Oregon Tsunami Data Standard

Version 1.03

March 2022

Endorsed by the Oregon Geographic Information Council
April 2022

Please address comments to:
Framework Implementation Team
Hazards Subcommittee
in care of Jonathan Allan and Fletcher O'Brien
Oregon Department of Geology and Mineral Industries
jonathan.allan@dogami.oregon.gov
fletcher.obrien@dogami.oregon.gov

Table of Contents

1.0 Introduction

The Oregon Geographic Information Council (OGIC) oversees preparation of geospatial data standards for the state. The development of these standards facilitates the sharing of geospatial data and assists with cooperative data development efforts. OGIC assigned a framework implementation team (FIT) to guide the development of standards for the various data themes, and separate framework work groups are developing standards for each theme. The Hazards Framework is a collection of spatially referenced digital representations of potential natural hazards. Data elements in the Hazards Framework include channel migration, coastal erosion, earthquakes, debris flows, drought areas, dust storm occurrences, flooding, landslides, volcanic hazards, wildfire, and tsunami inundation. Under the direction of the Oregon Geospatial Enterprise Office (GEO), the Oregon Department of Geology and Mineral Industries (DOGAMI) was tasked with developing a Tsunami Hazard Data Standard (THDS) to accompany the dataset.

The focus of the THDS is to develop a consistent framework to allow for the systematic processing, storage, display and public access of a wide variety of tsunami parameters including the earthquake deformation models used in performing tsunami modeling, and the resultant model outputs that include tsunami flow depths, current velocities, momentum flux, inundation zones, and runup elevations (Figure 1). The THDS will also assists with the production of certain derivative geospatial products that may be produced from the original tsunami model data, including evacuation modeling products, risk assessments and maritime tsunami modeling. The purpose of this standard is to help guide the development of both existing and future tsunami datasets and geospatial layers and ease the inclusion of these layers into existing and future statewide tsunami layers.

This document describes the steps taken to develop the THDS and data dictionary for the tsunami hazard element of the Hazard Framework Theme.

1.1 Mission and Goals of Standard

The Oregon THDS provides a consistent and maintainable structure for data producers and users to ensure the compatibility of datasets within the same framework feature set. The following goals influenced development of this standard:

- Foster the orderly development, sharing and maintenance of tsunami modeling data and associated derivative products that are being generated by DOGAMI and potentially others;

- Assemble and maintain the best available tsunami data for Oregon, and importantly make these more broadly available to agencies, local government and the public at large;

- Provide periodic updates to the various tsunami geodatabases and geospatial products as a result of improvements to the earthquake generating sources, and/or changes to the numerical model grids as a result of improvements to bathymetric and topographic digital elevation models (DEMs) of the continental shelf, coast, estuaries and terrestrial land surfaces;

- Provide improved understanding of the suite of data sources and references for tsunami data that are being generated for the state of Oregon.

The goal of the THDS is thus to ensure that tsunami hazard data are consistently produced, easily exchanged and made available for planning and preparation towards the next Cascadia Subduction Zone (CSZ) earthquake and tsunami, facilitate improved emergency operations planning and management, assist with land use planning, infrastructure development, and natural

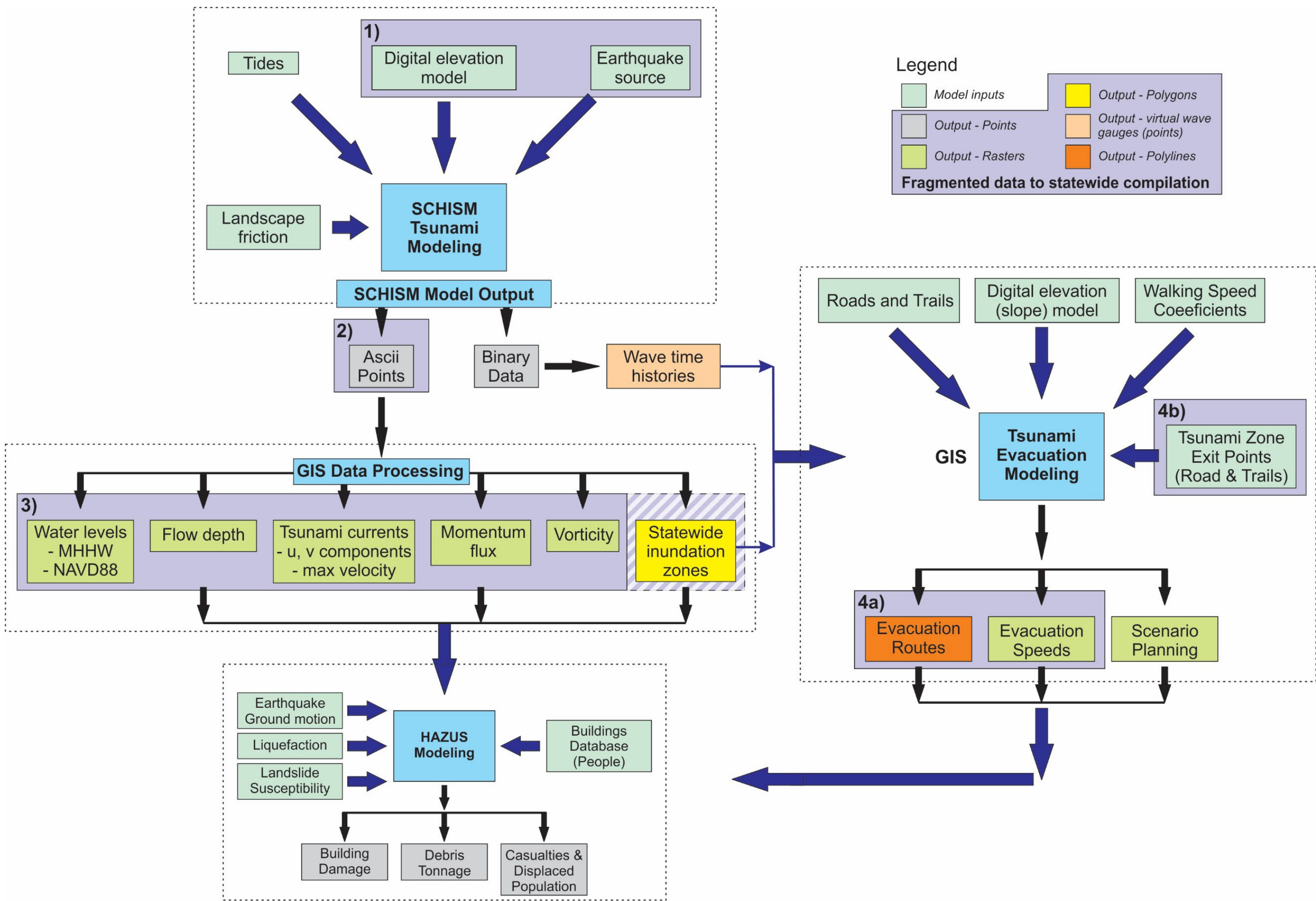

Figure 1: Conceptual framework depicting tsunami simulation inputs, outputs, collection of geospatial tsunami product layers, as well as areas targeted for a statewide data compilation. Figure highlights primary model outputs produced from tsunami modeling undertaken in Oregon, along with secondary modeling efforts such as tsunami evacuation and risk assessments using Hazus. Note that statewide geospatial layers produced as part of 3 and 4 are needed inputs for performing risk assessments using Hazus.

Note: SCHISM = Semi-implicit Cross-scale Hydroscience Integrated System Model, schism.wiki; Hazus = nationally standardized risk modeling methodology for various Hazards; MHHW = mean higher high water; NAVD88 = North American Vertical Datum of 1988 hazards mapping and planning. This standard is intended to increase confidence in the tsunami hazard element by ensuring data and metadata integrity.

1.2 Relationship to Existing Standards

Guidelines for tsunami modeling and mapping have been developed through a collaborative approach between scientists and emergency managers representing federal, state and territory members of the National Tsunami Hazard Mitigation Program (NTHMP), which is part of the National Weather Service (NWS) of the National Oceanic and Atmospheric Administration (NOAA). The NTHMP is a unique and effective partnership between NOAA, the Federal Emergency Management Agency (FEMA), the U.S. Geological Survey (USGS), and 28 U.S. coastal states and territories with the collective goal of protecting lives and reducing economic losses at the community level from tsunamis[1]. Since its inception in 1995, DOGAMI and Oregon Emergency Management (OEM) have been core members of the NTHMP, pioneering tsunami modeling and mapping activities in the Pacific Northwest.

Following the tragic events of the 2004 Indian Ocean tsunami (~230,000 fatalities) and the 2011 Tōhoku Japan tsunami (~18,000 fatalities), NTHMP member states and territories have accelerated efforts to model tsunami inundation along their respective coastlines. To ensure the modeling meets minimum standards of scientific competency, both NOAA NWS and the NTHMP Mapping and Modeling Subcommittee (MMS) have developed guidelines and standards for undertaking tsunami modeling (Synolakis and others, 2007; National Tsunami Hazard Mitigation Program, 2012; Horillo and others, 2015), as well as in the production of mapping products (MMS, 2021). These standards were developed to ensure sufficient quality of the tsunami inundation maps and to ensure a basic level of consistency between efforts in terms of products. To that end, all numerical models funded via the NWS of NOAA must be subject to a suite of rigorous benchmarking tests overseen by the NTHMP MMS to evaluate a model's ability to replicate analytical solutions, laboratory experiments, and observed field data. Thus, every model used by an NTHMP member state or territory has been evaluated to ensure the models solve the hydrodynamic equations of motion accurately (validation) and could represent geophysical reality appropriately (verification) based on field tests.

Simulations of tsunami propagation and inundation undertaken by DOGAMI between 2010 and 2013 (Witter and others 2011, Priest and others, 2013) used the hydrodynamic finite element model SELFE (Semi-implicit Eulerian-Lagrangian Finite Element), which successfully passed all standard NTHMP tsunami benchmark tests (Zhang and Baptista, 2008) and closely reproduced observed inundation and flow depths of the 1964 Alaska tsunami in a trial at Cannon Beach (Zhang and others, 2011). The original SELFE hydrodynamic model has since been replaced by SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model, Zhang and others (2016), schism.wiki). SCHISM is similar to SELFE but with added modular functionality. Most recently, SCHISM successfully passed a suite of standardized tsunami

[1] https://nws.weather.gov/nthmp/documents/NTHMPStrategicPlan.pdf

current benchmark tests organized via the NTHMP (Lynett and others, 2017; Zhang and others, 2016).

There are no comparable federal or state standards for tsunami model output data. Hence, this document describes a THDS that is applicable to tsunami model data outputs produced for the State of Oregon.

1.3 Description of Standard

The THDS outlines the different elements and data structures for tsunami data in Oregon. It describes all vector and tabular attributes and raster values. It also establishes naming convention rules which enforce layer name consistency between different categories of tsunami data and within individual projects which often contain 100+ individual data layers.

Tsunami data types include point, polygon, line, table, raster and raster mosaic datasets. These datasets include tsunami modeling source data and derivatives, maritime specific tsunami products, evacuation modeling products and statewide compilations of tsunami inundation zones. The THDS is adaptive and adheres to the data and interpretations the author used to developed the original tsunami products. Section 3 describes all the data layers and the Appendices lay out the layer naming convention rules.

1.4 Applicability and Intended Use of Standard

The THDS is applicable to tsunami hazard elements maintained in Oregon's Hazard Framework. The THDS enables users to understand how the tsunami hazard elements were produced and what uses are deemed appropriate by the authoritative data sources.

The THDS is not intended to replace other federal standards, nor is the data subject to this standard meant as a replacement for any official or regulatory publications by any other federal agency.

1.5 Standard Development Procedures

1.5.1 Participants

The Working Group amended the Tsunami Standard and published it on the Geospatial Enterprise Office standards web page on April 27, 2022. (https://www.oregon.gov/geo/Pages/standards.aspx).

1.5.2 Maintenance of the Standard

A public review and comment period commenced with the publication of the first revision on January 3, 2022. After incorporating comments, the Oregon Geographic Information Council endorsed the Tsunami Standard on April 20, 2022.

1.6 Maintenance of Standard

The Tsunami Standard will be revised as needed, initiated by members of the Hazards-FIT or a dedicated Tsunami Element Working Group. An initial working group that provided input on development of the tsunami datasets and standard consisted of representatives from the Oregon Coastal Management Program of the Department of Land Conservation and Development, Oregon Department of Geology and Mineral Industries, as well as input from a geospatial expert at William & Mary Virginia Institute of Marine Science. Updates to this standard will be presented, when appropriate, to the Hazards-FIT or Tsunami Element Working Group for comment, revision, and final endorsement. DOGAMI is implementing the standard to accompany the release of several new coastwide tsunami geospatial layers, as well as in response to select updates to existing statewide inundation layers. DOGAMI will remain the data steward for tsunami modeling undertaken for the Oregon coast.

2.0 Body of the Standard

2.1 Scope and Content of the Standard

The scope of this standard encompasses the public domain geospatial elements (point, polygon, line, table, raster and raster mosaic datasets), attributes of the geospatial data, and metadata compiled for a broad suite of tsunami modeling data. The various datasets that comprise the complete suite of tsunami input and modeling data are summarized in Figure 1 and include: earthquake deformation models used in performing tsunami modeling, resultant model outputs that include tsunami flow depths, current velocities, momentum flux, inundation zones, and runup elevations as well as various derivative geospatial products that have been produced from the original tsunami model data, including evacuation modeling products, risk assessments and maritime tsunami modeling.

DOGAMI is the state recognized agency for tsunami inundation modeling and mapping, having pioneered Cascadia tsunami modeling in the early 1990s in order to generate the first statewide tsunami regulatory line in the United States (Priest, 1995). Following the completion of those initial maps, DOGAMI initiated a series of community modeling efforts in order to generate localized tsunami evacuation brochures. However, it wasn't until 2009 that a concerted effort was initiated to complete tsunami inundation models of the entire coast. These latter data were eventually summarized in the work of Witter and others (2011) and Priest and others (2013). However, access to the complete suite of model outputs (other than the model text files) have not been possible until now, with the production of the THDS.

This THDS addresses three primary components:

1. Geospatial elements (point, polygon, line, table, raster and raster mosaic datasets);
2. Attributes (information about the geospatial elements); and,
3. Metadata for documentation

The list of geospatial and attribute elements included in this standard may be modified and added to in the future as the tsunami modeling outputs are refined and added to (e.g. to account for tsunami debris, or dune erosion associated with the tsunami forces). When appropriate, these modifications/additions will be submitted to the Tsunami Element Workgroup for acceptance and the revised data content publicized to all users of the standard. See Section 3 for a complete list of the different types of tsunami data addressed in this standard.

2.2 Need for the Standard

Tsunami data are used to guide tsunami wayfinding signage along major highways (e.g. Highway 101) and in coastal communities to facilitate evacuation, the establishment of new critical facilities, for evacuation modeling, and for maritime preparation and guidance. Specific users of this data include local and county emergency managers, emergency responders, resource managers, technical consultants and the public at large.

There are two main objectives of the THDS. First, to ensure consistency between many different types of tsunami data products that can be produced in Oregon. Second, given the lack of a national or regional tsunami data standard for geospatial data, this THDS may be used by other states or adapted for their own standard. Data consistency across the region would facilitate the sharing of datasets and development processes as well as the production of regional tsunami datasets.

2.3 Participation in Standards Development

The Tsunami Element Workgroup currently consists of state representatives. Participation in the workgroup is open to all entities that are concerned with the production, use and exchange of statewide digital tsunami information. Present member affiliations include:

Oregon Department of Geology and Mineral Industries
Oregon Department of Land Conservation and Development

2.4 Integration with Other Standards

The layout of this standard conforms to the OGIC layout template developed for the Oregon Framework Themes. The documentation component of this standard is specified in various tables listed in Appendix A to D. The metadata conforms to the OGIC-approved metadata standard.

Oregon's tsunami dataset contains fundamental information that is used in many other framework elements. This standard makes improvements to Foundational Framework data elements and Secondary Framework data elements under the Hazards, Geoscience, Elevation, and Preparedness FITS. The elements covered by this THDS include the following:

- Hazards
- Geoscience
- Preparedness
- Elevation

2.5 Technical and Operation Context

2.5.1 Data Environment

Tsunami elements may be comprised of points, polygons, lines, tables, rasters and raster mosaic datasets. The exchange formats for geographical data is the Esri file geodatabase, a format supported by GIS software most commonly used by local, state, and federal agencies. Information about file geodatabase formats may be found at the Esri website (http://www.esri.com).

2.5.2 Reference Systems

Tsunami data elements are referenced in the Oregon Statewide Lambert coordinate system. It is possible that in the future it may be appropriate to publish some tsunami source data points in the WGS84 coordinate system. This is because the tsunami modeling is performed in the WGS84 coordinate system. The datum transformation used to convert WGS84 to NAD83 is WGS_1984_(ITRF08)_To_NAD_1983_2011. All coordinate system information will be captured in the metadata for each data layer.

Horizontal Coordinate System: Tsunami elements are referenced to the 2011 North American 1983 Horizontal Datum (NAD83), consistent with Oregon Lambert coordinate system. The horizontal unit is international feet.

Vertical Datum: All tsunami element parameters that use a vertical datum are modeled in MHHW (mean higher high water) except for maritime modeling, which is done in MSL (mean sea level). Datum conversions of these parameters are typically included in NAVD88 and NGVD29.

2.5.4 Encoding

Tsunami elements are encoded in the Esri file geodatabase format. They include vector, table and raster data models. Section 3 of this standard illustrates the specifics of these models.

2.5.5 Resolution

The resolution of tsunami elements varies depending on location. Generally, urban areas have the highest resolution; other areas on land also tend to have relatively high resolution though it varies depending on population density. Data layers continue to experience high resolution to water depths of about 10 m (33 ft), especially around bathymetric features such as in estuary channels. With further progress seaward, the resolution decreases as the influence of the seabed on the tsunami wave and physics decreases with depth.

Thirteen computational grids were developed as part of the coastwide tsunami modeling undertaken between 2010 and 2013. These grids were constructed by first compiling digital elevation models (DEMs) covering five different model regions of the Oregon coast and then retrieving from the DEM elevations at a series of points defining a triangular irregular network (TIN). The DEM for the regional simulations was compiled from ETOPO1 1-arc-minute (~1.9 km (1.2 mi)) database (http://www.ngdc.noaa.gov/mgg/global/global.html) and 1/3-arc-second (~10 m (33 ft)) tsunami grids obtained for each region (Astoria, Garibaldi, Central and Port Orford) and obtained from the National Center for Environment Information (NCEI, formerly National Geophysical Data Center), supplemented in areas of dry land by 2008/2009 lidar (light detection and ranging) data. All data sets were adjusted to the North American Vertical Datum of 1988 (NAVD 88) and WGS 84 map projection. Computational grid spacing for tsunami simulations varied from ~3 to 5 km (1.9 to 3.1 mi) at the Cascadia Subduction Zone source, ~140 m (459 ft) at 70 m (230 ft) deep, ~50 m (164 ft) at 20 m (66 ft) deep, to ~7 m (23 ft) at the coast and on land. A typical grid thus consists of ~5 million horizontal nodes and ~10 million triangular elements.

More recent tsunami modeling follows a similar approach, the only difference being is that where available, these latest simulations incorporate more up-to-date bathymetric or topographic information in the model grids.

Although the potential scale range is large in a geospatial information system, the tsunami data are best viewed at scale range that varies from as detailed as 1:500 to as low as 1:500,000.

2.5.6 Accuracy

Horizontal Accuracy: This standard supports varying levels of horizontal accuracy, as implied by the range of bathymetric and topographic datasets that are used to generate the computational model grids.

Tsunami simulations performed for the State of Oregon using SELFE/SCHISM have been undertaken using unstructured computational grids constructed from detailed bathymetric and topographic data, including lidar collected via the Oregon lidar consortium. Spacing between computational grid points, a measure of the precision of these data, varies from ~3 to 5 km (1.9 to 3.1 mi) at the CSZ source, ~140 m (459 ft) at 70 m (230 ft) depth, ~50 m (164 ft) at 20 m (66 ft) depth, to ~7 m (23 ft) at the coast and on land. In general, spacing on land is less than 10 m (33 ft) in populated areas and at critical shoreline features such as abrupt changes in slope, jetties, breakwaters, and estuary channels.

Vertical accuracy: Non-tsunami simulations have demonstrated that the SELFE/SCHISM numerical model is accurate down to ~1cm, which is 1% of the tidal range (Zhang and Baptista, 2008; Zhang and others, 2016).

Raster values were derived from tsunami modeling using an unstructured grid and the hydrodynamic model SELFE or SCHISM. Both models have passed all standard tsunami benchmark tests required by the NTHMP and closely reproduced observed inundation and flow depths of the 1964 Alaska tsunami in a trial at Cannon Beach (Zhang et al, 2011).

This standard supports varying levels of vertical accuracy, as implied by the range of bathymetric and topographic datasets that are used to generate the computational model grids. Thirteen computational grids were developed as part of the original coastwide modeling. These grids were constructed by first compiling digital elevation models (DEMs) covering five different model regions of the Oregon coast and then retrieving from the DEM elevations at a series of points defining a triangular irregular network (TIN). The DEM for the regional simulations was compiled from ETOPO1 1-arc-minute (~1.9 km (1.2 mi)) database (http://www.ngdc.noaa.gov/mgg/global/global.html) and 1/3-arc-second (~10 m (33 ft)) tsunami grids obtained for each region (Astoria, Garibaldi, Central and Port Orford) and obtained from the National Center for Environment Information (NCEI, formerly National Geophysical Data Center), supplemented in areas of dry land by 2008-2009 lidar (light detection and ranging) data. Additional bathymetric data were obtained from the US Army Corps of Engineers for all navigational channels spanning Oregon estuaries. All data sets were adjusted to the North American Vertical Datum of 1988 (NAVD 88) and WGS 84 map projection. Vertical accuracy is therefore a function of many different factors, including the DEM, model physics, friction factors, and tidal stage.

2.5.7 Edge Matching
Many of the derivative data layers are seamless for the Oregon coast. The individual source layers contain overlaps. Site specific data layers are not always seamless for the entire coast. The degree of completeness of each data layer is described in the metadata. Overlapping geometry within any single data layer is not necessary and is not allowed.

2.5.8 Feature Identification Code
The source points derived from the tsunami modeling are linked directly back to their original modeling nodes with the “Grid_ID” column. Applicable tsunami data layers contain the “DataSourceID” column, which links the citation back to a data sources

citation table which is included in the same geodatabase. The latter is a source citation convention follows the GeMS (Geologic Map Schema) convention.

For many derivative tsunami data layers, a feature identifier coding serves no purpose and is not included. The feature identifiers will be created and maintained by the Horizontal Steward for tsunami elements.

2.5.9 Attributes

Attributes reflect any additional information that is collected and shared in relation to the representation of tsunami elements. See Section 3 for the specification of minimal and optional characteristics for tsunami element polygons, lines, points and tables.

2.5.10 Transactional Updating

Transactional updating for applicable data layers will be possible. The applicable data layers will have periodic updates and will be hosted at the Department of Geology and Mineral Industries.

2.5.11 Records Management

Past versions of Tsunami data will be maintained and available for retrieval through versioned releases hosted by the Horizontal Steward.

2.5.12 Metadata

The Tsunami Standard follows the Federal Geographic Data Committee (FGDC), Content Standard for Digital Geospatial Metadata. Metadata detailing the characteristics and quality of submitted tsunami data must be provided. Metadata must provide sufficient information to allow the user to determine if that dataset will meet the intended purpose, as well as telling the user how to access the data.

3.0 Data Characteristics

This section lists all the main layer names and defines their attributes or raster values. A recurring theme in our naming conventions is the use of the original tsunami t-shirt event size classification defined by Witter and others (2011) and Priest and others (2013) and thus reflect the following:

- Two Gulf of Alaska distant earthquake sources, termed AK64 after the historical 1964 Prince William Sound earthquake and a maximum-considered eastern Alaska-Aleutian Island rupture termed AKmax; and,
- Five locally generated earthquake scenarios occurring on the Cascadia Subduction zone termed small (SM1), medium (M1), large (L1), extra-large (XL1), and extra-extra-large (XXL1).

In addition to defining the tsunami data elements themselves, it is critical to outline the naming convention rules that shall be used in the naming of all tsunami layers. This is important for enforcing layer naming consistency, metadata generation and data review.

<u>Metadata:</u> Due to the large number of layers that are often published within a single project (100+), it is essential that the layer naming convention is consistent and descriptive enough to enable automated metadata generation for each layer. Writing metadata manually for each layer is not a realistic option. Consistently named tsunami layers within each project and across projects enables the use of a single automated metadata tool that will work for all tsunami layers. The standardized keywords found in each layer name, regardless of order, allow for scripts to identify these key identifiers and to construct and assign appropriate metadata values using a single lookup table.

<u>Data Review:</u> The layer naming convention defined here also allows for the use of automated data review tools that perform custom checks and compare GIS layer properties based on text keywords found in the file names.

See Appendix A table for lists for the possible layer name variation choices, Appendix B for the layer name convention rules, and Appendix C for layer name examples.

3.1 Minimum Graphic Data Elements

3.1.1 Points

Elev_Markers_XXL1_and_Akmax Point feature class shows tsunami runup elevations at a 500 meter interval for both the AKmax and XXL1 inundation zone boundaries.			
Column Name	**Type**	**Width**	**Description**
Runup_Elevation	Long Int	Default	The elevation at the landward extent of the tsunami inundation, in feet, relative to the NAVD88 vertical datum.
Event_Size	Text	5	The tsunami event size, either XXL1 or AKmax.
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.
Exit_Points_XXL1 Point feature class shows locations where roads or trails exit the XXL1 inundation zone.			
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.
Simulated_Gage_Stations Point feature class represents simulated gage stations where time series information has been extracted. Each gage station point is linked to multiple PDFs embedded with the Geodatabase. Use either Northing/Easting (NAD83) or Latitude/Longitude (WGS84) columns.			
Column Name	**Type**	**Width**	**Description**
StationName	Text	10	Unique number ID for simulated gage station.
Longitude	Double	Default	Longitude (WGS 84 geographic coordinate system).
Latitude	Double	Default	Latitude (WGS 84 geographic coordinate system).
Easting	Double	Default	Easting (Oregon State Plane (NAD83) North or South, meters).
Northing	Double	Default	Northing (Oregon State Plane (NAD83) North or South, meters).
Instructions	Text	1000	Instructions for accessing PDF attachments.
Points_Main This point feature class represents the detailed tsunami modeling results for a number of parameters. The parameters include Init_D_MHHW, Post_D_MHHW, Wet_Dry, Elev_MHHW, Flow_Depth, Max_Vel_Kn, U_Velocity and V_Velocity. Use either Northing/Easting (NAD83) or Latitude/Longitude (WGS84) columns.			
Column Name	**Type**	**Width**	**Description**
Grid_ID	Long Int	Default	Computational grid node ID number.
Longitude	Double	Default	Longitude (WGS 84 geographic coordinate system).
Latitude	Double	Default	Latitude (WGS 84 geographic coordinate system).
Easting	Double	Default	Easting (Oregon State Plane (NAD83) North or South, meters).
Northing	Double	Default	Northing (Oregon State Plane (NAD83) North or South, meters).
Init_D_MHHW	Double	Default	Pre-earthquake digital elevation model (DEM) used in the tsunami hydrodynamic modeling. Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values indicate depth in meters below MHHW and negative values represent points on dry land. To convert to GIS convention, signs would need to be inverted.
Post_D_MHHW	Double	Default	Post-earthquake digital elevation model (DEM) used in the tsunami hydrodynamic modeling. Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values

			indicate depth in meters below MHHW and negative values represent points on dry land. To convert to GIS convention, signs would need to be inverted.
Wet_Dry	Long Int	Default	Simulations of tsunami inundation predicted, for each grid node in the model, whether the point is wet (value = 1) or dry (value =2).
Elev_NGVD29	Double	Default	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NGVD29 vertical datum.
Elev_NAVD88	Double	Default	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NAVD88 vertical datum.
Elev_MHHW	Double	Default	Maximum wave elevation over the course of the entire simulation, in meters, relative to the MHHW tidal datum. Note that this layer includes pockets of negative values in some areas of shallow inundation depth. These negative values are legitimate - they are a result of the conversion from the MSL datum.
Flow_Depth	Double	Default	Maximum tsunami flow depth above the ground surface over the course of the entire simulation, in meters. Determined by finding the difference between the Elev_MHHW and Post_D_MHHW surfaces.
Max_Vel_Ms	Double	Default	Maximum tsunami flow speed over the course of the entire simulation, in meters/second.
U_Velocity	Double	Default	The east (positive) - west (negative) component of maximum tsunami flow velocity in meters/second.
V_Velocity	Double	Default	The north (positive) - south (negative) component of maximum tsunami flow velocity in meters/second.
Max_Vel_Kn	Double	Default	Maximum tsunami flow speed over the course of the entire simulation, in knots.

Points_Max_MF_Min_Depth

This point feature class represents the detailed tsunami modeling results for the parameters Max_MF and Min_Depth. Use either Northing/Easting (NAD83) or Latitude/Longitude (WGS84) columns.

Column Name	Type	Width	Description
Grid_ID	Long Int	Default	Computational grid node ID number.
Longitude	Double	Default	Longitude (WGS 84 geographic coordinate system).
Latitude	Double	Default	Latitude (WGS 84 geographic coordinate system).
Easting	Double	Default	Easting (Oregon State Plane (NAD83) North or South, meters).
Northing	Double	Default	Northing (Oregon State Plane (NAD83) North or South, meters).
Max_MF	Double	Default	Maximum momentum flux, in m 3/s/s.
Min_Depth	Double	Default	Minimum depth below the tsunami waves, in meters.

Points_Max_Vorticity

This point feature class represents the detailed tsunami modeling results for the parameter Max_Vorticity. Use either Northing/Easting (NAD83) or Latitude/Longitude (WGS84) columns.

Column Name	Type	Width	Description
Grid_ID	Long Int	Default	Computational grid node ID number.
Longitude	Double	Default	Longitude (WGS 84 geographic coordinate system).
Latitude	Double	Default	Latitude (WGS 84 geographic coordinate system).
Easting	Double	Default	Easting (Oregon State Plane (NAD83) North or South, meters).
Northing	Double	Default	Northing (Oregon State Plane (NAD83) North or South, meters).

Max_Vorticity	Double	Default	Maximum tsunami vorticity, expressed as the number of rotations per second.

3.1.2 Polygons

Inundation_XXL1_and_Akmax Polygon feature class represents the combined tsunami inundation extents of XXL1 and AKmax.			
Column Name	**Type**	**Width**	**Description**
Tsunami_Region	Text	50	The tsunami evacuation region. Definitions of each of the four different regions are provided. 1) Distant Tsunami Evacuation Zone = The distant tsunami evacuation zone is based on a maximum-considered eastern-Aleutian Island earthquake termed AKmax. 2) Local Tsunami Evacuation Zone = The local tsunami evacuation zone is based on a maximum-considered Cascadia Subduction Zone earthquake termed XXL1. Note, in this event, the distant zone plus the local evacuation zone reflects the entire extent of the local tsunami zone. 3) Outside Hazard Area = The outside tsunami hazard zone extends landward of the local tsunami evacuation zone and is considered to be safe from the effects of a Cascadia tsunami. 4) OPTIONAL - Outside Hazard Area = An optional area of high ground that is outside the L1 tsunami hazard zone that extends landward of the L1 local tsunami evacuation zone and is considered to be safe from the effects of an L1 Cascadia tsunami. Application of an OPTIONAL area of high ground presently only applies to the community of Gearhart in Clatsop County, due to the large evacuation distances needed to reach high ground associated with a maximum considered XXL1 tsunami.
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.
Inundation_Runs_Compilation Polygon feature class is a compilation, or merged version, of inundation zones from two or more model runs. The names of the model runs involved are described elsewhere in the metadata - they are not included in the file name.			
This feature class has no associated column names.			
Inundation Polygon feature class represents the tsunami inundation extent for a single event size and possibly for a specific modeled run, if applicable.			
This feature class has no associated column names.			
Tsunami_Grid_Index This polygon feature class shows the boundaries of the different grids used in the tsunami modeling.			
Column Name	**Type**	**Width**	**Description**
Grid_Name	Text	50	Name of the tsunami grid.
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.
Tsunami_Point_Spacing This polygon feature class shows average source tsunami modeling point spacing within each of its sampling grids. It effectively illustrates the variation in point spacing for the entire Oregon coast, which would be impossible to appreciate from only looking at the points themselves. There are two different grid sizes used to sample the points. The 500 x 500 ft grid sampling was used nearshore (landward of the 20-fathom bathy depth). The 5,000 x 5,000 ft grid sampling was used offshore (seaward of the 20-fathom bathy depth). The two different grid sizes allowed for more appropriate sampling in the higher and lower density point areas.			
Column Name	**Type**	**Width**	**Description**
Point_Spacing	Long Int	Default	Average distance between points, in feet. NULL values indicate that there were no points falling within the sampling polygon and point spacing could not be calculated.
Mosaic_Cell_Size_Groups			

This polygon feature class outlines the different raster cell size groups that are used to guide the creation of the individual rasters and the raster mosaic datasets located within this geodatabase.			
Column Name	**Type**	**Width**	**Description**
Group_Cellsize	Short Int	Default	The raster cell size group, which is expressed as its cell size.
Group_Criteria	Text	200	The criteria used to define the point spacing group.

BridgesIn_EvacuationFlowZones / BridgesOut_EvacuationFlowZones This polygon feature class shows the nearest safety destination for every point in the inundation zone (on the road and trail network) assuming [bridges fail OR remains intact text]. The DataSourceID column is only included in the statewide compilation - it is not included in community specific studies.			
Column Name	**Type**	**Width**	**Description**
Flow_zone	Short Int	Default	The Flow_zone attribute provides an identification number for each evacuation flow zone. The actual value is arbitrary; the intention is to allow a user to differentiate flow zones in order to more clearly see the larger evacuation regime for a region. Flow_zone IDs link with the corresponding Evacuation Route feature class Flow_zone IDs.
Arrival	Short Int	Default	The time, in seconds, after the Cascadia Subduction Zone earthquake when the first wave reaches the point of safety for each evacuation flow zone. The first wave arrival is defined as the time at which tsunami flow depth reaches more than 0.5 ft.
Arr_10min	Short Int	Default	The wave arrival time, in seconds, for each evacuation zone minus 10 minutes to account for the time in which earthquake shaking takes place, as well as human disorientation, and the time required to evacuate buildings. It is these values that were used to calculate Beat the wave (BTW) evacuation speeds.
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.

BridgesIn_WalkingSpeeds_Roads / BridgesOut_WalkingSpeeds_Roads This polygon feature class shows minimum evacuation speeds, on roads, needed to stay ahead of the wave assuming [bridges fail OR remains intact text]. The DataSourceID column is only included in the statewide compilation - it is not included in community specific studies.			
Column Name	**Type**	**Width**	**Description**
Vel_fps	Text	10	The range of minimum speeds (in feet per second, fps) needed to reach safety from each point in the evacuation zone. Evacuation speeds are collected into seven bins for easier interpretation on a map. They capture the natural boundaries between pedestrian speeds based on model of locomotion and the speed group most applicable to each bin: slow walking at 0-2 fps, walking at 2-4 fps (considered a maximum walking speed for elderly and impaired adults), and fast walking at 4-6 fps (considered a maximum walking speed for unimpaired adults). Additional categories describe areas where walking is not sufficient: jogging at 6-8 fps for fit adults, running at 8-10 fps, sprinting at 10-14.7 fps (10 mph), and unlikely to survive at greater than 14.7 fps (10 mph).
DataSourceID	Text	50	Foreign key to DataSources table, to track provenance of each data element.

3.1.3 Lines

BridgesIn_EvacuationRoutes / BridgesOut_EvacuationRoutes			
This line feature class shows the most efficient routes to safety for every point in the inundation zone (on the road and trail network) assuming [bridges fail OR remains intact text]. Symbolize in ArcGIS with arrow at end of each segment to see direction of line. The DataSourceID column is only included in the statewide compilation - it is not included in community specific studies.			
Column Name	**Type**	**Width**	**Description**
Flow_zone	SmallInteger	2	The Flow_zone attribute provides an identification number for each evacuation flow zone. The actual value is arbitrary; the intention is to allow a user to differentiate flow zones in order to more clearly see the larger evacuation regime for a region. Flow_zone IDs link with the corresponding Evacuation Route feature class Flow_zone IDs.
DataSourceID	String	50	Foreign key to DataSources table, to track provenance of each data element.

BridgesIn_WalkingSpeeds_Trails / BridgesOut_WalkingSpeeds_Trails			
This line feature class shows minimum evacuation speeds, on trails, needed to stay ahead of the wave assuming [bridges fail OR remains intact text]. This feature class contains data on trails and beach networks. The DataSourceID column is only included in the statewide compilation - it is not included in community specific studies.			
Column Name	**Type**	**Width**	**Description**
Vel_fps	Text	10	The range of minimum speeds (in feet per second, fps) needed to reach safety from each point in the evacuation zone. Evacuation speeds are collected into seven bins for easier interpretation on a map. They capture the natural boundaries between pedestrian speeds based on model of locomotion and the speed group most applicable to each bin: slow walking at 0-2 fps, walking at 2-4 fps (considered a maximum walking speed for elderly and impaired adults), and fast walking at 4-6 fps (considered a maximum walking speed for unimpaired adults). Additional categories describe areas where walking is not sufficient: jogging at 6-8 fps for fit adults, running at 8-10 fps, sprinting at 10-14.7 fps (10 mph), and unlikely to survive at greater than 14.7 fps (10 mph).
DataSourceID	String	50	Foreign key to DataSources table, to track provenance of each data element.

3.1.4 Rasters

This table defines the different raster names (see the column Main Layer Name in Appendices A-C) and provides a description of each different type of raster.

Raster Name	Description
Raster	Raster represents a specific parameter mapped from a parameter column in a corresponding tsunami modeling source point feature class. It is optionally associated with a tsunami event size and/or a specific model run.
Diff_Raster	Raster represents a comparison, in the form of subtraction, between two different model runs. A single parameter is used for the comparison. The model runs can be different event sizes or different tidal stages. In the layer name, it is the first run minus the second run, and the event size is indicated after each run. The raster only includes areas common to both runs.
Ensemble_Raster	Raster represents an ensemble of two or more different model runs. A raster ensemble is a merged version of two or more rasters, where, depending on the parameter, either the maximum or minimum values of all the rasters for each cell are preserved. Each ensemble raster uses the same Event Size and Parameter - only the Model Runs vary. The names of the model runs are NOT included in the layer name because of the large number of runs involved; this information is included in the metadata.
Raster_Indv	This raster represents a specific parameter and event size mapped from multiple corresponding source point feature classes. It is not intended to be viewed individually. This individual raster is desinged to be one of a collection of rasters used to form a single raster mosaic dataset. Each individual raster in the mosaic dataset is a different cell size. The different cell sizes reflect the variation point spacing of the source points. The westward extent of the raster varies by the parameter mapped. The westward extent of the parameters Min_Depth, Flow_Depth and Max_MF stop at the 10-fathom bathy contour. The westward extent of the parameter Max_Vorticity stops at the 20-fathom bathymetric contour. The westward extent of all other parameters stop at 125 deg, 20 min W. See the Mosaic_Cell_Size_Groups feature class in this geodatabase for an outline of the different cell size group areas.
Mosaic_DS	This raster mosaic dataset represents a specific parameter and event size. The individual rasters that form this mosaic vary by cell size. The purpose of the raster mosaic is to offer a coastwide raster composed of various cell sizes that reflects the variation in point spacing of the source tsunami modeling points.

This table describes the possible different raster values. The raster value definitions are recorded as the attribute definitions in the metadata.

Raster Value	Raster Value Definition
Init_D_MHHW	Pre-earthquake digital elevation model (DEM) used in the tsunami hydrodynamic modeling. Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values indicate depth in meters below MHHW and negative values represent points on dry land. To convert to GIS convention, signs would need to be inverted.
Post_D_MHHW	Post-earthquake digital elevation model (DEM) used in the tsunami hydrodynamic modeling. Ground elevation and bathymetry, in meters, relative to the Mean Higher High Water (MHHW) vertical datum. Positive values indicate depth in meters below MHHW and negative values represent points on dry land. To convert to GIS convention, signs would need to be inverted.

Elev_NGVD29	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NGVD29 vertical datum.
Elev_NAVD88	Maximum wave elevation over the course of the entire simulation, in meters, relative to the NAVD88 vertical datum.
Elev_MHHW	Maximum wave elevation over the course of the entire simulation, in meters, relative to the MHHW tidal datum. Note that this layer includes pockets of negative values in some areas of shallow inundation depth. These negative values are legitimate - they are a result of the conversion from the MSL datum.
Flow_Depth	Maximum tsunami flow depth over the course of the entire simulation, in meters.
Max_Vel_Ms	Maximum tsunami flow speed over the course of the entire simulation, in meters/second.
Max_Vel_Kn	Maximum tsunami flow speed over the course of the entire simulation, in knots.
Max_MF	Maximum momentum flux, in m 3/s/s.
Min_Depth	Minimum depth below the tsunami waves, in meters.
Max_Vorticity	Maximum tsunami vorticity, expressed as the number of rotations per second.
DEM_Elev_MHHW	The digital elevation model used as the terrain/bathymetry input by the numerical model SCHISM to model the tsunami. Units are in meters, relative to the Mean Higher High Water (MHHW) vertical datum.
Coseismic_Response	The vertical change of the landscape caused by the earthquake (in meters). This vertical change is calculated from subtracting the two parameters initD_MHHW - postD_MHHW. Negative values represent subsidence and positive values represent uplift.
Wave_Arrival	Estimated tsunami wave arrival times, in minutes.

3.2 Minimum Attribute or Non-graphic Data Elements

3.2.1 Tables

DataSources This table lists the references used to construct the Evacuation Modeling GIS layers.			
Column Name	**Type**	**Width**	**Description**
DataSources_ID	Text	50	Primary key. Values are the first four letters of the lead authors last name, their first and middle initials, and the publication year, occasionally followed by another identifier. Values must be unique to the database.
Source	Text	500	The data source citation.
URL	Text	300	Online link to the data source.

3.3 Optional Data Elements

This is not applicable.

References

Horrillo, J., Grilli, S.T., Nicolsky, D., Roeber, V. and Zhang, J., 2015. Performance benchmarking tsunami models for NTHMP's inundation mapping activities. Pure and Applied Geophysics, 172(3-4): 869-884.

Lynett, P.J., Gately, K., Wilson, R., Montoya, L., Arcas, D., Aytore, B., Bai, Y., Bricker, J.D., Castro, M.J. and Cheung, K.F., 2017. Inter-Model Analysis of Tsunami-Induced Coastal Currents. Ocean Modelling, 114: 14-32.

Mapping and Modeling Subcommittee, 2021. Tsunami Modeling and Mapping: Guidelines and Best Practices, Part II: Tsunami Inundation Maps. Unpublished Guidelines of National Tsunami Hazard Mitigation Program Mapping and Modeling Subcommittee. https://nws.weather.gov/nthmp/documents/2inundationmapguidelines.pdf

National Tsunami Hazard Mitigation Program. 2012. Proceedings and Results of the 2011 NTHMP Model Benchmarking Workshop. Boulder: U.S. Department of Commerce/NOAA/NTHMP; (NOAA Special Report). 436 p. https://nws.weather.gov/nthmp/documents/nthmpWorkshopProcMerged.pdf

Priest, G.R., 1995. Explanation of mapping methods and use of the tsunami hazard maps of the Oregon coast. Open-File-Report O-95-67, Oregon Department of Geology and Mineral Industries, Portland, Oregon, 105 pp.

Priest, G.R., Witter, R.C., Zhang, Y., Wang, K., Goldfinger, C., Stimely, L.L., English, J.T., Pickner, S.G., Hughes, K.L.B., Willie, T.E. and Smith, R.L., 2013. Tsunami inundation scenarios for Oregon. Open file report O-13-19, Oregon Department of Geology and Mineral Industries, Portland, Oregon. http://www.oregongeology.org/pubs/ofr/p-O-1319.htm

Synolakis, C.E., Bernard, E.N., Titov, V.V., Kânoğlu, U. and Gonzalez, F.I., 2007. Standards, Criteria, and Procedures for NOAA Evaluation of Tsunami Numerical Models NOAA Technical Memorandum OAR PMEL-135, Pacific Marine Environmental Laboratory, Seattle, WA, 60 pp. https://nctr.pmel.noaa.gov/benchmark/SP_3053.pdf

Witter, R., Zhang, Y., Wang, K., Priest, G.R., Goldfinger, C., Stimely, L.L., English, J.T. and Ferro, P.A., 2011. Simulating tsunami inundation at Bandon, Coos County, Oregon, using hypothetical Cascadia and Alaska earthquake scenarios. Special Paper 43, Oregon Department of Geology and Mineral Industries, Portland, Oregon, 57 pp. https://www.oregongeology.org/pubs/sp/p-SP-43.htm

Zhang, Y.J. and Baptista, A.M., 2008. An efficient and robust tsunami model on unstructured grids. Part I: Inundation benchmarks. Pure and Applied Geophysics, 165(11-12): 2229-2248.

Zhang, Y.J., Priest, G.R., Allan, J.C. and Gabel, L., 2016. Benchmarking an unstructured-grid model for tsunami current modeling. Pure and Applied Geophysics, 173(12): 4075–4087.

Zhang, Y.J., Stanev, E.V. and Grashorn, S., 2016. Seamless cross-scale modelling with SCHISM. Ocean Modelling, 102: 64-81.

Zhang, Y.J., Witter, R.C. and Priest, G.R., 2011. Tsunami–tide interaction in 1964 Prince William Sound tsunami. Ocean Modelling, 40: 246-259.

Appendix A. Layer Naming Variation

This table lists the possible text identifiers currently in use for the tsunami layer naming convention. Additional values may be added for new types of studies or products. See Appendix C for layer name examples. See Appendix B for the layer name convention rules. See Appendix D for definitions of the column names used in this table.

Applicable Groups	Data Type	Main Layer Name	Event Size	Raster Parameter	Model Run 1	Model Run 2	Spatial
Main Statewide	Point	Elev_Markers_XXL1_and_Akmax	AK64	Elev_MHHW	Run01a		ClatsopA
Maritime	Polygon	Exit_Points_XXL1	AKmax	Elev_NAVD88	Run02a		ClatsopB
Tsunami Modeling	Line	Points_Main	SM1	Elev_NGVD29	Run02b		NehalemNeskowin
Evacuation Modeling	Table	Points_Max_MF_Min_Depth	M1	Flow_Depth	Run02c		TillamookNetarts
All Groups	Raster	Points_Max_Vorticity	L1	Init_D_MHHW	(examples)		CentralCoastA
		Simulated_gage_stations	XL1	Post_D_MHHW			CentralCoastB
		Tsunami_Grid_Index	XXL1	Max_Vel_Ms			CentralCoastC
		Tsunami_Point_Spacing		Max_Vel_Kn			CoosBay
		Mosaic_Cell_Size_Groups		Max_MF			Bandon
		Inundation_XXL1_and_Akmax		Max_Vorticity			SouthCoast
		Inundation_Runs_Compilation		Min_Depth			
		Inundation		DEM_Elev_MHHW			
		DataSources		Coseismic_Response			
		Bridges[In/Out]_EvacuationFlowZones		Wave_Arrival			
		Bridges[In/Out]_EvacuationRoutes					
		Bridges[In/Out]_WalkingSpeeds_Roads					
		Bridges[In/Out]_WalkingSpeeds_Trails					
		Raster					
		Diff_Raster					
		Ensemble_Raster					
		Raster_Indv					
		Mosaic_DS					

Appendix B. Layer Naming Convention Rules

This table defines the required and optional layer name variations for each main layer name. There is no single order in which the variation text must be positioned in the layer name. The order used will vary depending on individual project needs and how layers will be sorted within the geodatabase. The order should generally be consistent within each project, although projects with multiple geodatabases and multiple categories of data may use multiple ordering conventions if there is a good reason to do so. See Appendix A table for lists for the possible name variation choices. See Appendix C for layer name examples. See Appendix D for definitions of the column names used in this table.

R = Required, **O** = Optional, NA = Not Applicable

Applicable Groups	Data Type	Main Layer Name	Name Variation				
			Event Size	**Model Run 1**	**Model Run 2**	**Raster Parameter**	**Spatial Extent**
Main Statewide	Point	Elev_Markers_XXL1_and_Akmax	NA	NA	NA	NA	NA
	Point	Exit_Points_XXL1	NA	NA	NA	NA	NA
	Polygon	Inundation_XXL1_and_Akmax	NA	NA	NA	NA	NA
Maritime	Polygon	Inundation_Runs_Compilation	**R**	NA	NA	NA	NA
	Raster	Diff_Raster	**R**	NA	**R**	**R**	NA
	Raster	Ensemble_Raster	**R**	NA	NA	**R**	NA
Maritime - - - & - - - Tsunami Modeling	Polygon	Inundation	**R**	**O**	NA	NA	NA
	Point	Points_Main	**R**	**O**	NA	NA	**O**
	Point	Points_Max_MF_Min_Depth	**R**	**O**	NA	NA	**O**
	Point	Points_Max_Vorticity	**R**	**O**	NA	NA	**O**
	Point	Simulated_gage_stations	NA	NA	NA	NA	NA
Tsunami Modeling	Polygon	Tsunami_Grid_Index	NA	NA	NA	NA	NA
	Polygon	Tsunami_Point_Spacing	NA	NA	NA	NA	NA
	Polygon	Mosaic_Cell_Size_Groups	NA	NA	NA	NA	NA
	Raster	Raster_Indv	**R**	NA	NA	**R**	**R**
	Mosaic	Mosaic_DS	**R**	NA	NA	**R**	NA
Evacuation Modeling	Polygon	BridgesIn_EvacuationFlowZones	**R**	NA	NA	NA	NA
		BridgesOut_EvacuationFlowZones					
	Line	BridgesIn_EvacuationRoutes	**R**	NA	NA	NA	NA
		BridgesOut_EvacuationRoutes					
	Polygon	BridgesIn_WalkingSpeeds_Roads	**R**	NA	NA	NA	NA
		BridgesOut_WalkingSpeeds_Roads					
	Line	BridgesIn_WalkingSpeeds_Trails	**R**	NA	NA	NA	NA
		BridgesOut_WalkingSpeeds_Trails					
All Groups	Raster	Raster	**O**	**O**	NA	**R**	NA

	Table	DataSources	NA	NA	NA	NA	NA

Appendix C. Layer Naming Convention Examples

This table provides examples of full layer names using the naming convention defined in this standard. See Appendix D for definitions of the column names used in this table.

Layer Name Examples color key:
Main Layer Name, **Event Size**, **Raster Parameter**, **Model Run**, **Spatial Extent**, **ID used by raster mosaic (NOT considered a variation)**

Applicable Groups	Data Type	Main Layer Name	Layer Name Examples
Main Statewide	Point	Elev_Markers_XXL1_and_Akmax	No name variation needed.
	Point	Exit_Points_XXL1	No name variation needed.
	Polygon	Inundation_XXL1_and_Akmax	No name variation needed.
Maritime	Polygon	Inundation_Runs_Compilation	**Inundation_Runs_Compilation_AKmax**
			Inundation_Runs_Compilation_XXL1
	Raster	Diff_Raster	**Diff_Raster_Max_Vel_Ms_Run01b_XXL1_Run05a_XXL1**
			Diff_Raster_Max_Vel_Ms_Run08a_L1_Run05a_L1
	Raster	Ensemble_Raster	**Ensemble_Raster_AKmax_Max_Vorticity**
			Ensemble_Raster_XXL1_Min_Depth
Maritime - - - & - - - Tsunami Modeling	Polygon	Inundation	**Inundation_AK64**
			Run05a_L1_Inundation
	Point	Points_Main	**Points_Main_XL1_ClatsopB**
			Points_Main_SM1_CentralCoastC
			Run06a_XXL1_Points_Main
	Point	Points_Max_MF_Min_Depth	**Points_Max_MF_Min_Depth_M1_Bandon**
			Points_Max_MF_Min_Depth_AKmax_TillamookNetarts
			Run03c_AK64_Points_Max_MF_Min_Depth
	Point	Points_Max_Vorticity	**Points_Max_Vorticity_XXL1_CentralCoastB**
			Points_Max_Vorticity_AK64_CentralCoastB
			Run04a_L1_Points_Max_Vorticity

Applicable Groups	Data Type	Main Layer Name	Layer Name Examples
Tsunami Modeling	Polygon	Tsunami_Grid_Index	No name variation needed.
	Polygon	Tsunami_Point_Spacing	No name variation needed.
	Polygon	Mosaic_Cell_Size_Groups	No name variation needed.
	Raster	Raster_Indv	**Raster_Indv_SM1_Elev_MHHW_20ft_CellSize**
			Raster_Indv_SM1_Elev_MHHW_25ft_CellSize
			Raster_Indv_SM1_Elev_MHHW_50ft_CellSize
			Raster_Indv_SM1_Elev_MHHW_100ft_CellSize
			Raster_Indv_SM1_Elev_MHHW_250ft_CellSize
			Raster_Indv_SM1_Elev_MHHW_500ft_CellSize
	Mosaic	Mosaic_DS	**Mosaic_DS_SM1_Elev_MHHW**
			Mosaic_DS_XL1_Init_D_MHHW
			Mosaic_DS_XXL1_Max_MF
	Point	Simulated_gage_stations	No name variation needed.
Evacuation Modeling	Polygon	BridgesOut_EvacuationFlowZones	**XXL1_BridgesOut_EvacuationFlowZones**
	Polygon	BridgesIn_EvacuationFlowZones	**L1_BridgesIn_EvacuationFlowZones**
	Line	BridgesOut_EvacuationRoutes	**XXL1_BridgesOut_EvacuationRoutes**
	Line	BridgesIn_EvacuationRoutes	**L1_BridgesIn_EvacuationRoutes**
	Polygon	BridgesOut_WalkingSpeeds_Roads	**XXL1_BridgesOut_WalkingSpeeds_Roads**
	Polygon	BridgesIn_WalkingSpeeds_Roads	**L1_BridgesIn_WalkingSpeeds_Roads**
	Line	BridgesOut_WalkingSpeeds_Trails	**XXL1_BridgesOut_WalkingSpeeds_Trails**
	Line	BridgesIn_WalkingSpeeds_Trails	**L1_BridgesIn_WalkingSpeeds_Trails**
	Table	DataSources	No name variation needed.
All Groups	Raster	Raster	**Wave_Arrival_Raster_AKmax**
			DEM_Raster_Run04a_XXL1
			Coseismic_Response_Raster_Run05a_L1
			Run01b_XXL1_Raster_Max_Vel_Ms
			Run07a_L1_Raster_Flow_Depth
	Table	DataSources	No name variation needed.

Appendix D. Appendix Column Name Definitions

This table describes some important columns used in the appendices.

Column Name	Definition
Applicable Groups	The group, or tsunami project type, that the layer belongs to. Some layers are exclusive to a specific group and others can exist in multiple groups.
Data Type	The GIS data type of the layer.
Main Layer Name	The "main" name of the layer, prior to the addition of any variation qualifier text.
Event Size	The tsunami event size
Raster Parameter	The single mapped raster parameter. Only applicable to rasters. Vectors may contain these parameters as column names but they are not added to the file name. There are two exceptions: Points_Max_MF_Min_Depth and Points_Max_Vorticity contain parameter text in their names, but in these cases, it is part of the main layer name and not treated as a permitted variation.
Model Run 1	The modeled run name. The run numbers vary by project but they follow the same naming convention.
Model Run 2	The second modeled run name if one exists. This is only used in situations where multiple modeled runs are being compared.
Spatial Extent	A spatial extent description. This is only used if a project's elements are divided into different areas.