category are listed in Appendix 1 under the "Field_Definitions" tab. Guidance for data providers on valid values for fields such as Analysis Category and Analysis is provided in Appendix 1 ("Valid_Value_Definitions," "Chemical_Codes," and "Analysis_Values" tabs), to ensure a level of standardization across wide-ranging types of data collected in the field. Expanded considerations for species naming conventions may also be incorporated; DIVER currently standardizes Latin species names using the Integrated Taxonomic Information System (see Section 6 for more information).

Key fields for Field Observations data:
Site ID + Study ID + Station + SmpCode + Replicate + Species + Analysis.

2.3. Photos

The DIVER Photos Data Category contains images and their keywords, location information and metadata. DIVER Photos replaces the NOAA Photologger desktop application, which provided a protocol

and a process for gathering, geotagging, and assigning keywords to photographs in order to meet litigation standards. This application served as a primary source of photos that are now incorporated into DIVER. Specific photos used for analysis (e.g., quadrat counts) or to document field conditions for NOAA-related efforts can be organized and uploaded into a DIVER File Collection through the DIVER Portal.[5]

The Photos Data Package formats, available in DIVER File Collections, support the upload and direct ingest of Geotagged Photos or Photos with external GPS. These Data Packages enable Photo editing in DIVER Explorer and allow photos to be exported for further use. More information on Data Packages is in Section 8, and the fields included in the Photos Data Category are listed in Appendix 1 under the "Field_Definitions" tab.

2.4. Telemetry

The Telemetry Data Category organizes spatial and geographic data from devices typically attached to organisms. These devices track and store or transmit the animals' movement. For example, this Data Category includes information collected by biologists tracking the movement of marine turtles, marine mammals, or fish using tags that transmit information via satellite at various intervals or when the organism surfaces. The Telemetry Data Category is not as robust as other telemetry data management systems (for example the IOOS Animal Telemetry Network[6]), and the DIVER team welcomes the opportunity to collaborate on data exchange and management. The fields that are currently part of the DIVER Telemetry Data Category are listed in Appendix 1 under the "Field_Definitions" tab. **Note that as of April 2025, telemetry data are only available in the Southeast region as part of the *Deepwater Horizon* data.**

2.5. Instruments

The Instruments Data Category contains information about devices or sensors that collect measurements in the field. For example, it includes information about a Conductivity-Temperature-Depth (CTD) Rosette, which is lowered through the water column to collect water quality parameters. This Data Category is primarily used for tracking sensor equipment details and does not contain the specific environmental results. Using the CTD Rosette example, the Instruments Data Category contains technical information such as sensor type, serial number, date, time, location, sampling organization, and work plan, but does not contain the water temperature or conductivity data collected in the field.

A user querying Instrument data in DIVER can separately download the instrument results (and associated files potentially including raw or processed data, sampling forms, calibration details) that may be housed in DIVER or links to a partner agency such as the NOAA's National Center for Environmental Information (NCEI).[7] If a field sampling team collected sensor data and Samples data (for example, water samples) and submitted to a DIVER File Collection, the DIVER system is designed to return both the Instruments and Samples information with links to primary or processed data. The fields that are part of the Instruments Data Category are listed in Appendix 1 under the "Field_Definitions" tab. **Note that as of April 2025, instruments data are only available in the Southeast region as part of the *Deepwater Horizon* Response and NRDA data.**

[5] The DIVER Portal is a login environment used by NOAA and partners to collect, manage and share data. File Collections are located within the DIVER Portal.

[6] International Ocean Observing System: Animal Telemetry Network: https://ioos.noaa.gov/project/atn/

[7] https://www.ncei.noaa.gov/

2.6. Bioassay

The Bioassay Data Category organizes and standardizes laboratory toxicity testing and other bioassay data from studies to determine the effects of contaminants or other stressors on specific species. This category contains legacy Query Manager bioassay data, primarily consisting of field collected samples (including sediment and water) analyzed in the laboratory for toxicity endpoints. It also encompasses extensive testing conducted for the *Deepwater Horizon* NRDA, which focused on laboratory tests under varying conditions (e.g., UV exposure, mixing method).[8] The Bioassay data in DIVER often have paired sediment chemistry results which are in the Samples Data Category. The fields that are part of the Bioassay Data Category are listed in Appendix 1 under the "Field Definitions" tab.

Key fields for unique Bioassay records:
Site ID + Study ID + Station + DB Sample ID + Test Description Code + Bioassay Series.

3. Core Fields

Each Data Category contains "Core Fields," which provide high-level descriptions of key information and are consistent across all of the Data Categories. The core fields support "Overview" queries in DIVER Explorer, providing output of high-level information across Data Categories. For example, an overview query will display all Stations across different Data Categories for a Data Source or Study Name or similar overarching values. The core fields listed in Table 2 are generally required for data brought into DIVER, but some of the fields (such as Region, Station Group, and Analysis Category) are assigned based on internal database and data processing rules.[9]

[8] Given the complexity and magnitude of the *Deepwater Horizon* toxicity testing program, a separate interface provides supplemental reference materials and allows for querying these data on additional fields: https://www.diver.orr.noaa.gov/dwh-toxicity-studies.

[9] For datasets that are referential (linked), or where core fields are unknown, incomplete records may be brought into DIVER.

Table 2. Core Fields for Environmental Data Categories

FIELD NAME	FIELD DEFINITION	FIELD SET WITHIN DIVER EXPLORER*
Case_Activity†	The name of the case incident or the activity used to collect data.	Case/Activity Overview
Region	Region	Case/Activity Overview
Station Group	Predefined sets of grouped stations/locations	Case/Activity Overview
Study Name	The name of the study under which the field data were collected.	Collection Summary
Data Category	General category of data collection (e.g., Samples, Bioassay, Field Observations, Instruments, Photographs, Telemetry, or SCAT).	Collection Summary
Data Source	The originating owner of the dataset.	Collection Summary
Collection Matrix	The type of sample or record collected (e.g., Sediment, Water, Photograph, Wipe).	Field Data
Sample ID	Unique ID assigned to each sample by the field sampler.	Field Data
Station	Station or site identifier. This is often defined by the workplan and/or recorded by the field team but may be standardized to database requirements.	Field Data
Area Description	General description or name of the area sampled (e.g., a particular reef or marsh).	Location/Date/Time
County	The County or Parish where the field collection was completed.	Location/Date/Time
Date‡	Data collection date, as year, month, and day.	Location/Date/Time
End Latitude‡	End Latitude in decimal degrees for trawls, transects or samples collected in a line.	Location/Date/Time
End Longitude‡	End Longitude in decimal degrees for trawls, transects or samples collected in a line.	Location/Date/Time
Start Latitude‡	Sample Latitude in decimal degrees, or start Latitude for samples collected by trawl, transect or in a line.	Location/Date/Time
Start Longitude‡	Sample Longitude in decimal degrees, or start longitude for samples collected by trawl, transect or in a line.	Location/Date/Time
State	The state where the field event took place.	Location/Date/Time
Analysis	Specific chemical or physical property measured. For groupings of analyses, see Analysis Type and/or Analysis Category.	Results: All Data Types
Analysis Category	General category of analysis performed (e.g., Plankton - Nekton, Visual Observation, Contaminant Chemistry). For additional detail, see Analysis Type and/or Analysis.	Results: All Data Types
Analysis Status	Status of samples in the analysis process as reported by laboratories or through results (e.g., Results Available, Results Rejected, etc.).	Results: All Data Types

FIELD NAME	FIELD DEFINITION	FIELD SET WITHIN DIVER EXPLORER*
Analysis Type	Subcategory (i.e., type) of analysis performed, such as Biomass, Hematology, Genetics, etc. For additional detail, see Analysis.	Results: All Data Types
Review Status	Extent of data quality review performed.	Results: All Data Types
Sharing Status	Identifies extent of data distribution (e.g., Publicly Available).	Results: All Data Types

* Field Set is assigned to each field to facilitate querying in DIVER Explorer by grouping similar fields together (e.g., all fields related to location, date, and time).

† Most recent data (2012 to present) that is integrated into DIVER and associated with a case will have information in this field. Users should be aware that older data (pre-DIVER) may not have consistent Case_Activity values, and the Station Group should be used for query and analysis.

‡ Date and location information are available for all records. Dates are queried through a special date filter, by month and year. Location can be queried through a spatial filter, by drawing or uploading shapes.

4. Detail Fields

Each Data Category contains dataset-specific fields in addition to Core Fields. All fields (i.e., both Core Fields and Detail Fields) are grouped into Field Sets to help with data access and querying. Field Sets are groupings of fields into topics such as Overview, Location/Date/Time, and Results; fields that are only available in the output results but are not queryable are not grouped into a field set.

Appendix 1 ("Field_Definitions" tab) contains a table describing all fields for each Data Category. The table includes field definitions, a designation of Core Field or Detail Field, whether the field has a list of valid values, and the field names as reported in shapefile outputs and DIVER's Data Services (ERDDAP). The concept of valid values is discussed in Section 6 of this document and in Appendix 1 ("Valid_Value_Definitions" tab), which contains definitions of valid values that are presented as codes within certain fields.

5. Spatial Attributes

The DIVER data warehouse natively stores spatial data attributes. Each record across all Data Categories has start and end coordinates (i.e., start latitude/end latitude and start longitude/end longitude). Spatial attributes are not required for data integration but are required for display on the map in the DIVER Explorer query tool. Data with no spatial attribution will still be available in the query result and in the Data and Export tab, but using a spatial filter will remove these results from the query. In addition to point coordinates, DIVER has the ability to natively store more complex geometries such as multipoint, multiline, and polygons. Coordinates are natively held in Decimal Degrees, Horizontal Datum NAD83 and presumed Vertical Datum NAVD88.

6. Valid Values

Each of the DIVER Data Categories use standards, conventions, and values that are specific to the type of data.[10] For example, the Samples and Bioassay data categories are standardized based on the legacy Query Manager database structure. Across DIVER, "Not Defined" corresponds to a blank or null value for text fields. In addition, DIVER standardizes the use of -999.99 and -9 in numeric fields to indicate a particular meaning across data categories; -999.99 indicates that a value should not be expected (i.e., an analysis was not conducted), while -9 indicates that a value was expected but not received (i.e., a missing value).[11] In order to assist the data provider in understanding which fields have associated valid values in DIVER, Appendix 1 contains lists of valid values for DIVER fields with standardized values, such as Analysis Category and Collection Matrix ("Valid_Value_Definitions" tab). A dictionary of chemical names and codes is also included ("Chemical_Codes" and "Analysis_Values" tabs).

Standardized values are used in several important fields to support user queries across studies and data sources. An important example is the "Matrix" fields that provide grouping (e.g., Matrix Group for Samples with Sediment, Tissue, Water, etc.) and increasing levels of detail in "Collection Matrix," "Analysis Matrix," and "Analysis Matrix Detailed" fields. Another important example is the "Station Group" field. This high-level field has standardized values that group data across studies and geographies that are useful for analysis and site specific work. Station Groups are curated by NOAA data managers with input from Trustees and partners, and in many cases provide consistency with legacy "Watershed" datasets.

DIVER has shifted the standardization of species names to the Integrated Taxonomic Information System (ITIS),[12] which contains authoritative taxonomic information on plants, animals, fungi, and microbes of North America. For marine organisms not in ITIS, DIVER uses the World Register of Marine Species (WoRMS).[13] As needed, data managers may discuss species name standardization with data providers and data users. DIVER also maintains a "Reported Taxon" field which provides the taxonomic or species value originally submitted, in addition to standardized taxonomic fields.

The DIVER team continues to work with partners to build and update our vocabulary of valid values. This may include working with data providers to modify valid values lists to include values not currently used in DIVER to better accommodate project-specific needs and terminology and efficient query building.

7. Export Files (Metadata and Supplementary Files)

DIVER Explorer creates spatial metadata for export with all data queries, describing the specific query run and metadata at the DIVER (system) level. Each of the data export options described in Section 1 provide the user with a spreadsheet in CSV format and an ISO 19115-2 compliant metadata record in XML and HTML. Depending on the type of data queried, the export may include supplemental files that

[10] The explicit type or format of a field when it is ingested by DIVER is also important. All fields, with the exception of date, are ingested as text. If a field exclusively contains numeric values, such as for the "Analysis Result" field, the field and values are converted to a numeric format on ingest.

[11] The number of decimal points included with a -999 value depends on the numerical structure of the field.

[12] https://www.itis.gov/

[13] https://www.marinespecies.org/

define qualifier codes, study notes, and study references. For example, chemistry data outputs typically include study notes files with more details about analytical methods, data treatment, and data caveats; a file that defines relevant qualifier codes by study; and a file that includes citations to study references. DIVER Explorer can also provide spatial data outputs in shapefile (SHP) and KML format including ISO 19115-2 metadata. Ideally, data submitted to DIVER should have metadata compliant with the ISO 19115-2[14] or FGDC CSDGM[15] metadata standards. However, the DIVER team often works with data submissions that do not meet this standard for various reasons.

8. Data Submission

The DIVER Data Warehouse can accept structured and unstructured data and related files. NOAA typically uses File Collections within the DIVER Portal application (login required) to gather both environmental data (e.g., spreadsheet or database files that match DIVER structures or contain sufficient information to allow DIVER data managers to transform the data) and related files (e.g., scanned field forms, GPS, field notes, photos, and other related files). NOAA OR&R has created Electronic Data Deliverables (EDDs), also known as Data Templates, for contaminant, chemistry, and bioassay data. These templates enable laboratories and data partners to provide integrated field and laboratory data in a standardized format. The DIVER team has also developed templates for delivery of standardized biological data, field observations and measurements, and non-analytical biological sample results. The most recent versions of these templates are available for download from the public **DIVER Field Forms, Data Templates, and Guidelines webpage**.[16]

The DIVER data team also works with data providers or utilizes received datasets to create ETL (Extract, Transform, and Load) procedures from data management systems, data stores, or electronic data sources. DIVER Data Managers routinely work with data providers and specialists to review and determine the best course of action to integrate data into the DIVER data warehouse.

DIVER Data Managers offer several user-friendly Data Package Formats for the integration and management of photos. Detailed information on each format can be found within the DIVER Portal.[17]

- The Geotagged Photos Package is for JPEG or TIFF format photographs that contain coordinates stored as part of the file metadata. The photos in this package will be loaded into the Photos database with the EXIF metadata explicitly written into the photo record.
- The Photo Package with GPS File Data Package format provides for original photos with an additional GPS trackline, and a photo of the GPS unit used to generate the trackline that displays the calendar date and time.
- The APL (Access Photologger) Database Package is a legacy package format that allows for DIVER integration from NOAA's APL desktop application (which is no longer distributed).

[14] https://www.iso.org/standard/67039.html

[15] https://www.fgdc.gov/metadata/csdgm-standard

[16] https://diver.orr.noaa.gov/web/guest/field-forms-and-templates

[17] https://portal.diver.orr.noaa.gov/group/national/diver-help

9. Appendices

Appendix 1. Spreadsheet with all DIVER Field Information, Valid Values for Standardized Fields, and Chemical Dictionary (.xlsx)