Appendix H - Private Industry MCAs

3GLP E-Terra

3GLP E-Terra is a skilled team of technology professionals with expertise in computer solutions and products. 3GLP E-Terra's knowledge of GIS, databases, the internet, and CAD systems provides clients with complete solutions customized for their specific needs. 3GLP E-Terra uses 3D data to produce map products for customers that use the data for a variety of purposes. 3GLP E-Terra also collects high resolution lidar and imagery at airports (Quality Level 0) data which support FAA requirements of Airport Obstruction Surveys for the Alaska DOT. Elevation data are used in the Aviation Safety Program in Alaska. Historical map information has not met national standards and is being migrated to navigation systems.

3GLP E-Terra's products and services, all of which rely on elevation data, include:

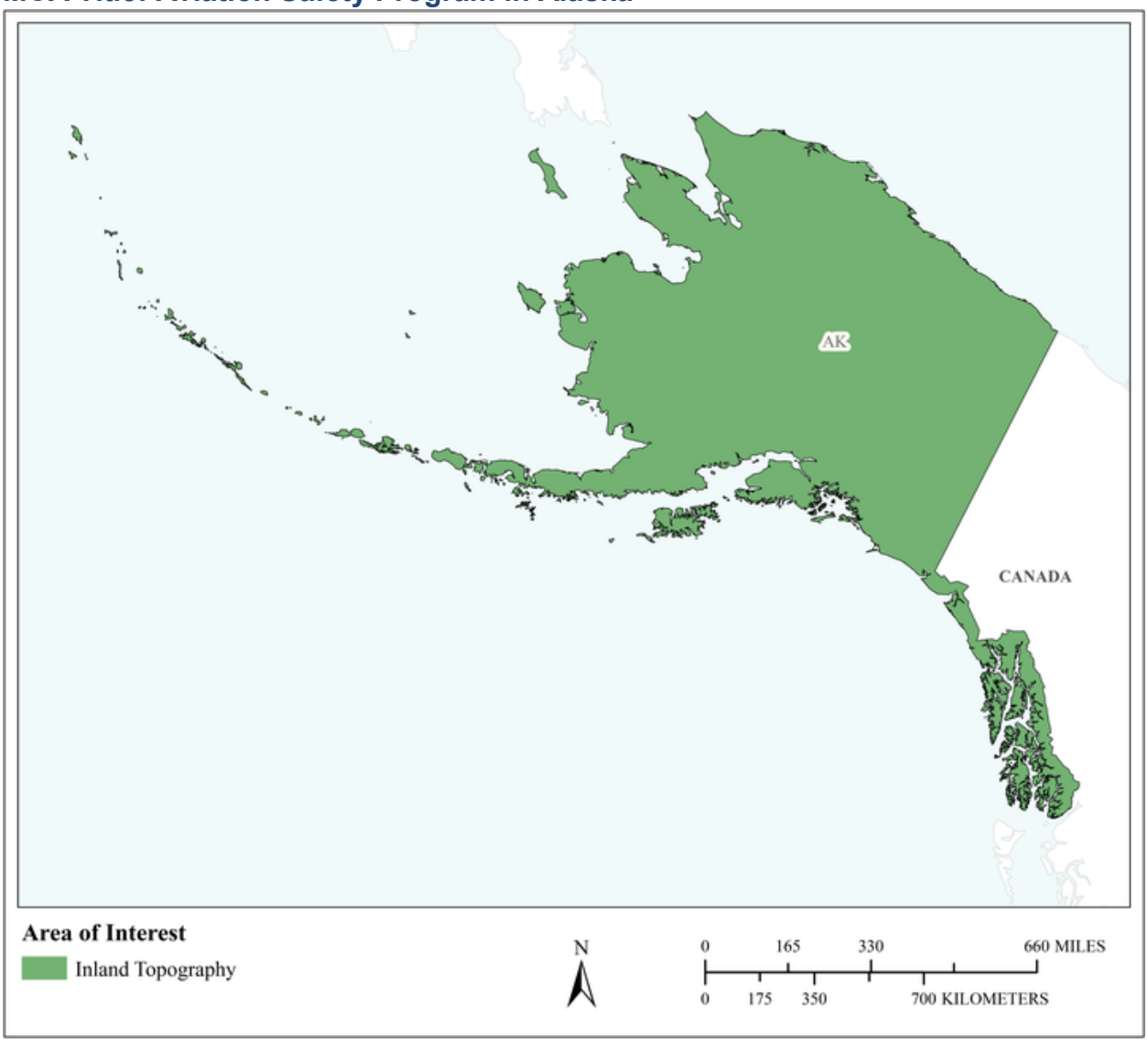
- 2D & 3D Visualization;
- Aerial Photography & Photogrammetry;
- Facilities Management;
- Forensics & Legal Support;
- Geographic Information Systems & CAD;
- Imagery & DEM Analysis;
- Interactive Simulations;
- In-Track Stereo Sales & Services;
- Mobile Application Development;
- Remote Asset Monitoring;
- Satellite Imagery Sales & Processing;
- Spatially Aware Custom Applications; and
- Web & Database Development.

3GLP E-Terra has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	3GLP E-Terra	22455	Aviation Safety Program in Alaska	Inland Topo	QL2	6-10 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate

MCA Title: Aviation Safety Program in Alaska



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	One or more states, territories, or counties			
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	We use 3D data to produce map products for customers that use the data for a variety of purposes. Much data is cost shared around multiple uses between multi agencies and levels of government. We also collect high resolution lidar and imagery at airports (QL0) data to support FAA requirements of Airport Obstruction Surveys for the Alaska DOT.
MCA Title	Aviation Safety Program in Alaska
MCA ID	22455
Organization Type	Private or Commercial
Organization Name	3GLP E-Terra
Sub-Agency or Division	
Organization Mission	Geo-spatial data processing and consulting
Program Name	Aviation Safety Program in Alaska. Historical map information has not met national standards and is being migrated to navigation systems.
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	BU 21 - Aviation Navigation and Safety
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Highly desirable
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Small features

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2			
Update Frequency	6-10 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 40 cm			
Acceptable Vertical Error	Up to 50 cm			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far onshore needed				
How far down the beach profile needed	To MLLW			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to double the required TVU at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Required			
Raw point cloud data	Highly desirable			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Nice to have			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Highly desirable			
Bridges/culverts	Nice to have			
Landmark features	Highly desirable			
Cultural resources	Nice to have			
Coastal and riverine structures	Nice to have			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	Moderate			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate			
Environmental	Moderate			
Public safety, including life and property	Moderate			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Cost savings/cost reduction	Moderate	Unable to provide										
Cost avoidance	Moderate	Unable to provide										
Increased revenues	Moderate	Unable to provide										
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide										
Improved response or timeliness	Moderate	Unable to provide										
Improved customer experience	Major	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate											
Environmental	Moderate											
Public safety, including life and property	Moderate											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes			
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

AECOM

AECOM is a global network of experts working with clients, communities, and colleagues to develop and implement innovative solutions to the world's most complex challenges. AECOM connects expertise across services, markets, and geographies to deliver transformative outcomes. Worldwide, AECOM designs, builds, finances, operates, and manages projects and programs that unlock opportunities, protect our environment, and improve people's lives. Elevation data are used for a variety of purposes including environmental impact statements that require spatial analysis and flood risk studies.

AECOM's Environmental Services division products and services include:

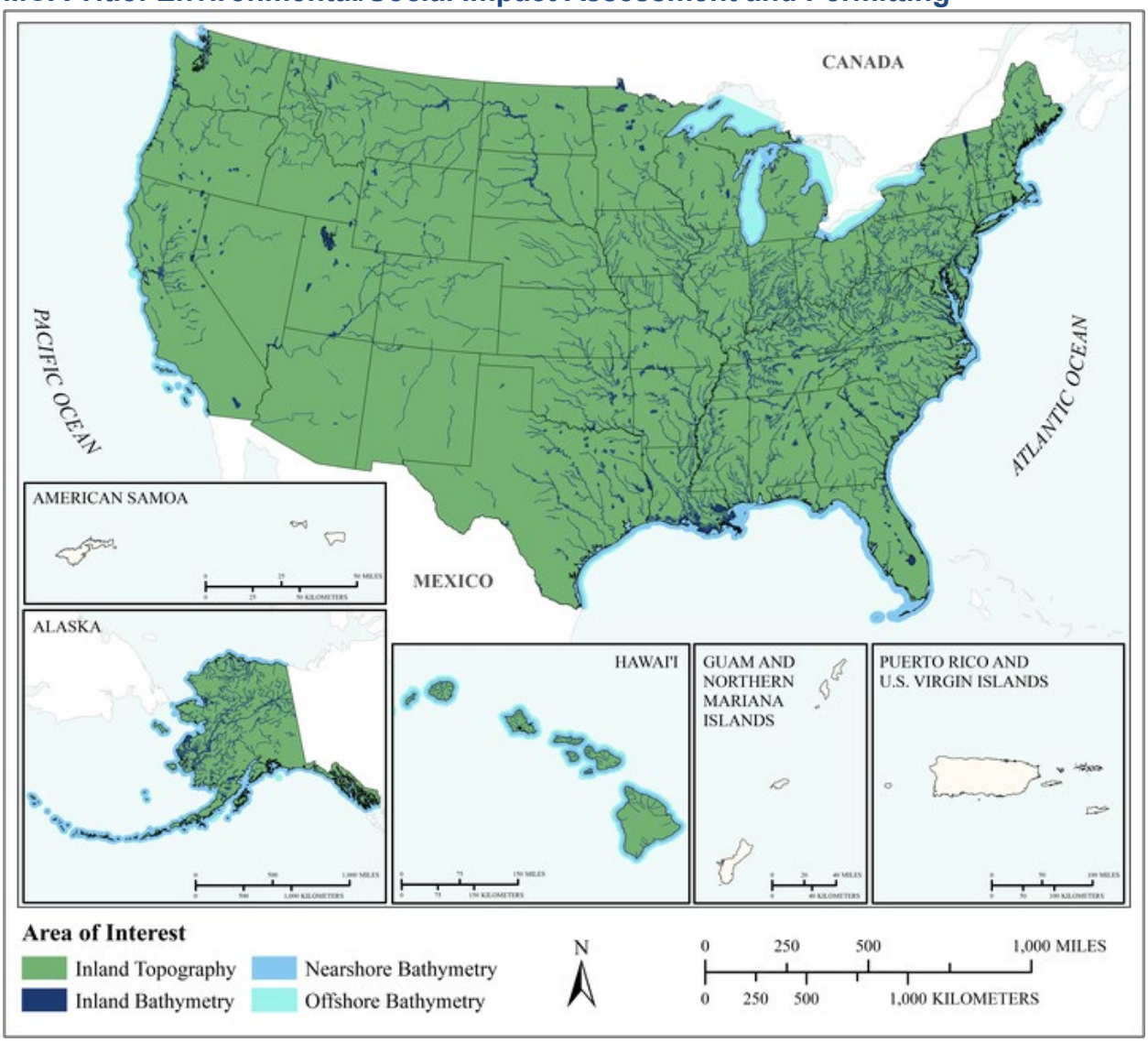
- Environmental/social impact assessment and permitting;
- Air quality consulting and engineering;
- Management information systems;
- Climate adaptation;
- Remediation, restoration, and redevelopment; and
- Environmental health and safety management consulting and compliance.

AECOM has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 06 – Natural Resource Management	AECOM	32684	Environmental/Social Impact Assessment and Permitting	Inland Topo	I don't know	It varies, it's client and project specific	Unable to quantify	Unable to quantify	I don't know	Moderate	Moderate
				Inland Bathy	I don't know	>10 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Nearshore Bathy	I don't know	6-10 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Offshore Bathy	Cross sections and/or transects meet needs	6-10 years	Unable to quantify	Unable to quantify	I don't know	Moderate	Moderate

MCA Title: Environmental/Social Impact Assessment and Permitting



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas	Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	Waters offshore off one or more states (including Great Lakes states), territories, or counties
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	We deliver solutions for our clients who may have a variety of mission critical activities/primary business uses. AECOM Environment focuses heavily on the National Environmental Policy Act (NEPA) process. Environmental impact statements require spatial analysis for the majority of the business cases below.
MCA Title	Environmental/Social Impact Assessment and Permitting
MCA ID	32684
Organization Type	Private or Commercial
Organization Name	AECOM
Sub-Agency or Division	
Organization Mission	AECOM is a global network of experts working with clients, communities and colleagues to develop and implement innovative solutions to the world's most complex challenges. We connect expertise across services, markets, and geographies to deliver transformative outcomes. Worldwide, we design, build, finance, operate and manage projects and programs that unlock opportunities, protect our environment and improve people's lives.
Program Name	AECOM - Environment
Total Annual Program Budget	
Primary Business Use	BU 06 - Natural Resources Conservation
Secondary Business Use	BU 07 - Wildlife and Habitat Management
Tertiary Business Use	BU 22 - Infrastructure and Construction Management

What Needs to be Measured in 3D	Response
Bare earth ground	Highly desirable
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	75,000 sq mi - 199,999 sq mi (e.g. large state or medium multi-state region)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Boring hole sample locations, monitoring well locations, etc.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Nice to have
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Nice to have
51 - 100 ft	Nice to have
101 - 500 ft	Highly desirable
501 - 2,500 ft	Highly desirable

Inland Bathy Feature Size Requirements	Response
Greater than 2,500 ft	Highly desirable
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Highly desirable
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Highly desirable

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	I don't know	I don't know	I don't know	Cross sections and/or transects meet needs
Update Frequency	It varies, it's client and project specific	>10 years	6-10 years	6-10 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	I don't know	I don't know	I don't know	I don't know
Acceptable Vertical Error	I don't know	I don't know	I don't know	I don't know
How far onshore needed			To cover the coastal uplands	
How far down the beach profile needed	This varies by client and project		To MHW	
Tide correction requirement			I don't know	I don't know
Cross sections and/or transects meet needs		Partial	Partial	Yes
Cross section/transect requirement		I don't know.	I don't know.	I don't know.

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Nice to have	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
Entire AOI under same environmental conditions	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
DEM for entire AOI needs to be seamless	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know	I don't know	I don't know	I don't know	I don't know	I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Not required	Nice to have	Nice to have
DTM	Highly desirable	Not required	Nice to have	Nice to have
DEM	Highly desirable	Nice to have	Nice to have	Nice to have
Raw point cloud data	Nice to have	Not required	Not required	Not required
Classified point cloud	Nice to have	Not required	Not required	
Edited/cube XYZ		Not required	Not required	Not required
Full waveform	Not required	Not required	Not required	Not required
Bathymetric Attributed Grid (BAG)		Not required	Not required	Not required
Breaklines required for standard hydro-flattening	Nice to have	Not required		
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Not required	Not required
Tide Predictions			Not required	Not required
Tidal Constituent And Residual Interpolation (TCARI)			Not required	Not required
Intensity imagery/sidescan imagery	Highly desirable	Not required	Nice to have	Not required
Ground control/ground truthing	Nice to have	Not required	Nice to have	Not required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Nice to have	Nice to have
Nautical and/or navigation charts			Highly desirable	Nice to have
Acoustic imagery of the seafloor			Nice to have	Nice to have
Aerial and/or satellite imagery	Highly desirable	Nice to have	Highly desirable	Nice to have
Underwater videography			Not required	Not required
Bottom texture			Nice to have	Nice to have
Bottom type			Nice to have	Nice to have
Submerged features			Highly desirable	Nice to have
Subbottom characteristics			Nice to have	Nice to have
Geologic and seismic data	Highly desirable	Nice to have	Highly desirable	Nice to have
Water column properties - Physical			Highly desirable	Nice to have
Water column properties - Chemical			Highly desirable	Nice to have
Water column properties - Biological			Highly desirable	Nice to have
Currents			Nice to have	Not required
Tide/wave heights			Nice to have	Not required
Sea ice conditions			Highly desirable	Nice to have
Habitat distribution and classification			Highly desirable	Nice to have
Boundaries			Required	Nice to have
Routes			Highly desirable	Nice to have
Offshore cadastral			Nice to have	Nice to have
Lease areas			Required	Nice to have
Fixed obstructions			Highly desirable	Nice to have
Floating observation/navigation systems			Nice to have	Nice to have
Shorelines – current, historic, change rates	Highly desirable	Highly desirable	Required	
Land use/land cover	Highly desirable	Nice to have	Required	Nice to have
Wetlands	Highly desirable	Nice to have	Required	Nice to have

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Highly desirable	Nice to have
Inland surface water features	Highly desirable	Nice to have	Required	
Bridges/culverts	Highly desirable	Nice to have		
Landmark features	Highly desirable	Nice to have	Nice to have	
Cultural resources	Highly desirable	Nice to have	Required	
Coastal and riverine structures	Highly desirable	Highly desirable	Nice to have	
Overhead structures			Required	
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	This depends on the project. It depends on the availability of data - sometimes the client will have already purchased imagery/elevation data specific to an area at the scale of their needs. The last notable time I went to obtain elevation data that was publicly available for an area was in the north slope, Alaska. The state's IFSAR collection had been processed in that region and I was able to obtain it, and roughly derive a line feature of the coastline that was a visibly noticeable improvement over other features that had been hand digitized from aerial maps nearly 10 or more years ago. I believe the resolution is 10m but I'm not sure about the other specs.	I've rarely needed to use bathymetric information. The last time I did I used NOAA nautical charts.	Not currently using bathymetric data.	Not currently using any.
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
State Repositories	Yes			
State repositories used	Alaska State Geospatial Data Clearinghouse and the Alaska Division of Geological and Geophysical Surveys.			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	I don't know	I don't know	I don't know
Cost savings/cost reduction	I don't know	I don't know	I don't know	I don't know
Cost avoidance	Moderate	I don't know	I don't know	I don't know
Increased revenues	I don't know	I don't know	I don't know	I don't know
Mission-driven performance improvements	Moderate	I don't know	I don't know	I don't know
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	I don't know	I don't know	I don't know
Improved response or timeliness	Minor	I don't know	I don't know	I don't know
Improved customer experience	Minor	I don't know	I don't know	I don't know
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	I don't know	I don't know	I don't know
Environmental	I don't know	I don't know	I don't know	I don't know
Public safety, including life and property	I don't know	I don't know	I don't know	I don't know

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		Moderate	Unable to provide	
Cost savings/cost reduction	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Cost avoidance	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		Major	Unable to provide	
Increased revenues	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Mission-driven performance improvements	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Improved response or timeliness	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Improved customer experience	Moderate	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		Moderate	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know			I don't know			I don't know			I don't know		
Environmental	Moderate			I don't know			I don't know			Moderate		
Public safety, including life and property	Moderate			I don't know			I don't know			Moderate		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes	Yes	Yes	Yes
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections	Yes			
Height-Above-Ground maps				
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Atlantic Shores Offshore Wind

Atlantic Shores Offshore Wind is a 50:50 partnership between Shell New Energies US, LLC and EDF Renewables North America. The joint-venture (JV) company was formed in December 2018 to co-develop a 183,353 acre lease area on the U.S. Outer Continental Shelf (OCS). The lease area (OCS-0499) is located within the New Jersey Wind Energy Area located 10-20 miles off the shoreline.

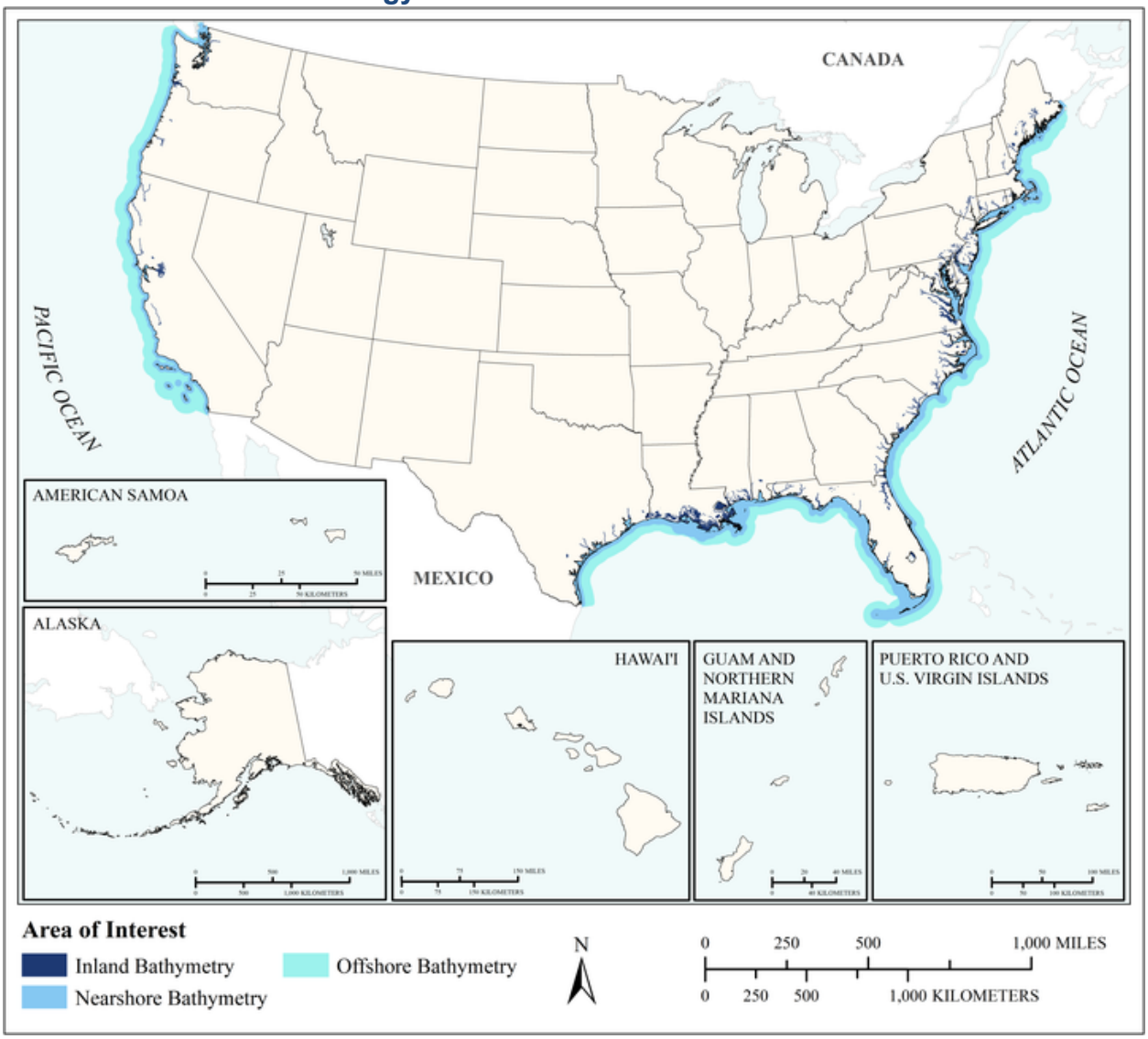
Together, EDF Renewables and Shell have years of technical, operational, and commercial energy expertise which is essential in developing an offshore wind project of this scale. This expertise will enable the JV to optimize future development of the lease area to the maximum benefit of New Jersey and New York. The project will create jobs for local communities, promote research opportunities for local colleges and universities, and reduce carbon emissions by providing clean energy for thousands of residents across the region. Atlantic Shores Offshore Wind anticipates delivering electricity by 2027 with New Jersey transitioning to 50% clean energy by 2030.

Atlantic Shores Offshore Wind has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 12 – Renewable Energy Resources	Atlantic Shores Offshore Wind	60733	Renewable Energy Resources	Inland Bathy	QL0B	2-3 years	$503,015	Unable to quantify	Moderate	Major	Major
				Nearshore Bathy	QL4B	2-3 years	$1,015,075	Unable to quantify	Minor	Moderate	Moderate
				Offshore Bathy	Special Order	2-3 years	$4,030,150	Unable to quantify	Minor	Moderate	Moderate

MCA Title: Renewable Energy Resources



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type		Required	Required	Required
Geographic Area Requirements		Custom description	Custom description	Custom description
Sub Area Requirements		30 miles inland on the East and West Coasts	30 miles off the shoreline of the East and West Coasts	30 miles off the shoreline of the East and West Coasts

MCA Description	Response
Mission Critical Activity	Alternate energy development – solar, tidal, wind, wave, and ocean current. Assessment of rooftops for solar energy potential. Analysis of wind energy potential and turbine placement. Low head power potential for hydropower.
MCA Title	Renewable Energy Resources
MCA ID	60733
Organization Type	Private or Commercial
Organization Name	Atlantic Shores Offshore Wind
Sub-Agency or Division	
Organization Mission	
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 12 - Renewable Energy Resources
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Highly desirable
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	
Smallest 3D features needed	
Description of smallest 3D features	

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Highly desirable
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order		QL0B	QL4B	Special Order
Update Frequency		2-3 years	2-3 years	2-3 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error		Up to 2 meters	Up to 10 meters	Up to 2 meters
Acceptable Vertical Error		Up to 30 cm	Up to 50 cm	Less than 1 meter
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season		Nice to have	Highly desirable	Highly desirable		Highly desirable
Entire AOI under same environmental conditions		Highly desirable	Highly desirable	Highly desirable		Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless		Required	Highly desirable	Highly desirable		Highly desirable
DEM for entire AOI needs to be seamless		Required	Required	Highly desirable		Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM		Highly desirable	Highly desirable	Required
DTM		Highly desirable	Required	Required
DEM		Required	Required	Required
Raw point cloud data		Nice to have	Highly desirable	Nice to have
Classified point cloud		Nice to have	Highly desirable	
Edited/cube XYZ		Nice to have	Nice to have	Nice to have
Full waveform		Not required	Nice to have	Nice to have
Bathymetric Attributed Grid (BAG)		Nice to have	Nice to have	Nice to have
Breaklines required for standard hydro-flattening		Not required		
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Not required	Not required
Tide Predictions			Nice to have	Not required
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	Not required
Intensity imagery/sidescan imagery		Nice to have	Highly desirable	Highly desirable
Ground control/ground truthing		Nice to have	Highly desirable	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Highly desirable
Nautical and/or navigation charts			Highly desirable	Highly desirable
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery		Required	Highly desirable	Highly desirable
Underwater videography			Nice to have	Nice to have
Bottom texture			Nice to have	Nice to have
Bottom type			Highly desirable	Highly desirable
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Required	Highly desirable
Geologic and seismic data		Nice to have	Highly desirable	Highly desirable
Water column properties - Physical			Nice to have	Nice to have
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Nice to have	Nice to have
Currents			Nice to have	Highly desirable
Tide/wave heights			Highly desirable	Highly desirable
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Nice to have	Nice to have
Boundaries			Required	Required
Routes			Required	Required
Offshore cadastral			Required	Required
Lease areas			Required	Required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Highly desirable	Required
Shorelines – current, historic, change rates		Required	Highly desirable	
Land use/land cover		Highly desirable	Required	Highly desirable
Wetlands		Required	Required	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Required	Highly desirable
Inland surface water features		Required	Required	
Bridges/culverts		Required		
Landmark features		Required	Not required	
Cultural resources		Highly desirable	Highly desirable	
Coastal and riverine structures		Required	Highly desirable	
Overhead structures			Nice to have	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts		Yes		
USACE navigation charts		Yes		
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings		Major	Major	Moderate
Cost savings/cost reduction		Major	Moderate	Moderate
Cost avoidance		Moderate	Moderate	Moderate
Increased revenues		Minor	Major	Major
Mission-driven performance improvements		Major	Major	Major
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services		Major	Major	Major

Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Improved response or timeliness		Major	Major	Major
Improved customer experience		Moderate	Major	Major
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach		Moderate	Major	Moderate
Environmental		Moderate	Major	Major
Public safety, including life and property		Major	Moderate	Moderate

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings				Major	Annual dollars saved/realized	$503,015	Major	Annual dollars saved/realized	$1,015,075	Major	Annual dollars saved/realized	$4,030,150
Time savings description				Water crossings for cable routes. Vessel time for surveys.			Vessel time for surveys. High-res bathy for planning landfall of cables.			Vessel time for surveys. High-res bathy for planning landfall of cables.		
Cost savings/cost reduction				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost avoidance				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Increased revenues				Major	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Mission-driven performance improvements				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services				Major	Unable to provide		Major	Unable to provide		Moderate	Unable to provide	
Improved response or timeliness				Major	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Improved customer experience				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach				Moderate			Minor			Minor		
Environmental				Major			Moderate			Moderate		
Environmental description				Feeds BOEM, NMFS, etc. for regional studies to enable faster permitting and forward planning for lease sales.			Feeds BOEM, NMFS, etc. for regional studies to enable faster permitting and forward planning for lease sales.			Feeds BOEM, NMFS, etc. for regional studies to enable faster permitting and forward planning for lease sales.		
Public safety, including life and property				Major			Moderate			Moderate		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1

Ayres Associates

Ayres Associates is an architectural and engineering services firm specializing in transportation, general civil, geospatial, environmental, and architecture.

Ayres Associates' products and services, many of which rely on elevation data, include:

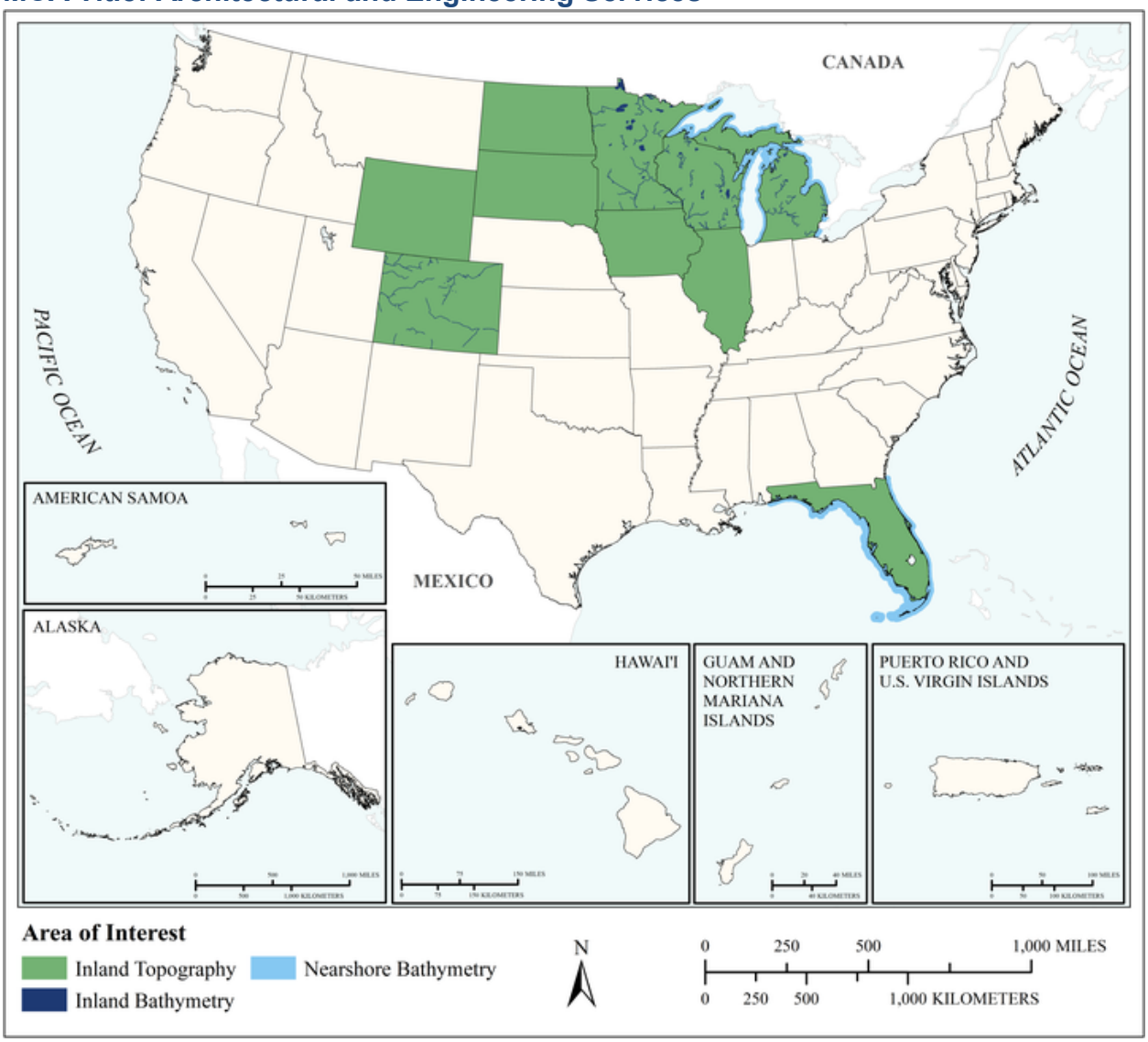
- Architecture;
- Civil and municipal engineering;
- Construction engineering;
- Environmental;
- Geospatial;
- Landscape architecture;
- Planning and development;
- River engineering and water resources;
- Roadway design;
- Structural design and analysis;
- Structural inspection;
- Telecommunications and subsurface utility engineering;
- Traffic engineering; and
- Transportation support services.

Ayres Associates has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	Ayres Associates	1440	Architectural and Engineering Services	Inland Topo	QL2	6-10 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Inland Bathy	I don't know	Event driven	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Nearshore Bathy	I don't know	Event driven	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Architectural and Engineering Services



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	
Geographic Area Requirements	One or more states, territories, or counties	One or more states, territories, or counties	Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Architectural & engineering services firm specializing in transportation, general civil, geospatial, environmental, and architecture. Hydraulic modeling requires elevation data for transportation, land development, and architecture applications. Requirements for elevation data vary by project. Recent inland bathymetry is required for transportation design and flood hazard modeling. Older NOAA nearshore data are OK for modeling, but cannot be used for design.
MCA Title	Architectural and Engineering Services
MCA ID	1440
Organization Type	Private or Commercial
Organization Name	Ayres Associates
Sub-Agency or Division	
Organization Mission	Professional Consulting: Architecture, Engineering, and Geospatial
Program Name	Ayres Associates: architectural & engineering services firm specializing in transportation, general civil, geospatial, environmental, and architecture.
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	BU 15 - Flood Risk Management
Tertiary Business Use	BU 01 - Water Supply and Quality

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Pole

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Required
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Not required
501 - 2,500 ft	Not required
Greater than 2,500 ft	Not required

Inland Bathy Feature Size Requirements	Response
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Nice to have
Greater than 10 acres	Nice to have

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	I don't know	I don't know	
Update Frequency	6-10 years	Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.	
Event type(s)		A new project, flood event, new bridge, roadway development along channels, or identification of a noticeable hazard.	A new project, bridge evaluation, coastal structure, etc.	
Quality Level and/or update frequency variability across AOI	QL0, QL0 HD, QL1, QL1 HD. QL1 for transportation work, QL2 for flood modeling.			
Acceptable Horizontal Error	Less than 20 cm	The best horizontal accuracy achievable for the vertical accuracy I need	The best horizontal accuracy achievable for the vertical accuracy I need	
Acceptable Vertical Error	Up to 10 cm	Up to 60 cm	I don't know	
How far onshore needed			To MHW	
How far down the beach profile needed	Not applicable		None	
Tide correction requirement			I don't know	
Cross sections and/or transects meet needs		Partial	Partial	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross section/transect requirement		Project dependent. Design level requires full surface, 1D flood models OK with cross sections, 2D models need full surface. For 1-D models, cross sections may be 1000 feet apart in open reaches, with additional cross sections immediately upstream and downstream of hydraulic structures (culverts, bridges, weirs, etc.)	FEMA or USACE standards	

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable	Nice to have	Nice to have		Nice to have	Nice to have
Entire AOI under same environmental conditions	Highly desirable	Nice to have	Nice to have		Nice to have	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Nice to have	Nice to have		Nice to have	Nice to have
DEM for entire AOI needs to be seamless	Highly desirable	Nice to have	Nice to have		Nice to have	Nice to have
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	I don't know	I don't know		I don't know	I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Nice to have	Nice to have	
DTM	Required	Required	Required	
DEM	Required	Highly desirable	Highly desirable	
Raw point cloud data	Required	Highly desirable	Highly desirable	
Classified point cloud	Required	Highly desirable	Highly desirable	
Edited/cube XYZ		Highly desirable	Highly desirable	
Full waveform	Nice to have	Not required	Not required	
Bathymetric Attributed Grid (BAG)		Highly desirable	Not required	
Breaklines required for standard hydro-flattening	Required	Required		
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Not required	
Tide Predictions			Not required	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Required	Highly desirable	Not required	
Ground control/ground truthing	Required	Required	Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	
Nautical and/or navigation charts			Nice to have	
Acoustic imagery of the seafloor			Nice to have	
Aerial and/or satellite imagery	Highly desirable	Highly desirable	Highly desirable	
Underwater videography			Not required	
Bottom texture			Not required	
Bottom type			Nice to have	
Submerged features			Nice to have	
Subbottom characteristics			Not required	
Geologic and seismic data	Not required	Not required	Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Not required	
Tide/wave heights			Nice to have	
Sea ice conditions			Not required	
Habitat distribution and classification				
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Nice to have	
Lease areas			Not required	
Fixed obstructions			Nice to have	
Floating observation/navigation systems			Nice to have	
Shorelines – current, historic, change rates	Not required	Not required	Highly desirable	
Land use/land cover	Highly desirable	Nice to have	Highly desirable	
Wetlands	Nice to have	Nice to have	Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Highly desirable	
Inland surface water features	Required	Highly desirable	Highly desirable	
Bridges/culverts	Required	Highly desirable		
Landmark features	Not required	Not required	Highly desirable	
Cultural resources	Not required	Highly desirable	Highly desirable	
Coastal and riverine structures	Nice to have	Highly desirable	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Ayres Associates both prepares and uses topographic mapping ranging from QL0 HD up to QL3.	Self generated from cross-section surveys	Self generated through side scan or survey	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	Colorado, Illinois, Minnesota			
Other	Yes		Yes	
Other description	Self-generated topo data		Self generated through side scan or survey	
Data that meet my needs are not available		Yes		

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Inland bathy data not available	I don't know	
Cost savings/cost reduction	Major	Inland bathy data not available	I don't know	
Cost avoidance	Minor	Inland bathy data not available	I don't know	
Increased revenues	Major	Inland bathy data not available	I don't know	
Mission-driven performance improvements	Major	Inland bathy data not available	I don't know	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Inland bathy data not available	I don't know	
Improved response or timeliness	Moderate	Inland bathy data not available	I don't know	
Improved customer experience	Minor	Inland bathy data not available	I don't know	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor	Inland bathy data not available	I don't know	
Environmental	Minor	Inland bathy data not available	I don't know	
Public safety, including life and property	Minor	Inland bathy data not available	I don't know	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Cost savings/cost reduction	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Cost avoidance	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Increased revenues	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Mission-driven performance improvements	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Improved response or timeliness	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Improved customer experience	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know			I don't know			I don't know					
Environmental	I don't know			I don't know			I don't know					
Public safety, including life and property	I don't know			I don't know			I don't know					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes		
Contours	Yes	Yes		
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections	Yes	Yes	Yes	
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids	Yes	Yes	Yes	
Hydrologic Flow Accumulation Grids	Yes	Yes	Yes	
Hydrologic networks (e.g. streams, lakes)	Yes	Yes	Yes	
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes	Yes	
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes	Yes		

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1

Cooke Aquaculture

Cooke Aquaculture's mission is to be a global seafood leader driven by an innovative team that delivers superior products, service, and value to its customers in a safe and environmentally sustainable manner. Cooke Aquaculture works closely with local communities to harvest and raise the very best seafood for its customers. The company operates in pristine marine environments, relies on science and experts to ensure sustainability, uses feed from sustainable resources, and constantly searches for ways to reduce its carbon footprint.

Cooke Aquaculture maintains both aquaculture and wild harvesting operations in Canada, Maine, the Atlantic seaboard, Gulf of Mexico, Pacific coast, Alaska, South America, and Europe.

Cooke Aquaculture's interest is in developing the growth of U.S. aquaculture. The U.S. is a net importer of seafood products and is losing a huge opportunity to increase domestic seafood production and the creation of thousands of jobs by relying on importing seafood for domestic consumption. Cooke Aquaculture believes that it is possible that having enhanced elevation information readily available to the public could spark more understanding of the coastal environment and that there are unique areas that could be suitable for the development of offshore aquaculture. Private industry could use these maps to identify potential areas and the mapping would help with modeling, engineering, regulatory understanding and the permitting work to accomplish a project.

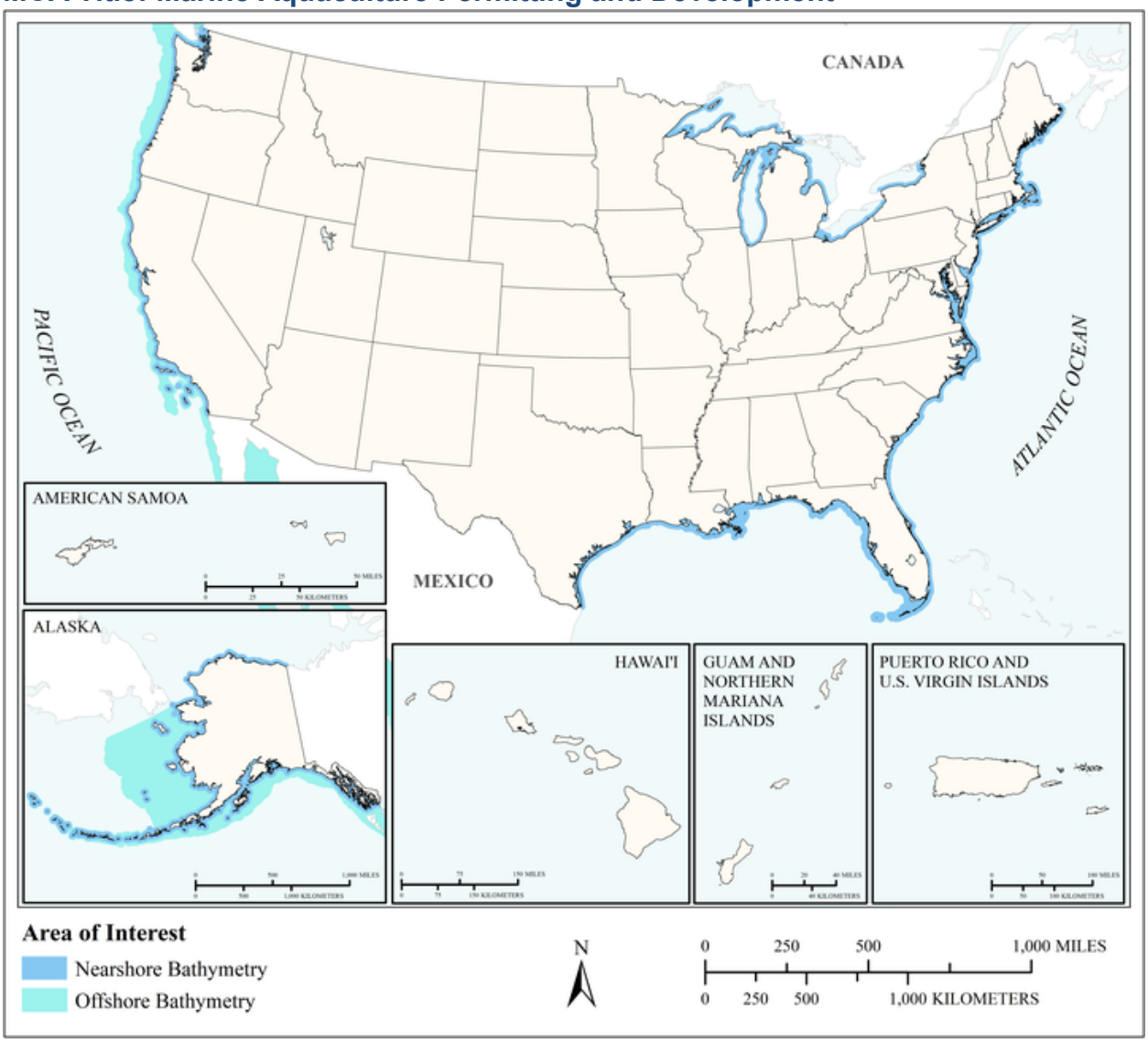
While unable to quantify future annual benefits from enhanced elevation data, Cooke Aquaculture noted that the cost to U.S. in lost opportunity is in the billions of dollars. According to NOAA's statistics on the marine economy, the U.S. seafood trade deficit was over $16 billion in 2019. This trade deficit in seafood demonstrates a large potential for U.S. aquaculture production, domestic job creation, and for increasing domestic markets.

Cooke Aquaculture has identified a Business Use and Mission Critical Activity that relies on bathymetric or topobathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 09 – Fisheries Management and Aquaculture	Cooke Aquaculture	32761	Marine Aquaculture Permitting and Development	Nearshore Bathy	QL4B	4-5 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Offshore Bathy	Order 1	4-5 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate

MCA Title: Marine Aquaculture Permitting and Development



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	Required
Geographic Area Requirements			Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	Custom description
Sub Area Requirements				To the shelf break along the Pacific coast of North America.

MCA Description	Response
Mission Critical Activity	Marine aquaculture permitting and development. Our interest is in developing the growth of U.S. aquaculture. The U.S. is a net importer of seafood products and is losing a huge opportunity to increase domestic seafood production and the creation of thousands of jobs by relying on importing seafood for domestic consumption. It is possible that having this information readily available to the public could spark more understanding of the coastal environment and that there are unique areas that could be suitable for the development of offshore aquaculture. Private industry could use these maps to identify potential areas and the mapping would help with modeling, engineering, regulatory understanding and the permitting work to accomplish a project.
MCA Title	Marine Aquaculture Permitting and Development
MCA ID	32761
Organization Type	Private or Commercial
Organization Name	Cooke Aquaculture
Sub-Agency or Division	Pacific
Organization Mission	Marine Finfish Aquaculture. Commercial production of aquaculture seafood products.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 09 - Fisheries Management and Aquaculture
Secondary Business Use	BU 30 - Maritime and Land Boundary Management
Tertiary Business Use	BU 22 - Infrastructure and Construction Management

What Needs to be Measured in 3D	Response
Bare earth ground	Nice to have
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Not required
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Small features

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			QL4B	Order 1
Update Frequency			4-5 years	4-5 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Acceptable Horizontal Error			Up to 5 meters	Up to 5 meters
Acceptable Vertical Error			Up to 1 meter	Up to 1 meter
How far onshore needed			500 meters inland	
How far down the beach profile needed			Below MLLW	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Not required	Not required		Not required
Entire AOI under same environmental conditions			Not required	Not required		Not required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Not required	Not required		Not required
DEM for entire AOI needs to be seamless			Not required	Not required		Not required
Amount of acceptable vertical manipulation to achieve spatial seamlessness			I don't know	I don't know		I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Nice to have	Nice to have
DTM			Nice to have	Nice to have
DEM			Nice to have	Nice to have
Raw point cloud data			Nice to have	Nice to have
Classified point cloud			Nice to have	
Edited/cube XYZ			Nice to have	Nice to have
Full waveform			Nice to have	Nice to have
Bathymetric Attributed Grid (BAG)			Nice to have	Nice to have
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Nice to have	Nice to have
Tide Predictions			Highly desirable	Highly desirable
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Highly desirable
Intensity imagery/sidescan imagery			Highly desirable	Highly desirable
Ground control/ground truthing			Nice to have	Nice to have

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	Highly desirable
Nautical and/or navigation charts			Highly desirable	Highly desirable
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery			Highly desirable	Highly desirable
Underwater videography			Nice to have	Nice to have
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Highly desirable	Highly desirable
Geologic and seismic data			Nice to have	Nice to have
Water column properties - Physical			Required	Required
Water column properties - Chemical			Required	Required
Water column properties - Biological			Required	Required
Currents			Required	Required
Tide/wave heights			Required	Required
Sea ice conditions			Required	Required
Habitat distribution and classification			Required	Required
Boundaries			Required	Required
Routes			Highly desirable	Highly desirable
Offshore cadastral			Highly desirable	Highly desirable
Lease areas			Required	Required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates			Required	
Land use/land cover			Highly desirable	Highly desirable
Wetlands			Highly desirable	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Highly desirable	Highly desirable
Inland surface water features			Nice to have	
Bridges/culverts				
Landmark features			Not required	
Cultural resources			Highly desirable	
Coastal and riverine structures			Nice to have	
Overhead structures			Nice to have	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			Best available	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts			Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			Moderate	Moderate
Cost savings/cost reduction			Moderate	Moderate
Cost avoidance			Moderate	Moderate
Increased revenues			Major	Major
Mission-driven performance improvements			Major	Major
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			Moderate	Moderate

Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Improved response or timeliness			Moderate	Moderate
Improved customer experience			Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			Minor	Minor
Environmental			Moderate	Moderate
Public safety, including life and property			Moderate	Moderate

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							I don't know	Unable to provide		I don't know	Unable to provide	
Cost savings/cost reduction							Major	Unable to provide		Major	Unable to provide	
Cost avoidance							Major	Unable to provide		Major	Unable to provide	
Increased revenues							Major	Unable to provide		Major	Unable to provide	
Mission-driven performance improvements							Moderate	Unable to provide		Moderate	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							Moderate	Unable to provide		Moderate	Unable to provide	
Improved response or timeliness							I don't know	Unable to provide		I don't know	Unable to provide	
Improved customer experience							I don't know	Unable to provide		I don't know	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							Moderate			Moderate		
Environmental							Moderate			Moderate		
Public safety, including life and property							Moderate			Moderate		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)			Yes	Yes
Contours			Yes	Yes
Hillshades			Yes	Yes
Slope maps			Yes	Yes
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps			Yes	Yes
Hydrologic Flow Direction Grids			Yes	Yes
Hydrologic Flow Accumulation Grids			Yes	Yes
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

ESGplus

ESGplus was created to provide clients of the maritime industry with a resilient, efficient, and socially responsible global maritime supply chain. ESGplus is invested in promoting sustainability, increased safety standards, and reducing the environmental impact of the maritime industry. The mission of ESGplus is to enhance the resilience and sustainability of the maritime supply chain for their clients and stakeholders using both proven and innovative methods.

ESGplus offers services to marine terminals, ports, charterers, shipowners, ship managers, insurers, financial institutions, trading houses, flag states, and marine departments. These services include:

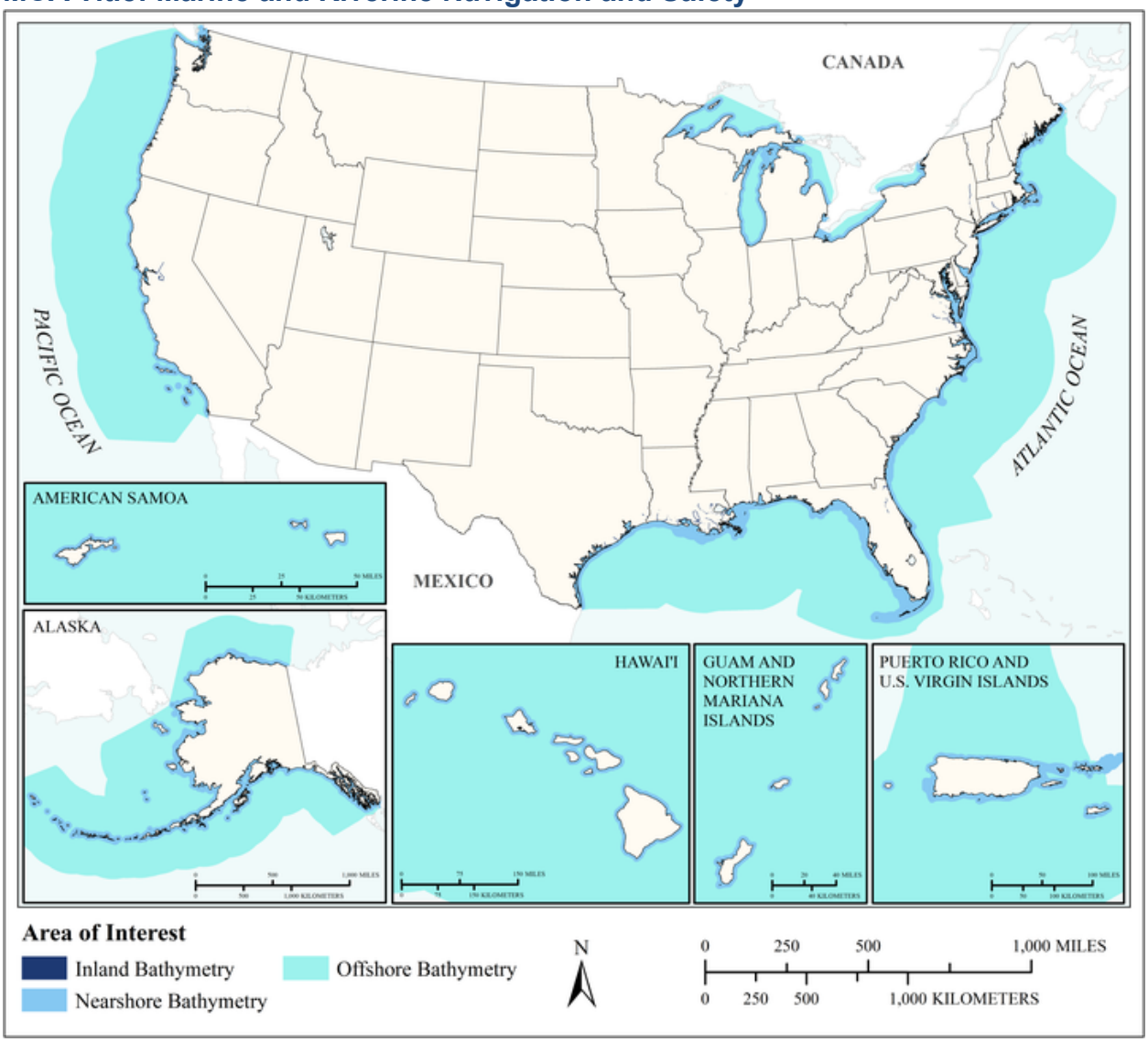
- reviewing and enhancing compliance and due diligence policies, procedures, and strategies to manage operational risk in the maritime domain;
- formulating specific vessel screening criteria based on risk exposure on various trades and transaction types;
- guidance on chartering and commercial operations;
- reviewing and enhancing ESG (environment, social, and governance) principles and practices;
- formulating greenhouse gases policy and strategy to reduce carbon footprint and emissions;
- reviewing and enhancing the marine assurance process for a resilient and competitive maritime supply chain; and
- assessment of operational risk for a voyage.

ESGplus has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	ESGplus	60732	Marine and Riverine Navigation and Safety	Inland Bathy	QL0B	Annually	Unable to quantify	Unable to quantify	Moderate	Major	Major
				Nearshore Bathy	QL0B	(a) Annually (b) 2-3 years (c) 4-5 years	Unable to quantify	Unable to quantify	Minor	Major	Major
				Offshore Bathy	Order 1a	(a) Annually (b) 2-3 years (c) 4-5 years	Unable to quantify	Unable to quantify	Moderate	Major	Major

MCA Title: Marine and Riverine Navigation and Safety



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type		Required	Required	Required
Geographic Area Requirements		Custom description	Area split by varying quality level or update frequency	Area split by varying quality level or update frequency
Sub Area Requirements		Maintained channels	All nearshore study waters	All offshore study waters

MCA Description	Response
Mission Critical Activity	Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels.
MCA Title	Marine and Riverine Navigation and Safety
MCA ID	60732
Organization Type	Private or Commercial
Organization Name	ESGplus
Sub-Agency or Division	
Organization Mission	
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Nice to have
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Larger than 2 million sq mi (e.g. National)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Highly desirable
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Highly desirable
Greater than 2,500 ft	Nice to have
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Nice to have
Greater than 10 acres	Nice to have

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order		QL0B	QL0B	Order 1a
Update Frequency		Annually	(a) Annually (b) 2-3 years (c) 4-5 years	(a) Annually (b) 2-3 years (c) 4-5 years
Event type(s)				
Quality Level and/or update frequency variability across AOI			Annually for port channels, anchorages, safety fairways, and ICWs. 2-3 years for lighterage areas. 4-5 years for all other nearshore locations.	Annually for port channels, anchorages, safety fairways, and ICWs. 2-3 years for lighterage areas. 4-5 years for all other offshore locations.
Acceptable Horizontal Error		Up to 2 meters	Up to 2 meters	Up to 5 meters
Acceptable Vertical Error		Up to 30 cm	Up to 30 cm	Less than 1 meter
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season		Nice to have	Nice to have	Nice to have		Nice to have
Entire AOI under same environmental conditions		Highly desirable	Highly desirable	Highly desirable		Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless		Required	Required	Highly desirable		Highly desirable
DEM for entire AOI needs to be seamless		Required	Required	Required		Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM		Highly desirable	Required	Required
DTM		Highly desirable	Required	Required
DEM		Required	Required	Required
Raw point cloud data		Nice to have	Required	Highly desirable
Classified point cloud		Nice to have	Nice to have	
Edited/cube XYZ		Nice to have	Highly desirable	Highly desirable
Full waveform		Not required	Not required	Nice to have
Bathymetric Attributed Grid (BAG)		Nice to have	Highly desirable	Highly desirable
Breaklines required for standard hydro-flattening		Not required		
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Required	Required
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Nice to have
Intensity imagery/sidescan imagery		Nice to have	Highly desirable	Highly desirable
Ground control/ground truthing		Nice to have	Highly desirable	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Required	Required
Aerial and/or satellite imagery		Required	Required	Highly desirable
Underwater videography			Nice to have	Not required
Bottom texture			Required	Highly desirable
Bottom type			Required	Required
Submerged features			Required	Required
Subbottom characteristics			Highly desirable	Required
Geologic and seismic data		Nice to have	Nice to have	Nice to have
Water column properties - Physical			Highly desirable	Highly desirable
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Highly desirable	Highly desirable
Currents			Highly desirable	Required
Tide/wave heights			Required	Required
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Nice to have	Highly desirable
Boundaries			Highly desirable	Required
Routes			Required	Required
Offshore cadastral			Nice to have	Highly desirable
Lease areas			Required	Highly desirable
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates		Required	Required	
Land use/land cover		Highly desirable	Highly desirable	Required
Wetlands		Required	Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Required	Required
Inland surface water features		Required	Highly desirable	
Bridges/culverts		Required		
Landmark features		Required	Required	
Cultural resources		Highly desirable	Highly desirable	
Coastal and riverine structures		Required	Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast		Yes	Yes	Yes
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes	Yes	Yes
USGS Inland Waters server		Yes		
USGS data series		Yes		
Marine Minerals Program GIS			Yes	Yes
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings		Major	Major	Major
Cost savings/cost reduction		Major	Major	Major
Cost avoidance		Moderate	Major	Major
Increased revenues		Minor	Minor	Minor
Mission-driven performance improvements		Major	Major	Major
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services		Major	Major	Major

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness		Major	Major	Major
Improved customer experience		Moderate	Major	Major
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach		Moderate	Moderate	Moderate
Environmental		Moderate	Major	Major
Public safety, including life and property		Major	Major	Major

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Time savings description				Fewer unnecessary diversions resulting in less time and bunker costs.			Fewer unnecessary diversions resulting in less time and bunker costs.			Fewer unnecessary diversions resulting in less time and bunker costs.		
Cost savings/cost reduction				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction description				Reduced insurance premiums.			Reduced insurance premiums.			Reduced insurance premiums.		
Cost avoidance				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost avoidance description				Less need and therefore lower costs for additional equipment and manpower.			Less need and therefore lower costs for additional equipment and manpower.			Less need and therefore lower costs for additional equipment and manpower.		
Increased revenues				Major	Unable to provide		Major	Unable to provide		Moderate	Unable to provide	
Increased revenues description				More accurate bathymetric data will lead to lower safety margins at every level, leading to higher cargo carrying capacity (and more economic trade). Benefits could be in the billions. A good example is the Port of Long Beach where the Very Large Crude Carrier (VLCC) draft was increased by 4 feet after better bathymetric measurements and associated Dynamic Under Keel Clearance (UKC) (No dredging) for the VLCCs, and the carrying capacity per vessel increased by 165x122 about 20,000 metric tons per vessel call. Huge impact on supply chain.			More accurate bathymetric data will lead to lower safety margins at every level, leading to higher cargo carrying capacity (and more economic trade). Benefits could be in the billions. A good example is the Port of Long Beach where the Very Large Crude Carrier (VLCC) draft was increased by 4 feet after better bathymetric measurements and associated Dynamic Under Keel Clearance (UKC) (No dredging) for the VLCCs, and the carrying capacity per vessel increased by 165x122 about 20,000 metric tons per vessel call. Signficant impact on supply chain.			More accurate bathymetric data will lead to lower safety margins at every level, leading to higher cargo carrying capacity (and more economic trade). Benefits could be in the billions. Significance to Wind Farm industry as well.		
Mission-driven performance improvements				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Value added to products or services description										Significance to Wind Farm industry.		
Improved response or timeliness				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved customer experience				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach				Moderate			Minor			Moderate		
Environmental				Major			Major			Major		
Environmental description				1) Decreases the incidence of incidents and associated accidental pollution due to lack of accurate bathymetric data, where vessels either divert into dangerous zones or unknowingly hit underwater objects. 2) Fewer diversions made to deeper water routes due to lack of accurate bathymetric data - more distance - more emissions! 3) Better bathymetric data also leads to a lower level of standby of equipment and power.			1) Decreases the incidence of incidents and associated accidental pollution due to lack of accurate bathymetric data, where vessels either divert into dangerous zones or unknowingly hit underwater objects. 2) Fewer diversions made to deeper water routes due to lack of accurate bathymetric data - more distance - more emissions! 3) Better bathymetric data also leads to a lower level of standby of equipment and power.			1) Decreases the incidence of incidents and associated accidental pollution due to lack of accurate bathymetric data, where vessels either divert into dangerous zones or unknowingly hit underwater objects. 2) Fewer diversions made to deeper water routes due to lack of accurate bathymetric data - more distance - more emissions! 3) Better bathymetric data also leads to a lower level of standby of equipment and power.		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Public safety, including life and property		Major	Major	Major
Public safety, including life and property description			1) Fewer accidents due to groundings and collisions/allisions. 2) Reduces fatigue for watchkeeping seafarers, as avoids unnecessary additional manning and standby. 3) Better rested crew - happier crew - higher performance. 4) Focus and targeted resources on actual bottle necks rather than perceived bottlenecks due to lack of data.	1) Fewer accidents due to groundings and collisions/allisions. 2) Reduces fatigue for watchkeeping seafarers, as avoids unnecessary additional manning and standby. 3) Better rested crew - happier crew - higher performance. 4) Focus and targeted resources on actual bottle necks rather than perceived bottlenecks due to lack of data.

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Esri

Esri is the world leader in GIS software development. Esri's GIS tools are used worldwide by users to understand our world and our impact on it. The Living Atlas is the world's largest collection of geospatial information and is comprised of content that includes XYZ from authoritative sources and is used as reference material for context with other data. Esri and its partners curate and prepare data layers that can be easily integrated into GIS workflows and combined with other sources. Additional Esri tools help users provide analytical results that are used by decision makers across government, commercial, academic, and non-profit clients around the world.

Included in the Living Atlas are numerous elevation data layers that include topography and bathymetry worldwide at differing resolutions. Having seamless datasets that can be delivered and used in an on-demand cloud-based environment will better support future workflows.

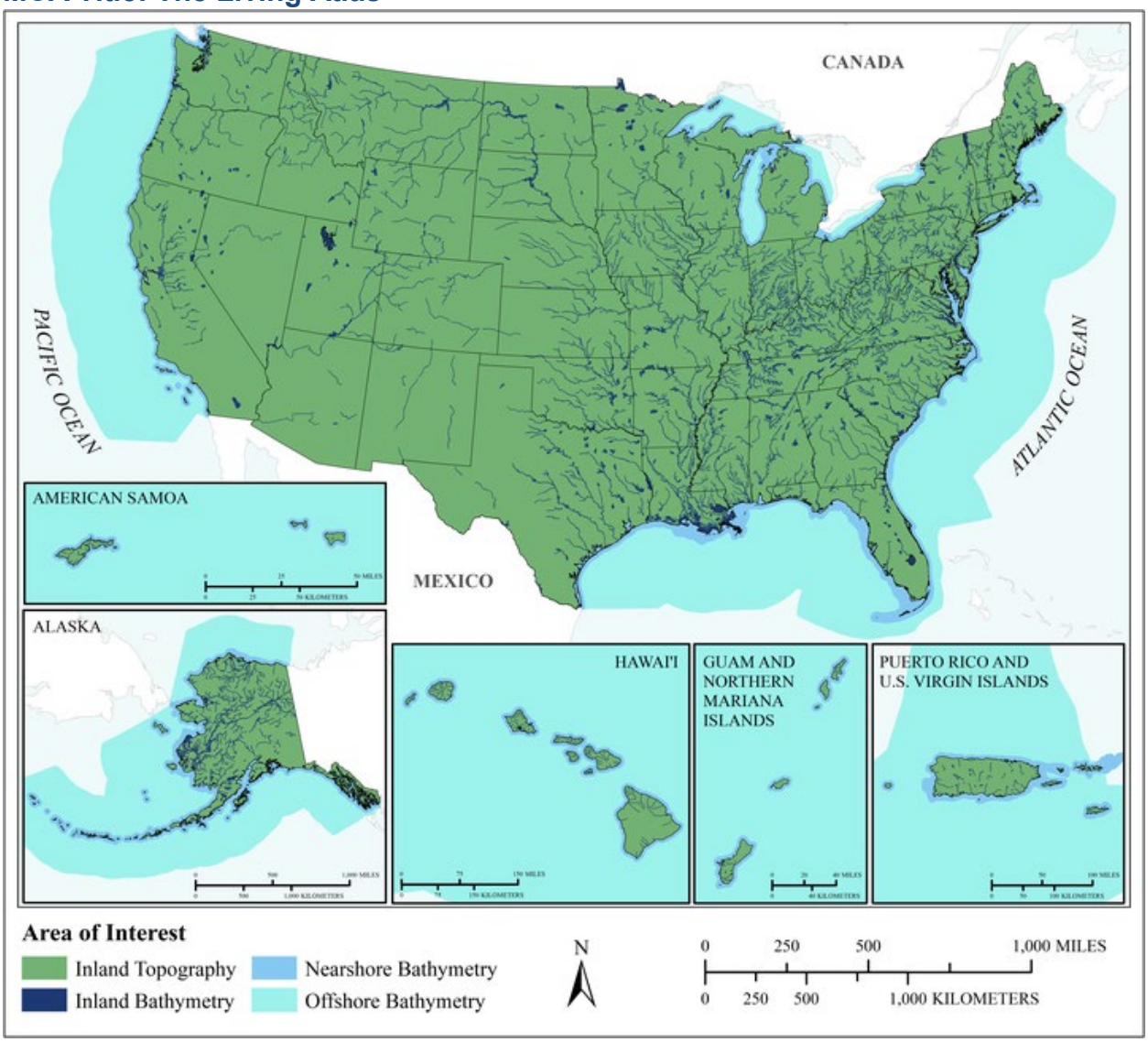
While unable to quantify the future annual benefits of enhanced elevation data, Esri noted that the realized value will be in the markets that use GIS tools and data, such as the accuracy of Federal Emergency Management Agency (FEMA) floodplain maps, the storm surge modeling of National Weather Service (NWS), and the habitat analysis of the U.S. Geological Survey (USGS), National Marine Fisheries Service (NMFS), and the National Center for Coastal Ocean Science (NCCOS) as they relate to coastal and riverine fisheries. All of these will have immediate improvement from higher-accuracy and -resolution observations made easier to share across agencies, academia, and private industry.

Esri has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 15 – Flood Risk Management	Esri	22048	The Living Atlas	Inland Topo	QL2	Annually	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Inland Bathy	QL1B	Annually	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Nearshore Bathy	QL0B	Annually	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Offshore Bathy	Order 2	6-10 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate

MCA Title: The Living Atlas



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	States and/or Territories	States and/or Territories	All study waters	All study waters
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau		

MCA Description	Response
Mission Critical Activity	The Living Atlas is comprised of content that includes XYZ from authoritative sources and is used as reference material for context of other data. Our tools can be used to combine Living Atlas elevation with other sources, such as DEPARE from navigational charts or topographic maps. Additional tools provide analytical results to decision makers across government, commercial, academic, and non-profit clients around the world. All BUs below are impacted by our tools and require authoritative data. Seeing changes to land use/land cover helps users understand impacts to all Business Uses; change detection helps users understand all issues.
MCA Title	The Living Atlas
MCA ID	22048
Organization Type	Private or Commercial
Organization Name	Esri
Sub-Agency or Division	
Organization Mission	Software development to create tools for understanding our world and our impact on it.
Program Name	ArcGIS
Total Annual Program Budget	
Primary Business Use	BU 15 - Flood Risk Management
Secondary Business Use	BU 26 - Education K12 and Beyond, Basic Research
Tertiary Business Use	BU 23 - Urban and Regional Planning

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Required
Subcanopy of vegetation/understory	Required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Roof structure, navigational rock (awash, etc.), and street furniture. Reefs, ecological and cultural features, wrecks, submerged human remnants, objects of 10m size, and smokers and seeps. Offshore cadastre is very important as well.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Required

Inland Bathy Feature Size Requirements	Response
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL1B	QL0B	Order 2
Update Frequency	Annually	Annually	Annually	6-10 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter	Up to 2 meters	The best horizontal accuracy achievable for the vertical accuracy I need	Up to 20 meters
Acceptable Vertical Error	Up to 20 cm	Up to 30 cm	Less than 10 cm	Up to 2 meters
How far onshore needed			To cover the coastal uplands	
How far down the beach profile needed	To MLLW		Below MLLW	
Tide correction requirement			MLLW	No requirement for tide correction
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Required
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Required	
Temporal Seamlessness						
Entire AOI in same acquisition season	Not required	Not required	Not required	Not required	Not required	Not required
Entire AOI under same environmental conditions	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Not required	Not required	Highly desirable	Not required	Not required	Not required
DEM for entire AOI needs to be seamless	Required	Required	Required	Required	Required	Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness	30 cm	Up to double the required TVU at the 95% confidence level	Information products should be created that provide the seamlessness at double TVU (95%) while honoring original observations (don't lose the original measurement in point cloud, etc.)	Up to double the required TVU at the 95% confidence level	Up to double the required TVU at the 95% confidence level	Up to double the required TVU at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Required	Required	Required
DTM	Highly desirable	Highly desirable	Highly desirable	Highly desirable
DEM	Required	Required	Required	Required
Raw point cloud data	Required	Required	Required	Required
Classified point cloud	Required	Required	Required	
Edited/cube XYZ		Highly desirable	Highly desirable	Highly desirable
Full waveform	Highly desirable	Highly desirable	Highly desirable	Highly desirable

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Bathymetric Attributed Grid (BAG)		Required	Required	Required
Breaklines required for standard hydro-flattening	Required	Required		
Additional breaklines for hydro-enforcement of culverts	Required			
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Highly desirable	Highly desirable
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Highly desirable
Intensity imagery/sidescan imagery	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Ground control/ground truthing	Required	Required	Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	Highly desirable
Nautical and/or navigation charts			Highly desirable	Highly desirable
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Underwater videography			Highly desirable	Highly desirable
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Highly desirable	Highly desirable
Geologic and seismic data	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Water column properties - Physical			Highly desirable	Highly desirable
Water column properties - Chemical			Highly desirable	Highly desirable
Water column properties - Biological			Highly desirable	Highly desirable
Currents			Highly desirable	Highly desirable
Tide/wave heights			Highly desirable	Highly desirable
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Highly desirable	Highly desirable
Boundaries			Required	Required
Routes			Required	Required
Offshore cadastral			Required	Required
Lease areas			Required	Required
Fixed obstructions			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Floating observation/navigation systems			Highly desirable	Highly desirable
Shorelines – current, historic, change rates	Required	Required	Required	
Land use/land cover	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Wetlands	Required	Required	Required	Required
Estuaries			Highly desirable	Highly desirable
Inland surface water features	Highly desirable	Highly desirable	Highly desirable	
Bridges/culverts	Required	Required		
Landmark features	Highly desirable	Highly desirable	Highly desirable	
Cultural resources	Highly desirable	Highly desirable	Highly desirable	
Coastal and riverine structures	Highly desirable	Highly desirable	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available	Best available	NCEI bathymetry archive, Digital Coast, and other hydrographic data from USACE and private industry	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes	Yes	Yes	Yes
NCEI	Yes	Yes	Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes	Yes	Yes
USGS Inland Waters server		Yes		
USGS data series		Yes		
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Other			Yes	
Other description			NRCS NAIS coastwise	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Minor	Minor	Major	Minor
Cost savings/cost reduction	None	None	Major	None
Cost avoidance	None	None	Major	None
Increased revenues	I don't know	I don't know	I don't know	I don't know
Mission-driven performance improvements	Minor	Minor	Minor	Minor
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Moderate	Moderate	Moderate
Improved response or timeliness	I don't know	I don't know	Major	I don't know
Improved customer experience	Moderate	Moderate	Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major	Major	Major	Major
Environmental	I don't know	I don't know	Major	I don't know
Public safety, including life and property	I don't know	I don't know	Major	I don't know

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide		I don't know	Unable to provide		Major	Unable to provide		I don't know	Unable to provide	
Time savings description							Typically would be performed by business partners. Very dependent on end user information product requirements that would drive tool development.					
Cost savings/cost reduction	I don't know	Unable to provide		I don't know	Unable to provide		Minor	Unable to provide		I don't know	Unable to provide	
Cost savings/cost reduction description							Primarily business partners perform this function.					
Cost avoidance	Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide	
Cost avoidance description	Customers have confidence in curated datasets, customers come to Esri for data.			Customers have confidence in curated datasets, customers come to Esri for data.			Customers have confidence in curated datasets, customers come to Esri for data.			Customers have confidence in curated datasets, customers come to Esri for data.		
Increased revenues	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Increased revenues description	Likely increase in value of tools that leverage high-resolution data.			Likely increase in value of tools that leverage high-resolution data.			Likely increase in value of tools that leverage high-resolution nearshore data.			Likely increase in value of tools that leverage high-resolution data.		
Mission-driven performance improvements	Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide	
Mission-driven performance improvements description	Improvements in tools if data were widely available.			Improvements in tools if data were widely available.			Improvements in tools if data were widely available, similar to value of ENCs.			Improvements in tools if data were widely available.		
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Value added to products or services description	Coastal inundation model improvement. Business partner enablement would improve (small business program).			Coastal inundation model improvement. Business partner enablement would improve (small business program).			Coastal inundation model improvement. Business partner enablement would improve (small business program).			Coastal inundation model improvement. Business partner enablement would improve (small business program).		
Improved response or timeliness	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Improved response or timeliness description	Analysis could leverage cloud-based decision support services. Could leverage cloud-based decision support services.			Analysis could leverage cloud-based decision support services. Could leverage cloud-based decision support services.			Analysis could leverage cloud-based decision support services. Could leverage cloud-based decision support services.			Analysis could leverage cloud-based decision support services. Could leverage cloud-based decision support services.		
Improved customer experience	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved customer experience description	Many industries or sectors would see improved requirements discovered/realized. Very dependent upon modality of sharing - services-based would be much better, rather than data-download. Confidence is difficult to measure, likely to improve.			Many industries or sectors would see improved requirements discovered/realized. Very dependent upon modality of sharing - services-based would be much better, rather than data-download. Confidence is difficult to measure, likely to improve.			Many industries or sectors would see improved requirements discovered/realized. Very dependent upon modality of sharing - services-based would be much better, rather than data-download. Confidence is difficult to measure, likely to improve.			Many industries or sectors would see improved requirements discovered/realized. Very dependent upon modality of sharing - services-based would be much better, rather than data-download. Confidence is difficult to measure, likely to improve.		
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate			Moderate			Moderate			Moderate		
Education or outreach description	Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized		
Environmental	Moderate			Moderate			Moderate			Moderate		
Environmental description	Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized			Many industries or sectors would see improved requirements discovered/realized		
Public safety, including life and property	Moderate			Moderate			Moderate			Moderate		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Public safety, including life and property description	Many industries or sectors would see improved requirements discovered/realized	Many industries or sectors would see improved requirements discovered/realized	Many industries or sectors would see improved requirements discovered/realized	Many industries or sectors would see improved requirements discovered/realized

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes	Yes	Yes
Contours	Yes	Yes	Yes	Yes
Hillshades	Yes	Yes	Yes	Yes
Slope maps	Yes	Yes	Yes	Yes
Aspect maps	Yes	Yes	Yes	Yes
Curvature maps	Yes	Yes	Yes	Yes
Cross sections	Yes	Yes	Yes	Yes
Height-Above-Ground maps	Yes	Yes	Yes	Yes
Viewshed maps	Yes	Yes	Yes	Yes
Hydrologic Flow Direction Grids	Yes	Yes	Yes	Yes
Hydrologic Flow Accumulation Grids	Yes	Yes	Yes	Yes
Hydrologic networks (e.g. streams, lakes)	Yes	Yes	Yes	Yes
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes	Yes	Yes
Building footprints	Yes	Yes	Yes	Yes
Breaklines for road edge-of-pavement	Yes	Yes	Yes	Yes
Rugosity/Surface Roughness	Yes	Yes	Yes	Yes

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	1
Update frequency	3

Fugro

Fugro collects and analyzes comprehensive geospatial information about the Earth and the structures built upon it. Through integrated data acquisition, analysis, and advice, Fugro uses spatial data to help clients design, build, and operate their assets in a safe, sustainable, and efficient manner.

Fugro's mission is to contribute to a safe, resilient, and livable world by being providing reliable and efficient geo-intelligence and asset integrity solutions. These are critical to the sustainable development of natural resources and sustainable construction and operation of facilities and critical infrastructure.

Elevation data are used for land and marine-based airborne / terrestrial surveying and remote monitoring services to help clients manage hazards, natural resources, infrastructure, and other critical resources more efficiently. Data are also used for:

- oil and gas exploration and production;
- pipeline and route selection;
- facility siting to mitigate geologic hazards;
- construction planning;
- environmental impact assessment and mitigation;
- regulatory compliance;
- nautical charting;
- bathymetric measurements of nearshore submerged coastal topography;
- sediment management at coastal navigation projects;
- precision marine navigation;
- movement of goods and fishing vessels;
- alternate energy development including solar, tidal, wind, wave, and ocean current;
- analysis of coastal erosion and inundation;
- hurricane storm surge and wind damage modeling and assessment;
- coastal hazard modeling, mapping, and mitigation;
- onshore or offshore mineral extraction; and
- environmental impact assessment and site restoration.

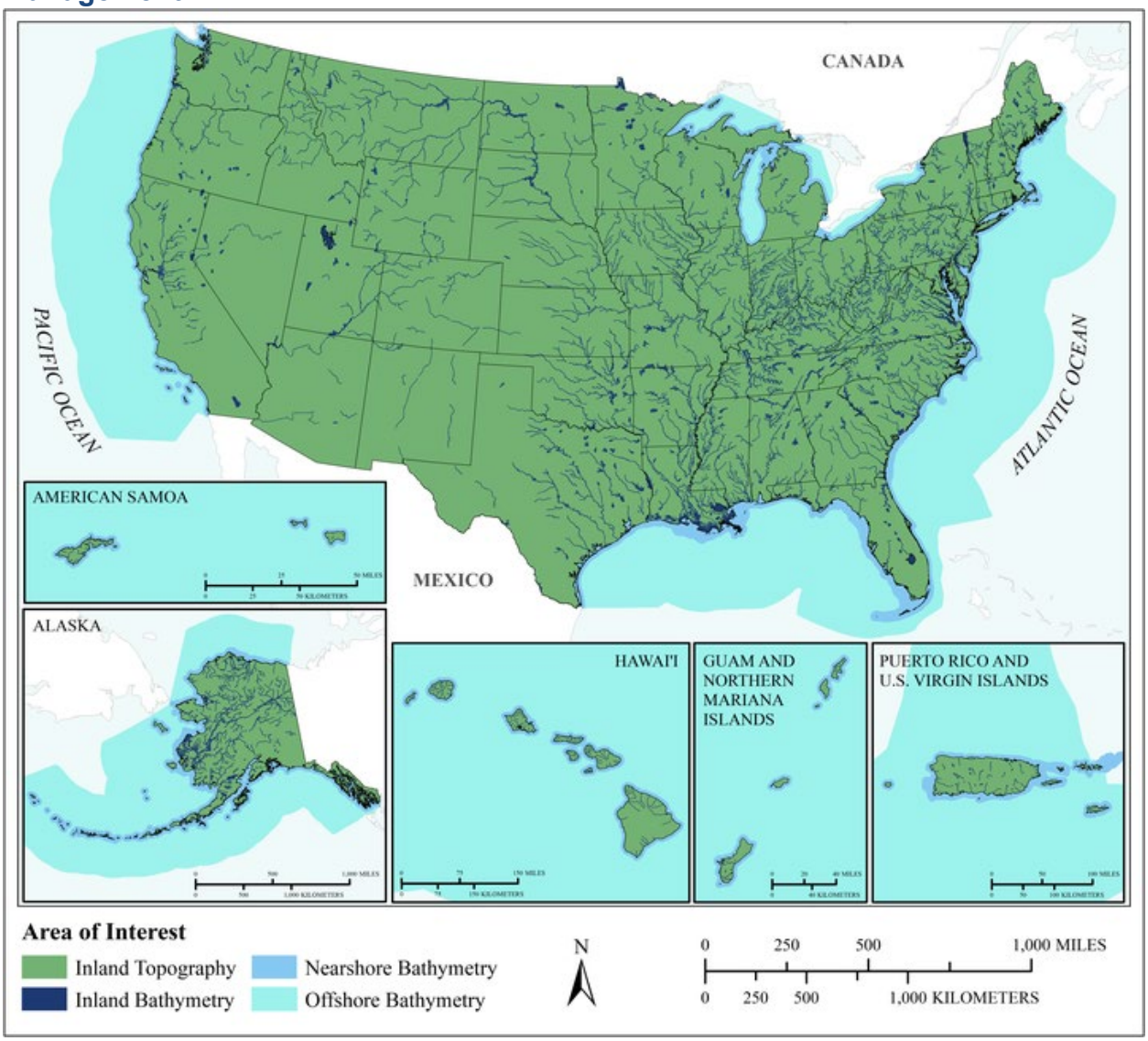
Fugro has identified Business Uses and Mission Critical Activities that rely on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 15 – Flood Risk Management	Fugro	21802	Hazard, Natural Resources, Infrastructure, and Critical Resource Management	Inland Topo	QL2	2-3 years	Unable to quantify	Unable to quantify	Moderate	Major	Major
				Inland Bathy	QL2B	This depends on the area. For areas where bathymetry changes frequently, then the frequency of updates should be greater than the in areas where bathymetry is stable and does not change frequently	Unable to quantify	Unable to quantify	Moderate	Moderate	Major
				Nearshore Bathy	QL2B	This is variable and depends on the frequency that bathymetry changes. Where bathymetry changes frequently, updates should occur more frequently than areas where bathymetry is stable and changes less frequently	Unable to quantify	Unable to quantify	Moderate	Moderate	Major
				Offshore Bathy	Order 2	Event driven	Unable to quantify	Unable to quantify	Moderate	Moderate	Major

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Fugro	21796	Data Acquisition and Analysis of the Coastal Zone, Sea Surface, and Seafloor for Multiple Disciplines	Inland Topo	QL2	2-3 years	$1,399,990	$394,965	Minor	Minor	Minor
				Inland Bathy	QL0B	2-3 years	$763,113	$741,200	Minor	Minor	Minor
				Nearshore Bathy	QL0B	2-3 years	$654,066	$151,956	Minor	Minor	Minor
				Offshore Bathy	Per IHO Standards for Hydrographic Surveys (S-44) Edition 5	This is variable and depends on the frequency that bathymetry changes. Where bathymetry changes frequently, updates should occur more frequently than areas where bathymetry is stable and changes less frequently. Generally speaking areas >40m water depth do not need to be updated frequently.	$1,128,391	$283,410	Minor	Minor	Minor

MCA Title: Hazard, Natural Resources, Infrastructure, and Critical Resource Management



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	States and/or Territories	States and/or Territories	All study waters	All study waters
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau		

MCA Description	Response
Mission Critical Activity	Land and marine-based airborne / terrestrial surveying and remote monitoring services to help clients manage hazards, natural resources, infrastructure, and other critical resources more efficiently.
MCA Title	Hazard, Natural Resources, Infrastructure, and Critical Resource Management
MCA ID	21802
Organization Type	Private or Commercial
Organization Name	Fugro
Sub-Agency or Division	USA
Organization Mission	To contribute to a safe, resilient, and livable world by being providing reliable and efficient geo-intelligence and asset integrity solutions. These are critical to the sustainable development of natural resources and sustainable construction and operation of facilities and critical infrastructure.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 15 - Flood Risk Management
Secondary Business Use	BU 23 - Urban and Regional Planning
Tertiary Business Use	BU 22 - Infrastructure and Construction Management

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Highly desirable
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1,000 sq mi - 24,999 sq mi (e.g. large county, small state, intrastate region [e.g. a multi-county region such as the San Francisco Bay Area, Tri-County Council, etc.])
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	2m cube in nearshore and ocean environments (<40m water depth)

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Highly desirable
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required

Inland Bathy Feature Size Requirements	Response
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Highly desirable
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL2B	QL2B	Order 2
Update Frequency	2-3 years	This depends on the area. For areas where bathymetry changes frequently, then the frequency of updates should be greater than the in areas where bathymetry is stable and does not change frequently	This is variable and depends on the frequency that bathymetry changes. Where bathymetry changes frequently, updates should occur more frequently than areas where bathymetry is stable and changes less frequently	Event driven only – Data need to coincide with a specific event.
Event type(s)				A change in bathymetry. Where bathymetry changes frequently, updates should occur more frequently than areas where bathymetry is stable and changes less frequently. Generally speaking areas >40m water depth do not need to be updated frequently.
Quality Level and/or update frequency variability across AOI				IHO Order changes with depth. Update frequency changes with depth. Data need to follow IHO Standards for Hydrographic Surveys (S-44) Edition 5 per applicable depth.
Acceptable Horizontal Error	Up to 1 meter	Up to 2 meters	Up to 5 meters	Up to 20 meters
Acceptable Vertical Error	Up to 20 cm	Up to 30 cm	Up to 50 cm	Up to 2 meters

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far onshore needed			To the fall line	
How far down the beach profile needed	To MLLW		To MLLW	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
Entire AOI under same environmental conditions	Required	Highly desirable	Highly desirable		Highly desirable	Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Highly desirable	Highly desirable		Highly desirable	Highly desirable
DEM for entire AOI needs to be seamless	Highly desirable	Highly desirable	Highly desirable		Highly desirable	Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Variable based on project location.	This should be variable, with the goal to be as small as possible, but allowing greater tolerance, as required	This should be variable, with the goal to be as small as possible, but allowing greater tolerance, as required		This should be variable, with the goal to be as small as possible, but allowing greater tolerance, as required	This should be variable, with the goal to be as small as possible, but allowing greater tolerance, as required

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Required	Required	Required
DTM	Highly desirable	Required	Required	Required
DEM	Required	Required	Required	Required
Raw point cloud data	Nice to have	Highly desirable	Highly desirable	Highly desirable
Classified point cloud	Required	Highly desirable	Highly desirable	
Edited/cube XYZ		Required	Required	Required
Full waveform	Nice to have	Nice to have	Nice to have	Not required
Bathymetric Attributed Grid (BAG)		Highly desirable	Highly desirable	Highly desirable
Breaklines required for standard hydro-flattening	Required	Highly desirable		

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Additional breaklines for hydro-enforcement of culverts	Highly desirable			
National Vertical Datum Transformation Tool (V-Datum)			Required	Required
Tide Predictions			Highly desirable	Highly desirable
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Highly desirable
Intensity imagery/sidescan imagery	Required	Highly desirable	Highly desirable	Highly desirable
Ground control/ground truthing	Required	Highly desirable	Highly desirable	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Highly desirable	Required
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery	Nice to have	Highly desirable	Highly desirable	Highly desirable
Underwater videography			Nice to have	Nice to have
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Nice to have	Nice to have
Geologic and seismic data	Nice to have	Highly desirable	Nice to have	Nice to have
Water column properties - Physical			Nice to have	Nice to have
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Nice to have	Nice to have
Currents			Highly desirable	Highly desirable
Tide/wave heights			Highly desirable	Highly desirable
Sea ice conditions			Nice to have	Nice to have
Habitat distribution and classification			Highly desirable	Highly desirable
Boundaries			Highly desirable	Highly desirable
Routes			Highly desirable	Highly desirable
Offshore cadastral			Nice to have	Nice to have
Lease areas			Nice to have	Nice to have
Fixed obstructions			Highly desirable	Highly desirable
Floating observation/navigation systems			Highly desirable	Highly desirable
Shorelines – current, historic, change rates	Highly desirable	Highly desirable	Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Land use/land cover	Highly desirable	Nice to have	Nice to have	Not required
Wetlands	Highly desirable	Nice to have	Nice to have	Not required
Estuaries			Nice to have	Not required
Inland surface water features	Required	Nice to have	Nice to have	
Bridges/culverts	Highly desirable	Nice to have		
Landmark features	Nice to have	Nice to have	Nice to have	
Cultural resources	Nice to have	Nice to have	Nice to have	
Coastal and riverine structures	Highly desirable	Nice to have	Nice to have	
Overhead structures			Nice to have	
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available	Best available	Best available	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes	Yes	Yes	Yes
NCEI		Yes	Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				Yes
State Repositories	Yes			
State repositories used	Varies based on regional program requirements.			
Other			Yes	Yes
Other description			GEBCO / Seabed 2030 / United Nations Decade of Ocean Science for Sustainable Development	GEBCO / Seabed 2030 / United Nations Decade of Ocean Science for Sustainable Development
Data that meet my needs are not available				

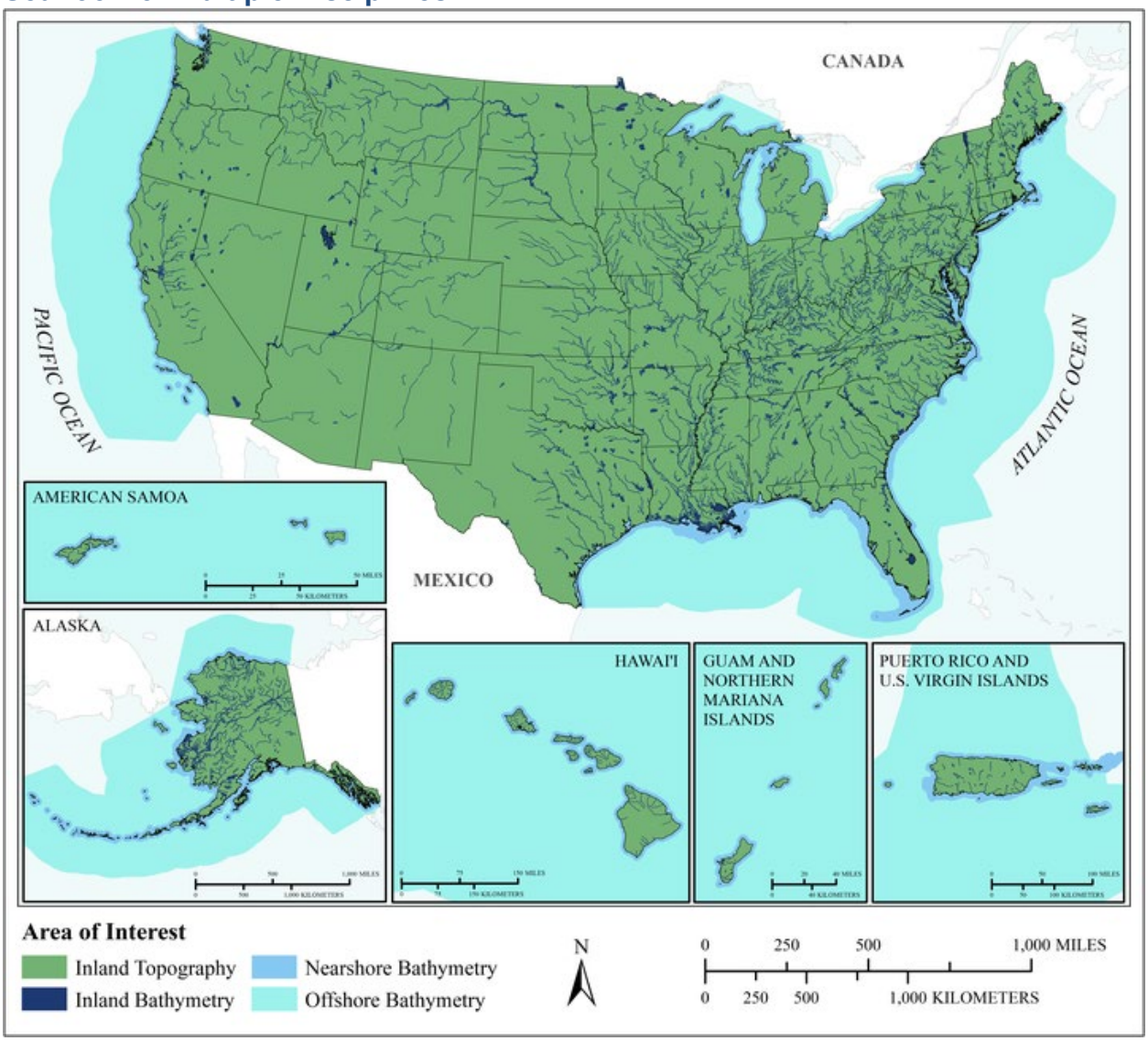
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Major	Major	Major
Cost savings/cost reduction	Major	Moderate	Moderate	Moderate
Cost avoidance	Moderate	Moderate	Moderate	Moderate
Increased revenues	Moderate	Moderate	Moderate	Moderate
Mission-driven performance improvements	Major	Moderate	Moderate	Moderate
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Moderate	Moderate	Moderate
Improved response or timeliness	Major	Moderate	Moderate	Moderate
Improved customer experience	Moderate	Moderate	Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	Minor	Minor	Moderate
Environmental	Major	Moderate	Moderate	Moderate
Public safety, including life and property	Major	Moderate	Moderate	Moderate

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost avoidance	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Increased revenues	Moderate	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Mission-driven performance improvements	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved response or timeliness	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved customer experience	Major	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate			Moderate			Moderate			Moderate		
Environmental	Major			Moderate			Moderate			Moderate		
Public safety, including life and property	Major			Major			Major			Major		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes	Yes	Yes
Contours	Yes	Yes	Yes	Yes
Hillshades	Yes	Yes	Yes	Yes
Slope maps	Yes	Yes	Yes	Yes
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections				
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids	Yes	Yes		
Hydrologic Flow Accumulation Grids	Yes	Yes		
Hydrologic networks (e.g. streams, lakes)	Yes	Yes		
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes		
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes	Yes	Yes	Yes

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Data Acquisition and Analysis of the Coastal Zone, Sea Surface, and Seafloor for Multiple Disciplines



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	States and/or Territories	States and/or Territories	All study waters	All study waters
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau		

MCA Description	Response
Mission Critical Activity	Oil and gas exploration and production. Pipeline and route selection. Facility siting to mitigate geologic hazards. Construction planning. Environmental impact assessment and mitigation. Regulatory compliance. Nautical charting. Bathymetric measurements of nearshore submerged coastal topography. Identification of hazards to navigation. Sediment management at coastal navigation projects. Precision marine navigation. Movement of goods and fishing vessels Alternate energy development solar, tidal, wind, wave, and ocean current. Analysis of coastal erosion and inundation. Hurricane storm surge and wind damage modeling and assessment. Coastal hazard modeling and mapping. Coastal hazard mitigation. Tsunami modeling. Onshore or offshore mineral extraction. Environmental impact assessment and site restoration.
MCA Title	Data Acquisition and Analysis of the Coastal Zone, Sea Surface, and Seafloor for Multiple Disciplines
MCA ID	21796
Organization Type	Private or Commercial
Organization Name	Fugro
Sub-Agency or Division	USA
Organization Mission	Fugro maps and measure the earth's surface. Fugro provide services to acquire, analyze and advise on studies and projects, on land, within the coastal zone, on the sea surface or the seafloor. This includes geologic, geotechnical, geophysical, hydrographic, oceanographic, meteorological, geospatial and related technologies and disciplines.
Program Name	NOAA NOS OCS Charting Updates
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	BU 03 - Coastal Zone Management
Tertiary Business Use	BU 13 - Oil and Gas Resources

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1,000 sq mi - 24,999 sq mi (e.g. large county, small state, intrastate region [e.g. a multi-county region such as the San Francisco Bay Area, Tri-County Council, etc.])
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	<1 meter cube

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required

Inland Bathy Feature Size Requirements	Response
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Nice to have
51 - 100 ft	Nice to have
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Nice to have
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL0B	QL0B	Per IHO Standards for Hydrographic Surveys (S-44) Edition 5
Update Frequency	2-3 years	2-3 years	2-3 years	This is variable and depends on the frequency that bathymetry changes. Where bathymetry changes frequently, updates should occur more frequently than areas where bathymetry is stable and changes less frequently. Generally speaking areas >40m water depth do not need to be updated frequently.
Event type(s)				
Quality Level and/or update frequency variability across AOI				IHO Order changes with depth. Update frequency changes with depth,
Acceptable Horizontal Error	Up to 30 cm	Less than 50 cm	Less than 50 cm	Per IHO Standards for Hydrographic Surveys (S-44) Edition 5
Acceptable Vertical Error	Up to 20 cm	Up to 20 cm	Up to 20 cm	Per IHO Standards for Hydrographic Surveys (S-44) Edition 5
How far onshore needed			500 meters inland	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far down the beach profile needed	Below MLLW		Below MLLW	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs		Partial		
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Nice to have

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Not required	Not required	Not required	Required	Highly desirable	Nice to have
Entire AOI under same environmental conditions	Highly desirable	Highly desirable	Required	Required	Highly desirable	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Highly desirable	Required	Required	Highly desirable	Required
DEM for entire AOI needs to be seamless	Highly desirable	Highly desirable	Required	Required	Highly desirable	Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Required	Highly desirable	Required
DTM	Highly desirable	Required	Highly desirable	Required
DEM	Required	Required	Highly desirable	Required
Raw point cloud data	Highly desirable	Required	Highly desirable	Required
Classified point cloud	Highly desirable	Highly desirable	Highly desirable	
Edited/cube XYZ		Highly desirable	Nice to have	Highly desirable
Full waveform	Highly desirable	Highly desirable	Nice to have	Highly desirable
Bathymetric Attributed Grid (BAG)		Highly desirable	Nice to have	Highly desirable

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Highly desirable	Highly desirable		
Additional breaklines for hydro-enforcement of culverts	Highly desirable			
National Vertical Datum Transformation Tool (V-Datum)			Nice to have	Highly desirable
Tide Predictions			Required	Required
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	Highly desirable
Intensity imagery/sidescan imagery	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Ground control/ground truthing	Highly desirable	Highly desirable	Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Highly desirable	Required
Aerial and/or satellite imagery	Nice to have	Highly desirable	Highly desirable	Highly desirable
Underwater videography			Nice to have	Nice to have
Bottom texture			Highly desirable	Nice to have
Bottom type			Required	Required
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Highly desirable	Required
Geologic and seismic data	Highly desirable	Highly desirable	Required	Required
Water column properties - Physical			Highly desirable	Nice to have
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Nice to have	Required
Currents			Required	Required
Tide/wave heights			Required	Required
Sea ice conditions			Required	Highly desirable
Habitat distribution and classification			Required	Required
Boundaries			Required	Required
Routes			Required	Required
Offshore cadastral			Required	Required
Lease areas			Required	Required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Required	Highly desirable	Required	
Land use/land cover	Nice to have	Highly desirable	Nice to have	Nice to have
Wetlands	Required	Highly desirable	Highly desirable	Highly desirable
Estuaries			Highly desirable	Highly desirable
Inland surface water features	Nice to have	Highly desirable	Nice to have	
Bridges/culverts	Nice to have	Not required		
Landmark features	Not required	Not required	Nice to have	
Cultural resources	Not required	Not required	Nice to have	
Coastal and riverine structures	Highly desirable	Required	Highly desirable	
Overhead structures			Nice to have	
Lowest Floor Elevation of Buildings	Nice to have			
Other	Required			
Other description	Seamless integration between hydrographic soundings and topograhic elevations			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available	Best available	Best available	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes	Yes	Yes	Yes
NCEI	Yes	Yes	Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes	Yes	Yes
USGS Inland Waters server		Yes		
USGS data series				
Marine Minerals Program GIS			Yes	Yes
State Repositories				
State repositories used				
Data that meet my needs are not available				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	Major	Major	Major
Cost savings/cost reduction	Major	Major	Major	Major
Cost avoidance	Major	Moderate	Major	Major
Increased revenues	Major	Major	Major	Major
Mission-driven performance improvements	Major	Major	Major	Major
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Major	Major	Major
Improved response or timeliness	Major	Major	Major	Major
Improved customer experience	Major	Major	Major	Major
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	Moderate	Minor	Minor
Environmental	Moderate	Moderate	Minor	Minor
Public safety, including life and property	Moderate	Moderate	Minor	Minor

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Annual dollars saved/realized	$198,990	Major	Annual dollars saved/realized	$163,112	Major	Annual dollars saved/realized	$148,036	Major	Annual dollars saved/realized	$438,381
Cost savings/cost reduction	Major	Annual dollars saved/realized	$1,000,000	Major	Annual dollars saved/realized	$500,000	Major	Annual dollars saved/realized	$501,000	Major	Annual dollars saved/realized	$500,000
Cost avoidance	Moderate	Annual dollars saved/realized	$101,000	Moderate	Annual dollars saved/realized	$100,002	Minor	Annual dollars saved/realized	$2,030	Major	Annual dollars saved/realized	$160,010
Increased revenues	Moderate	Annual dollars saved/realized	$100,000	None			Minor	Annual dollars saved/realized	$3,000	Moderate	Annual dollars saved/realized	$30,000
Mission-driven performance improvements	Major	Annual percent improvement	10%	Major	Annual percent improvement	10%	Major	Annual percent improvement	10%	Major	Annual percent improvement	10%
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Annual dollars saved/realized	$60,300	Moderate	Annual dollars saved/realized	$18,090	Moderate	Annual dollars saved/realized	$6,030	Moderate	Annual dollars saved/realized	$6,030
Improved response or timeliness	Major	Annual dollars saved/realized	$244,215	Major	Annual dollars saved/realized	$132,660	Major	Annual dollars saved/realized	$124,821	Major	Annual dollars saved/realized	$229,140
Improved customer experience	Major	Annual dollars saved/realized	$90,450	Major	Annual dollars saved/realized	$90,450	Moderate	Annual dollars saved/realized	$21,105	Moderate	Annual dollars saved/realized	$48,240
Other customer service benefits				Major	Annual dollars saved/realized	$500,000						
Other customer service benefits description												
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor			Minor			Minor			Minor		
Environmental	Minor			Minor			Minor			Minor		
Public safety, including life and property	Minor			Minor			Minor			Minor		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes	Yes	Yes	Yes
Hillshades	Yes			
Slope maps	Yes	Yes	Yes	Yes
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections		Yes	Yes	Yes
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes			
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes	Yes	Yes	Yes

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1

General Motors

General Motors is one of America's oldest automobile manufacturers founded in 1908 and is headquartered in Detroit, Michigan with 122 facilities in the U.S. General Motors has over 85,000 employees in the U.S. and 155,000 employees worldwide and is the largest American automobile manufacturer. General Motors' vision is a world with zero crashes, zero emissions and zero congestion through the creation of electric, self-driving, connected vehicles and shared mobility services.

Elevation data are used by General Motors to:

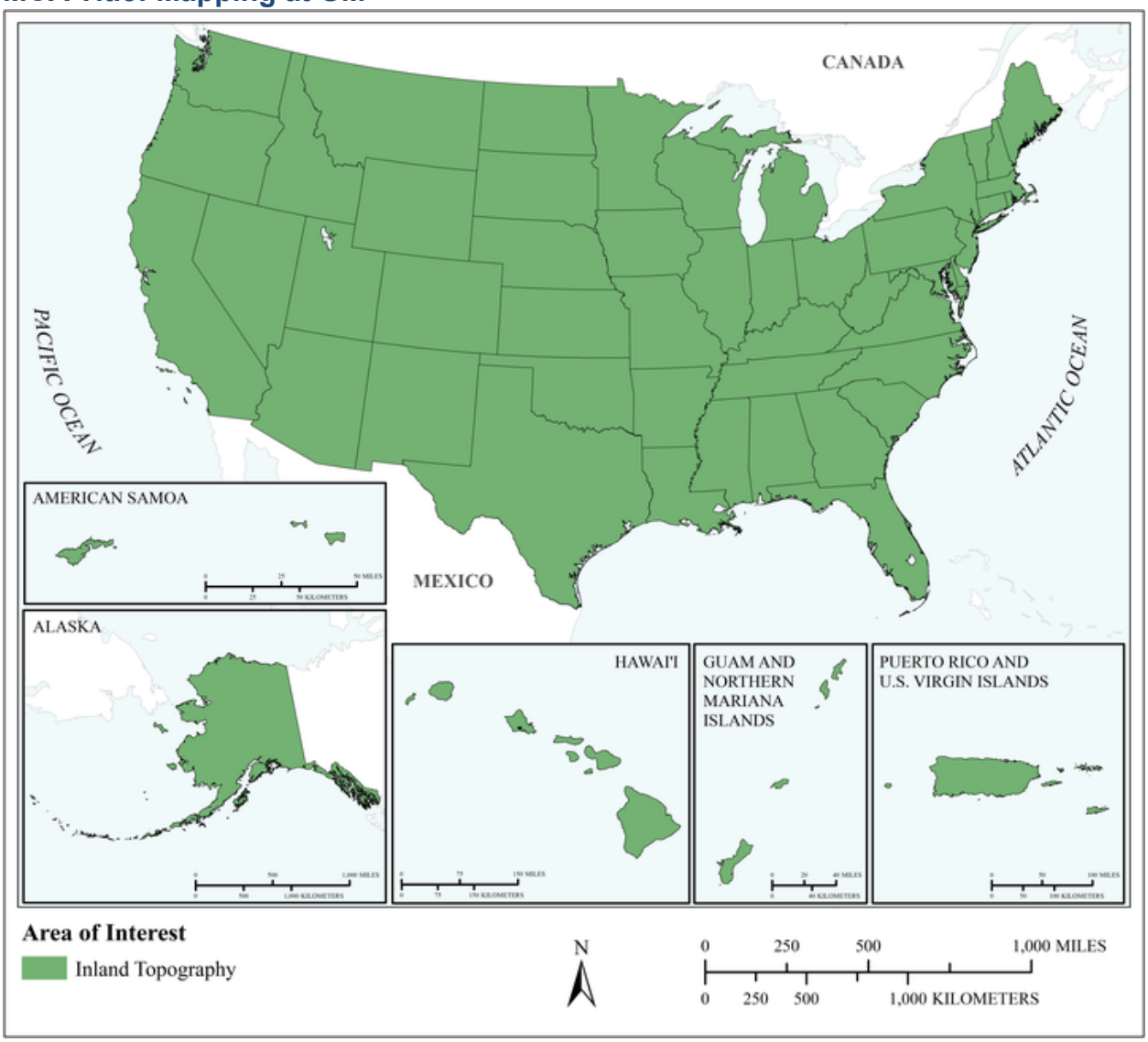
- Map publicly accessible roads and trails (including privately maintained roads and long driveways in campuses, building complexes, and residential communities);
- Build and verify a highly accurate lane-level map of all publicly accessible roads and off-road trails that will support safety and increasing vehicle autonomy; and
- Plan electric vehicle efficiency and convenience, including range estimation, route planning including charging stops, and charging station placement.

General Motors has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 19 – Land Navigation	General Motors	51003	Mapping at GM	Inland Topo	QL1	Annually	$12,931,650	Unable to quantify	None	Moderate	Moderate

MCA Title: Mapping at GM



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Mapping publicly-accessible roads and trails (including privately-maintained roads and long driveways in campuses, building complexes, and residential communities). Build and verify a highly accurate lane-level map of all publicly-accessible roads and off-road trails that will support safety and increasing vehicle autonomy. Electric vehicle efficiency and convenience, including range estimation, route planning including charging stops, charging station placement. Powertrain efficiency and chassis safety (fuel/charge), especially for trailering use cases, including predictive shifting, improved adaptive cruise control, reduced braking on long downslopes. Vehicle-to-Infrastructure data broadcasts at intersections.
MCA Title	Mapping at GM
MCA ID	51003
Organization Type	Private or Commercial
Organization Name	General Motors
Sub-Agency or Division	
Organization Mission	Vehicle manufacturing and services in support of "Zero Crashes, Zero Emissions, and Zero Congestion"
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 19 - Land Navigation and Safety
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	200,000 sq mi - 2 million sq mi (e.g. large state, large multi-state region such as the Great Basin, standard Federal region, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Traffic light, traffic barrier/divider wall, guardrail, gantry, speed hump

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1			
Update Frequency	Annually			
Event type(s)				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level and/or update frequency variability across AOI	Annual or faster preferred for on-road; Every 4 years for off-road trails			
Acceptable Horizontal Error	Up to 80 cm			
Acceptable Vertical Error	Less than 5 cm			
How far onshore needed				
How far down the beach profile needed	Not applicable			
Tide correction requirement				
Cross sections and/or transects meet needs	Partial			
Cross section/transect requirement	IF CROSS SECTIONS USED: Primary section along road with points sampled such that no intermediate point can be found more than 10 cm above or below section line segment connecting given points; perpendicular cross-sections across road located no more than [radius of curvature / 10.0] or 100m, whichever is less and with sample points along each cross section such that no intermediate point could be found more than road and no more than 5 cm above or below cross-section line segment connecting given points			

Hydrologic Processing Required	Response
Hydro-flattening	Not required
Hydro-enforcement	Not required

Hydrologic Processing Required	Response
Hydro-conditioning	Not required
No Treatment	Highly desirable

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Nice to have					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Nice to have					
DEM for entire AOI needs to be seamless	Required					
Other	Required					
Other description	Elevation relative error (difference in absolute error between two points within 100m of each other) less than 5 cm					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to triple the required TVU at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Nice to have			
DEM	Required			
Raw point cloud data	Nice to have			
Classified point cloud	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Nice to have			
Additional breaklines for hydro-enforcement of culverts	Not required			
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Highly desirable			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Not required			
Land use/land cover	Nice to have			
Wetlands	Not required			
Estuaries				
Inland surface water features	Not required			
Bridges/culverts	Required			
Landmark features	Nice to have			
Cultural resources	Nice to have			
Coastal and riverine structures	Not required			
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	3DEP			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	Perhaps in isolated cases			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cost savings/cost reduction	Moderate			
Cost avoidance	Moderate			
Increased revenues	Moderate			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			
Improved response or timeliness	Moderate			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate			
Environmental	Moderate			
Public safety, including life and property	Moderate			
Other Current Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Other	Moderate			
Other description	Helps reduce range anxiety and increase EV adoption; fuel/charge efficiency savings			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Moderate	Annual dollars saved/realized	$331,650									
Time savings description	2 FTE staff members. 1 FTE staff member.											
Cost savings/cost reduction	Minor	Annual dollars saved/realized	$100,000									
Cost savings/cost reduction description	(~1 MB per vehicle per year) vehicle data costs avoided.											
Cost avoidance	Moderate	Unable to provide										
Cost avoidance description	Better warnings of risky maneuvers help avoid accidents.											
Increased revenues	Moderate	Annual dollars saved/realized	$12,500,000									
Increased revenues description	Benefits of new features. (Estimate is based on a $50 industry average cost of an HD Map for an estimated volume of 250K vehicles/per year). Likely to increase over time.											
Mission-driven performance improvements	None											
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide										
Value added to products or services description	Fuel savings. Percent improvement in fuel savings is TBD.											
Improved response or timeliness	None											
Improved customer experience	Moderate	Unable to provide										
Improved customer experience description	Increased electric vehicle adoption and portion of GM sales.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	None											
Environmental	Moderate											
Environmental description	Increased efficiency leads to lower C02 emission (Amount TBD). Moderate benefits in aggregate.											
Public safety, including life and property	Moderate											
Public safety, including life and property description	Life and injury prevention due to better data on elevation and slopes. Better downshifting to manage speed, avoid mechanical failures, warn drivers of higher-risk maneuvers. Goal is zero preventable crashes.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades				
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections	Yes			
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes			
Other (please specify)	Yes			
Other description	Location/elevation of roadway superstructures when elevated above Earth surface.			

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	1
Update frequency	3

Geodynamics

Geodynamics was founded in 2001 by university researchers in marine geology, coastal science, and remote sensing with a goal of using cutting edge technologies to provide data products to support its clients' multidisciplinary needs. Geodynamics' focus is on marine remote sensing, survey, and the science behind it. Geodynamics provides high-resolution hydrographic and coastal survey data primarily as a contractor to the federal government and for large coastal engineering/environmental firms. Elevation data are used for the acquisition of modern marine and coastal data to support a variety of defense, Blue Economy, fisheries and coastal resilience, and cultural resource management objectives. The main practice areas that make use of existing 3D elevation data include the following.

Multibeam Hydrographic Surveys to support:

- Nautical chart updates;
- Naval subsea operations/training;
- Preservation of submerged cultural resources;
- Benthic habitat analysis; and
- Tidal inlet and wave dynamics modeling.

Seamless Topobathy Surveys to support:

- Beach erosion and rapid response post-storm monitoring;
- Beach nourishment design and construction;
- Basin retention for flood plain mapping/risk management; and
- Datum derived shoreline analysis.

Sub-Bottom and High-Resolution Seismic Surveys to support:

- Regional Sediment Management;
- Location of offshore sediment resources; and
- Offshore cable and pipeline burial.

As a 3D elevation data provider, Geodynamics' primary use of publicly available elevation data are generally as follows:

- Bathymetry:
    - Junction analysis/chart comparison to quality assure (QA) newly acquired bathymetric data; and
    - Mission/project planning.
- Lidar Derived Topography:
    - Topographic survey QA "reality checks" from recent data on non-changing surfaces; and
    - Mission/project planning.
- Center for Operational Oceanographic Products National Water Level Observation Network:
    - Hydrographic survey tidal elevation QA analysis;
    - "Reality checks" on project datum separation; and
    - Mission/project planning.
- National Geodetic Survey (NGS) Benchmarks & National Ocean Service (NOS) Vertical Datum (VDatum):

- Transformation of North American Vertical Datum of 1988 (NAVD88) to Mean Lower Low Water (MLLW) for hydrographic surveys.
- Transformation of NAVD88 to Mean High Water (MHW) for shoreline monitoring surveys.
- Benchmarks serve as daily survey QA checks and Real-Time Kinematic Global Navigation Satellite Systems base station setups for real-time corrections.
- Mission/project planning.

Aside from the critical data QA component, having access to comprehensive and quality elevation data is essential for detailed and accurate project and mission planning. Once in the field, there are always unknown elements to a project that cannot be controlled. These unmitigable factors can lead to reduced productivity and crew safety, as well as potential cost overruns to the client. To limit the inherent field risks, we spend a considerable amount of time meticulously planning every project to understand and accurately estimate the knowns.

To accomplish this, a standalone planning/logistics Geographic Information System (GIS) is developed in the estimating stages of each project where previously acquired and any relevant publicly available data are loaded. Perhaps the most important layer for our purposes are the publicly available, especially modern, 3D elevation datasets. These data generally benefit our group and our clients in the following ways:

Clients' Time + Cost Savings:

- Relevant Existing Data: By performing a miniature desktop study prior to each project, we can alert our clients to existing data that is suitable to use for their objectives.
  - RESULT 1: Relevant publicly available elevation data allows client to reduce scope and save budget.
  - RESULT 2: Cost savings allows client to acquire more data within set budget.
- Survey Design Accuracy: A high percentage of our hydrographic surveys, for example, focus on mapping areas that rapidly change due to storms or natural processes (e.g. tidal inlets and shoals). Having quality bathymetric elevations, especially those with associated metadata and calculated error, within and adjacent to a survey area greatly enhances the accuracy of our survey designs.
  - RESULT 1: Client's risk of cost overruns to meet specifications are greatly reduced.
  - RESULT 2: Contractors are now more certain of the data needed to meet specifications and the budgeting of uncertainty is reduced.

Contractor Time + Cost Savings:

- In-Field Efficiency & Increased Safety: Once in the field, our comprehensive planning and logistics GIS with surrounding elevation data allow us to be more efficient while in acquisition mode. For example, one of the more challenging types of hydrographic surveys we perform each year are of tidal inlets/port approaches. These approaches are often surrounded by complex shoal structures that can rapidly change in spatial dimension.
  - RESULT 1: Existing bathymetric data, regardless of age, allows us to understand the general proximity of shoaler water for daily survey efficiency and safe navigation.
- Quality Assurance Analysis: Existing elevation data with associated metadata and uncertainty estimates that are easily obtained, is an essential piece to our data QA workflows. NOAA bathymetric charts, NGS datum-derived shorelines and topobathy lidar, and USACE inland waterway bathymetry, etc., are always used in our junction or chart comparison analysis.

- RESULT 1: Our QA workflow and final documentation always entails a "reality check" comparison or junction analysis with 3rd party data. Easy access to these data saves a considerable amount of time by not having to scour the internet or contact colleagues to track down existing data by which to compare.
- RESULT 2: When we know upfront if there is readily available data to use for QA prior to submitting our budget, these time and cost savings are passed on to the client.

Client & Contractor Value Added Benefits:

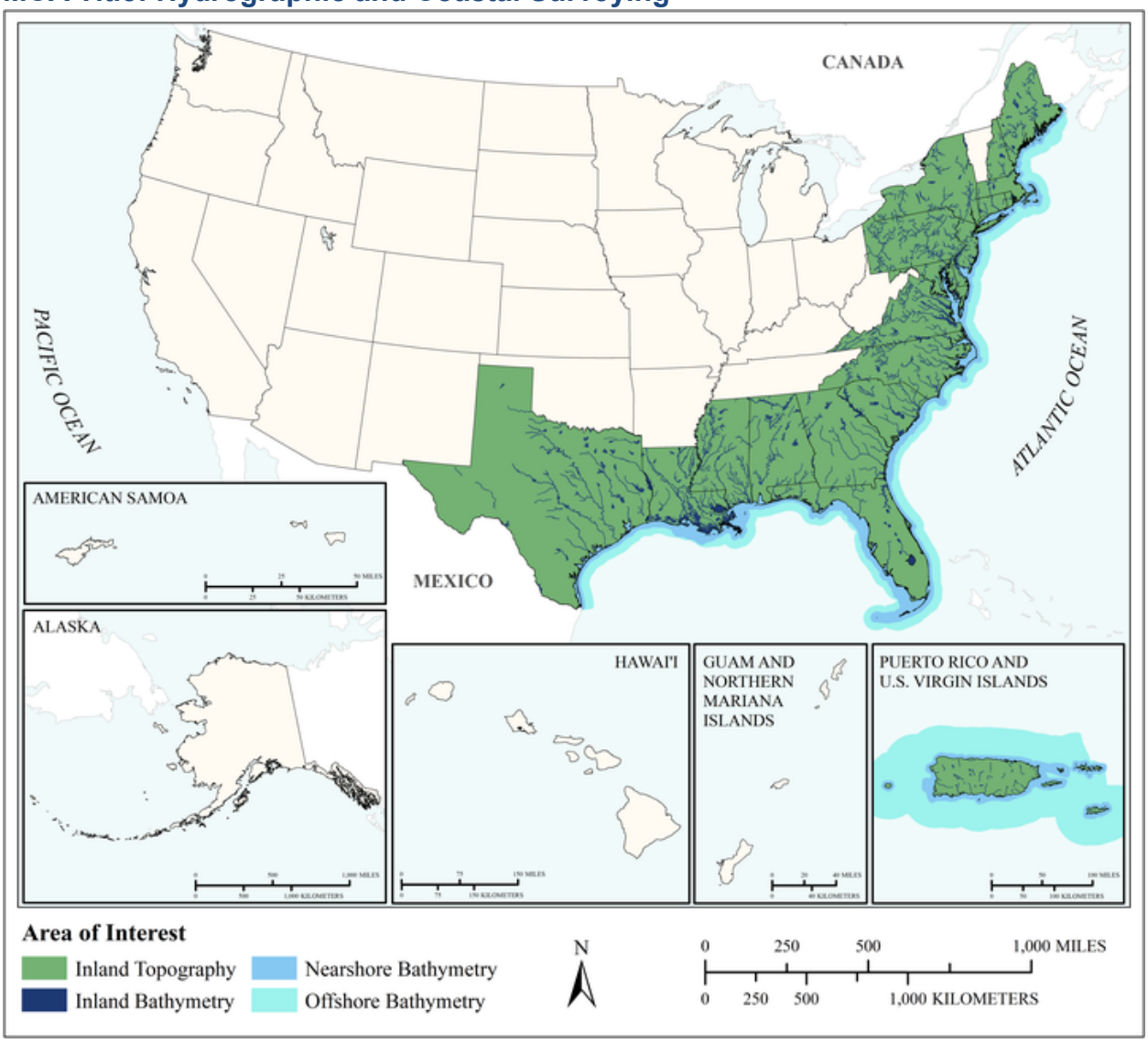
- Shoreline Datum Transformation: VDatum has and continues to save us an incredible amount of time in transforming our client's elevations to any desired datum quickly and accurately. We have several long-term beach and inlet monitoring programs with 1000s of miles of data collection that have or will need to undergo full Horizontal, Orthometric Datum, and Geoid modernization. Since 2000, we have been collecting seamless topobathy beach monitoring profiles once a year and after every "declared Federal Disaster" storm in Carteret County, NC. One of our data products and subsequent analysis is of the datum derived MHW shoreline and its movement over time.
  - RESULT 1: Prior to VDatum, the closest benchmark to calculate the NAVD88 to MHW separation was on the sound side and almost five miles from the ocean side. VDatum increased the accuracy of the MHW calculation by almost 0.5 meters and the use of the tool allowed our group to accurately transform all historic datasets.
  - RESULT 2: The integrity and accuracy of this ongoing monitoring project is paramount to not only the county but also serves as the model by which other shoreline monitoring programs are being undertaken within the state. As such, National Spatial Reference System (NSRS) Modernization by the NGS will need to be applied once completed, and VDatum will allow us to accurately transform this long-term dataset to the updated NSRS. (We have been doing similar work in Norfolk and Wallops Island, VA.)
- Multibeam Data Transformation: From 2003 to 2013, we collected two surveys per year and after significant storms for the Ocean City Inlet, MD. These monitoring data were collected for the USACE Baltimore District and their Regional Sediment Management and sediment bypassing to Assateague Island program. Early data was collected in North American Datum of 1927 and National Geodetic Vertical Datum of 1929, but in 2008 a shift to North American Datum of 1983 and NAVD88 was made. In 2012, the USACE contracted us to bring those legacy datasets into the current, at that time, spatial reference frame.
  - RESULT 1: Essentially, this would not have been be possible without VDatum.

Geodynamics has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Geodynamics	32591	Hydrographic and Coastal Surveying	Inland Topo	QL0 HD	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Inland Bathy	QL0B	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Nearshore Bathy	QL0B	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Offshore Bathy	Order 1a	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Hydrographic and Coastal Surveying



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	One or more states, territories, or counties	One or more states, territories, or counties	Custom description	Custom description
Sub Area Requirements			Nearshore off Atlantic, Gulf of Mexico, and Caribbean states and territories	Offshore off Atlantic, Gulf of Mexico, and Caribbean states and territories out to the contiguous zone

MCA Description	Response
Mission Critical Activity	Collection of yearly beach profiles and nearshore multibeam to support coastal management decisions. Collection of multibeam bathymetry to support benthic habitat mapping and fisheries management. Mutibeam bathymetry and sub-bottom / seismic data to support beach renourishment projects. High resolution seafloor mapping to support the preservation of submerged cultural resources. High resolution seafloor mapping to aid in basin retention for flood plain mapping and flood risk management. Nautical charting. Offshore surveys to support Naval sub-sea operations / training.
MCA Title	Hydrographic and Coastal Surveying
MCA ID	32591
Organization Type	Private or Commercial
Organization Name	Geodynamics
Sub-Agency or Division	
Organization Mission	Provide high-resolution hydrographic and coastal survey data for primarily the federal government and large engineering / environmental firms.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	BU 03 - Coastal Zone Management
Tertiary Business Use	BU 07 - Wildlife and Habitat Management

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Small features

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Highly desirable
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required

Inland Bathy Feature Size Requirements	Response
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0 HD	QL0B	QL0B	Order 1a
Update Frequency	2-3 years	2-3 years	2-3 years	2-3 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Less than 20 cm	Up to 2 meters	Up to 2 meters	Up to 5 meters
Acceptable Vertical Error	Less than 5 cm	Up to 30 cm	Up to 30 cm	Less than 1 meter
How far onshore needed				
How far down the beach profile needed	To MLLW			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Required
Hydro-conditioning	Required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have	Nice to have
Entire AOI under same environmental conditions	Highly desirable	Highly desirable	Highly desirable	Highly desirable	Nice to have	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Required	Required	Highly desirable	Highly desirable	Highly desirable
DEM for entire AOI needs to be seamless	Required	Required	Required	Required	Highly desirable	Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Highly desirable	Required	Required
DTM	Highly desirable	Highly desirable	Required	Required
DEM	Required	Required	Required	Required
Raw point cloud data	Highly desirable	Nice to have	Required	Highly desirable
Classified point cloud	Required	Nice to have	Nice to have	
Edited/cube XYZ		Nice to have	Highly desirable	Highly desirable
Full waveform	Nice to have	Not required	Not required	Nice to have
Bathymetric Attributed Grid (BAG)		Nice to have	Highly desirable	Highly desirable
Breaklines required for standard hydro-flattening	Nice to have	Not required		
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Required	Required
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Nice to have
Intensity imagery/sidescan imagery	Highly desirable	Nice to have	Highly desirable	Highly desirable
Ground control/ground truthing	Required	Nice to have	Highly desirable	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Required	Required
Aerial and/or satellite imagery	Required	Required	Required	Highly desirable
Underwater videography			Nice to have	Not required
Bottom texture			Required	Highly desirable
Bottom type			Required	Required
Submerged features			Required	Required
Subbottom characteristics			Highly desirable	Required
Geologic and seismic data	Highly desirable	Nice to have	Nice to have	Nice to have
Water column properties - Physical			Highly desirable	Highly desirable
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Highly desirable	Highly desirable
Currents			Highly desirable	Required
Tide/wave heights			Required	Required
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Nice to have	Highly desirable
Boundaries			Highly desirable	Required
Routes			Required	Required
Offshore cadastral			Nice to have	Highly desirable
Lease areas			Required	Highly desirable
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates	Required	Required	Required	
Land use/land cover	Highly desirable	Highly desirable	Highly desirable	Required
Wetlands	Highly desirable	Required	Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Required	Required
Inland surface water features	Highly desirable	Required	Highly desirable	
Bridges/culverts	Highly desirable	Required		
Landmark features	Highly desirable	Required	Required	
Cultural resources	Nice to have	Highly desirable	Highly desirable	
Coastal and riverine structures	Required	Required	Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings	Required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	QL2			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast	Yes		Yes	
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes		
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	I don't know	I don't know	I don't know
Cost savings/cost reduction	None	I don't know	I don't know	I don't know
Cost avoidance	None	I don't know	I don't know	I don't know
Increased revenues	None	I don't know	I don't know	I don't know
Mission-driven performance improvements	Major	I don't know	I don't know	I don't know
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	I don't know	I don't know	I don't know

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Moderate	I don't know	I don't know	I don't know
Improved customer experience	Moderate	I don't know	I don't know	I don't know
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	I don't know	I don't know	I don't know
Environmental	Moderate	I don't know	I don't know	I don't know
Public safety, including life and property	Moderate	I don't know	I don't know	I don't know

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Moderate	Unable to provide		Moderate	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Time savings description	Our QA workflow and final documentation always entails a “reality check” comparison or junction analysis with 3rd party data. Easy access to these data saves a considerable amount of time by not having to scour the internet or contact colleagues to track down existing data by which to compare.			Our QA workflow and final documentation always entails a “reality check” comparison or junction analysis with 3rd party data. Easy access to these data saves a considerable amount of time by not having to scour the internet or contact colleagues to track down existing data by which to compare.			Existing bathymetric data, regardless of age, allows us to understand the general proximity of shoaler water for daily survey efficiency and safe navigation. Our QA workflow and final documentation always entails a “reality check” comparison or junction analysis with 3rd party data. Easy access to these data saves a considerable amount of time by not having to scour the internet or contact colleagues to track down existing data by which to compare.			Existing bathymetric data, regardless of age, allows us to understand the general proximity of shoaler water for daily survey efficiency and safe navigation. Our QA workflow and final documentation always entails a “reality check” comparison or junction analysis with 3rd party data. Easy access to these data saves a considerable amount of time by not having to scour the internet or contact colleagues to track down existing data by which to compare.		
Cost savings/cost reduction	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Cost savings/cost reduction description	Relevant publicly available elevation data allows client to reduce scope and save budget. Cost saving allows client to acquire more data within set budget.			Relevant publicly available elevation data allows client to reduce scope and save budget. Cost saving allows client to acquire more data within set budget.			Relevant publicly available elevation data allows client to reduce scope and save budget. Cost saving allows client to acquire more data within set budget.			Relevant publicly available elevation data allows client to reduce scope and save budget. Cost saving allows client to acquire more data within set budget.		
Cost avoidance	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Increased revenues	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Mission-driven performance improvements	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Value added to products or services description	Cost savings to clients. Having quality elevations, especially those with associated metadata and calculated error, within and adjacent to a survey area greatly enhances the accuracy of our survey designs. When we know upfront if there is readily available data to use for QA prior to submitting our budget, these time and ultimate cost savings are passed on to the client. Client's risk of cost overruns to meet specifications are greatly reduced. Contractors are now more certain of the data needed to meet specifications and the budgeting of uncertainty is reduced.			Having quality bathymetric elevations, especially those with associated metadata and calculated error, within and adjacent to a survey area greatly enhances the accuracy of our survey designs. VDatum has and continues to save us an incredible amount of time in transforming our client's elevations to any desired datum quickly and accurately. Cost savings to clients. When we know upfront if there is readily available data to use for QA prior to submitting our budget, these time and ultimate cost savings are passed on to the client. Client's risk of cost overruns to meet specifications are greatly reduced. Contractors are now more certain of the data needed to meet specifications and the budgeting of uncertainty is reduced.			Having quality bathymetric elevations, especially those with associated metadata and calculated error, within and adjacent to a survey area greatly enhances the accuracy of our survey designs. VDatum has and continues to save us an incredible amount of time in transforming our client's elevations to any desired datum quickly and accurately. Cost savings to clients. When we know upfront if there is readily available data to use for QA prior to submitting our budget, these time and ultimate cost savings are passed on to the client. Client's risk of cost overruns to meet specifications are greatly reduced. Contractors are now more certain of the data needed to meet specifications and the budgeting of uncertainty is reduced.			Having quality bathymetric elevations, especially those with associated metadata and calculated error, within and adjacent to a survey area greatly enhances the accuracy of our survey designs. VDatum has and continues to save us an incredible amount of time in transforming our client's elevations to any desired datum quickly and accurately. Cost savings to clients. When we know upfront if there is readily available data to use for QA prior to submitting our budget, these time and ultimate cost savings are passed on to the client. Client's risk of cost overruns to meet specifications are greatly reduced. Contractors are now more certain of the data needed to meet specifications and the budgeting of uncertainty is reduced.		
Improved response or timeliness	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Improved customer experience	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know			I don't know			I don't know			I don't know		
Environmental	I don't know			I don't know			I don't know			I don't know		
Public safety, including life and property	I don't know			I don't know			I don't know			I don't know		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

GIS Engineering

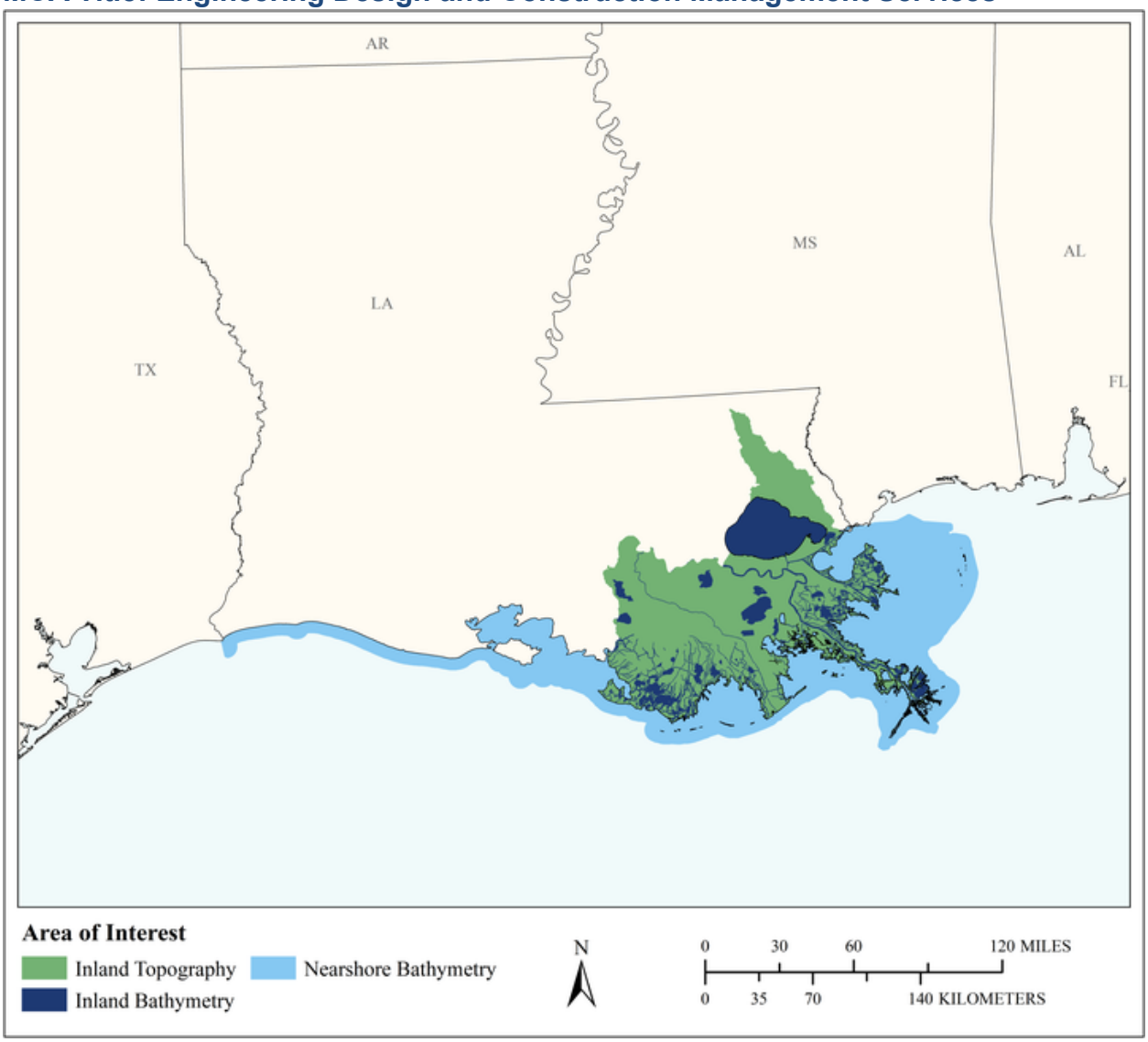
GIS Engineering provides engineering design and construction management services, including civil engineering and land surveying to customers, both public and private, in the southeastern Louisiana area. Its main focus is on infrastructure projects, including water management, port facilities, and transportation. GIS Engineering has offices in Louisiana and Texas.

GIS Engineering has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	GIS Engineering	43181	Engineering Design and Construction Management Services	Inland Topo	Cross sections and/or transects meet needs	4-5 years	$101,296	$10,000	Minor	None	None
				Inland Bathy	Cross sections and/or transects meet needs	4-5 years	Unable to quantify	Unable to quantify	None	None	None
				Nearshore Bathy	Cross sections and/or transects meet needs	2-3 years	Unable to quantify	Unable to quantify	None	None	None

MCA Title: Engineering Design and Construction Management Services



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	
Geographic Area Requirements	One or more Hydrologic Units (HUC4s)	One or more Hydrologic Units (HUC4s)	Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	GIS Engineering provides engineering design and construction management services. Our main focus is on infrastructure projects, including water management, port facilities, and transportation.
MCA Title	Engineering Design and Construction Management Services
MCA ID	43181
Organization Type	Private or Commercial
Organization Name	GIS Engineering
Sub-Agency or Division	
Organization Mission	GIS Engineering provides civil engineering and land surveying to customers, both public and private, in the southeastern Louisiana area. We have offices in Houma, Baton Rouge, Gretna, and Galliano.
Program Name	Our MCA supports our designs of water control structures, levees, and other drainage systems.
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Not required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	We are interested in the topographic features that would affect the design of our facilities. We would need to know the locations of features like drainage catch basins, manholes, power poles and other utility facilities.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Highly desirable
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required

Inland Bathy Feature Size Requirements	Response
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Highly desirable
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	
Update Frequency	4-5 years	4-5 years	2-3 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 30 cm	Less than 50 cm	Up to 5 meters	
Acceptable Vertical Error	Less than 5 cm	Up to 20 cm	Up to 20 cm	
How far onshore needed			To cover the beach slope	
How far down the beach profile needed	Below MLLW		Below MLLW	
Tide correction requirement			No requirement for tide correction	
Cross sections and/or transects meet needs	Yes	Yes	Yes	
Cross section/transect requirement	We would prefer a vertical accuracy of 5cm. Cross sections approximately 30m apart would typically be sufficient.	We would need the vertical accuracy to be within 15cm. The horizontal accuracy would need to within 30cm.	We would need horizontal accuracy to 5m. We would need vertical accuracy to 15cm.	

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Highly desirable	Nice to have		Highly desirable	Nice to have
Entire AOI under same environmental conditions	Highly desirable	Highly desirable	Nice to have		Highly desirable	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Highly desirable	Highly desirable		Nice to have	Highly desirable
DEM for entire AOI needs to be seamless	Highly desirable	Highly desirable	Highly desirable		Highly desirable	Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to double the required TVU at the 95% confidence level	Up to double the required TVU at the 95% confidence level	Up to double the required TVU at the 95% confidence level		Up to double the required TVU at the 95% confidence level	Up to double the required TVU at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Nice to have	Nice to have	
DTM	Highly desirable	Highly desirable	Highly desirable	
DEM	Required	Required	Required	
Raw point cloud data	Nice to have	Highly desirable	Highly desirable	
Classified point cloud	Nice to have	Nice to have	Nice to have	
Edited/cube XYZ		Nice to have	Nice to have	
Full waveform	Nice to have	Not required	Not required	
Bathymetric Attributed Grid (BAG)		Not required	Not required	
Breaklines required for standard hydro-flattening	Highly desirable	Nice to have		
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Nice to have	
Tide Predictions			Not required	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Nice to have	Not required	Nice to have	
Ground control/ground truthing	Highly desirable	Nice to have	Nice to have	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	
Nautical and/or navigation charts			Nice to have	
Acoustic imagery of the seafloor			Nice to have	
Aerial and/or satellite imagery	Required	Required	Required	
Underwater videography			Not required	
Bottom texture			Not required	
Bottom type			Nice to have	
Submerged features			Nice to have	
Subbottom characteristics			Nice to have	
Geologic and seismic data	Not required	Not required	Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Nice to have	
Tide/wave heights			Nice to have	
Sea ice conditions			Not required	
Habitat distribution and classification			Not required	
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Not required	
Lease areas			Nice to have	
Fixed obstructions			Nice to have	
Floating observation/navigation systems			Nice to have	
Shorelines – current, historic, change rates	Highly desirable	Highly desirable	Highly desirable	
Land use/land cover	Highly desirable	Nice to have	Nice to have	
Wetlands	Highly desirable	Highly desirable	Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Highly desirable	
Inland surface water features	Required	Highly desirable	Highly desirable	
Bridges/culverts	Required	Required		
Landmark features	Highly desirable	Highly desirable	Highly desirable	
Cultural resources	Nice to have	Nice to have	Nice to have	
Coastal and riverine structures	Required	Highly desirable	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Right now, we mostly use topographic information we obtain from our survey sources. We do also use LiDAR information we obtain.	We typically use bathymetric data we collect ourselves, using dual beam hydrographic equipment.	We use bathymetric data we obtain ourselves, using dual beam hydrographic survey equipment.	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts			Yes	
USACE navigation charts				
USGS Inland Waters server				
USGS data series		Yes		
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	None	None	None	
Cost savings/cost reduction	None	None	None	
Cost avoidance	None	Minor	None	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Increased revenues	None	None	None	
Mission-driven performance improvements	None	Minor	None	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Minor	None	None	
Improved response or timeliness	Minor	None	None	
Improved customer experience	Minor	None	None	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	None	None	
Environmental	None	None	None	
Public safety, including life and property	None	None	None	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Moderate	Annual dollars saved/realized	$19,296	Minor	Unable to provide		Minor	Unable to provide				
Time savings description	This information would allow us to plan our field surveys better and possibly limit how much work we have to perform in the field.											
Cost savings/cost reduction	Minor	Annual dollars saved/realized	$48,000	None			Minor	Unable to provide				
Cost avoidance	Minor	Annual dollars saved/realized	$34,000	Minor	Unable to provide		Minor	Unable to provide				
Increased revenues	None			None			None					
Mission-driven performance improvements	Minor	Unable to provide		None			Minor	Unable to provide				
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide		Minor	Unable to provide		Minor	Unable to provide				
Improved response or timeliness	Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide				
Improved customer experience	Moderate	Annual dollars saved/realized	$10,000	Minor	Unable to provide		None					
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor			None			None					
Environmental	None			None			None					
Public safety, including life and property	None			None			None					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes	Yes	
Contours	Yes	Yes	Yes	
Hillshades	Yes	Yes	Yes	
Slope maps	Yes			
Aspect maps				
Curvature maps				
Cross sections	Yes	Yes	Yes	
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)	Yes	Yes		
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes		
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Glorieta Geoscience, Inc. (GGI)

GGI provides professional consulting services in groundwater development, water rights, geomorphology, dairy regulatory compliance, and environmental science and serves federal, state, and municipal entities, tribal governments, private corporations, and individuals.

GGI has active environmental and water resource projects in New Mexico, Texas, Arizona, California, Nevada, Washington, and Idaho spanning diverse types of projects involving development of conceptual site models, initial planning, to project completion. GGI works with a wide range of state and federal rules and regulations. GGI has drafted environmental and water rights regulations in multiple states and in federal rule-making processes.

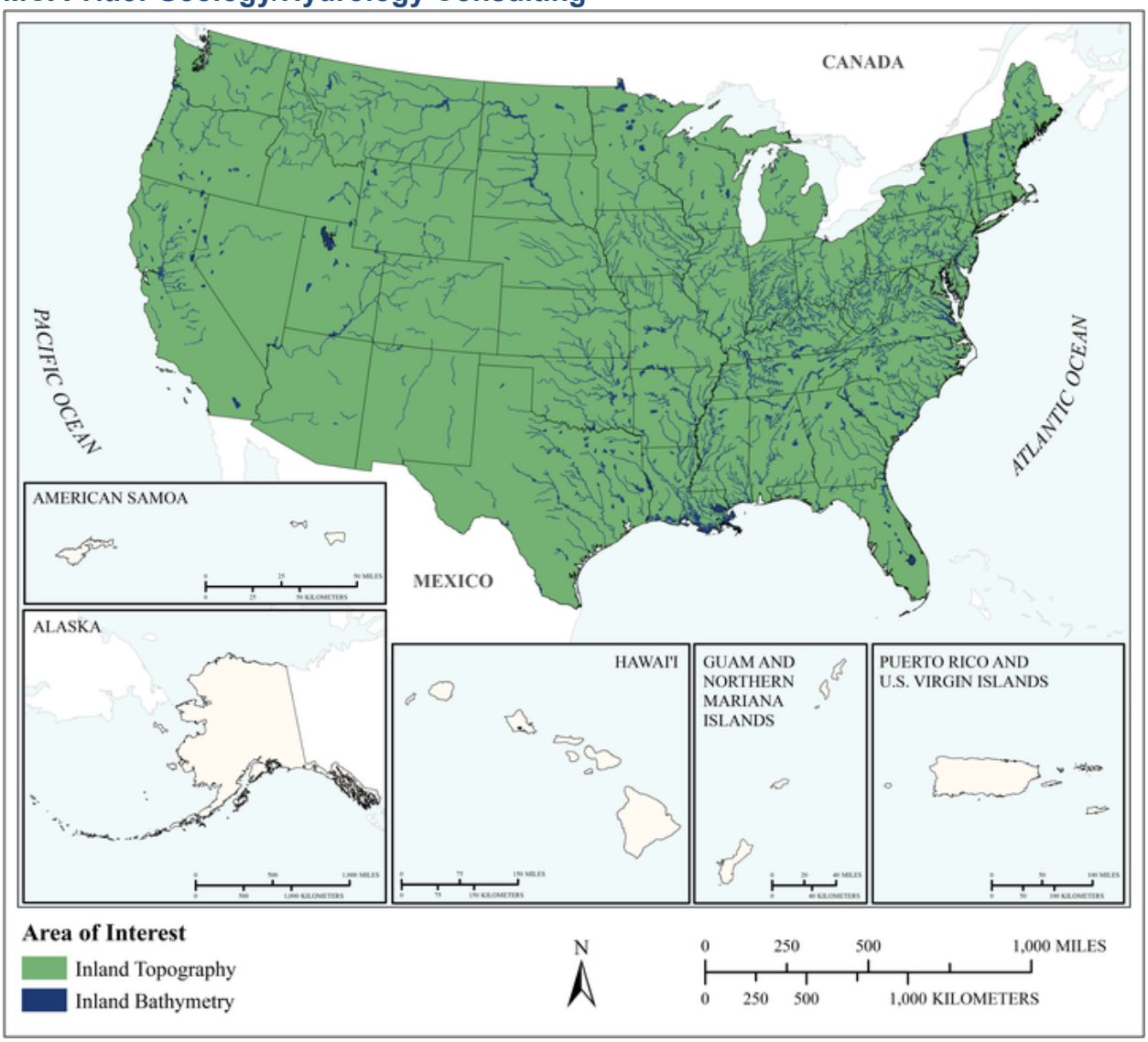
Elevation data are needed to perform lake and reservoir capacity studies, landslide analyses, geomorphic mapping, and cross section analysis of the riverbeds of the Rio Grande and other large rivers for capacity and sedimentation, flooding, and water release to other states and Mexico. The states, U.S. Army Corps of Engineers, Bureau of Reclamation, and Bureau of Indian Affairs are involved in the river monitoring activities and the Interstate Stream Commission administers the stream compacts.

GGI has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 01 – Water Supply and Quality	Glorieta Geoscience, Inc.	21612	Geology/Hydrology Consulting	Inland Topo	QL2	Event driven	Unable to quantify	Unable to quantify	None	Moderate	Minor
				Inland Bathy	QL2B	6-10 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Geology/Hydrology Consulting



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required		
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas		
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Soils and wetlands mapping and characterization, Stream channel analysis and mapping, Detailed site analysis to support precision farming, Geologic mapping and analysis, Identification of geomorphologic units. Glorieta Geoscience is a hydrologic consulting firm. Elevation data are needed to perform cross section analysis of the river beds of the Rio Grande and other large rivers for capacity and sedimentation, also flooding, and water release to other states/Mexico. Similar activities would apply to other users in New Mexico as well. The state, USACE, BOR, and BIA are involved in the river monitoring activities and the Interstate Stream Commission administers the stream compacts.
MCA Title	Geology/Hydrology Consulting
MCA ID	21612
Organization Type	Private or Commercial
Organization Name	Glorieta Geoscience, Inc.
Sub-Agency or Division	
Organization Mission	Geology/hydrology consulting
Program Name	Hydrogeologic characterization, resource assessment, and precision farming
Total Annual Program Budget	
Primary Business Use	BU 01 - Water Supply and Quality
Secondary Business Use	BU 08 - Agriculture and Precision Farming
Tertiary Business Use	BU 10 - Geologic Assessment and Hazard Mitigation

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Resolution to 1-ft elevation contour

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Highly desirable
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Highly desirable
51 - 100 ft	Highly desirable
101 - 500 ft	Highly desirable
501 - 2,500 ft	Highly desirable

Inland Bathy Feature Size Requirements	Response
Greater than 2,500 ft	Highly desirable
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Highly desirable
1.1 – 2 acres	Highly desirable
2.1 – 5 acres	Highly desirable
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Highly desirable

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL2B		
Update Frequency	Event driven only – Data need to coincide with a specific event.	6-10 years		
Event type(s)	Projects.			
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 30 cm	Up to 2 meters		
Acceptable Vertical Error	Up to 10 cm	Up to 40 cm		
How far onshore needed				
How far down the beach profile needed	To MHHW			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Not required
Hydro-conditioning	Not required
No Treatment	Highly desirable

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Not required	Highly desirable			Highly desirable	
Entire AOI under same environmental conditions	Not required	Highly desirable			Highly desirable	
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Required			Highly desirable	
DEM for entire AOI needs to be seamless	Highly desirable	Required			Highly desirable	
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Not required	Highly desirable		
DTM	Required	Highly desirable		
DEM	Required	Highly desirable		
Raw point cloud data	Required	Not required		
Classified point cloud	Required	Highly desirable		
Edited/cube XYZ		Not required		
Full waveform	Highly desirable	Not required		
Bathymetric Attributed Grid (BAG)		Not required		
Breaklines required for standard hydro-flattening	Nice to have	Highly desirable		
Additional breaklines for hydro-enforcement of culverts	Not required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable	Nice to have		
Ground control/ground truthing	Required	Highly desirable		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required	Required		
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Required	Required		
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Not required	Nice to have		
Land use/land cover	Highly desirable	Highly desirable		
Wetlands	Required	Highly desirable		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required	Highly desirable		
Bridges/culverts	Highly desirable	Highly desirable		
Landmark features	Highly desirable	Highly desirable		
Cultural resources	Highly desirable	Nice to have		
Coastal and riverine structures	Highly desirable	Highly desirable		
Overhead structures				
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	LiDAR, DEM	Data that meet my needs are not available		
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI	Yes			
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	NM RGIS - New Mexico Resource Geographic Information System			
Data that meet my needs are not available		Yes		
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	Inland bathy data not available		
Cost savings/cost reduction	Minor	Inland bathy data not available		

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cost avoidance	I don't know	Inland bathy data not available		
Increased revenues	Moderate	Inland bathy data not available		
Mission-driven performance improvements	Major	Inland bathy data not available		
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Inland bathy data not available		
Improved response or timeliness	Minor	Inland bathy data not available		
Improved customer experience	Moderate	Inland bathy data not available		
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	None	Inland bathy data not available		
Environmental	Moderate	Inland bathy data not available		
Public safety, including life and property	None	Inland bathy data not available		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide		I don't know	Unable to provide							
Cost savings/cost reduction	I don't know	Unable to provide		I don't know	Unable to provide							
Cost avoidance	I don't know	Unable to provide		I don't know	Unable to provide							
Increased revenues	Moderate	Unable to provide		I don't know	Unable to provide							
Mission-driven performance improvements	Moderate	Unable to provide		I don't know	Unable to provide							
Other operational benefits	Moderate	Unable to provide										
Other operational benefits description												
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide		I don't know	Unable to provide							
Improved response or timeliness	Moderate	Unable to provide		I don't know	Unable to provide							
Improved customer experience	I don't know	Unable to provide		I don't know	Unable to provide							
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	None			I don't know								
Environmental	Moderate			I don't know								
Public safety, including life and property	Minor			I don't know								

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours	Yes			
Hillshades	Yes			
Slope maps				
Aspect maps				
Curvature maps				
Cross sections	Yes			
Height-Above-Ground maps				
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Great Lakes Dredge & Dock Company (Great Lakes)

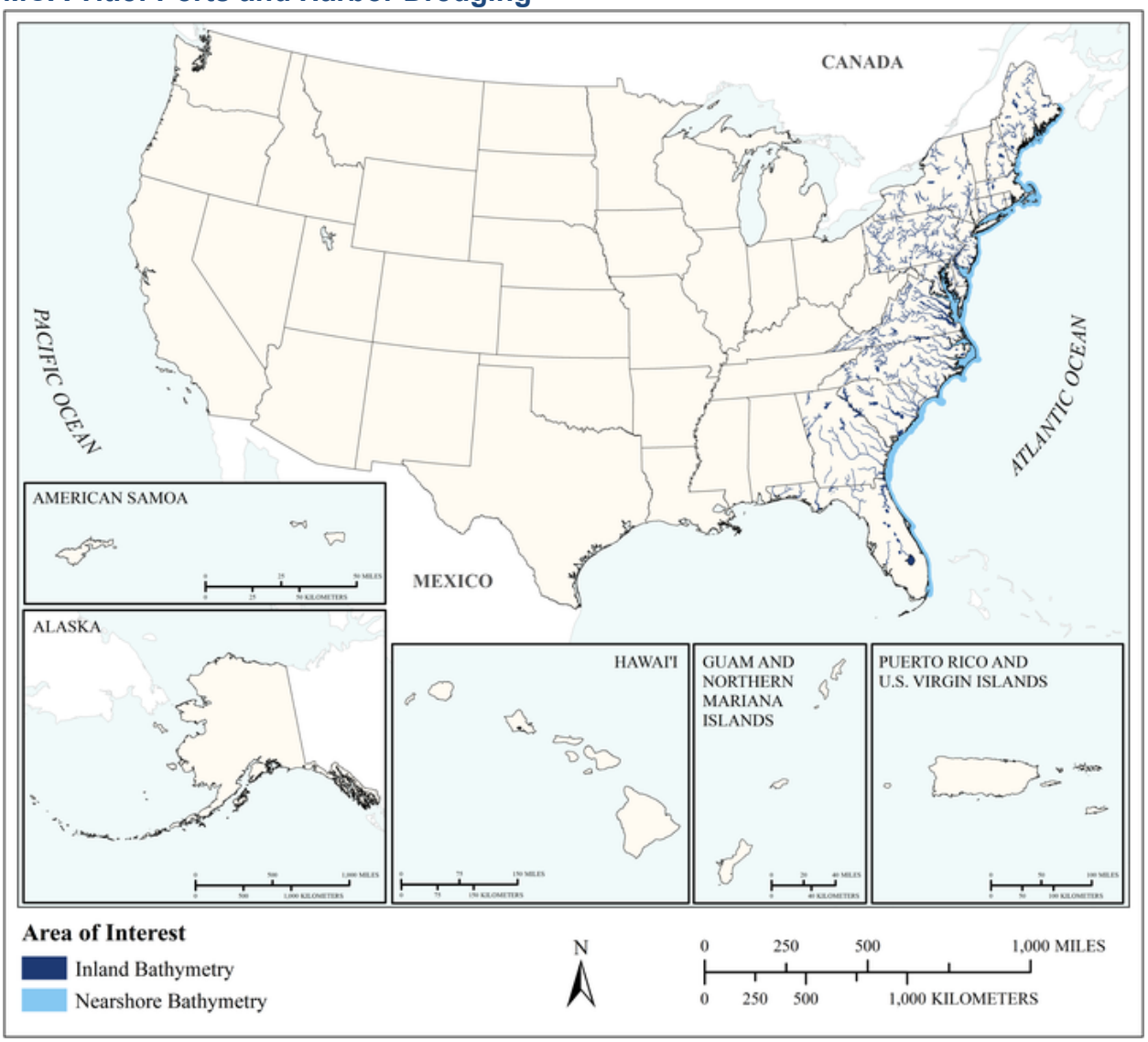
Great Lakes provides domestic and international capital, coastal protection, and restoration dredging services that help shape the environment by maintaining and deepening America's ports, protecting its shorelines, and creating barrier islands and land reclamations. With 200 specialized vessels, including smaller hydraulic dredges for inland and shallow water environments, Great Lakes owns and operates the largest and most diverse fleet in the U.S. dredging industry. Since its founding, Great Lakes has been a leader in the building and maintenance of the nation's navigation system, the protection of shorelines, the restoration of sensitive habitats, and the creation of critical aquatic infrastructure. Great Lakes is committed to delivering innovative and high-quality workmanship to clients while executing every project with a focus on employee safety.

Great Lakes has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	Great Lakes Dredge & Dock Company	22355	Ports and Harbor Dredging	Inland Bathy	Cross sections and/or transects meet needs	Annually	$288,087	$45,225	I don't know	I don't know	I don't know
				Nearshore Bathy	Cross sections and/or transects meet needs	Twice annually	$288,087	$45,225	I don't know	I don't know	I don't know

MCA Title: Ports and Harbor Dredging



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type		Required	Required	
Geographic Area Requirements		One or more states, territories, or counties	Custom description	
Sub Area Requirements			East coast, excluding the Great Lakes.	

MCA Description	Response
Mission Critical Activity	Coastal Zone Management, Geologic Resource Mining and Extraction, Marine and Riverine Navigation and Safety, Infrastructure and Construction Management,
MCA Title	Ports and Harbor Dredging
MCA ID	22355
Organization Type	Private or Commercial
Organization Name	Great Lakes Dredge & Dock Company
Sub-Agency or Division	
Organization Mission	Great Lakes Dredge & Dock Company, LLC (GLDD) provides domestic and international capital, coastal protection, and restoration-dredging services that help shape the environment by maintaining and deepening America's ports, protecting its shorelines, and creating barrier islands and land reclamations.
Program Name	Ports and harbor dredging
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Not required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Not required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Seabed features, rocks, vegetation.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Not required
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Not required
Other	Nice to have
Other description	10-25 ft
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Not required

Inland Bathy Feature Size Requirements	Response
½ - 1 acre	Not required
1.1 – 2 acres	Not required
2.1 – 5 acres	Not required
5.1 – 10 acres	Not required
Greater than 10 acres	Highly desirable

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order		Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	
Update Frequency		Annually	Twice annually	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error		Up to 1 meter	Less than 1 meter	
Acceptable Vertical Error		Less than 10 cm	Less than 10 cm	
How far onshore needed			To cover the beach slope	
How far down the beach profile needed			~1500 ft from shorelines	
Tide correction requirement			MLLW	
Cross sections and/or transects meet needs		Yes	Yes	
Cross section/transect requirement		Accuracy, IAW USACE hydrographic surveying manual, then to IHO standard. Desired +/- 1.0 foot accuracy.	Required, IAW USACE / IHO standards	

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season		Required	Required			Required
Entire AOI under same environmental conditions		Highly desirable	Required			Required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless		Nice to have	Highly desirable			Highly desirable
DEM for entire AOI needs to be seamless		Nice to have	Required			Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM		Required	Required	
DTM		Required	Required	
DEM		Required	Required	
Raw point cloud data		Not required	Highly desirable	
Classified point cloud		Highly desirable	Highly desirable	
Edited/cube XYZ		Nice to have	Highly desirable	
Full waveform		Nice to have	Highly desirable	
Bathymetric Attributed Grid (BAG)		Nice to have	Highly desirable	
Breaklines required for standard hydro-flattening		Highly desirable		
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Required	
Tide Predictions			Highly desirable	
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	
Intensity imagery/sidescan imagery		Nice to have	Highly desirable	
Ground control/ground truthing		Required	Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	
Nautical and/or navigation charts			Highly desirable	
Acoustic imagery of the seafloor			Highly desirable	
Aerial and/or satellite imagery		Highly desirable	Nice to have	
Underwater videography			Nice to have	
Bottom texture			Highly desirable	
Bottom type			Highly desirable	
Submerged features			Highly desirable	
Subbottom characteristics			Highly desirable	
Geologic and seismic data		Nice to have	Not required	
Water column properties - Physical			Nice to have	
Water column properties - Chemical			Not required	
Water column properties - Biological			Nice to have	
Currents			Highly desirable	
Tide/wave heights			Required	
Sea ice conditions			Not required	
Habitat distribution and classification			Highly desirable	
Boundaries			Not required	
Routes			Highly desirable	
Offshore cadastral			Nice to have	
Lease areas			Highly desirable	
Fixed obstructions			Nice to have	
Floating observation/navigation systems			Highly desirable	
Shorelines – current, historic, change rates		Nice to have	Highly desirable	
Land use/land cover		Nice to have	Nice to have	
Wetlands		Nice to have	Nice to have	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Nice to have	
Inland surface water features		Nice to have	Nice to have	
Bridges/culverts		Nice to have		
Landmark features		Nice to have	Nice to have	
Cultural resources		Nice to have	Nice to have	
Coastal and riverine structures		Highly desirable	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used		NOAA Access Data Viewer	NOAA, USACE nautical charts	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI			Yes	
Open Topography				
NOAA nautical charts		Yes	Yes	
USACE navigation charts		Yes	Yes	
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings		Minor	Moderate	
Cost savings/cost reduction		Minor	Minor	
Cost avoidance		Minor	None	
Increased revenues		Minor	None	
Mission-driven performance improvements		Major	Major	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services		None	Moderate	
Improved response or timeliness		Moderate	Moderate	
Improved customer experience		None	None	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach		None	None	
Environmental		None	Major	
Public safety, including life and property		None	Major	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings				Moderate	Annual dollars saved/realized	$138,087	Moderate	Annual dollars saved/realized	$138,087			
Time savings description				At minimum two persons time. In office process reduction for one team.			At minimum two persons time. In office process reduction for one team.					
Cost savings/cost reduction				Moderate	Annual dollars saved/realized	$150,000	Moderate	Annual dollars saved/realized	$150,000			
Cost savings/cost reduction description				At least 5 survey deployments annually.			At least 5 survey deployments annually.					
Cost avoidance				I don't know	Unable to provide		I don't know	Unable to provide				
Increased revenues				I don't know	Unable to provide		I don't know	Unable to provide				
Mission-driven performance improvements				Major	Annual percent improvement	40%	Major	Annual percent improvement	40%			
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services				None			None					
Improved response or timeliness				Major	Annual dollars saved/realized	$45,225	Major	Annual dollars saved/realized	$45,225			
Improved customer experience				Moderate	Unable to provide		Moderate	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach				I don't know			I don't know					
Environmental				I don't know			I don't know					
Public safety, including life and property				I don't know			I don't know					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)		Yes	Yes	
Contours		Yes	Yes	
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections		Yes	Yes	
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	1
Update frequency	2

GSI Service Group, Inc. (GSI)

GSI provides professional services to support the Department of Defense (DoD) as well as federal and civilian customers worldwide, supporting environmental, conventional, and chemical munitions response projects and providing support and tailored solutions to meet DoD and other federal customer needs. GSI's services include the following.

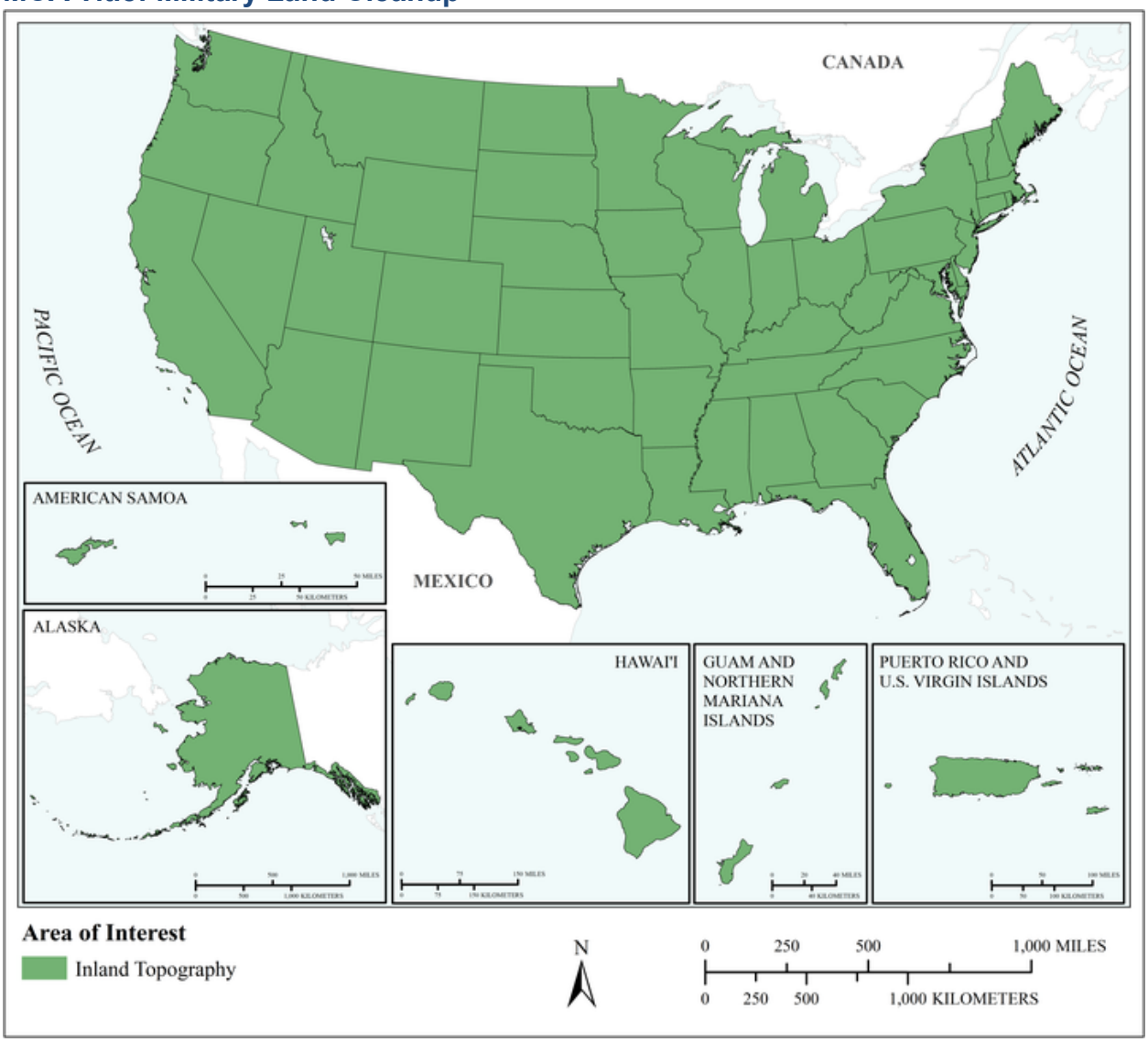
- Environmental, Scientific, and Technical Consulting;
- Data and Policy Analysis;
- Program Management and Implementation Support;
- Logistical Support and Analysis;
- Regulatory and Policy Support;
- Strategic Planning;
- Archival Research;
- Mission-Critical Training;
- HAZMAT Coordination; and
- Safety and Environmental Staffing.

GSI has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 29 – Military	GSI Service Group, Inc.	22283	Military Land Cleanup	Inland Topo	Cross sections and/or transects meet needs	4-5 years	$2,602,412	$3,075	Moderate	Moderate	Major

MCA Title: Military Land Cleanup



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Military land cleanup
MCA Title	Military Land Cleanup
MCA ID	22283
Organization Type	Private or Commercial
Organization Name	GSI Service Group, Inc.
Sub-Agency or Division	
Organization Mission	Help check and cleanup government agencies' property.
Program Name	MMRP
Total Annual Program Budget	
Primary Business Use	BU 29 - Military
Secondary Business Use	BU 10 - Geologic Assessment and Hazard Mitigation
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Not required
River/lake bottom	Highly desirable
Nearshore elevation (<10 m deep)	Highly desirable
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Highly desirable

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	High detail of ground features, to include signs and anomalies.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	Cross sections and/or transects meet needs			
Update Frequency	4-5 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Less than 20 cm			
Acceptable Vertical Error	Less than 5 cm			
How far onshore needed				
How far down the beach profile needed	To MHW			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Tide correction requirement				
Cross sections and/or transects meet needs	Yes			
Cross section/transect requirement	I seldom do cross sections			

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Nice to have					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable					
DEM for entire AOI needs to be seamless	Highly desirable					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required			
DTM	Required			
DEM	Highly desirable			
Raw point cloud data	Highly desirable			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Highly desirable			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Required			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Required			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Highly desirable			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Required			
Land use/land cover	Nice to have			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Nice to have			
Landmark features	Nice to have			
Cultural resources	Nice to have			
Coastal and riverine structures	Nice to have			
Overhead structures				
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Looking for Alaska data, which does not have same options as lower 48.			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI	Yes			
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	Alaska DNR, AK GIS Clearing house, NOAA			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	Moderate			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Moderate			
Public safety, including life and property	Moderate			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Minor	Annual dollars saved/realized	$965									
Time savings description	Time saved. Less processing. Less online searches.											
Cost savings/cost reduction	Major	Annual dollars saved/realized	$501,206									
Cost savings/cost reduction description	Less need for larger coverage area of LiDAR. Clean data. LiDAR.											
Cost avoidance	Major	Annual dollars saved/realized	$2,100,241									
Cost avoidance description	Property saved; could be billions. Less Errors. Less processing. Property saved; better for military; could save millions.											
Increased revenues	Major	Unable to provide										
Increased revenues description	Know fields better; 100s of pounds of additional crops. More diversity; send 100s of more products. Plan route; 1000s of pounds of increased cargo capacity.											
Mission-driven performance improvements	Moderate	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Minor	Annual dollars saved/realized	$965									
Value added to products or services description	No editing. Better coverage.											
Improved response or timeliness	Major	Annual dollars saved/realized	$904									
Improved response or timeliness description	Faster data accessibility. Less time looking for data; better data! Better planning for events. Property saved; 100s of lives saved. Property saved. Faster data accessibility; faster usage.											
Improved customer experience	Moderate	Annual dollars saved/realized	$1,206									
Improved customer experience description	Easier to find data. New items to learn; new products. Less double checking.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate											
Education or outreach description	Learning opportunities; Learn usage, analytics											
Environmental	Moderate											
Environmental description	Learn usage, analytics											
Public safety, including life and property	Major											
Public safety, including life and property description	Learning opportunities; Learn usage, analytics											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

HERE Technologies

HERE Technologies is a leading provider and market leader globally in location platforms, maps, navigation, data, location intelligence, location services, and developer ecosystem. HERE Technologies seeks to create a digital representation of the world by mapping every road (with navigable attributes), building, and business and by providing live and historical traffic data, geocoding, routing, and other services. This enables companies to run faster and more efficiently in support of a variety of endeavors such as supply chain optimization. HERE Technologies uses location data to improve how businesses and cities run – at a fraction of the energy and environmental costs. By collecting data from over 100,000 sources and with 80 billion API calls per month to continuously update its content, HERE Technologies can provide the most accurate digital representation of the world.

Elevation data are used for:

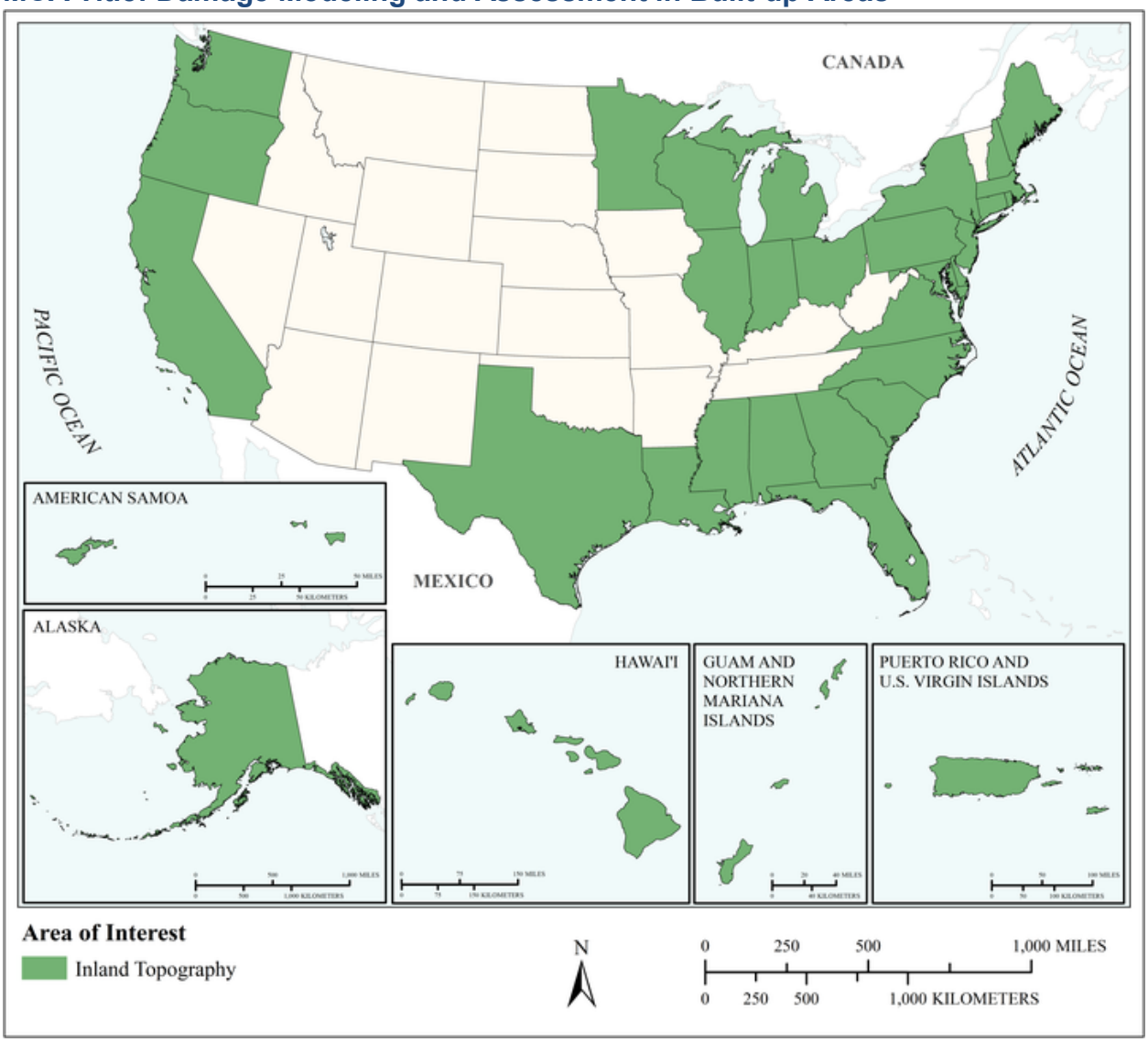
- Damage modeling and assessments and mobile lidar solutions post disaster;
- Determination of standing inventory of forest resources;
- Enhanced situational awareness, planning, and change detection capabilities;
- Highly Automated Driving (Highway autopilot, etc.), autonomous driving, and connected ADAS opportunities (Dynamic speed signs, traffic, safety hazards, etc.);
- Creating accurate maps as the building blocks of autonomous driving (together with cameras, radar, and lasers, etc.);
- Building site analysis, road infrastructure, and power line planning;
- Urban landscape modeling; and
- Digital site survey of street furniture assets in urban environments for 5G Network planning.

HERE Technologies has identified Business Uses and Mission Critical Activities that rely on topographic data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 03 – Coastal Zone Management	HERE Technologies	60721	Damage Modeling and Assessment in Built-up Areas	Inland Topo	QL0	4-5 years	Unable to quantify	Unable to quantify	Major	Major	Major
BU 15 – Flood Risk Management	HERE Technologies	60722	Mobile Lidar Solutions Post Disaster	Inland Topo	QL0	4-5 years	Unable to quantify	Unable to quantify	Major	Moderate	Major
BU 17 – Wildfire Management	HERE Technologies	60723	Determination of Standing Inventory of Forest Resources	Inland Topo	QL0	Annually	Unable to quantify	Unable to quantify	Major	Major	Major
BU 18 – Homeland Security	HERE Technologies	60724	Enhanced Situational Awareness, Planning, and Change Detection Capabilities	Inland Topo	QL0	2-3 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Major
BU 19 – Land Navigation	HERE Technologies	60725	Automated Driving Systems	Inland Topo	QL0	2-3 years	Unable to quantify	Unable to quantify	Minor	Major	Major
BU 22 – Infrastructure Management	HERE Technologies	60726	Building Site analysis, Road Infrastructure, and Power Line Planning	Inland Topo	QL0	2-3 years	Unable to quantify	Unable to quantify	Minor	Moderate	Major
BU 23 – Urban and Regional Planning	HERE Technologies	60727	Urban Landscape Modeling	Inland Topo	QL0	4-5 years	Unable to quantify	Unable to quantify	Moderate	Major	Major
BU 28 – Telecom-munications	HERE Technologies	60728	Digital Site Survey of street furniture assets in urban environments for 5G Network planning	Inland Topo	QL0	Annually	Unable to quantify	Unable to quantify	Minor	Minor	Minor

MCA Title: Damage Modeling and Assessment in Built-up Areas



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Damage modeling and assessment in built-up areas.
MCA Title	Damage Modeling and Assessment in Built-up Areas
MCA ID	60721
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 03 - Coastal Zone Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	Larger than 2 million sq mi (e.g. National)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	4-5 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 20 cm			
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have			
DTM	Required			
DEM	Required			
Raw point cloud data	Nice to have			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Not required			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Required			
Land use/land cover	Highly desirable			
Wetlands	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Highly desirable			
Landmark features	Nice to have			
Cultural resources	Nice to have			
Coastal and riverine structures	Required			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	None			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

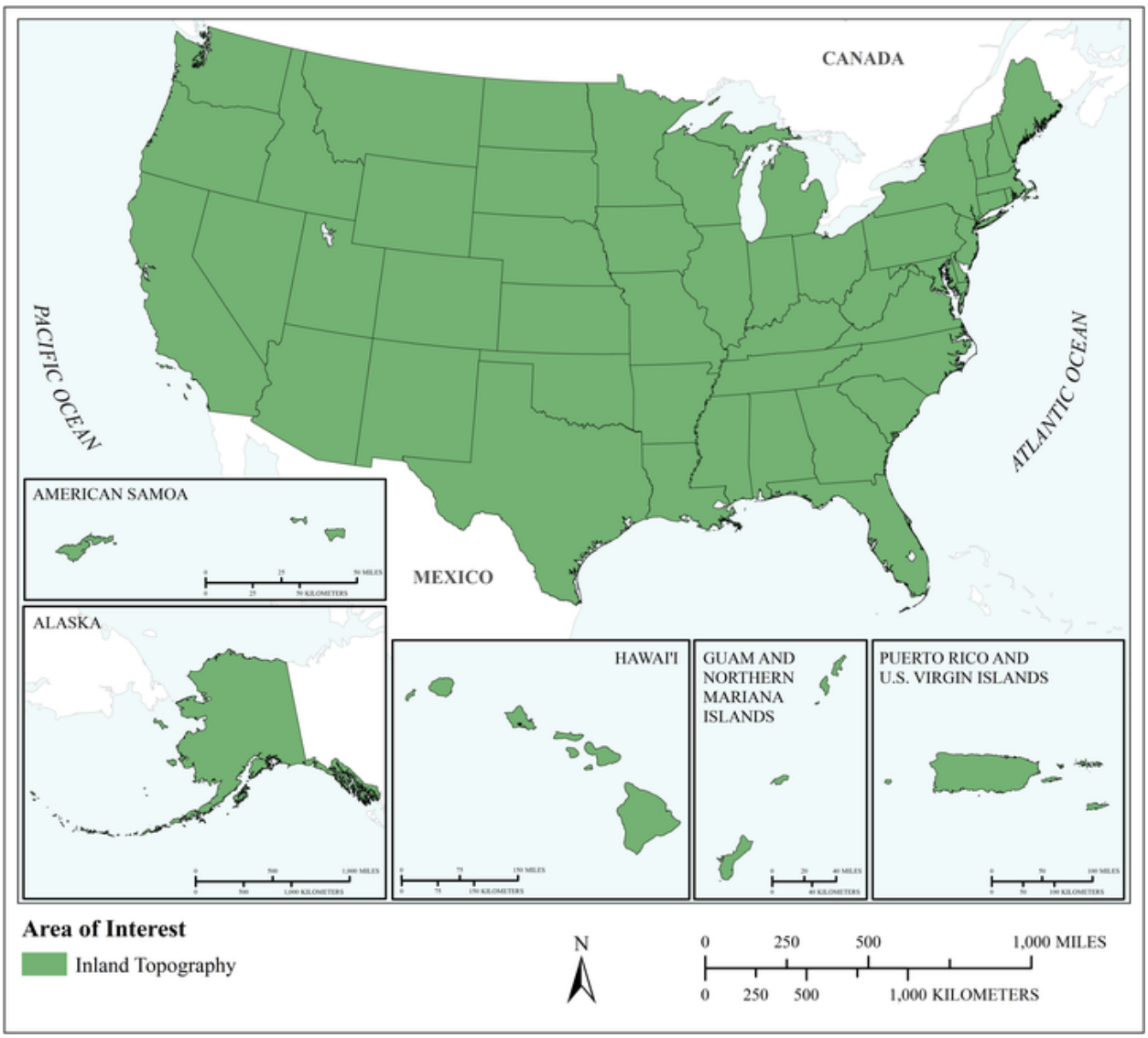
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major			
Environmental	Major			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Increased revenues	Minor	Unable to provide										
Increased revenues description	Produced enhanced DTMs and DEMs in urban settings to offer the market.											
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Improved response or timeliness	Major	Unable to provide										
Improved response or timeliness description	Expedited delivery of property assessments for insurance claims.											
Improved customer experience	Major	Unable to provide										
Improved customer experience description	Insurance companies deliver more precise compensation to affected customers. Reduce costly and time-consuming on-site surveys.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major											
Environmental	Major											
Environmental description	Monitor at the ground level to environmental change such as erosion.											
Public safety, including life and property	Major											
Public safety, including life and property description	Coastal zones are increasingly inhabited by humans. Using mobile lidar to map human development before and after natural disasters enhances and expedites recovery efforts for FEMA.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections	Yes			
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes			
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes			

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Mobile Lidar Solutions Post Disaster



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Mobile Lidar solutions post disaster.
MCA Title	Mobile Lidar Solutions Post Disaster
MCA ID	60722
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 15 - Flood Risk Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Larger than 2 million sq mi (e.g. National)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	4-5 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 20 cm			
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have			
DTM	Required			
DEM	Required			
Raw point cloud data	Highly desirable			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Required			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Highly desirable			
Cultural resources	Nice to have			
Coastal and riverine structures	Required			
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	Minor			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

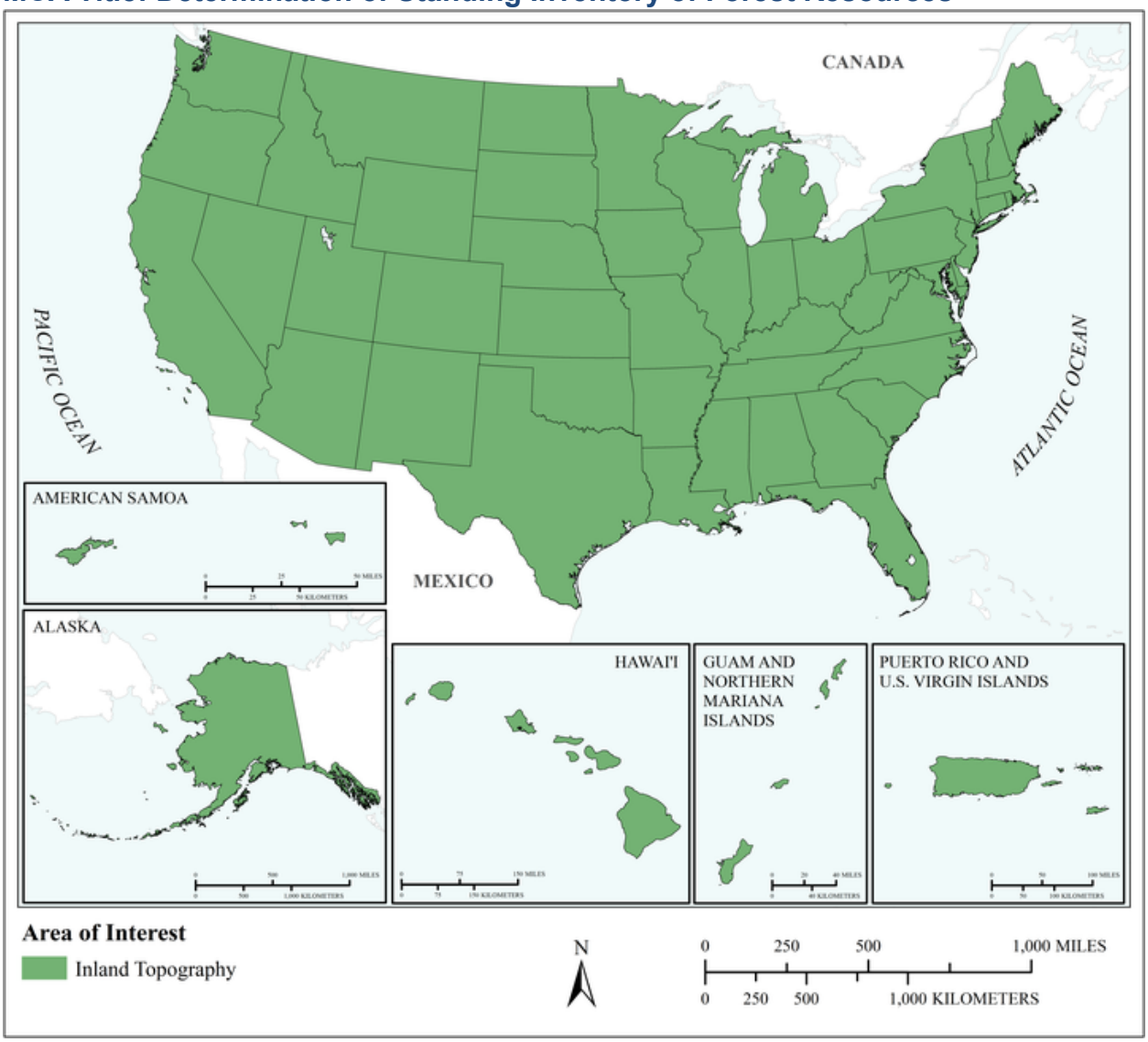
Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major			
Environmental	Moderate			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	Reduce time to assess damage requiring time consuming field surveys.											
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Cost avoidance description	Spend Offices of Emergency Management resources more wisely.											
Increased revenues	Minor	Unable to provide										
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Value added to products or services description	Contributes to flood hazard and risk assessment data for innovative ways to build more resilient communities.											
Improved response or timeliness	Major	Unable to provide										
Improved customer experience	Major	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major											
Education or outreach description	Increase public awareness.											
Environmental	Moderate											
Environmental description	Understand the human developed land at the ground level to better understand impact of flooding.											
Public safety, including life and property	Major											
Public safety, including life and property description	Promotes actions that reduce risk to life and property.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes			
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Determination of Standing Inventory of Forest Resources



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Determination of standing inventory of forest resources.
MCA Title	Determination of Standing Inventory of Forest Resources
MCA ID	60723
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 17 - Wildfire Management, Planning, and Response
Secondary Business Use	BU 04 - Forest Resources Management
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	
Smallest 3D features needed	
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	Annually			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 20 cm			
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Required					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required			
DTM	Required			
DEM	Required			
Raw point cloud data	Nice to have			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Not required			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Nice to have			
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Not required			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Highly desirable			
Bridges/culverts	Nice to have			
Landmark features	Nice to have			
Cultural resources	Nice to have			
Coastal and riverine structures	Nice to have			
Overhead structures				
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate			
Cost savings/cost reduction	Moderate			
Cost avoidance	Major			
Increased revenues	Minor			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

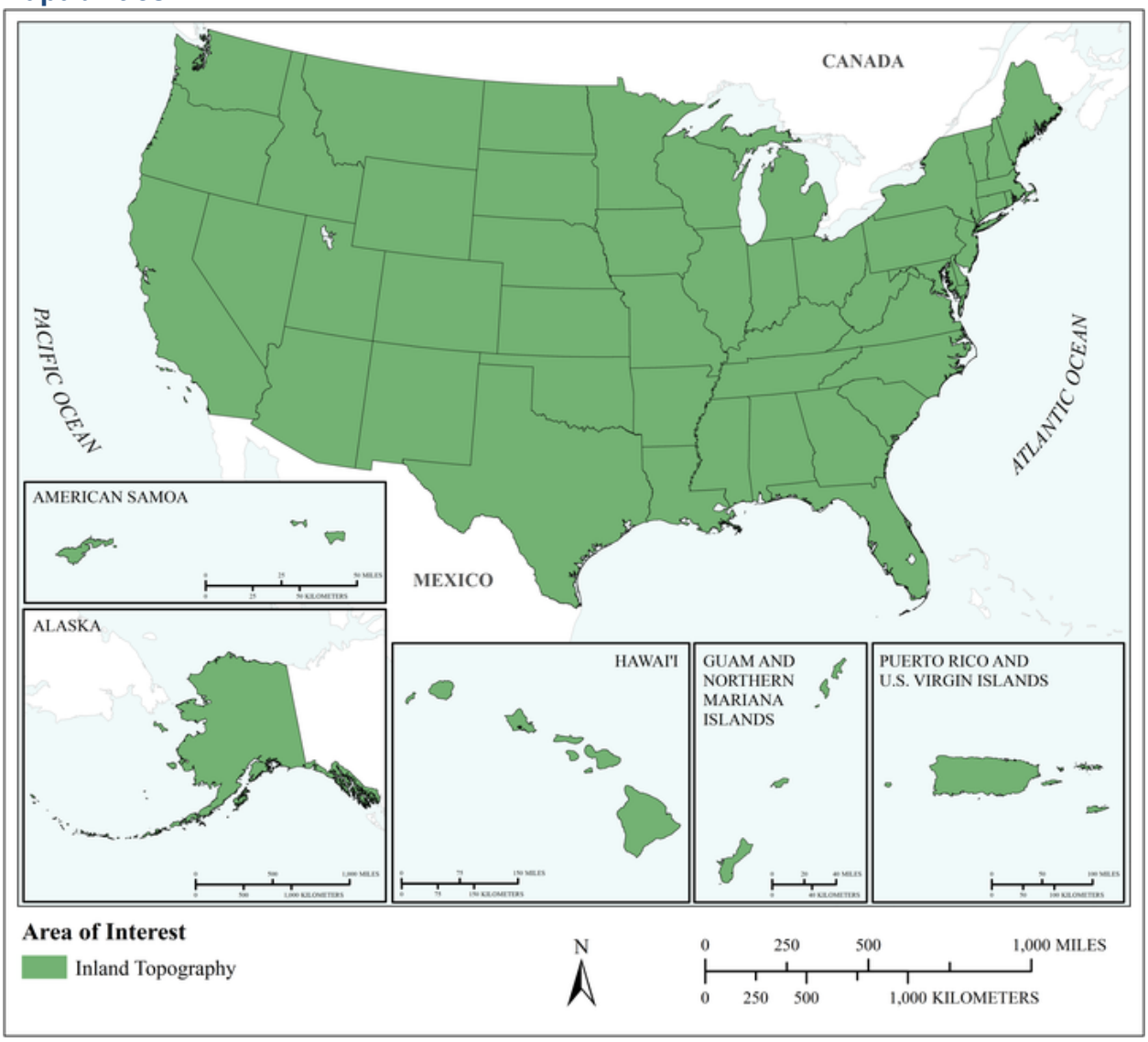
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Moderate			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major			
Environmental	Major			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Cost avoidance description	Reduce chance of budget overages in government budgets for wildland firefighting.											
Increased revenues	Minor	Unable to provide										
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Improved response or timeliness	Major	Unable to provide										
Improved response or timeliness description	For government projects: reduce planning and tactical response techniques for wildland firefighting. Office of Emergency Management and first responders better execute fire mitigation in and around the road network. For industry projects: assess insurance claims faster to better serve its customers.											
Improved customer experience	Major	Unable to provide										
Improved customer experience description	For government projects: better ability to save lives and property. For industry projects: better ability to serve insurance claims to property for the affected population.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major											
Education or outreach description	Understand temporal differences in vegetation cover at the ground level to better understand ecosystems.											
Environmental	Major											
Public safety, including life and property	Major											
Public safety, including life and property description	Saving property will reduce federal disaster relief spending and reduce economic hardships on those impacted by a fire.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	1
Vertical accuracy	2
Update frequency	3

MCA Title: Enhanced Situational Awareness, Planning, and Change Detection Capabilities



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Enhanced situational awareness, planning, and change detection capabilities.
MCA Title	Enhanced Situational Awareness, Planning, and Change Detection Capabilities
MCA ID	60724
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 18 - Homeland Security, Law Enforcement, Disaster Response, and Emergency Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	Larger than 2 million sq mi (e.g. National)
Smallest 3D features needed	Large features (e.g. groups of trees, house, building, road, underwater wreck, large commercial pier, etc.)
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	2-3 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI	Based on use case			
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 20 cm			
How far onshore needed				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Required			
Raw point cloud data	Nice to have			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Highly desirable			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Highly desirable			
Cultural resources	Nice to have			
Coastal and riverine structures	Required			
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	None			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

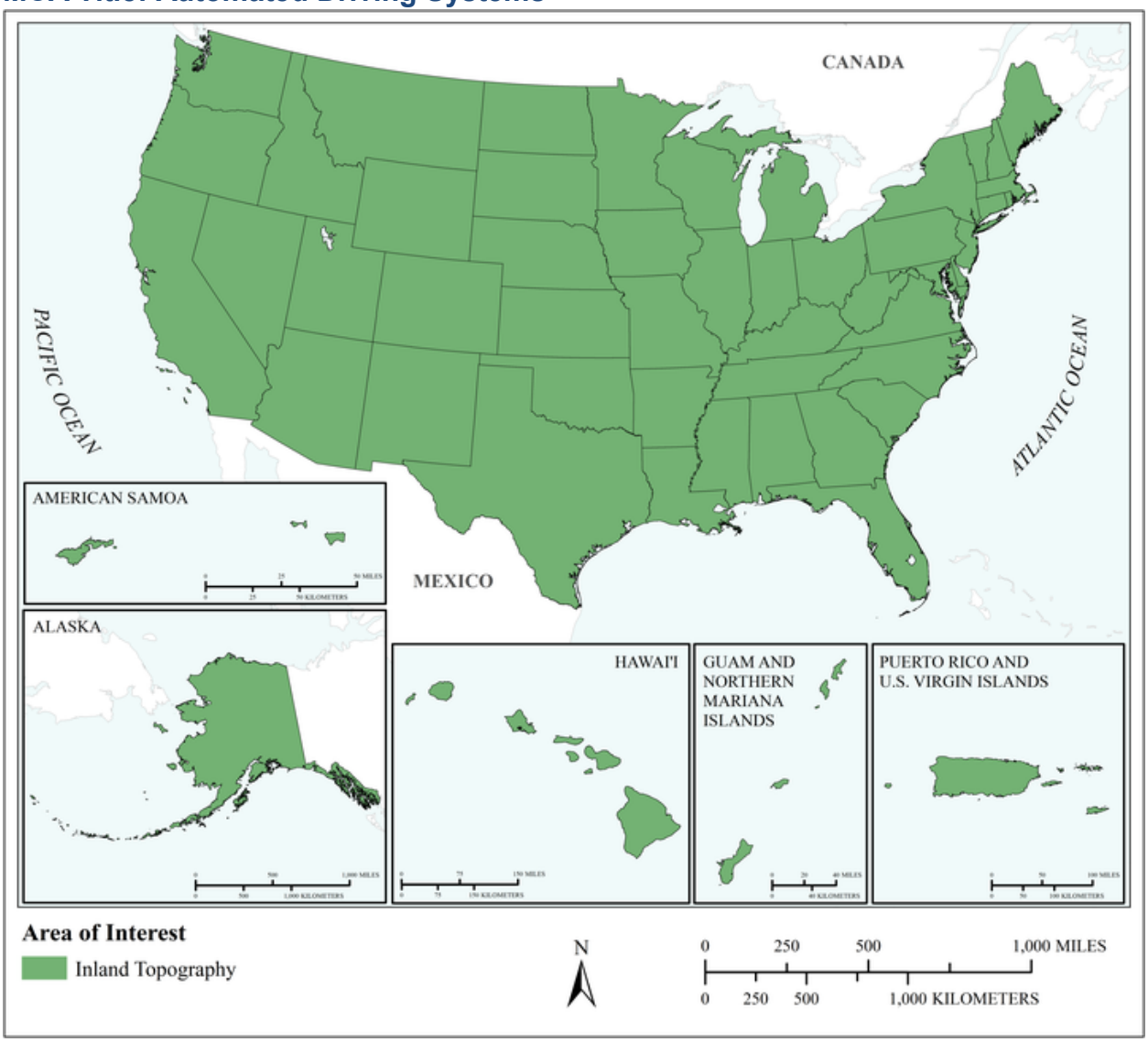
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Minor			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	Efficiencies gained in target actions associated with all stages of emergency management: planning, response, mitigation, and recovery.											
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Cost avoidance description	Expensive on-site emergency response simulations/exercises.											
Increased revenues	Minor	Unable to provide										
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Value added to products or services description	Enhancing the nation’s security through innovation and intelligence.											
Improved response or timeliness	Major	Unable to provide										
Improved response or timeliness description	Reduce tactical response times for the last meter arrival.											
Improved customer experience	Major	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate											
Education or outreach description	Improve training for first responders to prepare for emergencies.											
Environmental	Moderate											
Public safety, including life and property	Major											
Public safety, including life and property description	Save lives and property.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections				
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Automated Driving Systems



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Highly Automated Driving (Highway autopilot, etc.), autonomous driving, and connected ADAS opportunities (Dynamic speed signs, traffic, safety hazards, etc.). Creating accurate, fresher maps as the building blocks of autonomous driving (together with cameras, radar, and lasers, etc.). OEM customers require end to end HAD (Highly Automated Driving) and connected ADAS solutions including this map. HERE are currently providing a Cloud service (HD Live Map), and there is a strong gap in the client side (car), currently covered by OEMs or other suppliers.
MCA Title	Automated Driving Systems
MCA ID	60725
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 19 - Land Navigation and Safety
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Day-to-day is not needed
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	2-3 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 80 cm			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Acceptable Vertical Error	Up to 10 cm			
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable					
DEM for entire AOI needs to be seamless	Highly desirable					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have			
DTM	Required			
DEM	Required			
Raw point cloud data	Highly desirable			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Highly desirable			
Wetlands	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Highly desirable			
Cultural resources	Highly desirable			
Coastal and riverine structures	Highly desirable			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Moderate			
Increased revenues	None			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

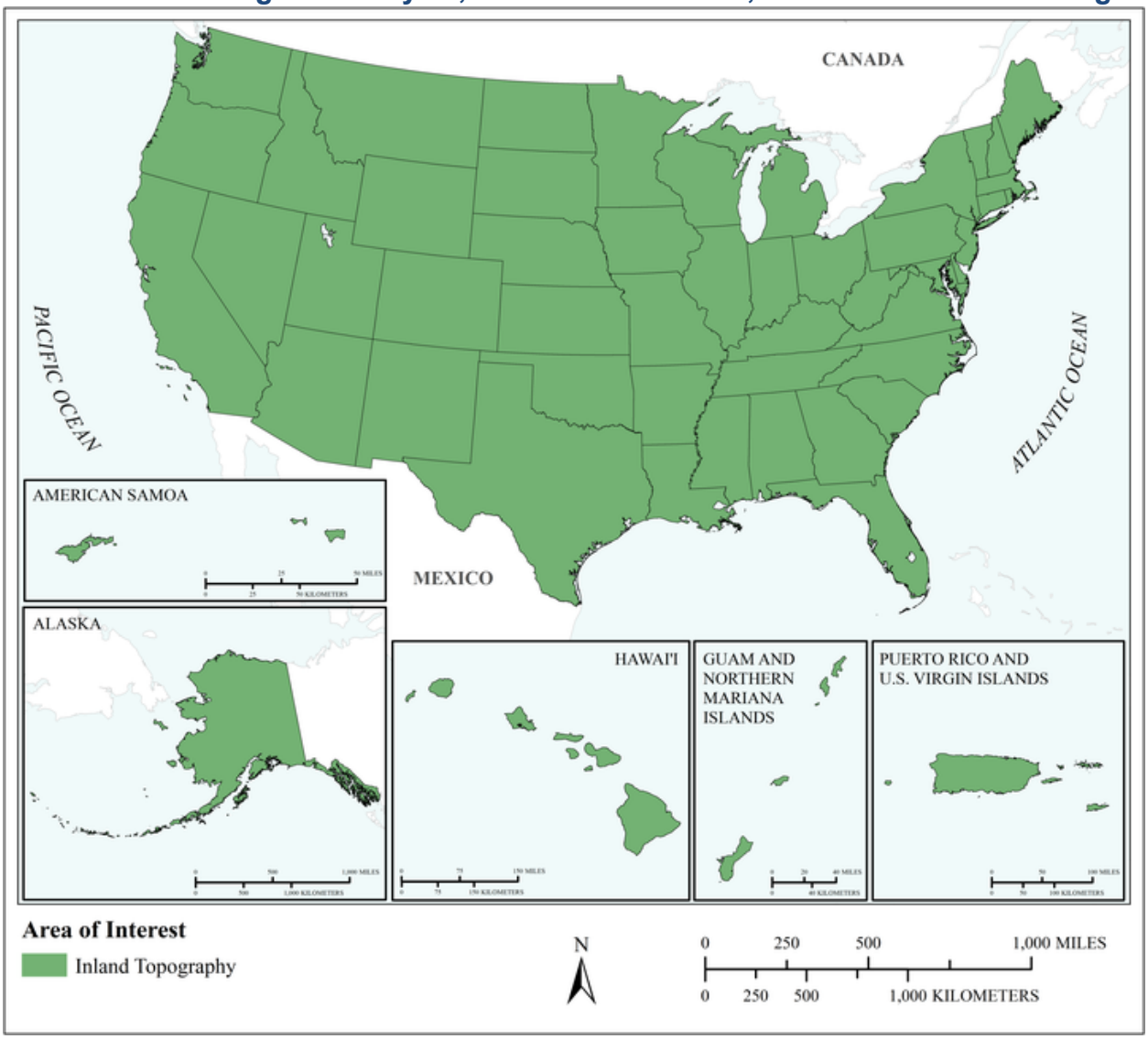
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Moderate			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	Faster to market for automotive OEMs to deliver semi-autonomous driving solutions.											
Cost savings/cost reduction	Major	Unable to provide										
Cost savings/cost reduction description	Licensing content for a high definition map to support C/AV is less expensive than an OEM attempting to developing and building it on their own.											
Cost avoidance	Moderate	Unable to provide										
Cost avoidance description	Reduce risk of sensor-based mapping of roads for this use case.											
Increased revenues	Minor	Unable to provide										
Mission-driven performance improvements	Moderate	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Moderate	Unable to provide										
Improved response or timeliness	Major	Unable to provide										
Improved response or timeliness description	Faster development and productization of HAD solutions.											
Improved customer experience	Moderate	Unable to provide										
Improved customer experience description	Customers can save money and development time by licensing the embedded software stack required to create HAD and connected ADAS solutions. They will also strongly benefit from tools which help them faster research and develop solutions using HERE's HD Live Map Service.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor											
Environmental	Major											
Environmental description	An overall reduction in net energy use and greenhouse gas emissions.											
Public safety, including life and property	Major											
Public safety, including life and property description	Traffic reduction, decreased road deaths, reduced travel time, augmented lane capacity, reduced costs to operate vehicles.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours	Yes			
Hillshades				
Slope maps	Yes			
Aspect maps				
Curvature maps	Yes			
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	1
Update frequency	3

MCA Title: Building Site analysis, Road Infrastructure, and Power Line Planning



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Building site analysis, road infrastructure, and power line planning. Some focus on Engineering and construction of dams, levees, dikes, reservoirs, and coastal structures.
MCA Title	Building Site analysis, Road Infrastructure, and Power Line Planning
MCA ID	60726
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	2-3 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 80 cm			
Acceptable Vertical Error	Up to 10 cm			
How far onshore needed				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have			
DTM	Required			
DEM	Required			
Raw point cloud data	Highly desirable			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Highly desirable			
Cultural resources	Highly desirable			
Coastal and riverine structures	Required			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	None			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

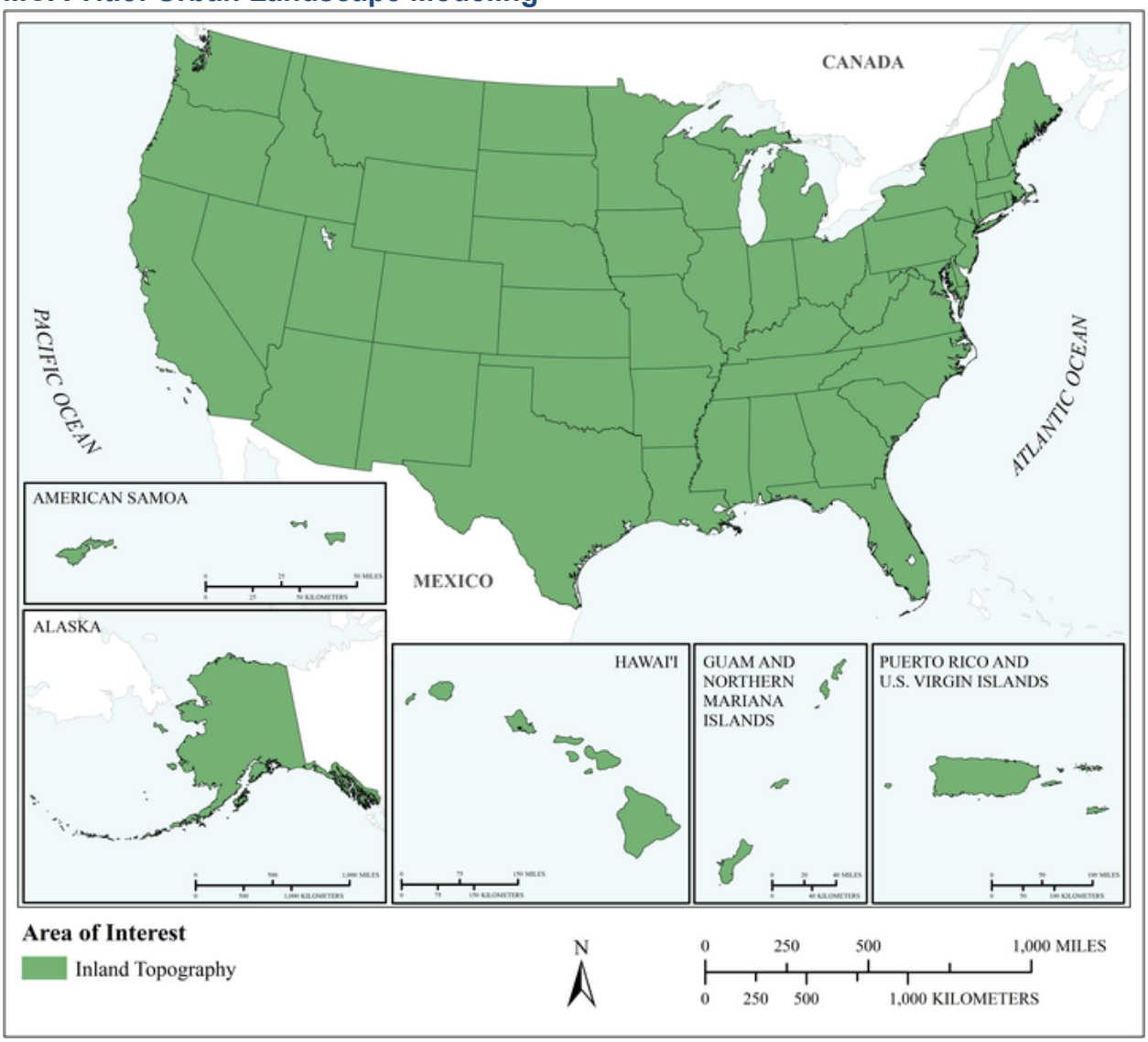
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Moderate			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Moderate			
Public safety, including life and property	Moderate			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	Eliminate pre site survey lead time. Reduce post site survey lead time.											
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Cost avoidance description	Enhance into asset management system in support of bridge and roadway inspection, conduct crack detection and reporting, identify foliage to be trimmed, and guardrails to be replaced, etc.											
Increased revenues	None											
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Improved response or timeliness	Major	Unable to provide										
Improved response or timeliness description	A scalable approach for DOTs to perform feature detection and inventory management.											
Improved customer experience	Major	Unable to provide										
Improved customer experience description	DOTs desire the ability to better identify: Roadway characteristics. Highway performance monitoring systems. MIRE modeling inventory requirement elements – 200 requirements total. Collecting ADA features = curb access for wheelchair access, etc.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor											
Environmental	Moderate											
Public safety, including life and property	Major											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps				
Curvature maps				
Cross sections	Yes			
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Urban Landscape Modeling



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Verifying the slope and clearance of pedestrian paths, sidewalks, and curb ramps. Classifying buildings' features for real estate assessment and taxation purposes.
MCA Title	Urban Landscape Modeling
MCA ID	60727
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 23 - Urban and Regional Planning
Secondary Business Use	BU 25 - Real Estate, Banking, Mortgage, and Insurance
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Larger than 2 million sq mi (e.g. National)
Smallest 3D features needed	Large features (e.g. groups of trees, house, building, road, underwater wreck, large commercial pier, etc.)
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	4-5 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 20 cm			
How far onshore needed				
How far down the beach profile needed				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Required					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Required			
Raw point cloud data	Required			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Required			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Required			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Highly desirable			
Cultural resources	Highly desirable			
Coastal and riverine structures	Highly desirable			
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	Minor			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

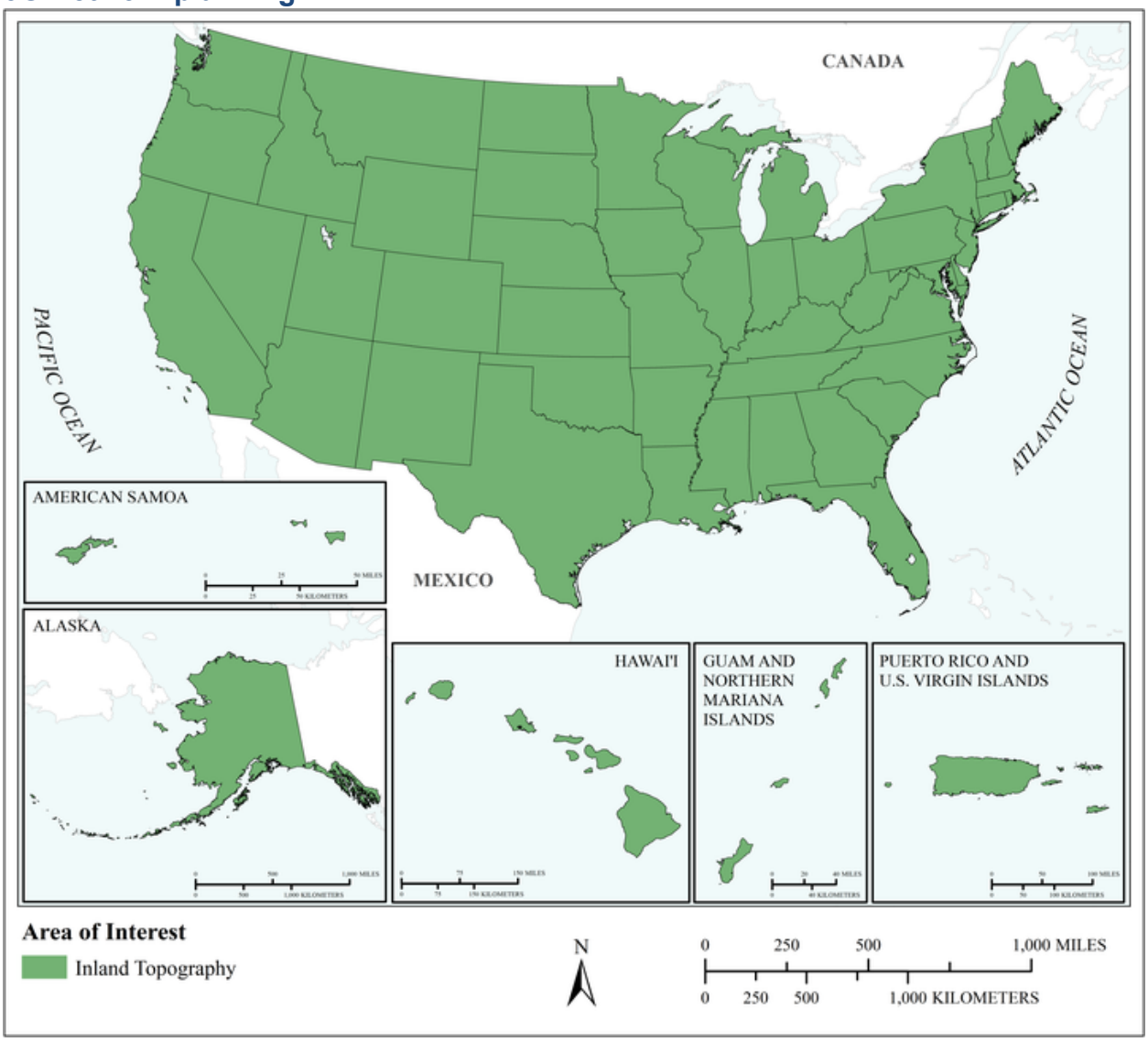
Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate			
Environmental	Major			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	Eliminate pre site survey lead time. Reduce post site survey lead time. Verify the slope and clearance of pedestrian paths, sidewalks and curb ramps.											
Cost savings/cost reduction	Major	Unable to provide										
Cost avoidance	Major	Unable to provide										
Increased revenues	Minor	Unable to provide										
Increased revenues description	Classify buildings' features for real estate assessment and taxation purposes. Use in-house machine learning to classify features for real estate assessment.											
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Value added to products or services description	Develop new right of ways for connected and automated vehicles. Modify urban infrastructure to accommodate 5G network infrastructure.											
Improved response or timeliness	Major	Unable to provide										
Improved customer experience	Major	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate											
Environmental	Major											
Environmental description	Urban landscape that complies to urban environment.											
Public safety, including life and property	Major											
Public safety, including life and property description	Saving life and property thanks to building compliance and better enforcement.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours	Yes			
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps	Yes			
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness	Yes			

Importance of 3D Data Requirements	Response
Geographic coverage	1
Vertical accuracy	2
Update frequency	3

MCA Title: Digital Site Survey of street furniture assets in urban environments for 5G Network planning



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	States and/or Territories			
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau			

MCA Description	Response
Mission Critical Activity	Digital Site Survey of street furniture assets in urban environments for 5G Network planning. Radio frequency planning and network design based on the high precision geodata models extracted from remote sensors like lidar and aerial/satellite images.
MCA Title	Digital Site Survey of street furniture assets in urban environments for 5G Network planning
MCA ID	60728
Organization Type	Private or Commercial
Organization Name	HERE Technologies
Sub-Agency or Division	
Organization Mission	Creating a digital representation of reality to radically improve the way everyone and everything lives, moves and interacts.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 28 - Telecommunications
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	25,000 sq mi - 74,999 sq mi (e.g. medium state or large multi-county region)
Smallest 3D features needed	Large features (e.g. groups of trees, house, building, road, underwater wreck, large commercial pier, etc.)
Description of smallest 3D features	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0			
Update Frequency	Annually			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter			
Acceptable Vertical Error	Up to 1 meter			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Required					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Highly desirable			
DEM	Highly desirable			
Raw point cloud data	Highly desirable			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Highly desirable			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Highly desirable			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Highly desirable			
Wetlands	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required			
Bridges/culverts	Required			
Landmark features	Required			
Cultural resources	Highly desirable			
Coastal and riverine structures	Required			
Overhead structures				
Lowest Floor Elevation of Buildings	Required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	None			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	None			
Environmental	None			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide										
Time savings description	40% reduction.											
Cost savings/cost reduction	Major	Unable to provide										
Cost savings/cost reduction description	1. Physical Site Survey Avoidance Reduce truck rolls Enable more strategic skilled labor dispatch paradigm 2. Accelerate Real Estate Acquisition Environmental digitization of cell site candidate locations Precise measurements Coarse line of site analysis 3. Centralized Network Planning Small cells (pole based) Rooftop macro cells Cell tower macro cells											
Cost avoidance	Major	Unable to provide										
Cost avoidance description	Avoid time consuming, errors prone, and expensive field survey to collect data.											
Increased revenues	None											
Mission-driven performance improvements	Major	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Improved response or timeliness	Major	Unable to provide										
Improved customer experience	Major	Unable to provide										
Improved customer experience description	Eliminate pre site survey lead time. Reduce post site survey lead time via centralized, digital approach to network planning: Centralized, digitized cell site candidate real estate records Accelerate procurement of base station equipment Accelerate ancillary HW (e.g. mounting) Conflate fiber optic routes & access points with cell sites											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor											
Environmental	Minor											
Public safety, including life and property	Minor											
Public safety, including life and property description	Building a successful 5G Network enables more capabilities.											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections	Yes			
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness	Yes			

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Hobu

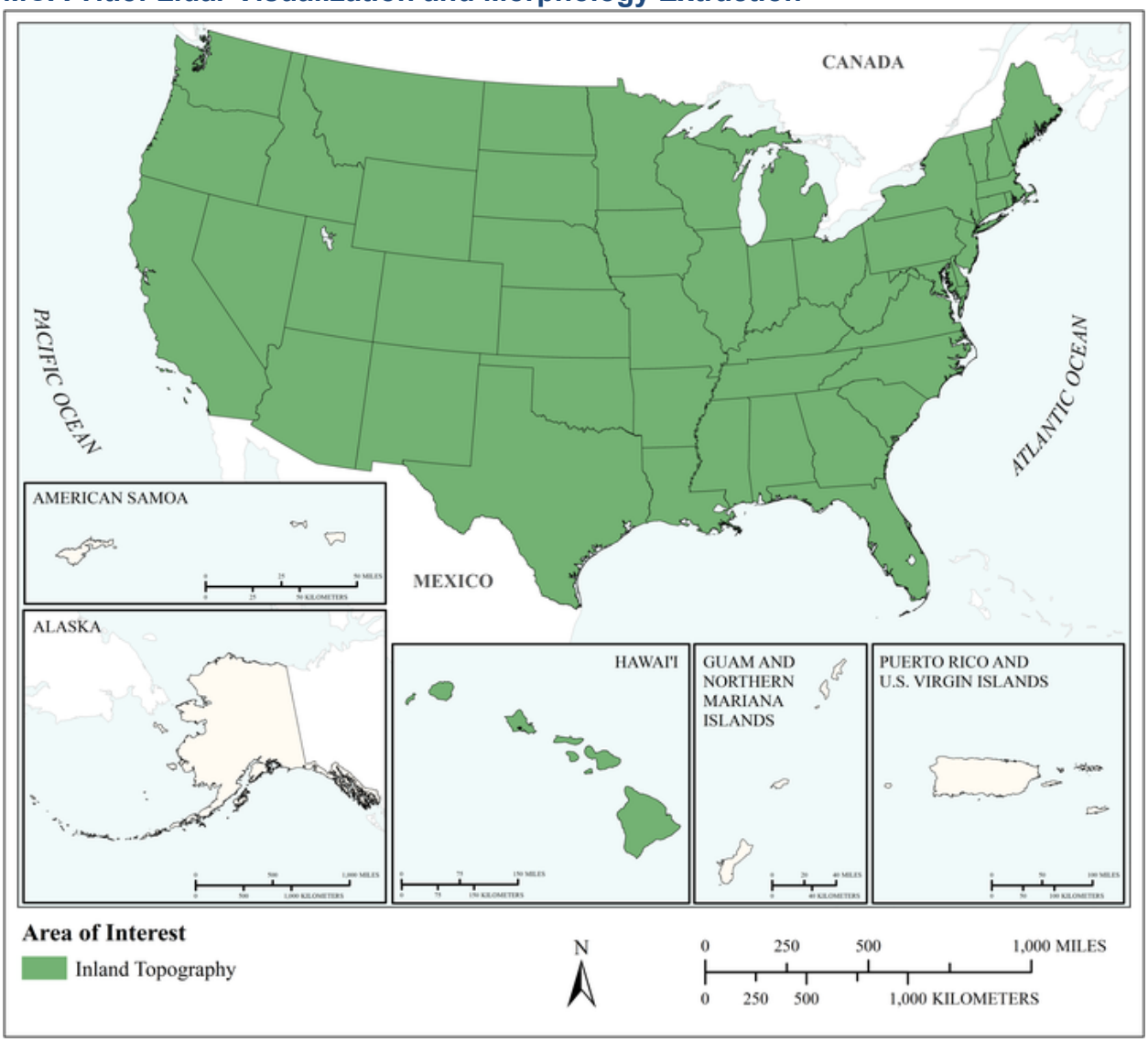
Hobu provides open source lidar and GIS software development services, in addition to contract research and development, systems design, evaluation, and implementation.

Hobu has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 06 – Natural Resource Management	Hobu	21949	Lidar Visualization and Morphology Extraction	Inland Topo	QL2	4-5 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Lidar Visualization and Morphology Extraction



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	Nationwide, inland areas			
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Lidar visualization and morphology extraction.
MCA Title	Lidar Visualization and Morphology Extraction
MCA ID	21949
Organization Type	Private or Commercial
Organization Name	Hobu
Sub-Agency or Division	
Organization Mission	We develop open source lidar processing and organization software
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 06 - Natural Resources Conservation
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Small features

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2			
Update Frequency	4-5 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 50 cm			
Acceptable Vertical Error	Up to 50 cm			
How far onshore needed				
How far down the beach profile needed	To MHW			
Tide correction requirement				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross sections and/or transects meet needs	Partial			
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have					
Entire AOI under same environmental conditions	Nice to have					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Nice to have					
DEM for entire AOI needs to be seamless	Nice to have					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to double the required TVU at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have			
DTM	Highly desirable			
DEM	Highly desirable			
Raw point cloud data	Required			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Nice to have			
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Highly desirable			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Highly desirable			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Highly desirable			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Nice to have			
Bridges/culverts	Nice to have			
Landmark features	Nice to have			
Cultural resources	Nice to have			
Coastal and riverine structures	Nice to have			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes			
NCEI	Yes			
Open Topography	Yes			
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate			
Cost savings/cost reduction	Moderate			
Cost avoidance	Major			
Increased revenues	Moderate			
Mission-driven performance improvements	Moderate			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Moderate			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate			
Environmental	Moderate			
Public safety, including life and property	Moderate			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide										
Cost savings/cost reduction	I don't know	Unable to provide										
Cost avoidance	I don't know	Unable to provide										
Increased revenues	I don't know	Unable to provide										
Mission-driven performance improvements	I don't know	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide										
Improved response or timeliness	I don't know	Unable to provide										
Improved customer experience	I don't know	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know											
Environmental	I don't know											
Public safety, including life and property	I don't know											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

HydroTerra Technologies, LLC

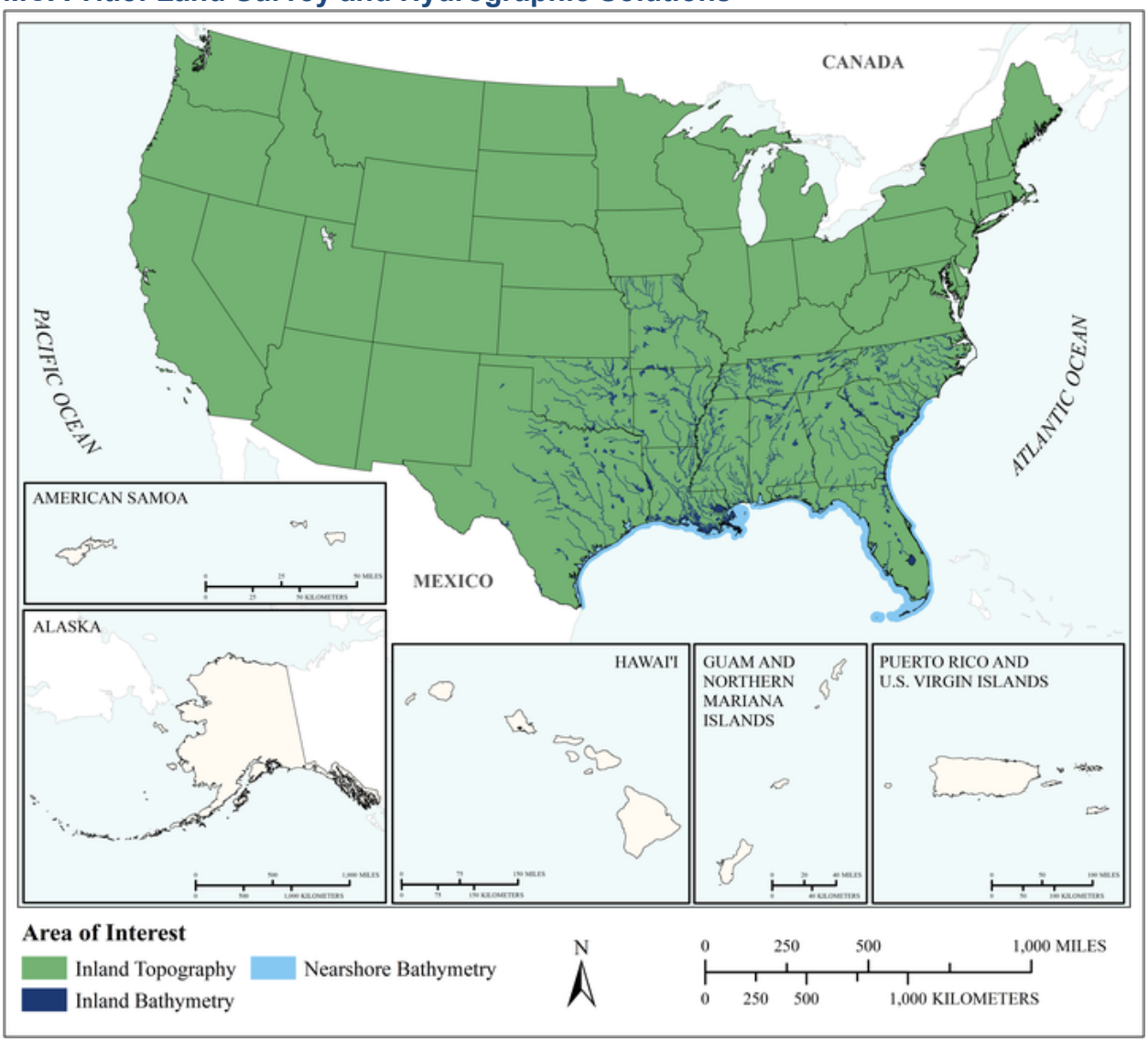
HydroTerra Technologies, LLC is a full service land and hydrographic surveying firm, specializing in inshore and near shore shallow water hydrographic surveying and a wide range of land survey services. Using the latest technology and innovative techniques, HydroTerra Technologies, LLC provides cost-effective land and hydrographic solutions to clients including: oil and gas well location surveys, pipeline and utility route surveys, right-of-way mapping, dredging support surveys, site clearance and investigation, hazard surveys, bathymetric surveys, GIS acquisition and development, consulting and training, and mapping and charting. Elevation data are largely used for land and hydrographic surveying in support of coastal restoration projects, shoreline protection projects and dredging projects.

HydroTerra Technologies, LLC has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				Requirements			Future Operational Benefits	Future Customer Service Benefits	Future Societal Benefits		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 03 – Coastal Zone Management	HydroTerra Technologies, LLC	22013	Land Survey and Hydrographic Solutions	Inland Topo	Cross sections and/or transects meet needs	Annually	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Inland Bathy	Cross sections and/or transects meet needs	Annually	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know
				Nearshore Bathy	Cross sections and/or transects meet needs	Annually	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Land Survey and Hydrographic Solutions



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	
Geographic Area Requirements	Nationwide, inland areas	One or more states, territories, or counties	Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Land and hydrographic surveying in support of coastal restoration projects, shoreline protection projects and dredging projects
MCA Title	Land Survey and Hydrographic Solutions
MCA ID	22013
Organization Type	Private or Commercial
Organization Name	HydroTerra Technologies, LLC
Sub-Agency or Division	
Organization Mission	HydroTerra Technologies, LLC is a Hudson Initiative Certified Small and Emerging Business Enterprise, a Hudson Certified Active Small Entrepreneurship Business and a BBB Accredited Business. We are a full service land and hydrographic surveying firm, specializing in inshore and near shore shallow water hydrographic surveying and a wide range of land survey services. Although initially formed as a consulting firm, we have expanded our initial focus and capabilities to provide a wide array of land and hydrographic surveying services to a diverse variety of clientele. Using the latest technology and innovative techniques, LLC provides cost effective land and hydrographic solutions to our clients including; dredging support surveys, oil and gas well location surveys, pipeline and utility route surveys, right of way mapping, site clearance and investigation, hazard surveys, bathymetric surveys, multibeam surveys, GIS acquisition and development, consulting and training, and mapping and charting. We currently have professional survey licenses for Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama, Florida and Tennessee, in addition to having a certified Hydrographer on staff.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 03 - Coastal Zone Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Not required
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Exposed pipelines

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Nice to have

Inland Bathy Feature Size Requirements	Response
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Nice to have
51 - 100 ft	Nice to have
101 - 500 ft	Nice to have
501 - 2,500 ft	Not required
Greater than 2,500 ft	Not required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Nice to have
Greater than 10 acres	Nice to have

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	
Update Frequency	Annually	Annually	Annually	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Less than 20 cm	Less than 50 cm	Less than 50 cm	
Acceptable Vertical Error	Less than 5 cm	Less than 10 cm	Less than 10 cm	
How far onshore needed			1 kilometer inland	
How far down the beach profile needed	Below MLLW		Below MLLW	
Tide correction requirement			MLLW	
Cross sections and/or transects meet needs	Yes	Yes	Yes	
Cross section/transect requirement	Varies by project. Cross section spacing 25'-100', 10-25' along the cross section and vertical accuracy is usually RTK methods			

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Nice to have

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Nice to have	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
Entire AOI under same environmental conditions	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Nice to have	Nice to have		Nice to have	Not required
DEM for entire AOI needs to be seamless	Highly desirable	Nice to have	Nice to have		Nice to have	Nice to have
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Not required	Nice to have	Not required	
DTM	Nice to have	Nice to have	Nice to have	
DEM	Highly desirable	Nice to have	Nice to have	
Raw point cloud data	Not required	Not required	Not required	
Classified point cloud	Not required	Not required	Not required	
Edited/cube XYZ		Not required	Not required	
Full waveform	Not required	Not required	Not required	
Bathymetric Attributed Grid (BAG)		Not required	Not required	
Breaklines required for standard hydro-flattening	Not required	Not required		
Additional breaklines for hydro-enforcement of culverts	Not required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Nice to have	
Tide Predictions			Nice to have	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Not required	Nice to have	Not required	
Ground control/ground truthing	Highly desirable	Nice to have	Not required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Nice to have	
Nautical and/or navigation charts			Nice to have	
Acoustic imagery of the seafloor			Not required	
Aerial and/or satellite imagery	Required	Nice to have	Nice to have	
Underwater videography			Not required	
Bottom texture			Not required	
Bottom type			Not required	
Submerged features			Not required	
Subbottom characteristics			Not required	
Geologic and seismic data	Not required	Not required	Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Not required	
Tide/wave heights			Not required	
Sea ice conditions			Not required	
Habitat distribution and classification			Not required	
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Not required	
Lease areas			Nice to have	
Fixed obstructions			Not required	
Floating observation/navigation systems			Nice to have	
Shorelines – current, historic, change rates	Highly desirable	Nice to have	Nice to have	
Land use/land cover	Not required	Not required	Not required	
Wetlands	Nice to have	Nice to have	Nice to have	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Nice to have	
Inland surface water features	Highly desirable	Nice to have	Nice to have	
Bridges/culverts	Highly desirable	Nice to have		
Landmark features	Highly desirable	Nice to have	Not required	
Cultural resources	Not required	Not required	Not required	
Coastal and riverine structures	Highly desirable	Nice to have	Nice to have	
Overhead structures			Nice to have	
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	None	Best available	Best available	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast		Yes		
NCEI		Yes		
Open Topography				
NOAA nautical charts			Yes	
USACE navigation charts		Yes	Yes	
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	Base flood maps			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	Minor	Minor	
Cost savings/cost reduction	Moderate	Minor	Minor	
Cost avoidance	Moderate	Minor	Minor	
Increased revenues	Moderate	Minor	Minor	
Mission-driven performance improvements	Moderate	Minor	Minor	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Minor	Minor	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Moderate	Minor	Minor	
Improved customer experience	Moderate	Minor	Minor	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	I don't know	None	Minor	
Environmental	I don't know	None	Minor	
Public safety, including life and property	I don't know	None	Minor	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Cost savings/cost reduction	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Cost avoidance	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Increased revenues	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Mission-driven performance improvements	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Improved response or timeliness	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Improved customer experience	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know			I don't know			I don't know					
Environmental	I don't know			I don't know			I don't know					
Public safety, including life and property	I don't know			I don't know			I don't know					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

JMS Geomatics

JMS Geomatics is focused on mapping, CAD, GIS, and data acquisition for the golf industry. JMS Geomatics has mapped and analyzed golf courses across the U.S. and overseas.

Elevation data are used in conjunction with orthoimagery for course mapping, design, renovation, and maintenance. Elevation data have also been used by course owners, superintendents, and architects for historical documentation and slope analysis. The data can also help identify drainage issues, identify features in heavily wooded areas, and for change detection. Additionally, environmental and cost improvements can be realized by course owners when applications (e.g. seed, fertilizer, and water) are optimized using elevation data. Lidar also provides value in the ability to identify above ground features such as trees and tall vegetation.

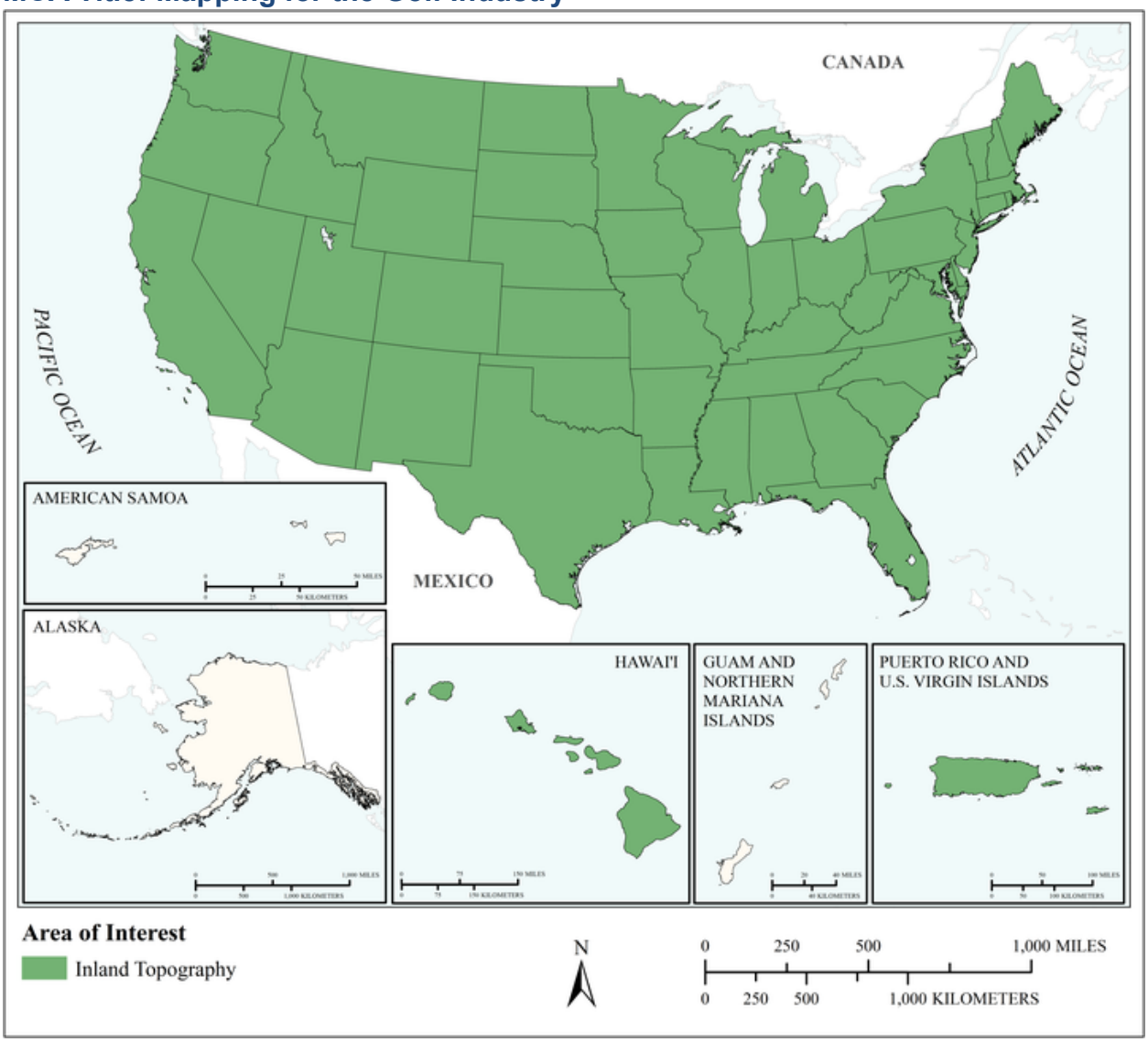
JMS Geomatics uses Quality Level 2 lidar data from the National Map coupled with ground-based surveys and mapping as well as data captured with Unmanned Aerial Systems to create detailed 3D models of courses to support its clients.

JMS Geomatics has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 23 – Urban and Regional Planning	JMS Geomatics	21931	Mapping for the Golf Industry	Inland Topo	QL1	Event driven	$13,266	Unable to quantify	None	Moderate	None

MCA Title: Mapping for the Golf Industry



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	Nationwide, inland areas			
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Mapping, CAD and GIS for the golf industry. Elevation data are used for redesign of golf courses and prediction of drainage issues. Lidar from 2012 and newer with the higher point density works well for this. The data can help identify ponding, wet areas, and areas where irrigation may not be properly spaced. The data can help increase irrigation efficiency. Lidar can be used independent from imagery to show creeks, etc. in heavily wooded areas. Historic data are also useful. Imagery is also needed to evaluate change, calculate fertilizer requirements, etc. Environmental improvements are realized if application (e.g. seed, fertilizer, and water) is precisely calculated. Lidar also provides value in the ability to identify above ground features such as trees and tall vegetation.
MCA Title	Mapping for the Golf Industry
MCA ID	21931
Organization Type	Private or Commercial
Organization Name	JMS Geomatics
Sub-Agency or Division	
Organization Mission	We map golf courses
Program Name	Mapping for the Golf Industry
Total Annual Program Budget	
Primary Business Use	BU 23 - Urban and Regional Planning
Secondary Business Use	BU 27 - Recreation
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Trees, bushes and other landscaping would be the smallest 3D features I'm interested in. Also shorelines.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1			
Update Frequency	Event driven only – Data need to coincide with a specific event.			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Event type(s)	Hurricane or flooding event. Baseline update requirements vary by course.			
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 30 cm			
Acceptable Vertical Error	Up to 10 cm			
How far onshore needed				
How far down the beach profile needed	Not applicable			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Not required
Hydro-enforcement	Not required
Hydro-conditioning	Not required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Not required			
Raw point cloud data	Required			
Classified point cloud	Required			
Edited/cube XYZ				
Full waveform	Not required			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Not required			
Additional breaklines for hydro-enforcement of culverts	Not required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Nice to have			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Required			
Land use/land cover	Not required			
Wetlands	Not required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Nice to have			
Bridges/culverts	Nice to have			
Landmark features	Not required			
Cultural resources	Not required			
Coastal and riverine structures	Nice to have			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	A lot of the data I use is QL2 level from over several years. I ground truth all of the data and have been very pleased with most of it.			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	Minnesota, others			
Other	Yes			
Other description	City and county resources			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			

Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Cost savings/cost reduction	Major			
Cost avoidance	Major			
Increased revenues	Moderate			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			
Improved response or timeliness	Major			
Improved customer experience	Major			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	I don't know			
Environmental	Major			
Public safety, including life and property	Major			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Moderate	Annual dollars saved/realized	$13,266									
Time savings description	We can identify streams and other similar features much more easily. We use the data to fill in areas where ground based mapping is difficult. Approximately 50 courses per year are reviewed.											
Cost savings/cost reduction	I don't know	Unable to provide										
Cost avoidance	I don't know	Unable to provide										
Increased revenues	I don't know	Unable to provide										
Mission-driven performance improvements	Major	Unable to provide										
Mission-driven performance improvements description	The better the data the less time we have to spend on the ground and the less impact we have on those playing golf.											
Other operational benefits	Major	Unable to provide										
Other operational benefits description	As the data gets better, it will mean less field time for us.											
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide										
Improved response or timeliness	Moderate	Unable to provide										
Improved customer experience	Major	Unable to provide										
Other customer service benefits	Moderate	Unable to provide										
Other customer service benefits description	The data enhances our ground based mapping.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	None											
Environmental	Moderate											
Environmental description	With good terrain we can predict drainage issues better, also better calculate application (e.g. fertilizer, seed, water, etc.) requirements.											
Public safety, including life and property	None											
Other	Better terrain means a better product											
Other benefits	Moderate											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Lampl Herbert Consultants, Inc. (LHC)

LHC is a natural resources consulting firm whose practice extends to federal, state, and local policy and regulatory venues. LHC commonly serves as project agent, manager, and coordinator for regulatory permitting projects including development and submittal of permit applications, supporting studies, briefings, monitoring, and community relations. In other settings, LHC functions as the outside team to local governments responsible for regulation of mining companies, and, separately, consults with public agencies and non-profit organizations engaged in acquiring conservation easements across private lands and/or private properties to be used for mitigation banks.

LHC's research projects extend to the socio-political setting in which public policy is created. From time-to-time, LHC lobbies at the state government level with clients who want to inform public policy. In some cases, LHC provides a "road map" to the policy process and coaches its clients regarding the culture of the political system.

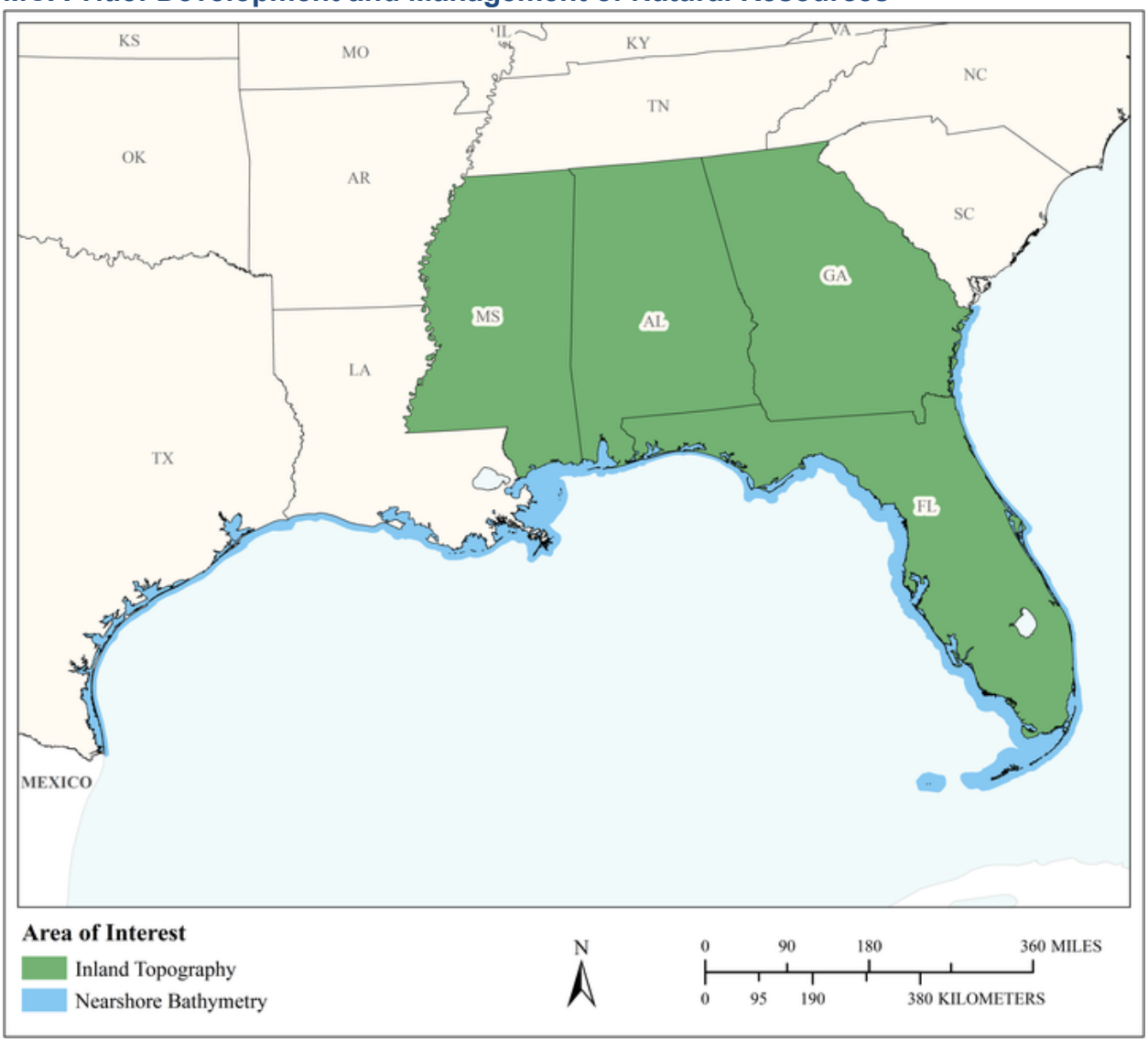
LHC teammates are currently working in regulatory arenas that govern exploration for and production of oil and gas resources; avoid habitats for keystone species including monarch butterfly production areas; identification of mineral resources; regulation and drilling of industrial water wells, and discussions about the life cycle of natural resource development projects.

LHC has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 13 – Oil and Gas Resources	Lampl Herbert Consultants, Inc.	51000	Development and Management of Natural Resources	Inland Topo	QL1	2-3 years	$750,000 to $3,000,000	Unable to quantify	Major	Major	Major
				Nearshore Bathy	QL0B	6-10 years	$300,000 to $1,250,000	Unable to quantify	Major	Major	Major

MCA Title: Development and Management of Natural Resources



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required		Required	
Geographic Area Requirements	One or more states, territories, or counties		Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Mine area delineation, wetlands, oil and gas location development, seismic survey planning. Elevation data are beneficial for conducting infills and updates.
MCA Title	Development and Management of Natural Resources
MCA ID	51000
Organization Type	Private or commercial
Organization Name	Lampl Herbert Consultants, Inc.
Sub-Agency or Division	
Organization Mission	Development and management of natural resources
Program Name	Oil and gas development, coastal resiliency, Naval research
Total Annual Program Budget	$2,000,000
Primary Business Use	BU 13 - Oil and Gas Resources
Secondary Business Use	BU 11 - Geologic Resource Mining and Extraction
Tertiary Business Use	BU 10 - Geologic Assessment and Hazard Mitigation

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Not required
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Required
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	1 meter objects

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1		QL0B	
Update Frequency	2-3 years		6-10 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 60 cm		Up to 2 meters	
Acceptable Vertical Error	Less than 5 cm		Less than 10 cm	
How far onshore needed			1 kilometer inland	
How far down the beach profile needed	Below MLLW		Below MLLW	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Tide correction requirement			MLLW	
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Required
Hydro-conditioning	Required
No Treatment	Required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have		Nice to have			Nice to have
Entire AOI under same environmental conditions	Nice to have		Nice to have			Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Nice to have		Nice to have			Nice to have
DEM for entire AOI needs to be seamless	Nice to have		Nice to have			Nice to have
Amount of acceptable vertical manipulation to achieve spatial seamlessness	I don't know		I don't know			I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required		Required	
DTM	Not required		Not required	
DEM	Required		Required	
Raw point cloud data	Not required		Not required	
Classified point cloud	Not required		Not required	
Edited/cube XYZ			Not required	
Full waveform	Not required		Not required	
Bathymetric Attributed Grid (BAG)			Not required	
Breaklines required for standard hydro-flattening	Not required			
Additional breaklines for hydro-enforcement of culverts	Not required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Not required	
Tide Predictions			Not required	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Required		Required	
Ground control/ground truthing	Not required		Not required	
Other	Required		Required	
Other description	Project report		Project report	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Not required	
Nautical and/or navigation charts			Not required	
Acoustic imagery of the seafloor			Not required	
Aerial and/or satellite imagery	Not required		Not required	
Underwater videography			Not required	
Bottom texture			Not required	
Bottom type			Not required	
Submerged features			Not required	
Subbottom characteristics			Nice to have	
Geologic and seismic data	Nice to have		Nice to have	
Water column properties - Physical			Nice to have	
Water column properties - Chemical			Not required	
Water column properties - Biological			Required	
Currents			Not required	
Tide/wave heights			Not required	
Sea ice conditions			Not required	
Habitat distribution and classification			Not required	
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Not required	
Lease areas			Not required	
Fixed obstructions			Not required	
Floating observation/navigation systems			Required	
Shorelines – current, historic, change rates	Highly desirable		Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Land use/land cover	Nice to have		Nice to have	
Wetlands	Highly desirable		Highly desirable	
Estuaries			Not required	
Inland surface water features	Not required		Not required	
Bridges/culverts	Not required			
Landmark features	Not required		Not required	
Cultural resources	Not required		Not required	
Coastal and riverine structures	Not required		Not required	
Overhead structures			Not required	
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available		Best available	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI	Yes		Yes	
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	FDEP			
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major		Major	
Cost savings/cost reduction	Major		Major	
Cost avoidance	Major		Major	
Increased revenues	Major		Major	
Mission-driven performance improvements	Major		Major	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate		Moderate	
Improved response or timeliness	Major		Major	
Improved customer experience	Moderate		Moderate	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate		Moderate	
Environmental	Moderate		Moderate	
Public safety, including life and property	Moderate		Moderate	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide					Major	Unable to provide				
Cost savings/cost reduction	Major	Unable to provide					Major	Unable to provide				
Cost avoidance	Major	Unable to provide					Major	Unable to provide				
Increased revenues	Major	Unable to provide					Major	Unable to provide				
Mission-driven performance improvements	Major	Unable to provide					Major	Unable to provide				
Other operational benefits	Major	Annual dollars saved/realized	$750,000 to $3,000,000				Major	Annual dollars saved/realized	$300,000 to $1,250,000			
Other operational benefits description	Conduct infills and updates.						Conduct infills and updates.					
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide					Major	Unable to provide				
Improved response or timeliness	Major	Unable to provide					Major	Unable to provide				
Improved customer experience	Major	Unable to provide					Major	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major						Major					
Environmental	Major						Major					
Public safety, including life and property	Major						Major					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades	Yes		Yes	
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps	Yes			
Cross sections	Yes			
Height-Above-Ground maps	Yes			
Viewshed maps	Yes			
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

Leading Edge Geomatics

Established in 2007, Leading Edge Geomatics specializes in remote sensing and geomatics solutions, focused on airborne digital imagery and lidar data acquisition. Headquartered in New Brunswick, Canada, Leading Edge Geomatics provides aerial survey and geomatics services across North America to clients across a number of industries including energy, forestry, mining, and bathymetry.

Leading Edge Geomatics' elevation data are used for forest resources management, natural resources management, and wildfire management. Leading Edge Geomatics has developed a Forest Management Solution integrating Enhanced Forest Inventory with lidar terrain and surface products. The Forest Management Solution can help to:

- analyze variation in forest growth and performance;
- improve change detection; and
- predict accurate forest metrics.

Leading Edge Geomatics uses elevation data to support natural resources management by routinely gathering data on ecosystems of interest and offering constant up to date information. By acquiring aerial data, users can monitor the state of any area or changes in characteristics of the landscape and water. Data collection contributes to efforts in sustainable resource management, environmental management, tourism, parks and recreation, transportation, agriculture and rural development, and municipal affairs.

Through the generation of a lidar-derived DEMs, users can identify and locate:

- watercourses, flood plains, and watershed boundaries;
- flow channels and related blockages;
- seasonally varying depth to water ratios; and
- sensitive aquatic habitats.

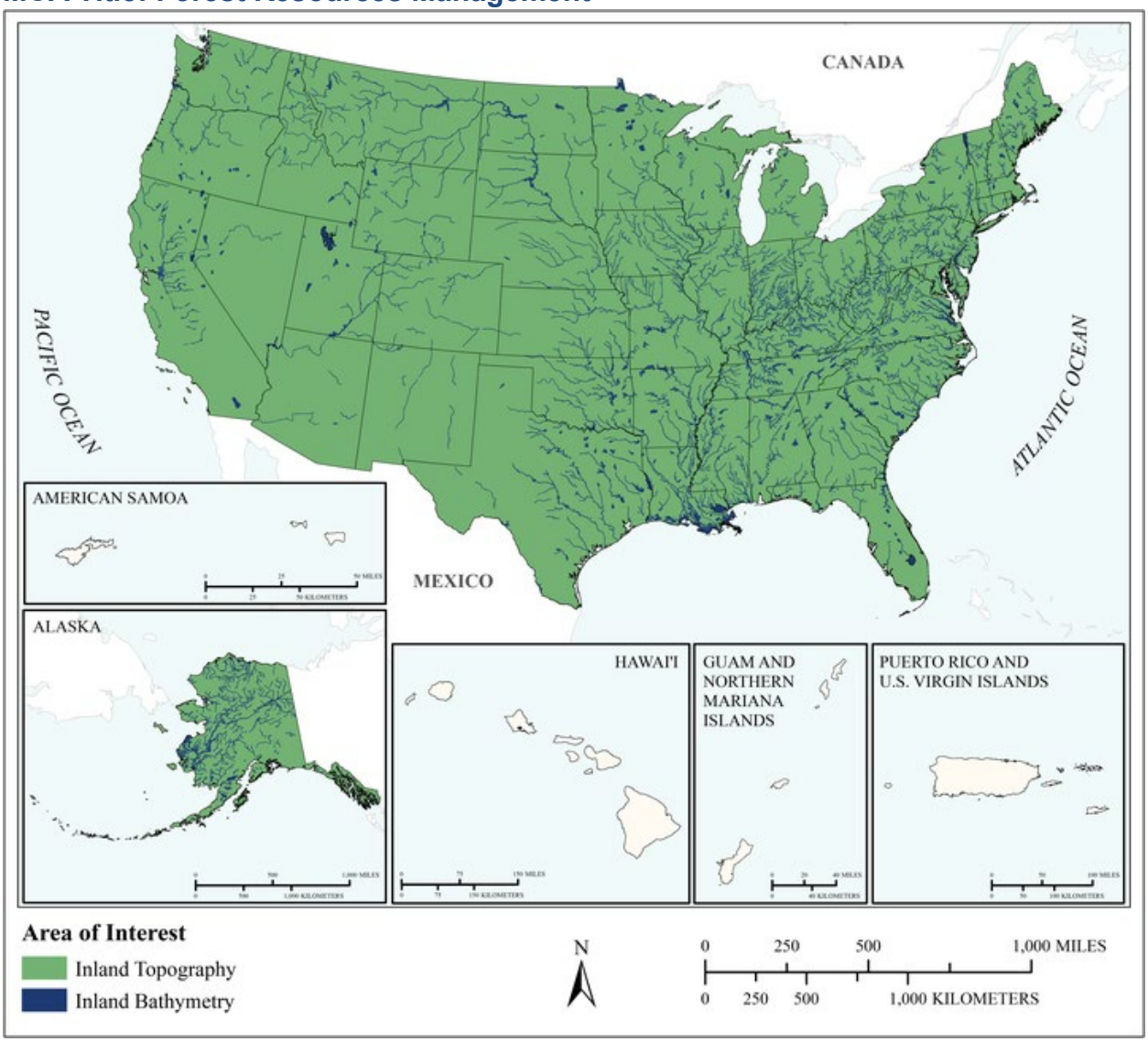
Lidar allows for identifying, monitoring, and assessing wildlife habitat. Using lidar data, habitat identification can now be expanded to consider species and habitat variables that are characteristic of specific wildlife habitats, allowing for more accurate habitat and population assessments, and consequently improved habitat and population planning.

Leading Edge Geomatics has identified Business Uses and Mission Critical Activities that rely on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 04 – Forest Resource Management	Leading Edge Geomatics	60729	Forest Resources Management	Inland Topo	QL1	2-3 years	$500,000	Unable to quantify	Major	Major	Major
				Inland Bathy	QL1B	6-10 years	Unable to quantify	Unable to quantify	Moderate	Major	Major
BU 06 – Natural Resource Management	Leading Edge Geomatics	60730	Natural Resources Conservation	Inland Topo	QL1	4-5 years	$150,000	Unable to quantify	Major	Major	Major
				Inland Bathy	QL1B	6-10 years	$400,000	Unable to quantify	Major	Major	Major
BU 17 – Wildfire Management	Leading Edge Geomatics	60731	Wildfire Management, Planning, and Response	Inland Topo	QL1	4-5 years	Unable to quantify	Unable to quantify	Major	Major	Major
				Inland Bathy	QL1B	2-3 years	Unable to quantify	Unable to quantify	Major	Major	Major

MCA Title: Forest Resources Management



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required		
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas		
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Forest health assessment. Determination of standing inventory of forest resources. Prescribed burn planning. Analysis of carbon stocks for trade. Harvest systems planning.
MCA Title	Forest Resources Management
MCA ID	60729
Organization Type	Private or Commercial
Organization Name	Leading Edge Geomatics
Sub-Agency or Division	
Organization Mission	
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 04 - Forest Resources Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Required
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1,000 sq mi - 24,999 sq mi (e.g. large county, small state, intrastate region [e.g. a multi-county region such as the San Francisco Bay Area, Tri-County Council, etc.])
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Highly desirable
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Required
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required

Inland Bathy Feature Size Requirements	Response
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1	QL1B		
Update Frequency	2-3 years	6-10 years		
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter	Up to 2 meters		
Acceptable Vertical Error	Up to 20 cm	Up to 30 cm		
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Required	
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable	Highly desirable			Highly desirable	
Entire AOI under same environmental conditions	Required	Required			Required	
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Highly desirable			Required	
DEM for entire AOI needs to be seamless	Required	Required			Required	
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	I don't know			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Not required		
DTM	Required	Not required		
DEM	Required	Required		
Raw point cloud data	Highly desirable	Highly desirable		
Classified point cloud	Required	Highly desirable		
Edited/cube XYZ		Not required		
Full waveform	Nice to have	Nice to have		
Bathymetric Attributed Grid (BAG)		Nice to have		
Breaklines required for standard hydro-flattening	Nice to have	Highly desirable		
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable	Highly desirable		
Ground control/ground truthing	Highly desirable	Highly desirable		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required	Required		
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have	Highly desirable		
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have	Required		
Land use/land cover	Required	Required		
Wetlands	Required	Required		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required	Required		
Bridges/culverts	Highly desirable	Required		
Landmark features	Nice to have	Highly desirable		
Cultural resources	Highly desirable	Nice to have		
Coastal and riverine structures	Nice to have	Required		
Overhead structures				
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Moderate		
Cost savings/cost reduction	Major	Moderate		
Cost avoidance	Moderate	Moderate		
Increased revenues	Minor	Minor		
Mission-driven performance improvements	Major	Moderate		
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Moderate		

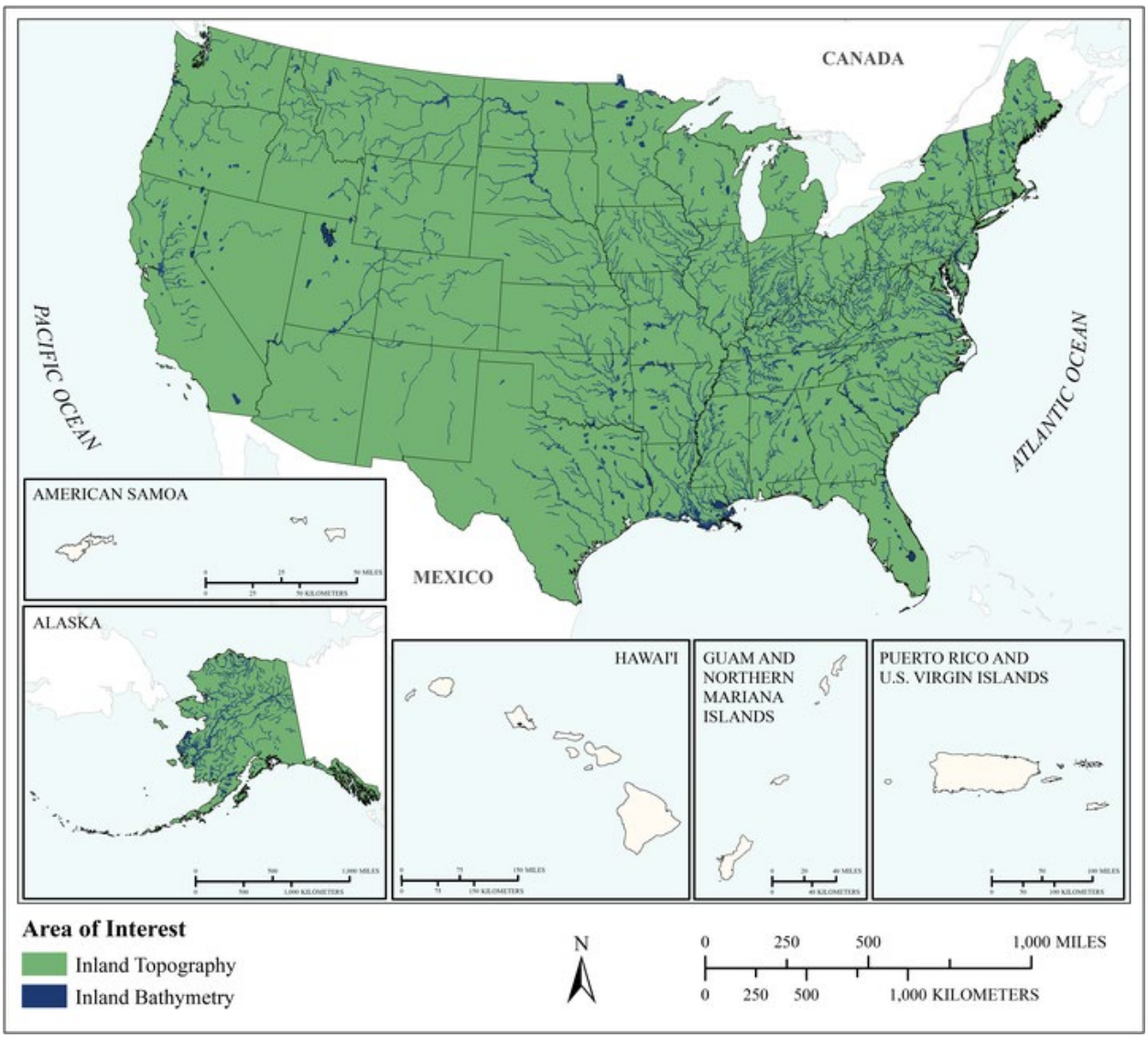
Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Improved response or timeliness	Major	Moderate		
Improved customer experience	Moderate	Moderate		
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Moderate	Moderate		
Environmental	Major	Moderate		
Public safety, including life and property	Major	Moderate		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Major	Unable to provide							
Cost savings/cost reduction	Major	Unable to provide		Major	Unable to provide							
Cost avoidance	Major	Annual dollars saved/realized	$500,000	Major	Unable to provide							
Cost avoidance description	Low estimate, but more up to date access of LiDAR/Imagery allows for revenue generation without collection for inventory work.											
Increased revenues	Major	Unable to provide		Moderate	Unable to provide							
Mission-driven performance improvements	Major	Unable to provide		Major	Unable to provide							
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Major	Unable to provide							
Improved response or timeliness	Major	Unable to provide		Major	Unable to provide							
Improved customer experience	Major	Unable to provide		Major	Unable to provide							
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major			Moderate								
Environmental	Major			Major								
Environmental description				Forest services require a lot more assessment of water quality, habitat, etc. which inland bathy can provide								
Public safety, including life and property	Major			Major								

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes		
Contours	Yes	Yes		
Hillshades	Yes	Yes		
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps		Yes		
Cross sections		Yes		
Height-Above-Ground maps	Yes			
Viewshed maps				
Hydrologic Flow Direction Grids		Yes		
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)	Yes	Yes		
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes		
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness	Yes			

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MCA Title: Natural Resources Conservation



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required		
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas		
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Conservation engineering. Soils and wetlands mapping and characterization. Modeling of biological and ecological systems. Erosion control. Rainfall penetration studies, impervious surfaces.
MCA Title	Natural Resources Conservation
MCA ID	60730
Organization Type	Private or Commercial
Organization Name	Leading Edge Geomatics
Sub-Agency or Division	
Organization Mission	
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 06 - Natural Resources Conservation
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Highly desirable
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Required
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Highly desirable
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Highly desirable
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1	QL1B		
Update Frequency	4-5 years	6-10 years		
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter	Up to 2 meters		
Acceptable Vertical Error	Up to 20 cm	Up to 30 cm		
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Required
Hydro-conditioning	Highly desirable
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Required	
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable	Highly desirable			Required	
Entire AOI under same environmental conditions	Required	Required			Required	
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Required			Required	
DEM for entire AOI needs to be seamless	Required	Required			Required	
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Highly desirable		
DTM	Required	Required		
DEM	Required	Required		
Raw point cloud data	Required	Required		
Classified point cloud	Required	Required		
Edited/cube XYZ		Nice to have		
Full waveform	Nice to have	Nice to have		
Bathymetric Attributed Grid (BAG)		Highly desirable		
Breaklines required for standard hydro-flattening	Required	Required		
Additional breaklines for hydro-enforcement of culverts	Required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable	Highly desirable		
Ground control/ground truthing	Required	Required		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required	Required		
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have	Nice to have		
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Highly desirable	Required		
Land use/land cover	Required	Highly desirable		
Wetlands	Required	Required		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Required	Required		
Bridges/culverts	Required	Required		
Landmark features	Nice to have	Nice to have		
Cultural resources	Highly desirable	Nice to have		
Coastal and riverine structures	Highly desirable	Required		
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Major		
Cost savings/cost reduction	Major	Moderate		
Cost avoidance	Major	Moderate		
Increased revenues	Minor	Minor		
Mission-driven performance improvements	Major	Major		
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Major		

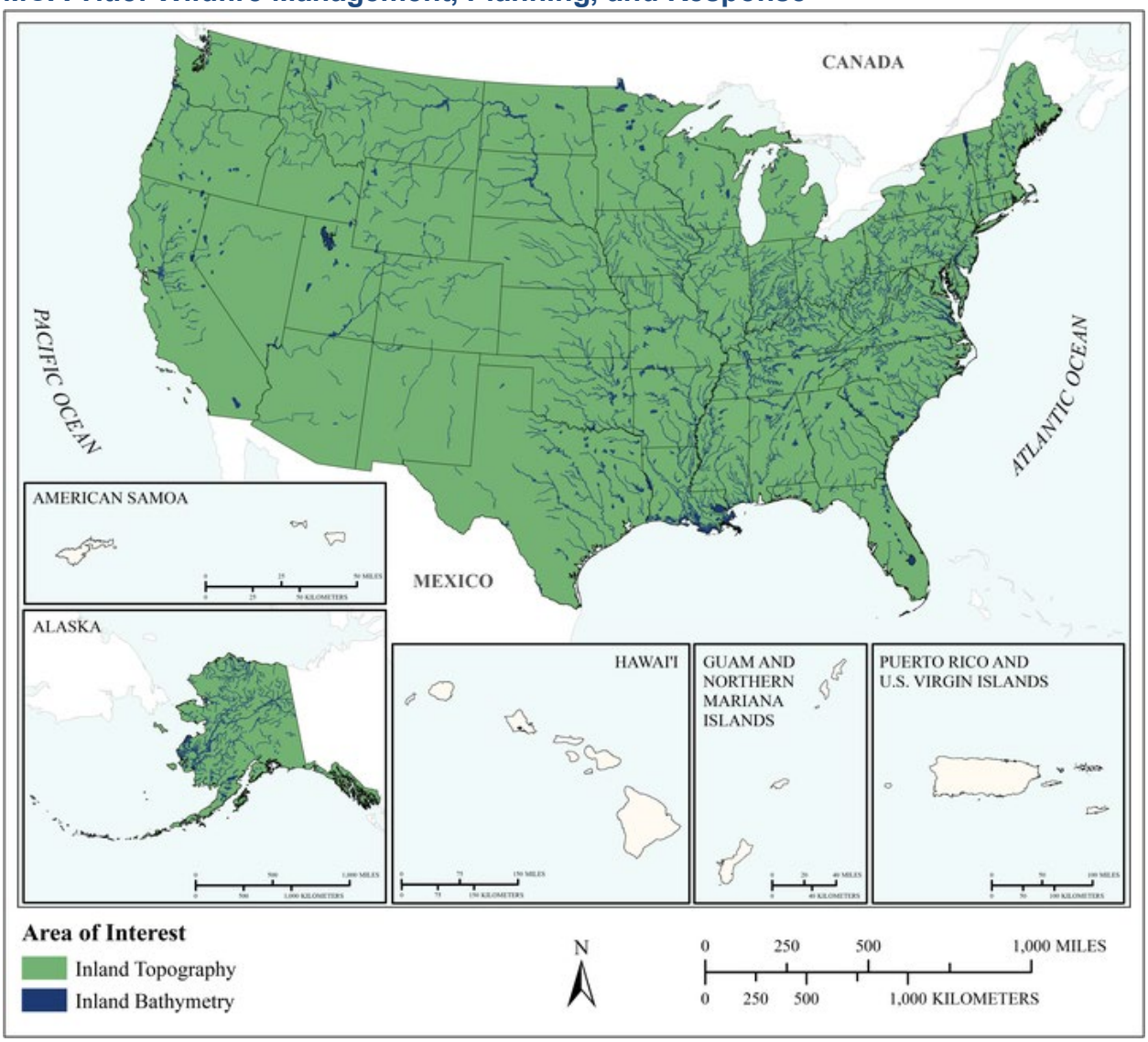
Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Improved response or timeliness	Major	Major		
Improved customer experience	Major	Moderate		
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major	Moderate		
Environmental	Major	Major		
Public safety, including life and property	Major	Moderate		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Major	Unable to provide							
Cost savings/cost reduction	Major	Unable to provide		Major	Unable to provide							
Cost avoidance	Major	Unable to provide		Major	Unable to provide							
Increased revenues	Major	Annual dollars saved/realized	$150,000	Major	Annual dollars saved/realized	$400,000						
Mission-driven performance improvements	Major	Unable to provide		Major	Unable to provide							
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Major	Unable to provide							
Improved response or timeliness	Major	Unable to provide		Major	Unable to provide							
Improved customer experience	Major	Unable to provide		Moderate	Unable to provide							
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major			Major								
Environmental	Major			Major								
Environmental description				The ability to access data will allow us to provide more services to those who can't afford collection.								
Public safety, including life and property	Major			Major								

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes		
Contours	Yes	Yes		
Hillshades	Yes	Yes		
Slope maps	Yes	Yes		
Aspect maps	Yes			
Curvature maps				
Cross sections	Yes	Yes		
Height-Above-Ground maps	Yes			
Viewshed maps	Yes	Yes		
Hydrologic Flow Direction Grids		Yes		
Hydrologic Flow Accumulation Grids		Yes		
Hydrologic networks (e.g. streams, lakes)	Yes	Yes		
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes	Yes		
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1

MCA Title: Wildfire Management, Planning, and Response



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required		
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas		
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Determination of forest fuel and fire susceptibility. Fire behavior modeling to support wildfire suppression activities. Wildland/urban interface building identification. Post fire analysis to determine landslide prone areas.
MCA Title	Wildfire Management, Planning, and Response
MCA ID	60731
Organization Type	Private or Commercial
Organization Name	Leading Edge Geomatics
Sub-Agency or Division	
Organization Mission	
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 17 - Wildfire Management, Planning, and Response
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	
Smallest 3D features needed	
Description of smallest 3D features	

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Required
10 - 50 ft	Highly desirable
51 - 100 ft	Highly desirable
101 - 500 ft	Nice to have
501 - 2,500 ft	Nice to have
Greater than 2,500 ft	Nice to have
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Required
½ - 1 acre	Highly desirable
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Nice to have
Greater than 10 acres	Nice to have

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1	QL1B		
Update Frequency	4-5 years	2-3 years		
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter	Up to 2 meters		
Acceptable Vertical Error	Up to 20 cm	Up to 30 cm		
How far onshore needed				
How far down the beach profile needed				
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Required	
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable	Required			Required	
Entire AOI under same environmental conditions	Required	Required			Required	
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Required			Required	
DEM for entire AOI needs to be seamless	Required	Required			Required	
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Required		
DTM	Required	Required		
DEM	Required	Required		
Raw point cloud data	Nice to have	Required		
Classified point cloud	Highly desirable	Required		
Edited/cube XYZ		Nice to have		
Full waveform	Not required	Nice to have		
Bathymetric Attributed Grid (BAG)		Nice to have		
Breaklines required for standard hydro-flattening	Nice to have	Nice to have		
Additional breaklines for hydro-enforcement of culverts	Nice to have			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable	Nice to have		
Ground control/ground truthing	Highly desirable	Nice to have		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required	Required		
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have	Required		
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Not required	Not required		
Land use/land cover	Highly desirable	Required		
Wetlands	Highly desirable	Nice to have		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Highly desirable	Required		
Bridges/culverts	Nice to have	Required		
Landmark features	Nice to have	Required		
Cultural resources	Nice to have	Required		
Coastal and riverine structures	Nice to have	Highly desirable		
Overhead structures				
Lowest Floor Elevation of Buildings	Not required			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used				
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	Major		
Cost savings/cost reduction	Moderate	Major		
Cost avoidance	Major	Major		
Increased revenues	Minor	Major		
Mission-driven performance improvements	Major	Major		
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Major		

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness	Moderate	Major		
Improved customer experience	Major	Major		
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major	Major		
Environmental	Major	Major		
Public safety, including life and property	Major	Major		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Major	Unable to provide							
Cost savings/cost reduction	Major	Unable to provide		Major	Unable to provide							
Cost avoidance	Major	Unable to provide		Major	Unable to provide							
Increased revenues	Minor	Unable to provide		Major	Unable to provide							
Mission-driven performance improvements	Major	Unable to provide		Major	Unable to provide							
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Major	Unable to provide							
Improved response or timeliness	Major	Unable to provide		Major	Unable to provide							
Improved response or timeliness description	Do not have a dollar value at this time, but available data will improve response time significantly and provide updates using structural data.											
Improved customer experience	Major	Unable to provide		Major	Unable to provide							
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Major			Major								
Environmental	Major			Major								
Environmental description				Inland bathy can support changes in hydrological/geomorphological modelling								
Public safety, including life and property	Major			Major								

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	1
Vertical accuracy	2
Update frequency	3

Leidos

Leidos' mission is to make the world safer, healthier, and more efficient through information technology, engineering, and science. Leidos' vision is to become the global leader in the integration and application of information technology, and science to solve customers' most demanding challenges. Leidos delivers innovative solutions through the efforts of its diverse and talented people who are dedicated to customers' success. Leidos empowers its teams, contributes to communities, and operates sustainably.

The scope of services provided by Leidos' Marine Survey and Engineering Solutions Branch includes the following.

- Design, manufacture, test, and service integrated oceanographic/hydrographic survey systems;
- Plan and conduct marine survey projects using these and other systems;
- Process and analyze data collected by these systems and prepare reports and other data products;
- Analyze and make recommendations;
- Develop requirements, create and review designs, fabricate prototypes, conduct tests, and provide in-service engineering; and
- Support government and commercial hardware systems.

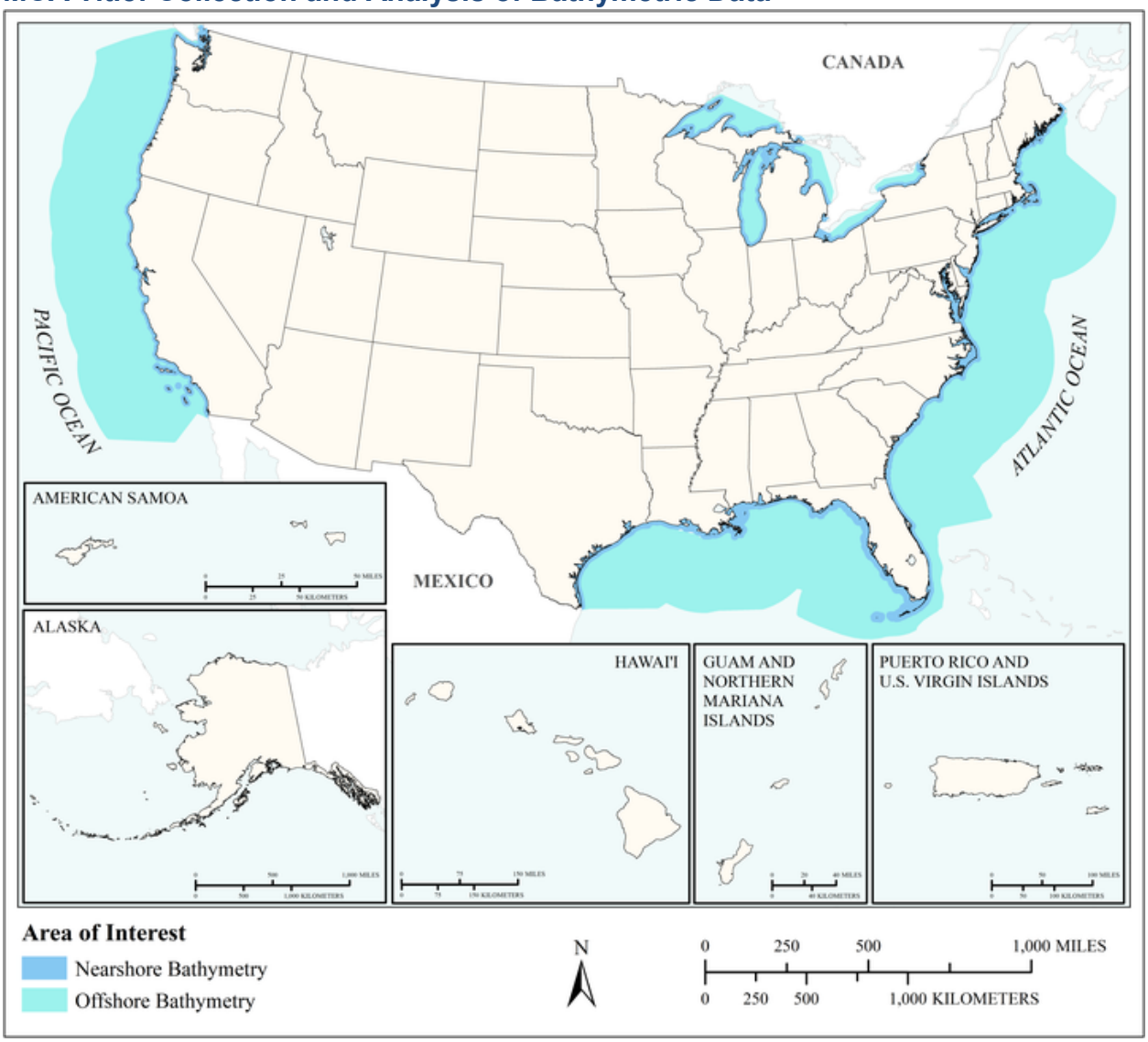
Elevation data are used for identifying hazards to navigation and updating nautical products. Additionally, Leidos has conducted surveys to support a potential claim for extended jurisdiction by the United States under United Nations Convention on the Law of the Sea (UNCLOS) Article 76.

Leidos has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Leidos	22199	Collection and Analysis of Bathymetric Data	Nearshore Bathy	QL4B	>10 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Offshore Bathy	Order 1a	6-10 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate

MCA Title: Collection and Analysis of Bathymetric Data



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	Required
Geographic Area Requirements			Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	Custom description
Sub Area Requirements				CONUS, mostly to Territorial Sea, some out to EEZ

MCA Description	Response
Mission Critical Activity	Collection and analysis of bathymetric data for the use of identifying hazards to navigation, updating nautical products. Additionally have conducted surveys to support a potential claim for extended jurisdiction by the United States under United Nations Convention on the Law of the Sea (UNCLOS) Article 76.
MCA Title	Collection and Analysis of Bathymetric Data
MCA ID	22199
Organization Type	Private or Commercial
Organization Name	Leidos
Sub-Agency or Division	Marine Survey and Engineering Solutions Branch
Organization Mission	Leidos' mission: Leidos makes the world safer, healthier, and more efficient through information technology, engineering, and science. Leidos' vision: Become the global leader in the integration and application of information technology, and science to solve our customers' most demanding challenges. We will deliver innovative solutions through the efforts of our diverse and talented people who are dedicated to our customers' success. We will empower our teams, contribute to our communities, and operate sustainably. Scope for Marine Survey and Engineering Solutions Branch: Design, Manufacture, Test and Service Integrated Oceanographic/Hydrographic Survey Systems; Plan and Conduct Marine Survey Projects using these and Other Systems; Process and Analyze Data Collected by these Systems, Prepare Reports and Other Data Products. Analyze and Make Recommendations, Develop Requirements, Create and Review Designs, Fabricate Prototypes, Conduct Tests and Provide In-Service Engineering, Support for Government and Commercial Hardware Systems.
Program Name	Marine Survey and Engineering Solutions NOAA Hydrographic Survey Backlog
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	BU 30 - Maritime and Land Boundary Management
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Not required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Highly desirable
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.

General Geographic Area and Size	
Description of smallest 3D features	Detect and include in the grid bathymetry all significant features measuring at least 1 m x 1 m x 1 m in waters up to 20 meters. In depths greater than 20 meters, detect and include in the grid bathymetry features measuring approximately 5% of depth vertically.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			QL4B	Order 1a
Update Frequency			>10 years	6-10 years
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error			Up to 5 meters	Up to 5 meters
Acceptable Vertical Error			Up to 50 cm	Less than 1 meter
How far onshore needed			To MHW	
How far down the beach profile needed			None	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Nice to have	Nice to have		Nice to have
Entire AOI under same environmental conditions			Not required	Not required		Not required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Highly desirable	Required		Required
DEM for entire AOI needs to be seamless			Required	Required		Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Required	Required
DTM			Not required	Not required
DEM			Required	Required
Raw point cloud data			Required	Required
Classified point cloud			Not required	
Edited/cube XYZ			Required	Required
Full waveform			Not required	Not required
Bathymetric Attributed Grid (BAG)			Required	Required
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Required	Required
Tide Predictions			Highly desirable	Highly desirable
Tidal Constituent And Residual Interpolation (TCARI)			Required	Nice to have
Intensity imagery/sidescan imagery			Required	Required
Ground control/ground truthing			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Required	Required
Aerial and/or satellite imagery			Nice to have	Highly desirable
Underwater videography			Nice to have	Not required
Bottom texture			Nice to have	Not required
Bottom type			Required	Nice to have
Submerged features			Required	Required
Subbottom characteristics			Not required	Not required
Geologic and seismic data			Not required	Not required
Water column properties - Physical			Nice to have	Not required
Water column properties - Chemical			Nice to have	Not required
Water column properties - Biological			Nice to have	Not required
Currents			Highly desirable	Not required
Tide/wave heights			Required	Nice to have
Sea ice conditions			Not required	Not required
Habitat distribution and classification			Not required	Not required
Boundaries			Not required	Not required
Routes			Highly desirable	Nice to have
Offshore cadastral			Not required	Not required
Lease areas			Not required	Not required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates			Nice to have	
Land use/land cover			Not required	Not required
Wetlands			Not required	Not required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Not required	Not required
Inland surface water features			Not required	
Bridges/culverts				
Landmark features			Required	
Cultural resources			Highly desirable	
Coastal and riverine structures			Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			We collect and provide hydrographic survey data along U.S. coast to IHO Order 1 quality.	We collect and provide hydrographic survey data along U.S. coast to IHO Order 1 quality.
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts			Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			I don't know	I don't know
Cost savings/cost reduction			I don't know	I don't know
Cost avoidance			I don't know	I don't know
Increased revenues			I don't know	I don't know

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Mission-driven performance improvements			Moderate	Moderate
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			I don't know	I don't know
Improved response or timeliness			I don't know	I don't know
Improved customer experience			Major	Major
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			None	None
Environmental			I don't know	I don't know
Public safety, including life and property			I don't know	I don't know

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							Moderate	Unable to provide		Moderate	Unable to provide	
Cost savings/cost reduction							Moderate	Unable to provide		Moderate	Unable to provide	
Cost avoidance							Major	Unable to provide		Major	Unable to provide	
Increased revenues							None			None		
Mission-driven performance improvements							Major	Unable to provide		Major	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							Major	Unable to provide		Major	Unable to provide	
Improved response or timeliness							Major	Unable to provide		Major	Unable to provide	
Improved customer experience							Major	Unable to provide		Major	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							Moderate			Moderate		
Environmental							Moderate			Moderate		
Public safety, including life and property							Moderate			Moderate		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				
Other (please specify)			Yes	Yes
Other description	BAG			

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Maxar Technologies (Maxar)

Maxar is a commercial company with a mission of "Seeing a better world." Maxar owns and operates a sophisticated constellation of Earth imaging satellites. With five active satellites in orbit, Maxar collects more than three million square kilometers of imagery each day to provide its customers with a current view of our changing planet. Maxar provides satellite-based terrain models and in conjunction with its partner TCarta, provides satellite-based nearshore bathymetry.

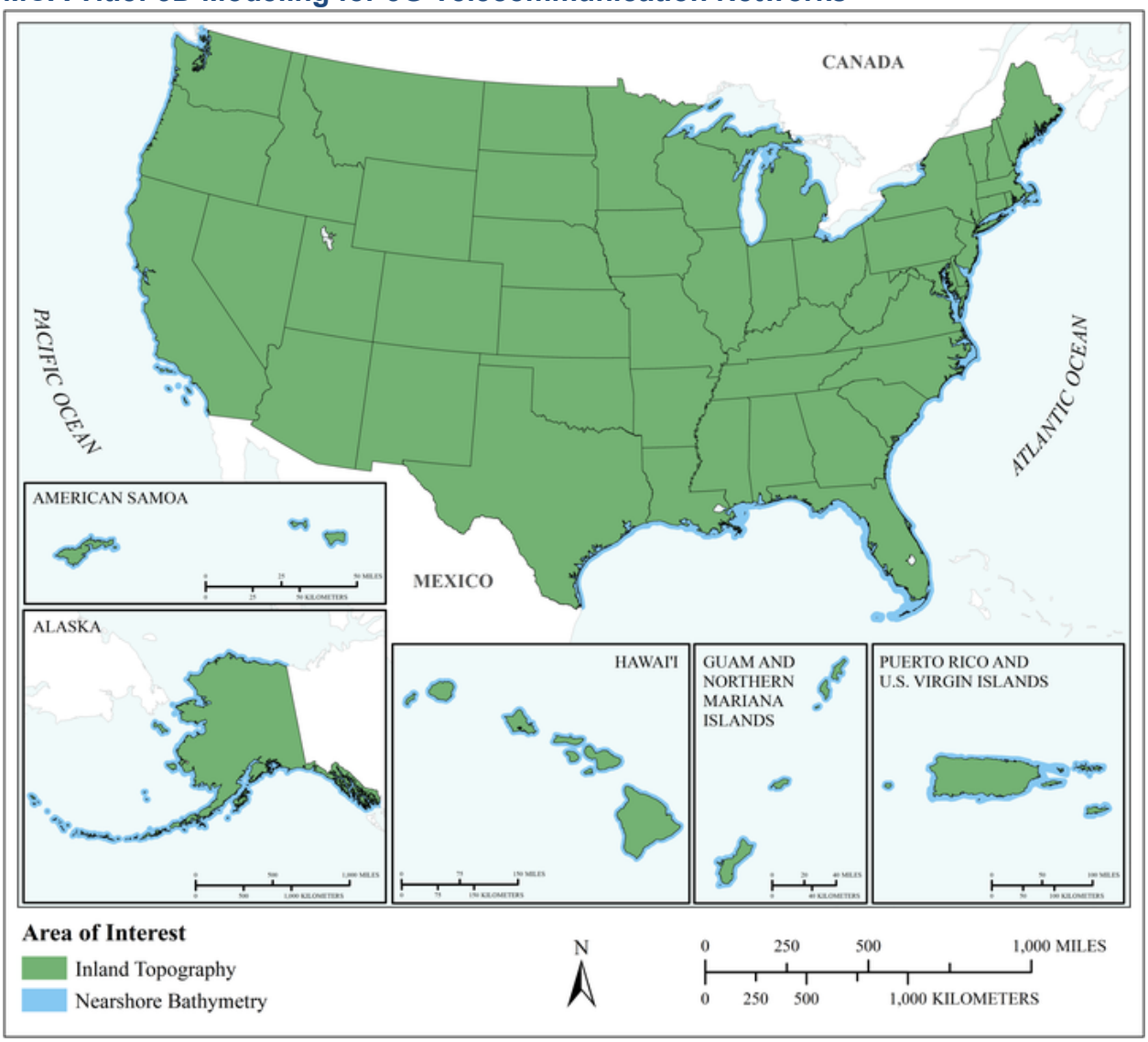
3D data is critical for a variety of applications for Maxar's customers. As a commercial company, Maxar benefits from internal operational efficiencies and product integration for mapping and navigation. Based on customer needs in telecommunications, civil/federal government, technology, oil and gas, and others, elevation data is a valuable dataset for commercial customers.

Maxar has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of topographic and bathymetric elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 28 – Telecom-munications	Maxar Technologies	21943	3D Modeling for 5G Telecommunication Networks	Inland Topo	QL2	Annually	Unable to quantify	Unable to quantify	Minor	None	None
				Nearshore Bathy	I don't know	4-5 years	Unable to quantify	Unable to quantify	None	None	None

MCA Title: 3D Modeling for 5G Telecommunication Networks



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required		Nice to have	
Geographic Area Requirements	States and/or Territories		States and/or Territories	
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau		Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	

MCA Description	Response
Mission Critical Activity	Telecommunications: Provide 3D models for 5G networks. Maxar Technologies provides its customers with satellite-based terrain models and in conjunction with its partner TCarta, provides satellite-based nearshore bathymetry. In both cases, higher accuracy elevation products are used to calibrate satellite data. Maxar's customers use the elevation data for 5G telecommunications modeling, which is highly sensitive to vegetation and any changes to the surface model, also for placing underwater energy pipelines, and for disaster response to include tsunami and wildfire. In the case of wildfire, short wave infrared sensors can penetrate smoke and combined with higher accuracy elevation models, the data can help pinpoint responders to the right locations.
MCA Title	3D Modeling for 5G Telecommunication Networks
MCA ID	21943
Organization Type	Private or Commercial
Organization Name	Maxar Technologies
Sub-Agency or Division	
Organization Mission	Maxar Technologies is a commercial company with a mission of "Seeing a better world". We want to help our customers see earth clearly and in new ways, to make our earth a better place. We are proud to be a mission partner for our U.S. government customers with our very high resolution imagery.
Program Name	Support 5G planning for telecommunications with detailed 3D models
Total Annual Program Budget	
Primary Business Use	BU 28 - Telecommunications
Secondary Business Use	BU 13 - Oil and Gas Resources
Tertiary Business Use	BU 17 - Wildfire Management, Planning, and Response

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Required
Tops of vegetation	Required
Tops of submerged structures, objects	Not required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1,000 sq mi - 24,999 sq mi (e.g. large county, small state, intrastate region [e.g. a multi-county region such as the San Francisco Bay Area, Tri-County Council, etc.])
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Individual tree that can affect radio frequency (RF) propagation of radio signal for 5G

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2		I don't know	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Update Frequency	Annually		4-5 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 50 cm		Up to 1 meter	
Acceptable Vertical Error	Up to 30 cm		Up to 50 cm	
How far onshore needed			To MHW	
How far down the beach profile needed	Not applicable		To MLLW	
Tide correction requirement			No requirement for tide correction	
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Nice to have
Hydro-enforcement	Nice to have
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Not required		Not required			Not required
Entire AOI under same environmental conditions	Required		Not required			Not required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required		Not required			Nice to have
DEM for entire AOI needs to be seamless	Required		Not required			Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer		I don't know			I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required		Nice to have	
DTM	Required		Not required	
DEM	Required		Not required	
Raw point cloud data	Required		Not required	
Classified point cloud	Nice to have		Not required	
Edited/cube XYZ			Not required	
Full waveform	Nice to have		Not required	
Bathymetric Attributed Grid (BAG)			Not required	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Not required			
Additional breaklines for hydro-enforcement of culverts	Nice to have			
National Vertical Datum Transformation Tool (V-Datum)			Not required	
Tide Predictions			Not required	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Nice to have		Not required	
Ground control/ground truthing	Required		Not required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Not required	
Nautical and/or navigation charts			Nice to have	
Acoustic imagery of the seafloor			Not required	
Aerial and/or satellite imagery	Required		Nice to have	
Underwater videography			Not required	
Bottom texture			Not required	
Bottom type			Not required	
Submerged features			Not required	
Subbottom characteristics			Not required	
Geologic and seismic data	Not required		Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Not required	
Tide/wave heights			Not required	
Sea ice conditions			Not required	
Habitat distribution and classification			Not required	
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Not required	
Lease areas			Not required	
Fixed obstructions			Not required	
Floating observation/navigation systems			Not required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Required		Not required	
Land use/land cover	Required		Nice to have	
Wetlands	Nice to have		Nice to have	
Estuaries			Nice to have	
Inland surface water features	Nice to have		Nice to have	
Bridges/culverts	Required			
Landmark features	Nice to have		Nice to have	
Cultural resources	Nice to have		Nice to have	
Coastal and riverine structures	Nice to have		Not required	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Point cloud and 3D models extracted from our Worldview satellite imagery. Currently we are achieving <3 meters CE90 and LE90 but require higher accuracies for 5G network		Shallow water Bathymetry derived from our satellite imagery	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast			Yes	
NCEI			Yes	
Open Topography				
NOAA nautical charts			Yes	
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Other	Yes		Yes	
Other description	We make it from our own satellite imagery		From our own sources	
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major		Minor	
Cost savings/cost reduction	Major		Minor	
Cost avoidance	None		Minor	
Increased revenues	None		None	
Mission-driven performance improvements	Moderate		None	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	None		None	
Improved response or timeliness	None		None	
Improved customer experience	None		Moderate	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	None		None	
Environmental	None		None	
Public safety, including life and property	None		None	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide					Minor	Unable to provide				
Cost savings/cost reduction	Major	Unable to provide					None					
Cost savings/cost reduction description	For ortho rectification of our imagery, this would be a valuable dataset.											
Cost avoidance	Major	Unable to provide					Minor	Unable to provide				
Cost avoidance description	For ortho rectification of our imagery, this would be a valuable dataset.											
Increased revenues	None						None					
Mission-driven performance improvements	Major	Unable to provide					Minor	Unable to provide				
Other operational benefits	Major	Unable to provide					Minor	Unable to provide				
Other operational benefits description	Improved operational efficiencies.											
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide					Minor	Unable to provide				
Value added to products or services description	More accurate imagery and 3D models from our satellite imagery.											
Improved response or timeliness	Major	Unable to provide					Minor	Unable to provide				
Improved customer experience	Major	Unable to provide					Minor	Unable to provide				
Improved customer experience description	Increased confidence and quality of our products. Improves timelines if the data is ready for ortho production instead of us creating 3D models from our imagery.											
Other customer service benefits	Major	Unable to provide										
Other customer service benefits description	Improved operational efficiencies.											
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor						None					
Education or outreach description	Help promote our products											
Environmental	None						None					
Public safety, including life and property	None						None					
Other							Integrate satellite imagery with bathy data for mapping portals					
Other benefits							Minor					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes			
Contours	Yes			
Hillshades	Yes			
Slope maps	Yes			
Aspect maps	Yes			
Curvature maps				
Cross sections				
Height-Above-Ground maps	Yes			
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

MSA Professional Services (MSA)

MSA provides municipal engineering and planning services to include: road infrastructure design, water/sewer utility design, stormwater modeling, pollution point and non-point source modeling, floodplain modeling, new development site analysis, agricultural design, airport design, park/recreational planning, architectural design, and municipal comprehensive planning.

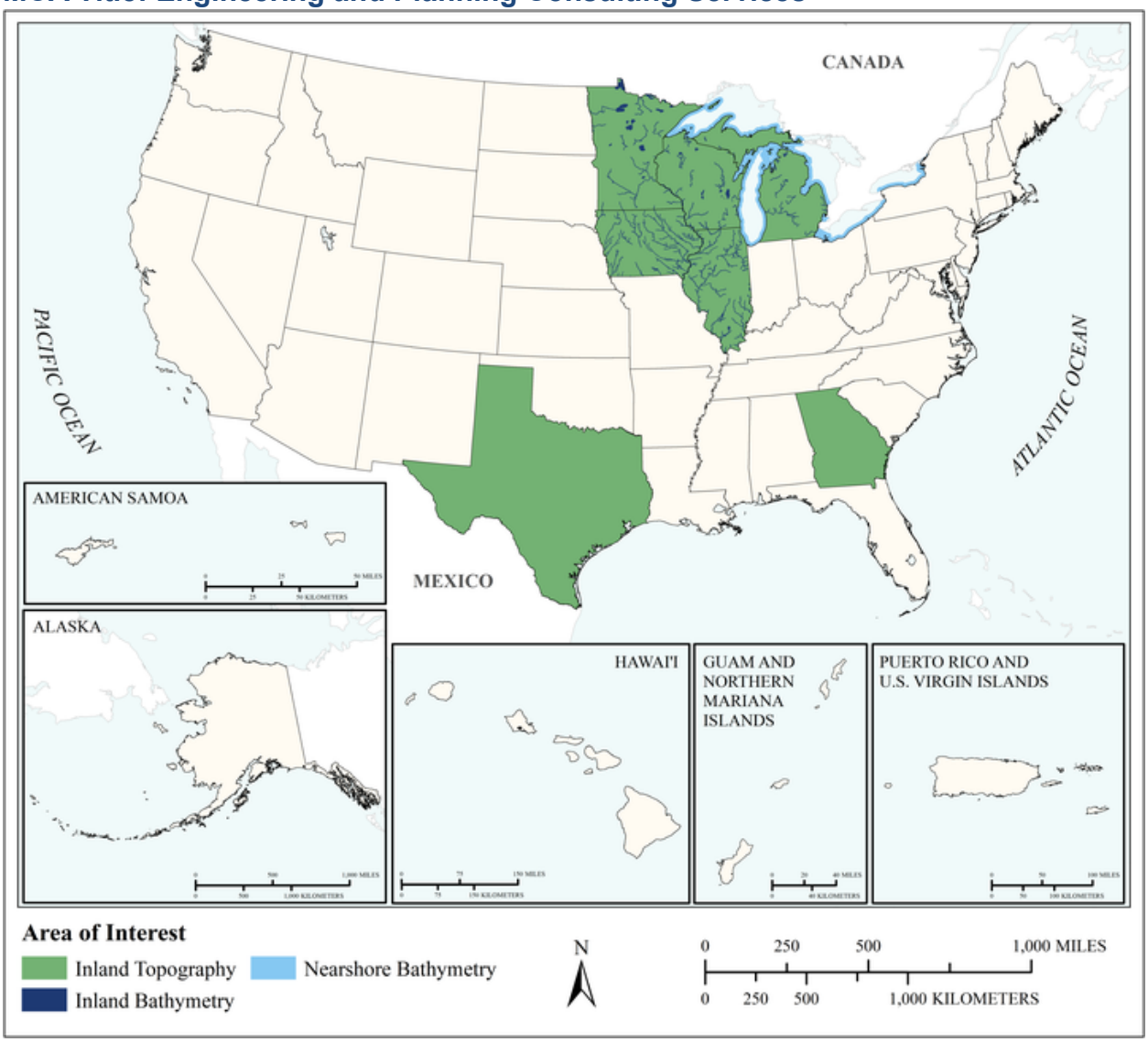
Elevation data are needed for effective engineering design which can be significantly improved with improved 3D elevation data, providing greater confidence that designs will perform as desired. Elevation data have improved significantly in recent years -- moving from USGS 10-ft contours to lidar derivatives; more accurate/frequent datasets would simply help improve projects for our clients. However, making the data more accessible is key. Our clients are often small municipalities who do not have funding to complete their own elevation surveys. Data that is free to publicly download in readily accessible formats greatly improves our project designs and therefore benefits our clients.

MSA has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	MSA Professional Services	1467	Engineering and Planning Consulting Services	Inland Topo	QL2	4-5 years	$38,496	$18,090	Minor	Major	Major
				Inland Bathy	Cross sections and/or transects meet needs	4-5 years	$8,055	$5,427	Minor	Moderate	Major
				Nearshore Bathy	Cross sections and/or transects meet needs	4-5 years	$13,015	$3,015	Minor	Moderate	Major

MCA Title: Engineering and Planning Consulting Services



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	
Geographic Area Requirements	One or more states, territories, or counties	One or more states, territories, or counties	Custom description	
Sub Area Requirements			Great Lakes	

MCA Description	Response
Mission Critical Activity	Municipal engineering and planning including: road infrastructure design, water/sewer utility design, stormwater modeling, pollution point and non-point source modeling, floodplain modeling, new development site analysis, agricultural design, airport design, park/recreational planning, architectural design, and municipal comprehensive planning. Additional Business Uses are BU 15 – Flood Risk Management and BU 27 – Recreation. Engineering design can be significantly improved with improved 3D elevation data and provide greater confidence that designs will perform as desired. Elevation data have improved significantly in recent years -- moving from USGS 10-ft contours to LiDAR derivatives; more accurate/frequent datasets would simply help improve projects for our clients. However, making the data more accessible is key. Our clients are often small municipalities who do not have funding to complete their own elevation surveys. Data that is free to publicly download in readily accessible formats greatly improves our project designs and therefore benefits our clients.
MCA Title	Engineering and Planning Consulting Services
MCA ID	1467
Organization Type	Private or Commercial
Organization Name	MSA Professional Services
Sub-Agency or Division	
Organization Mission	MSA Professional Services is an architecture, engineering and construction organization dedicated to enabling people to positively impact the lives of others.
Program Name	
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	BU 23 - Urban and Regional Planning
Tertiary Business Use	BU 01 - Water Supply and Quality

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Not required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.

General Geographic Area and Size	
Description of smallest 3D features	All of our engineering design projects necessitate survey-level elevation information (e.g. back of curb, road centerline, building corners, etc). At the planning stage, slightly less accurate data is required (e.g. site slopes) which is usually augmented with higher grade elevation data as the project moves into the design phase.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Required
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Required
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	Cross sections and/or transects meet needs	Cross sections and/or transects meet needs	
Update Frequency	4-5 years	4-5 years	4-5 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI	Project dependent			
Acceptable Horizontal Error	Up to 1 meter	Up to 1 meter	Up to 1 meter	
Acceptable Vertical Error	Up to 20 cm	Less than 10 cm	Up to 40 cm	
How far onshore needed			>1 kilometer inland	
How far down the beach profile needed	Below MLLW		Below MLLW	
Tide correction requirement			MHW	
Cross sections and/or transects meet needs	Partial	Yes	Yes	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cross section/transect requirement	Cross sections are commonly used for floodplain modeling. Cross sections are therefore needed adjacent to structures (e.g. bridges) and at set intervals along the river/stream. Vertical accuracy to 0.1 ft and longitudinal sampling at 25' would be sufficient for this work.	Vertical to 0.1 ft and longitudinal sampling at 25 ft.	Vertical to 1 ft and longitudinal sampling at 50ft intervals	

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Required
Hydro-conditioning	Required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Nice to have	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
Entire AOI under same environmental conditions	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
Other	Required					
Other description	Individual project area in same acquisition season					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Nice to have	Nice to have	Nice to have		Nice to have	Nice to have
DEM for entire AOI needs to be seamless	Highly desirable	Highly desirable	Nice to have		Nice to have	Nice to have
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to double the required TVU at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have	Nice to have	Nice to have	
DTM	Required	Required	Required	
DEM	Required	Required	Required	
Raw point cloud data	Nice to have	Highly desirable	Highly desirable	
Classified point cloud	Highly desirable	Highly desirable	Required	
Edited/cube XYZ		Nice to have	Nice to have	
Full waveform	Not required	Not required	Not required	
Bathymetric Attributed Grid (BAG)		Nice to have	Nice to have	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Highly desirable	Required		
Additional breaklines for hydro-enforcement of culverts	Highly desirable			
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	
Tide Predictions			Nice to have	
Tidal Constituent And Residual Interpolation (TCARI)			Not required	
Intensity imagery/sidescan imagery	Nice to have	Nice to have	Highly desirable	
Ground control/ground truthing	Required	Required	Required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	
Nautical and/or navigation charts			Highly desirable	
Acoustic imagery of the seafloor			Nice to have	
Aerial and/or satellite imagery	Required	Required	Required	
Underwater videography			Nice to have	
Bottom texture			Nice to have	
Bottom type			Nice to have	
Submerged features			Highly desirable	
Subbottom characteristics			Highly desirable	
Geologic and seismic data	Not required	Not required	Nice to have	
Water column properties - Physical			Nice to have	
Water column properties - Chemical			Nice to have	
Water column properties - Biological			Nice to have	
Currents			Highly desirable	
Tide/wave heights			Highly desirable	
Sea ice conditions			Not required	
Habitat distribution and classification			Nice to have	
Boundaries			Nice to have	
Routes			Nice to have	
Offshore cadastral			Nice to have	
Lease areas			Nice to have	
Fixed obstructions			Highly desirable	
Floating observation/navigation systems			Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Nice to have	Nice to have	Highly desirable	
Land use/land cover	Required	Highly desirable	Highly desirable	
Wetlands	Required	Required	Required	
Estuaries			Highly desirable	
Inland surface water features	Required	Required	Required	
Bridges/culverts	Required	Required		
Landmark features	Highly desirable	Nice to have	Highly desirable	
Cultural resources	Nice to have	Not required	Nice to have	
Coastal and riverine structures	Required	Highly desirable	Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy

Current dataset used	We currently use the most recent data as available in each region, most commonly DEM and contours. Classified point cloud datasets and breaklines are used as well, albeit less frequently. More detailed elevation data is typically obtained via a on-the-ground survey to account for more recent development and to have higher levels vertical and longitudinal accuracy. In Wisconsin, the source/date/accuracy varies widely. Many flights were completed in ~2010 and are obtained either from Wisconsin View or the individual counties. Larger communities sometimes have their own elevation data sets since they develop more rapidly. In Iowa, we commonly leverage the statewide flight data from 2009. Larger communities sometimes have their own elevation data sets since they develop more rapidly. In Minnesota, we use all available datasets in the Minnesota GeoSpatial commons. Timing /accuracy of the flights vary by location. In	Self-collected. We are relying on on-the-ground surveys for our projects. This usually consists of surveyors taking a cross section of streams or heading out on boats.	Very minimal available is available for our marine work. Commonly we rely on data provided to us by our clients (often none) and Great Lakes mapping which has been inaccurate at times causing unforeseen problems with marine designs (e.g. sand bars developing that require a design change to stabilize the system).	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
	Illinois, we commonly use data from IDOT, with the dates/accuracy of the flights varying by location. In Georgia, we acquire elevation data less frequently and typically from the County directly.			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series		Yes		
Marine Minerals Program GIS				
State Repositories	Yes			
State repositories used	WisconsinView Iowa Geodata Minnesota GeoSpatial Commons Illinois Geospatial Data Clearinghouse			
Other	Yes	Yes	Yes	
Other description	Counties/Cities that house their data. NPS contacts. Forestry contacts. Anyone I can find who has data. Self-collected.	Self-collected	Self-collected	
Data that meet my needs are not available		Yes		
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Major	Major	
Cost savings/cost reduction	Moderate	Minor	Moderate	
Cost avoidance	Major	Major	Moderate	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Increased revenues	Major	Moderate	Minor	
Mission-driven performance improvements	Major	Major	Moderate	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Major	Major	
Improved response or timeliness	Major	Major	Moderate	
Improved customer experience	Major	Moderate	Major	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major	Moderate	Moderate	
Environmental	Major	Major	Moderate	
Public safety, including life and property	Major	Moderate	Major	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Annual dollars saved/realized	$27,497	Major	Annual dollars saved/realized	$7,960	Major	Annual dollars saved/realized	$3,015			
Time savings description	Specifically for water resource work and CAD design, which leverage 3d elevation datasets (derived from an aerial flight) integrated with on-side surveys. Readily available data would greatly improve model development and CAD design efforts. Time savings for less more uniform data delivery. However, projects usually have specific coordinate system requirements. Therefore, some data manipulation will be required regardless. Project planning (conceptual before formal design) and detailed watershed delineations require large area coverage of elevation data. This would be avoiding additional on-site-survey data. The 3D elevation current datasets are disjointed and non-uniform. A centralized repository for data would allow for more novice users to be trained in how to effectively integrate the data into their workflow.			Less processing for floodplain analysis. Better understanding of stream flow for floodplain analysis. Survey cross sections of stream for floodplain analysis.			No data available currently, therefore we are not modifying it to suit our needs. Improved 3D elevation data would improve project designs and reduce last minute modifications during construction. Modeling would be more costly with improved data (since modeling currently cannot take place since we don't have any data to use). Field surveys are rarely allotted within our budgets. Therefore not much time saved through cost avoidance. Improved 3D elevation data would improve project designs and overall confidence that designs will perform as intended.					
Cost savings/cost reduction	Minor	Annual dollars saved/realized	$2,000	Major	Annual dollars saved/realized	$48	None					
Cost savings/cost reduction description	We commonly rely on on-the ground surveys for estimating materials prior to construction. Even with a more reliable/accuracy 3D dataset available, most project managers would still insist on a field-survey. Costs to purchase data varies considerably. This is a rough estimate.			Less processing for floodplain analysis.			We are not commonly purchasing this sort of data since it doesn't exist.					
Cost avoidance	Major	Annual dollars saved/realized	$9,000	Major	Annual dollars saved/realized	$48	Major	Annual dollars saved/realized	$10,000			
Cost avoidance description	We regularly do floodplain analysis and sizing for stormwater pipes. Underestimating flood events and culvert sizes due to inaccurate topographic information is not possible to easily estimate. This would be for quality control of hydrotreatment. Roadway design might be improved by better topography, resulting in fewer crashes. But most roads are ground surveyed. Better topographic information to flag errors in watershed delineations or trigger field surveys.			Less processing for floodplain analysis. Less processing for floodplain analysis. Currently we don't have this type of data, therefore we aren't classifying pint clouds, etc. Unclear how to estimate physical damage from flooding that could have been avoided through better floodplain analysis.			No data available currently, therefore we are not modifying it to suit our needs. Improved designs would avoid last minute (or after construction) design changes to account for unknowns in bathymetry information. I am unable to estimate how many marina accidents could have been avoided if the engineers/architects had access to better bathymetry data. However, they would have MUCH more confidence in their designs.					
Increased revenues	None			None			None					
Increased revenues description				My firm does not do this kind of work.			My firm does not do this kind of work.					
Mission-driven performance improvements	Major	Annual percent improvement	7%	Major	Annual percent improvement	3%	Major	Annual percent improvement	5%			
Mission-driven performance improvements description	Improved topography information leads to better engineering designs and confidence in our work. Improved topography information leads to better engineering designs, improving the lives of people within these communities. Improved topography information leads to better engineering designs for our clients (commonly small municipalities).			Better understanding of stream flow for floodplain analysis.			This Future Operational Benefit is the most important to our marina design group, since they currently do not have much confidence in the elevation data currently. Improved bathymetry data would augment their designs.					

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Annual dollars saved/realized	$9,045	Moderate	Annual dollars saved/realized	$1,447	None					
Value added to products or services description	Improves understanding of floodplains and provides better mapping for our clients. Improved web mapping capabilities for clients.			Better understanding of stream flow for floodplain analysis. My firm does not develop apps.								
Improved response or timeliness	Moderate	Annual dollars saved/realized	$5,427	Moderate	Annual dollars saved/realized	$1,809	Moderate	Annual dollars saved/realized	$603			
Improved response or timeliness description	Wetland reviews/mapping/determination process improvements. More accurate floodplain mapping for our clients. Improved web mapping for municipal clients.			Better understanding of stream flow for floodplain analysis by using more current data. Provide better visuals to explain floodplain analysis to clients. My firm does not perform or process reviews and approvals.								
Improved customer experience	Major	Annual dollars saved/realized	$3,618	Major	Annual dollars saved/realized	$2,171	Major	Annual dollars saved/realized	$2,412			
Improved customer experience description	Uniform data availability and download allows for more individuals to be easily trained in their access/use/function. More flexibility in selecting the appropriate models for water resources work.			Currently using surveyed cross sections for floodplain analysis which is very accurate. Additional 3D elevation data would improve processing time but not necessarily more confidence in the modeling. A uniform process/place for accessing data would assist in training staff and make modeling more efficient.			Improved 3D elevation data would improve project designs and overall confidence that designs will perform as intended. Currently we are not downloading data like this -- but a uniform site for accessing data would be useful. We are currently not using models that require detailed bathymetry data but we would if that data was available.					
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor			Minor			Minor					
Education or outreach description	Better web mapping displaying elevation data and/or model results			Provide better visuals to explain floodplain analysis			Better visual displays of projects					
Environmental	Major			Moderate			Moderate					
Environmental description	Improved estimates for nutrient loadings (P/N) from agricultural lands and urbanized areas.			Provide better understanding of streamflow and improve outcome of stream bank erosion projects			Improved shoreline preservation efforts					
Public safety, including life and property	Major			Major			Major					
Public safety, including life and property description	Improved floodplain delineations, road designs and other municipal infrastructure			Provide better floodplain analysis and mapping			Better marina designs					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes	Yes	
Contours	Yes	Yes	Yes	
Hillshades	Yes			
Slope maps	Yes			
Aspect maps				
Curvature maps				
Cross sections	Yes	Yes	Yes	
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids	Yes			
Hydrologic networks (e.g. streams, lakes)	Yes			
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)	Yes			
Building footprints	Yes			
Breaklines for road edge-of-pavement	Yes			
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Quality Positioning Services (QPS)

QPS is focused on system integration of survey sensors and the development of software applications used for hydrographic surveys, sea-floor mapping, portable pilot units, and Electronic Navigation Charts (ENC) production. The key technology of QPS is based on precise navigation through the collection and presentation of large volumes of navigation and depth data. This also includes new techniques for 3D visualization of the underwater environment. QPS navigation and positioning software is used on board offshore construction vessels, pipe-lay barges, drilling rigs, seismic research vessels, and hydrographic survey vessels. QPS has a fast growing market share in the offshore oil and gas industry, dredging industry, and port communities.

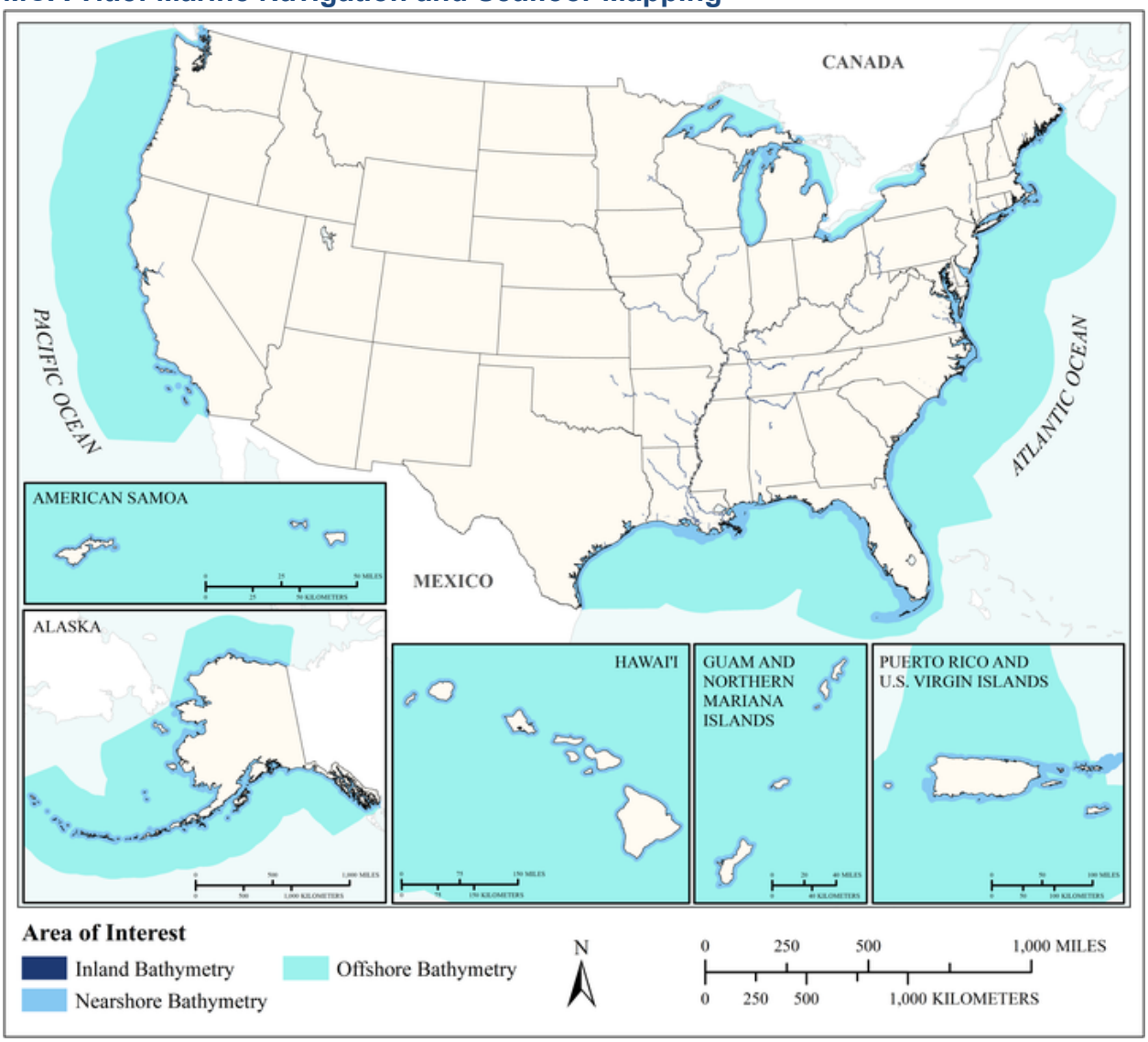
Elevation data are used for marine based applications that involve the acquisition, processing, visualization, and analysis of time based xyz information. This includes but is not limited to avigation, seafloor mapping, oil and gas, dredging, academic research, offshore renewables, defense, etc.

QPS has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Quality Positioning Services	32593	Marine Navigation and Seafloor Mapping	Inland Bathy	QL0B	Event driven	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Nearshore Bathy	QL0B	Event driven	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate
				Offshore Bathy	Order 2	Event driven	Unable to quantify	Unable to quantify	Moderate	Moderate	Moderate

MCA Title: Marine Navigation and Seafloor Mapping



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type		Required	Required	Required
Geographic Area Requirements		Custom description	All study waters	All study waters
Sub Area Requirements		Navigable waters		

MCA Description	Response
Mission Critical Activity	Any and all marine based applications that involve the acquisition, processing, visualization and analysis of time based xyz information. This includes but is not limited to Navigation, Seafloor Mapping, Oil & Gas, Dredging, Academic Research, Offshore Renewables, Defense, etc.
MCA Title	Marine Navigation and Seafloor Mapping
MCA ID	32593
Organization Type	Private or Commercial
Organization Name	Quality Positioning Services
Sub-Agency or Division	
Organization Mission	QPS is focused on system integration of survey sensors and the development of software applications used for hydrographic surveys, sea-floor mapping, portable pilot units and Electronic Navigation Charts (ENC) production. QPS is seen as market leader in these fields. The key technology of QPS is based on precise navigation, the collection and presentation of large volumes of navigation and depth data. This also includes new techniques for 3D visualization of the underwater environment. QPS navigation and positioning software is used on board offshore construction vessels, pipe-lay barges, drilling rigs, seismic research vessels and hydrographic survey vessels. QPS has a fast growing market share in the offshore oil and gas industry, dredging industry and port communities.
Program Name	Marine navigation
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	BU 22 - Infrastructure and Construction Management
Tertiary Business Use	BU 03 - Coastal Zone Management

What Needs to be Measured in 3D	Response
Bare earth ground	Nice to have
Tops of buildings, structures, objects	Not required
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Highly desirable
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Required
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Any feature that can pose a threat to safe navigation such as the top of a rock, shipwreck, etc. Any feature that requires inspection & maintenance such as a pipeline, Christmas tree, riser, etc. Any feature that delineates habitat.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Required
10 - 50 ft	Required
51 - 100 ft	Required
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Required
½ - 1 acre	Required
1.1 – 2 acres	Required
2.1 – 5 acres	Required
5.1 – 10 acres	Required
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order		QL0B	QL0B	Order 2
Update Frequency		Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.
Event type(s)		Event driven only	Event driven only	Event driven only
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error		Less than 50 cm	Less than 50 cm	Up to 20 meters
Acceptable Vertical Error		Less than 10 cm	Less than 10 cm	Up to 2 meters
How far onshore needed			To Mean Lower Low Water (MLLW)	
How far down the beach profile needed			To MHHW	
Tide correction requirement			MSL	MSL
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season		Highly desirable	Highly desirable	Highly desirable		Highly desirable
Entire AOI under same environmental conditions		Highly desirable	Highly desirable	Highly desirable		Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless		Highly desirable	Highly desirable	Highly desirable		Highly desirable
DEM for entire AOI needs to be seamless		Required	Highly desirable	Highly desirable		Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM		Nice to have	Required	Required
DTM		Required	Required	Required
DEM		Required	Required	Required
Raw point cloud data		Required	Required	Required
Classified point cloud		Highly desirable	Required	
Edited/cube XYZ		Required	Required	Required
Full waveform		Highly desirable	Highly desirable	Highly desirable
Bathymetric Attributed Grid (BAG)		Required	Required	Required
Breaklines required for standard hydro-flattening		Required		
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Required	Required
Tidal Constituent And Residual Interpolation (TCARI)			Required	Required
Intensity imagery/sidescan imagery		Highly desirable	Highly desirable	Highly desirable
Ground control/ground truthing		Highly desirable	Highly desirable	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery		Nice to have	Nice to have	Nice to have
Underwater videography			Highly desirable	Highly desirable
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Highly desirable	Highly desirable
Subbottom characteristics			Required	Required
Geologic and seismic data		Required	Highly desirable	Highly desirable
Water column properties - Physical			Highly desirable	Highly desirable
Water column properties - Chemical			Highly desirable	Highly desirable
Water column properties - Biological			Highly desirable	Highly desirable
Currents			Highly desirable	Highly desirable
Tide/wave heights			Highly desirable	Highly desirable
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Highly desirable	Highly desirable
Boundaries			Highly desirable	Highly desirable
Routes			Highly desirable	Highly desirable
Offshore cadastral			Highly desirable	Highly desirable
Lease areas			Highly desirable	Highly desirable
Fixed obstructions			Highly desirable	Highly desirable
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates		Required	Highly desirable	
Land use/land cover		Nice to have	Nice to have	Nice to have
Wetlands		Nice to have	Nice to have	Nice to have

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Nice to have	Nice to have
Inland surface water features		Highly desirable	Nice to have	
Bridges/culverts		Highly desirable		
Landmark features		Nice to have	Nice to have	
Cultural resources		Nice to have	Nice to have	
Coastal and riverine structures		Required	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used		Best available	Best available	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast		Yes	Yes	Yes
NCEI		Yes	Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes	Yes	Yes
USGS Inland Waters server		Yes		
USGS data series		Yes		
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings		Moderate	Moderate	Moderate
Cost savings/cost reduction		Moderate	Moderate	Moderate
Cost avoidance		Moderate	Moderate	Moderate
Increased revenues		Major	Moderate	Moderate
Mission-driven performance improvements		Major	Moderate	Moderate
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services		Major	Moderate	Moderate

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Improved response or timeliness		Major	Moderate	Moderate
Improved customer experience		Moderate	Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach		Moderate	Minor	Minor
Environmental		Moderate	Minor	Minor
Public safety, including life and property		Major	Minor	Minor

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction				I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Cost avoidance				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Increased revenues				I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Mission-driven performance improvements				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Other operational benefits				Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Other operational benefits description												
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved response or timeliness				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Improved customer experience				Major	Unable to provide		Major	Unable to provide		Major	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach				Moderate			Moderate			Moderate		
Environmental				Moderate			Moderate			Moderate		
Public safety, including life and property				Moderate			Moderate			Moderate		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

Sapphos Environmental, Inc.

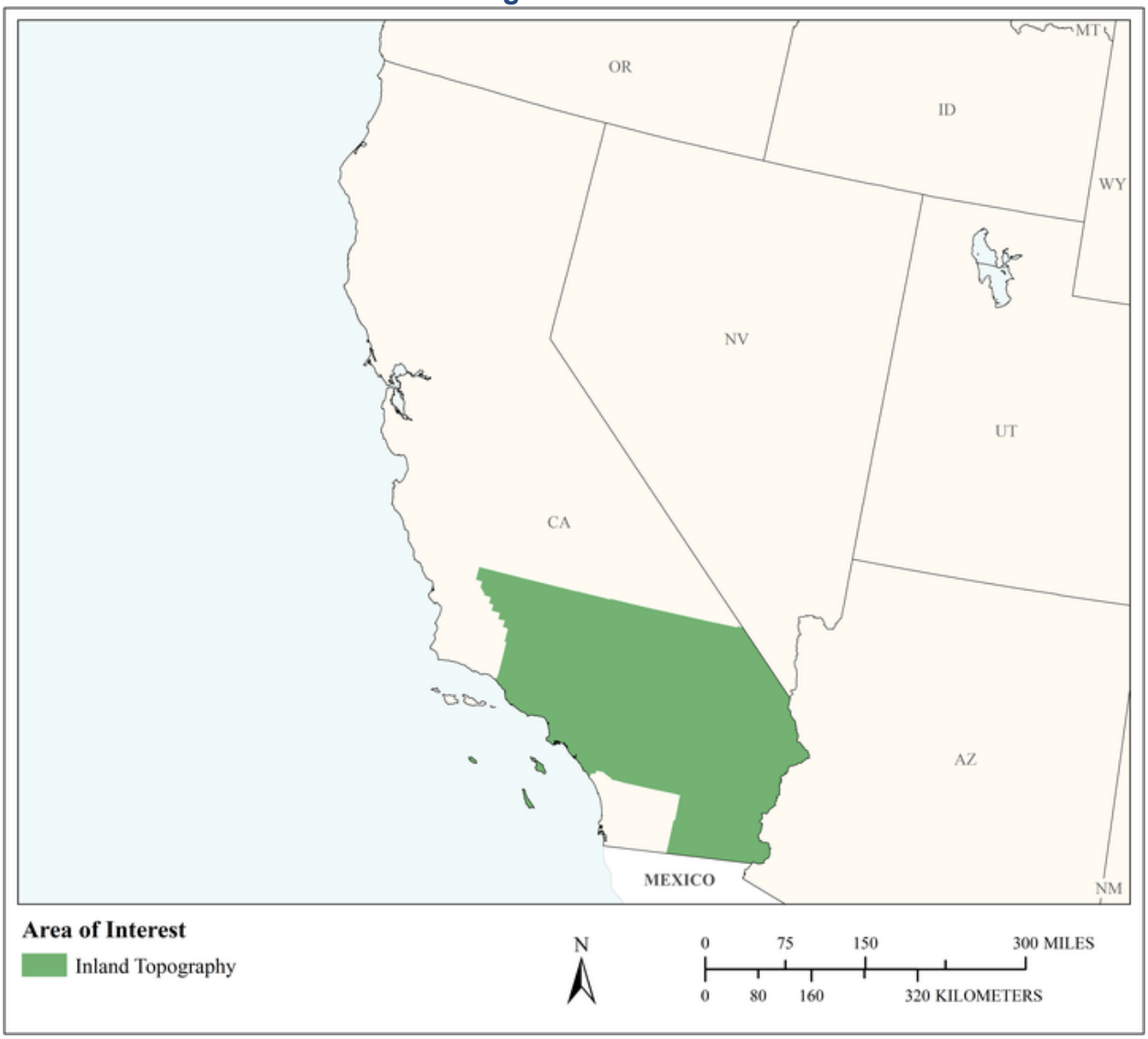
Sapphos Environmental, Inc. resolves planning, resource management, and environmental compliance issues through the development of pragmatic solutions and exemplary client service. Sapphos Environmental, Inc. provides environmental consulting services. Elevation data are used for a variety of purposes including riverine, coastal zone, and wildlife management; renewable energy and oil and gas resources; cultural resources preservation; and urban and regional planning.

Sapphos Environmental, Inc. has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 06 – Natural Resource Management	Sapphos Environmental, Inc.	22346	Environmental Consulting	Inland Topo	QL2	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Environmental Consulting



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	One or more states, territories, or counties			
Sub Area Requirements	Los Angeles, Kern, Orange, Riverside, Ventura, San Bernardino, and Imperial Counties, CA			

MCA Description	Response
Mission Critical Activity	Environmental consulting services. Elevation data are used for a variety of purposes including riverine, coastal zone, and wildlife management; renewable energy and oil and gas resources; cultural resources preservation; and urban and regional planning.
MCA Title	Environmental Consulting
MCA ID	22346
Organization Type	Private or Commercial
Organization Name	Sapphos Environmental, Inc.
Sub-Agency or Division	
Organization Mission	Environmental Consulting
Program Name	Environmental Consulting
Total Annual Program Budget	
Primary Business Use	BU 06 - Natural Resources Conservation
Secondary Business Use	BU 12 - Renewable Energy Resources
Tertiary Business Use	BU 23 - Urban and Regional Planning

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Nice to have
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Nice to have

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Large features (e.g. groups of trees, house, building, road, underwater wreck, large commercial pier, etc.)
Description of smallest 3D features	Groups of trees and rock formations.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2			
Update Frequency	2-3 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	The best horizontal accuracy achievable for the vertical accuracy I need			
Acceptable Vertical Error	Up to 20 cm			

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far onshore needed				
How far down the beach profile needed	Not applicable			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Not required
Hydro-enforcement	Not required
Hydro-conditioning	Not required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Required					
Entire AOI under same environmental conditions	Required					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required					
DEM for entire AOI needs to be seamless	Required					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Required			
Raw point cloud data	Highly desirable			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Nice to have			
Additional breaklines for hydro-enforcement of culverts	Highly desirable			
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Highly desirable			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Highly desirable			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Highly desirable			
Land use/land cover	Highly desirable			
Wetlands	Highly desirable			
Estuaries				
Inland surface water features	Highly desirable			
Bridges/culverts	Highly desirable			
Landmark features	Highly desirable			
Cultural resources	Highly desirable			
Coastal and riverine structures	Highly desirable			
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Digital Coast NOAA Ifsar data 2003			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast	Yes			
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Major			
Cost avoidance	Major			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Increased revenues	Major			
Mission-driven performance improvements	Major			
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major			
Improved response or timeliness	I don't know			
Improved customer experience	Minor			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Moderate			
Public safety, including life and property	I don't know			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide										
Cost savings/cost reduction	I don't know	Unable to provide										
Cost avoidance	I don't know	Unable to provide										
Increased revenues	I don't know	Unable to provide										
Mission-driven performance improvements	I don't know	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide										
Improved response or timeliness	I don't know	Unable to provide										
Improved customer experience	I don't know	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know											
Environmental	I don't know											
Public safety, including life and property	I don't know											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

SEARCH

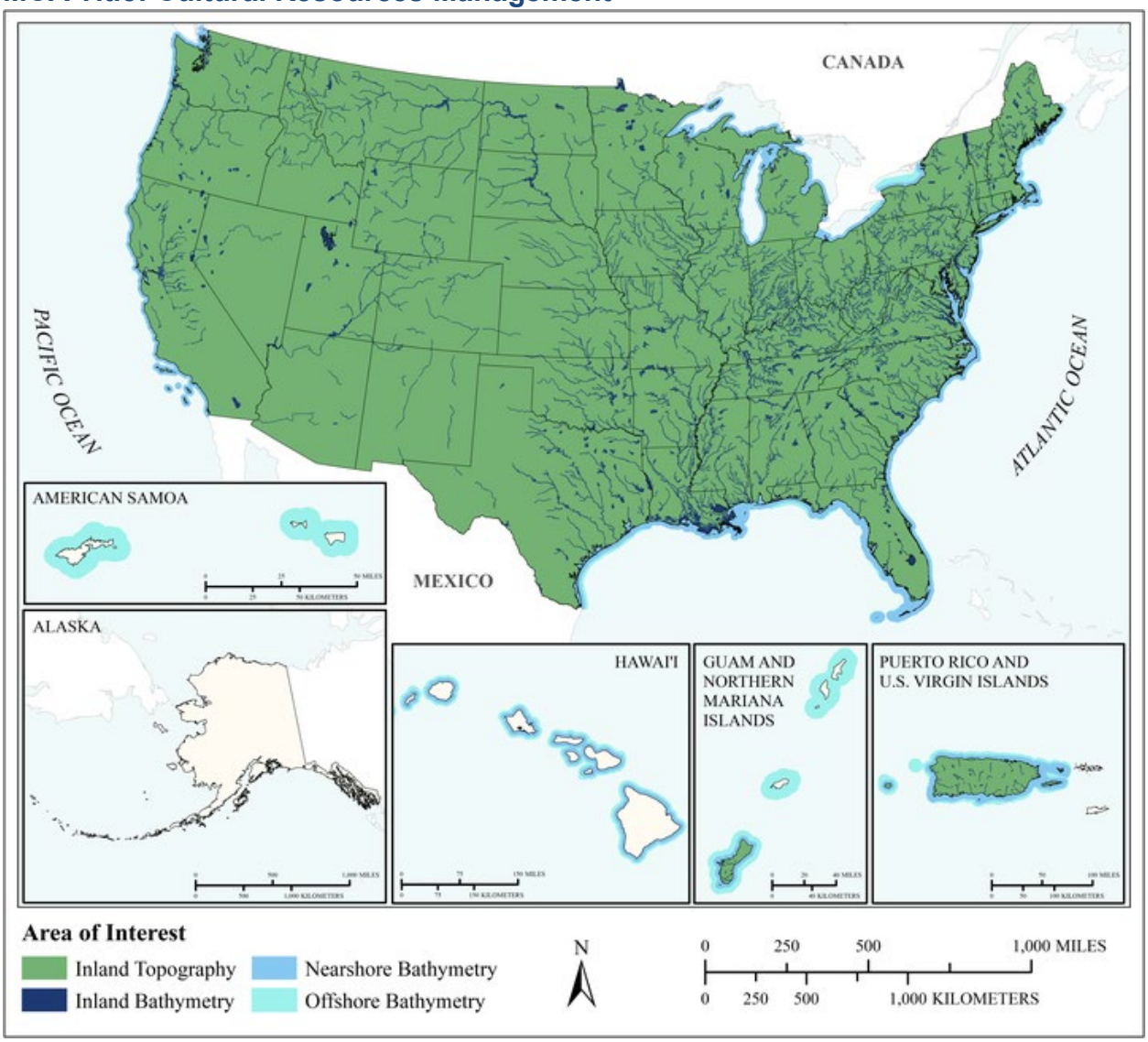
SEARCH is the largest archaeology and cultural resources management company in the world, and SEARCH$_2$0 is the largest underwater archaeology program. Specializing in mega infrastructure projects and emergency response on land and water, SEARCH delivers high-capacity cultural resource services. SEARCH specializes in the full spectrum of cultural services related to Archaeology, Maritime Archaeology, Architectural History, History, Archives, Collections Management, Museum Services, GIS, Documentary Media, and Public Affairs.

SEARCH has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 14 – Cultural Resource Management	SEARCH	22205	Cultural Resources Management	Inland Topo	QL1	Annually	Unable to quantify	Unable to quantify	Minor	Minor	Minor
				Inland Bathy	QL0B	Event driven	Unable to quantify	Unable to quantify	Minor	Minor	None
				Nearshore Bathy	QL0B	Annually	Unable to quantify	Unable to quantify	Minor	Minor	Minor
				Offshore Bathy	Order 1a	Annually	Unable to quantify	Unable to quantify	Minor	Minor	Minor

MCA Title: Cultural Resources Management



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	Nationwide, inland areas	Nationwide, inland areas	Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	Waters offshore off one or more states (including Great Lakes states), territories, or counties
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Cultural and historical resource management including onshore archaeology and offshore maritime archaeology
MCA Title	Cultural Resources Management
MCA ID	22205
Organization Type	Private or Commercial
Organization Name	SEARCH
Sub-Agency or Division	
Organization Mission	Cultural resources management
Program Name	Cultural resources management
Total Annual Program Budget	
Primary Business Use	BU 14 - Cultural Resources Preservation and Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Nice to have
Subcanopy of vegetation/understory	Not required
River/lake bottom	Nice to have
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Large features (e.g. groups of trees, house, building, road, underwater wreck, large commercial pier, etc.)
Description of smallest 3D features	Cultural or archaeological artifacts

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Nice to have
Rivers and Streams	
Less than 10 ft	Nice to have
10 - 50 ft	Nice to have
51 - 100 ft	Nice to have
101 - 500 ft	Nice to have
501 - 2,500 ft	Nice to have
Greater than 2,500 ft	Nice to have
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Nice to have
½ - 1 acre	Nice to have
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Nice to have
Greater than 10 acres	Nice to have

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL1	QL0B	QL0B	Order 1a
Update Frequency	Annually	Event driven only – Data need to coincide with a specific event.	Annually	Annually
Event type(s)		Event driven only		
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	I don't know	The best horizontal accuracy achievable for the vertical accuracy I need	Less than 50 cm	Less than 50 cm
Acceptable Vertical Error	Up to 10 cm	Less than 10 cm	Less than 10 cm	Less than 1 meter
How far onshore needed			To cover the coastal uplands	
How far down the beach profile needed	Below MLLW		Below MLLW	
Tide correction requirement			MSL	MSL
Cross sections and/or transects meet needs	Partial	Partial		
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Not required
Hydro-enforcement	Not required
Hydro-conditioning	Not required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Nice to have	
Temporal Seamlessness						
Entire AOI in same acquisition season	Nice to have	Nice to have	Highly desirable	Highly desirable	Nice to have	Highly desirable
Entire AOI under same environmental conditions	Nice to have	Nice to have	Highly desirable	Highly desirable	Nice to have	Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable	Nice to have	Highly desirable	Highly desirable	Highly desirable	Highly desirable
DEM for entire AOI needs to be seamless	Highly desirable	Nice to have	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable	Nice to have	Nice to have	Highly desirable
DTM	Highly desirable	Nice to have	Required	Required
DEM	Required	Nice to have	Nice to have	Nice to have
Raw point cloud data	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Classified point cloud	Highly desirable	Highly desirable	Highly desirable	
Edited/cube XYZ		Highly desirable	Highly desirable	Highly desirable
Full waveform	Highly desirable	Highly desirable	Highly desirable	Nice to have
Bathymetric Attributed Grid (BAG)		Highly desirable	Highly desirable	Highly desirable

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Not required	Not required		
Additional breaklines for hydro-enforcement of culverts	Not required			
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Nice to have
Tide Predictions			Nice to have	Nice to have
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	Nice to have
Intensity imagery/sidescan imagery	Required	Required	Required	Required
Ground control/ground truthing	Highly desirable	Highly desirable	Highly desirable	Highly desirable

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Required	Required
Aerial and/or satellite imagery	Required	Highly desirable	Highly desirable	Nice to have
Underwater videography			Highly desirable	Highly desirable
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Required	Required
Subbottom characteristics			Required	Required
Geologic and seismic data	Required	Highly desirable	Highly desirable	Highly desirable
Water column properties - Physical			Highly desirable	Nice to have
Water column properties - Chemical			Highly desirable	Nice to have
Water column properties - Biological			Highly desirable	Nice to have
Currents			Highly desirable	Nice to have
Tide/wave heights			Highly desirable	Nice to have
Sea ice conditions			Highly desirable	Highly desirable
Habitat distribution and classification			Highly desirable	Nice to have
Boundaries			Required	Highly desirable
Routes			Required	Nice to have
Offshore cadastral			Nice to have	Nice to have
Lease areas			Required	Required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Required	Highly desirable	Required	
Land use/land cover	Required	Highly desirable	Nice to have	Nice to have
Wetlands	Required	Highly desirable	Nice to have	Nice to have
Estuaries			Nice to have	Nice to have
Inland surface water features	Required	Highly desirable	Not required	
Bridges/culverts	Required	Highly desirable		
Landmark features	Highly desirable	Nice to have	Not required	
Cultural resources	Required	Required	Required	
Coastal and riverine structures	Required	Highly desirable	Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available	Best available	Best available	Best available
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast		Yes		
NCEI	Yes	Yes	Yes	Yes
Open Topography				
NOAA nautical charts		Yes	Yes	Yes
USACE navigation charts		Yes	Yes	Yes
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Moderate	Moderate	Major	Moderate
Cost savings/cost reduction	Moderate	Moderate	Major	Moderate
Cost avoidance	Moderate	Moderate	Major	Moderate
Increased revenues	Moderate	Moderate	Moderate	Minor

Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Mission-driven performance improvements	Minor	Minor	Moderate	Minor
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Moderate	Moderate	Moderate	Moderate
Improved response or timeliness	Moderate	Moderate	Moderate	Major
Improved customer experience	Moderate	Moderate	Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor	Minor	Moderate	Minor
Environmental	Minor	Minor	Moderate	Minor
Public safety, including life and property	Minor	Minor	Minor	Minor

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Minor	Unable to provide		Moderate	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction	Moderate	Unable to provide		Minor	Unable to provide		Moderate	Unable to provide		Minor	Unable to provide	
Cost avoidance	Major	Unable to provide		Minor	Unable to provide		Moderate	Unable to provide		Minor	Unable to provide	
Increased revenues	None			None			None			None		
Mission-driven performance improvements	Minor	Unable to provide		Minor	Unable to provide		None			Minor	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Moderate	Unable to provide		Major	Unable to provide		Minor	Unable to provide	
Improved response or timeliness	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Minor	Unable to provide	
Improved customer experience	Moderate	Unable to provide		Minor	Unable to provide		Minor	Unable to provide		Minor	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor			Minor			Minor			Minor		
Environmental	Minor			Minor			Minor			Minor		
Public safety, including life and property	Minor			None			Minor			Minor		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours				
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	
Vertical accuracy	
Update frequency	

Sounding Science

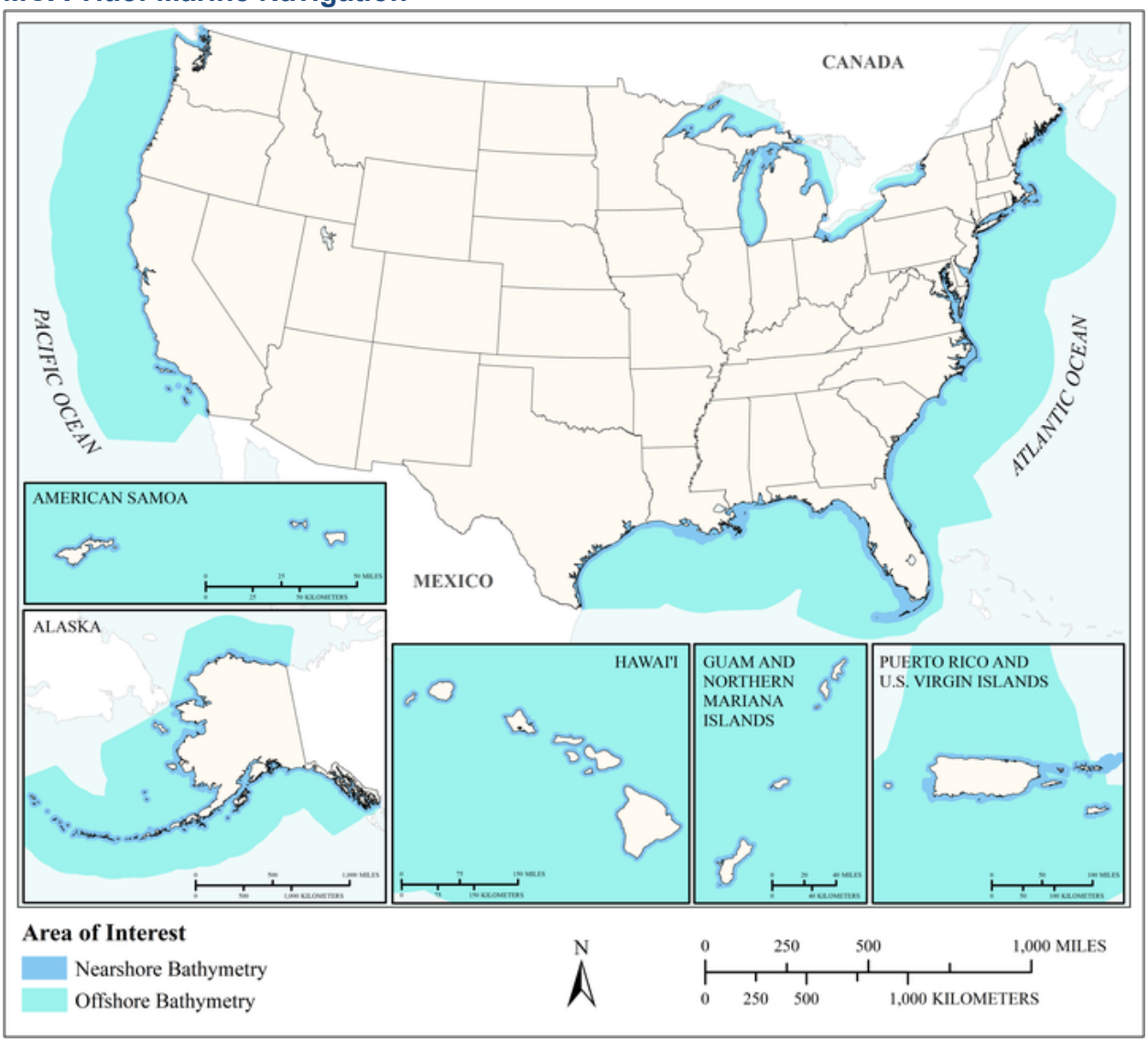
Sounding Science is a hydrographic data science consultancy, specializing in marine geospatial software research and development. Sounding Science has developed the Geopoint System, hydrographic data processing software that is available as a cloud native web service. The Geopoint software was designed to ingest and rapidly transform large amounts of bathymetric survey data into common GIS data formats. Core to the development is to provide deliverables that conform to IHO charting standards. Sounding Science also provides post processing data analysis and deliverables using various sources of marine spatial data. Processed bathymetric data are used to create customized marine GIS products for users in government, academia and a broad range of marine related activities.

Sounding Science has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				Requirements			Future Operational Benefits	Future Customer Service Benefits	Future Societal Benefits		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Sounding Science	21966	Marine Navigation	Nearshore Bathy	QL0B	Most recent	$200,000	Unable to quantify	Moderate	Minor	Moderate
				Offshore Bathy	Order 1b	Most recent	$1,800,000	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Marine Navigation



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	Required
Geographic Area Requirements			All study waters	All study waters
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Marine Navigation. Sounding Science provides post processing data analysis and deliverables using various sources of marine spatial data. Processed bathymetric data are used to create customized marine GIS products for users in government, academia and a broad range of marine related activities.
MCA Title	Marine Navigation
MCA ID	21966
Organization Type	Private or Commercial
Organization Name	Sounding Science
Sub-Agency or Division	
Organization Mission	Sounding Science is a hydrographic data science consultancy, specializing in marine geospatial software research and development. Sounding Science has developed the Geopoint System, hydrographic data processing software that is available as a cloud native web service. The Geopoint software was designed to ingest and rapidly transform large amounts of bathymetric survey data into common GIS data formats.
Program Name	Marine navigation
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Not required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Not required
River/lake bottom	Highly desirable
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Rocks, wrecks and obstructions.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			QL0B	Order 1b
Update Frequency			Most recent	Most recent
Event type(s)				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level and/or update frequency variability across AOI			Use best available data. Update frequency varies by area, or if sands shift, or event driven.	Use best available data. Update frequency varies by area, or if sands shift, or event driven.
Acceptable Horizontal Error			Up to 2 meters	Up to 5 meters
Acceptable Vertical Error			Up to 20 cm	Less than 1 meter
How far onshore needed			To Mean Lower Low Water (MLLW)	
How far down the beach profile needed			Below MLLW	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Nice to have	Nice to have		Highly desirable
Entire AOI under same environmental conditions			Highly desirable	Highly desirable		Highly desirable
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Highly desirable	Nice to have		Highly desirable
DEM for entire AOI needs to be seamless			Highly desirable	Nice to have		Highly desirable
Amount of acceptable vertical manipulation to achieve spatial seamlessness			Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer		Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Required	Highly desirable
DTM			Required	Highly desirable
DEM			Required	Highly desirable
Raw point cloud data			Highly desirable	Nice to have
Classified point cloud			Highly desirable	
Edited/cube XYZ			Highly desirable	Nice to have
Full waveform			Nice to have	Not required
Bathymetric Attributed Grid (BAG)			Required	Required

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Nice to have	Nice to have
Tidal Constituent And Residual Interpolation (TCARI)			Highly desirable	Highly desirable
Intensity imagery/sidescan imagery			Highly desirable	Nice to have
Ground control/ground truthing			Nice to have	Nice to have

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Highly desirable	Required
Acoustic imagery of the seafloor			Highly desirable	Nice to have
Aerial and/or satellite imagery			Nice to have	Nice to have
Underwater videography			Not required	Not required
Bottom texture			Not required	Not required
Bottom type			Required	Required
Submerged features			Required	Required
Subbottom characteristics			Nice to have	Not required
Geologic and seismic data			Not required	Not required
Water column properties - Physical			Not required	Not required
Water column properties - Chemical			Not required	Not required
Water column properties - Biological			Not required	Not required
Currents			Nice to have	Nice to have
Tide/wave heights			Highly desirable	Required
Sea ice conditions			Not required	Not required
Habitat distribution and classification			Not required	Not required
Boundaries			Required	Required
Routes			Required	Required
Offshore cadastral			Nice to have	Nice to have
Lease areas			Nice to have	Nice to have
Fixed obstructions			Required	Required
Floating observation/navigation systems			Highly desirable	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates			Required	
Land use/land cover			Not required	Not required
Wetlands			Nice to have	Nice to have
Estuaries			Nice to have	Highly desirable
Inland surface water features			Nice to have	
Bridges/culverts				
Landmark features			Required	
Cultural resources			Nice to have	
Coastal and riverine structures			Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			We currently use NOAA acquired multibeam data. Quality is IHO Order 1.	NOAA acquired multibeam data.
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts			Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			Major	Major
Cost savings/cost reduction			Major	Major

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cost avoidance			Major	Major
Increased revenues			Moderate	Moderate
Mission-driven performance improvements			Moderate	Major
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			Moderate	Moderate
Improved response or timeliness			Major	Moderate
Improved customer experience			Major	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			I don't know	I don't know
Environmental			I don't know	I don't know
Public safety, including life and property			Moderate	Major

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							Major	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction							Major	Unable to provide		Major	Unable to provide	
Cost avoidance							Moderate	Unable to provide		Major	Unable to provide	
Increased revenues							Minor	Annual dollars saved/realized	$200,000	Major	Annual dollars saved/realized	$1,800,000
Increased revenues description										This is our primary business model, and projected annual revenue.		
Mission-driven performance improvements							Minor	Unable to provide		Major	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							Major	Unable to provide		Major	Unable to provide	
Improved response or timeliness							Moderate	Unable to provide		Major	Unable to provide	
Improved customer experience							Major	Unable to provide		Major	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							Moderate			I don't know		
Environmental							Minor			I don't know		
Public safety, including life and property							Moderate			I don't know		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)			Yes	Yes
Contours			Yes	Yes
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints			Yes	Yes
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1

SubCom

SubCom is a leading global supplier of undersea communications systems around the world. SubCom designs, manufactures, deploys, and maintains the undersea fiber optic cable systems that are the backbone of global communications.

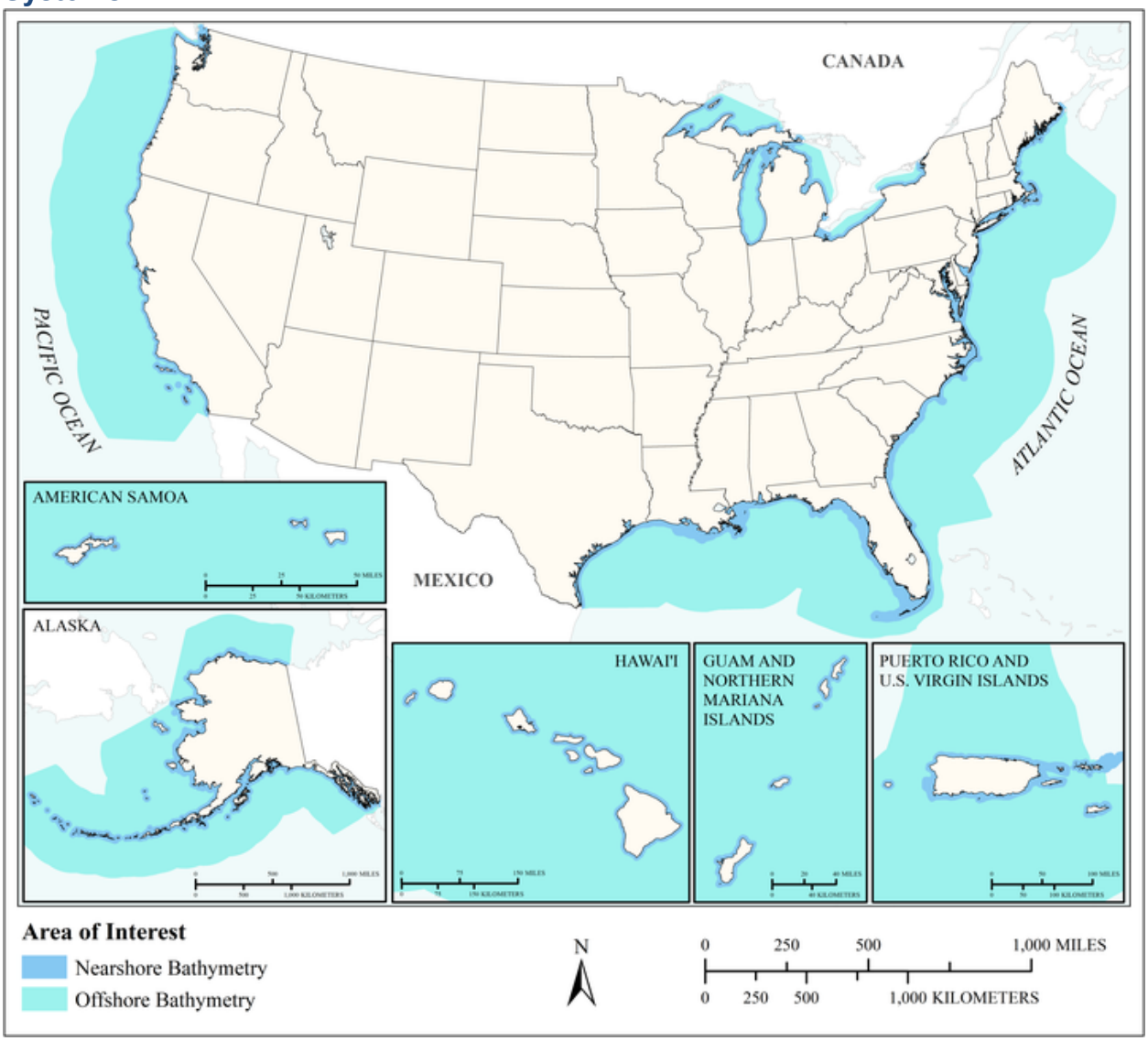
Elevation data are used to design, manufacture, and install submarine fiber optic cable systems worldwide. Each component involves understanding the oceanographic and marine geological environment in order to design the appropriate system for a specific part of the world, armor the cable where necessary, choose an appropriate route, and install the system with cable ships. Submarine cables are the global communications network, connecting people via the internet around the world. Thus, access to publicly available bathymetric data and improved nautical charts based upon such data are one of the first lines of defense against cable snags by allowing increased cable awareness by mariners and other users of the marine space to protect this global network.

SubCom has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 28 – Telecom-munications	SubCom	22104	Design, Manufacture, and Installation of Submarine Fiber Optic Cable Systems	Nearshore Bathy	Cross sections and/or transects meet needs	Event driven	Unable to quantify	Unable to quantify	Major	None	Major
				Offshore Bathy	Cross sections and/or transects meet needs	Event driven	Unable to quantify	Unable to quantify	Major	Major	Major

MCA Title: Design, Manufacture, and Installation of Submarine Fiber Optic Cable Systems



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	Required
Geographic Area Requirements			All study waters	All study waters
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	SubCom's primary Mission Critical Activity (MCA) is to design, manufacture, and install submarine fiber optic cable systems worldwide. Each component to this overall MCA involves understanding the oceanographic and marine geological environment in order to design the appropriate system for a specific part of the world, armor the cable where necessary, choose an appropriate route, and install the system with cable ships. Each component to this overall MCA involves understanding the oceanographic and marine geological environment in order to design the appropriate system for a specific part of the world, armor the cable where necessary, choose an appropriate route, and install the system with cable ships. It is also important to note that submarine cables are the global communications network, connecting people via the internet around the world. Thus, access to publicly available bathymetric data and improved nautical charts based upon such data are one of the first lines of defense against cable snags by allowing us to increase cable awareness with mariners and other users of the marine space to protect this global network.
MCA Title	Design, Manufacture, and Installation of Submarine Fiber Optic Cable Systems
MCA ID	22104
Organization Type	Private or Commercial
Organization Name	SubCom
Sub-Agency or Division	
Organization Mission	SubCom is a leading global supplier of undersea communications systems around the world. SubCom designs, manufactures, deploys, and maintains the undersea fiber optic cable systems that are the backbone of global communications.
Program Name	SubCom's internal organization is designed to target each aspect of the company's MCA, specifically the design, manufacturing, and installation of submarine cables. Note: I am a bit unsure what is meant by a program supported by a Mission Critical Activity. I would think it would be the reserve, a program within an entity supports a MCA.
Total Annual Program Budget	
Primary Business Use	BU 28 - Telecommunications
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Not required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	200,000 sq mi - 2 million sq mi (e.g. large state, large multi-state region such as the Great Basin, standard Federal region, etc.)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	The smallest features we are interested in are those that pose an obstacle to a cable's path or help identify marine uses in the area. Examples would include un-exploded ordnances (UXOs), fishing gear (e.g., lobster pots), and even characteristics of the marine geological landscape (e.g., boulder fields).

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			Cross sections and/or transects meet needs	Cross sections and/or transects meet needs
Update Frequency			Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.
Event type(s)			A new project.	A new project.
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error			Up to 2 meters	Up to 2 meters
Acceptable Vertical Error			Up to 30 cm	Less than 1 meter
How far onshore needed			500 meters inland	
How far down the beach profile needed			To MHHW	
Tide correction requirement			I don't know	I don't know
Cross sections and/or transects meet needs			Yes	Yes
Cross section/transect requirement			Transects are required for cable landings.	Survey data is collected along the cable route's planned route. This data is utilized to determine the best route for the cable within that swath width.

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Highly desirable	Required		Required
Entire AOI under same environmental conditions			Highly desirable	Required		Required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Required	Required		Required
DEM for entire AOI needs to be seamless			Required	Required		Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness			Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level		Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Highly desirable	Highly desirable
DTM			Required	Required
DEM			Required	Required
Raw point cloud data			Required	Required
Classified point cloud			Highly desirable	
Edited/cube XYZ			Highly desirable	Required
Full waveform			Nice to have	Not required
Bathymetric Attributed Grid (BAG)			Highly desirable	Highly desirable
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	Highly desirable
Tide Predictions			Required	Highly desirable
Tidal Constituent And Residual Interpolation (TCARI)			Required	Highly desirable
Intensity imagery/sidescan imagery			Required	Required
Ground control/ground truthing			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Required	Required
Aerial and/or satellite imagery			Highly desirable	Highly desirable
Underwater videography			Nice to have	Highly desirable
Bottom texture			Required	Required
Bottom type			Required	Required
Submerged features			Required	Required
Subbottom characteristics			Required	Required
Geologic and seismic data			Highly desirable	Highly desirable
Water column properties - Physical			Highly desirable	Highly desirable
Water column properties - Chemical			Highly desirable	Highly desirable
Water column properties - Biological			Highly desirable	Highly desirable
Currents			Required	Required
Tide/wave heights			Required	Required
Sea ice conditions			Required	Required
Habitat distribution and classification			Required	Required
Boundaries			Required	Required
Routes			Required	Required
Offshore cadastral			Highly desirable	Highly desirable
Lease areas			Required	Required
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required
Shorelines – current, historic, change rates			Required	
Land use/land cover			Not required	Not required
Wetlands			Not required	Not required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries			Not required	Not required
Inland surface water features			Not required	
Bridges/culverts				
Landmark features			Required	
Cultural resources			Required	
Coastal and riverine structures			Required	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			The nearshore bathymetric data used meets survey quality specifications.	Unable to provide.
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast			Yes	Yes
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts			Yes	Yes
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			Major	Major
Cost savings/cost reduction			Major	Major
Cost avoidance			Major	I don't know
Increased revenues			I don't know	I don't know
Mission-driven performance improvements			Major	Major

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			Moderate	Major
Improved response or timeliness			Major	None
Improved customer experience			Major	None
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			Major	Major
Environmental			Moderate	Major
Public safety, including life and property			Major	Major

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							Major	Unable to provide		Major	Unable to provide	
Cost savings/cost reduction							Minor	Unable to provide		None		
Cost avoidance							Major	Unable to provide		Major	Unable to provide	
Cost avoidance description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags.			Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear. Note comments in nearshore bathymetric section. Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Increased revenues							None			Major	Unable to provide	
Increased revenues description										Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Mission-driven performance improvements							Major	Unable to provide		Major	Unable to provide	
Mission-driven performance improvements description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags.			Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Other operational benefits							Major	Unable to provide		Major	Unable to provide	
Other operational benefits description										Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							Moderate	Unable to provide		Major	Unable to provide	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Value added to products or services description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags.			Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Improved response or timeliness							Major	Unable to provide		Major	Unable to provide	
Improved response or timeliness description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags.					
Improved customer experience							None			Major	Unable to provide	
Other customer service benefits							Major	Unable to provide		Major	Unable to provide	
Other customer service benefits description												
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							Major			Major		
Education or outreach description							Improved nautical charts improves cable safety and can be used to teach fishermen about where cables are to protect them and their fishing gear from cable snags.					
Environmental							None			Major		
Public safety, including life and property							Major			Major		
Public safety, including life and property description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags. Improved nautical charts improves cable safety and can be used to teach fishermen about where cables are to protect them and their fishing gear from cable snags.			Bathymetric data collection used to improve nautical charts is critical to cable awareness. We utilize these charts to overlay cables so that fishermen are aware of where they are. These maps are the first line of defense to protect submarine cables from cable snags with fishing gear.		
Other												
Other benefits							Major					
Other description							The first line of defense for protecting cables are creating maps with the local nautical charts overlaid with the cables. Therefore, having more accurate (and new) charts (from bathymetric data collection), improves our ability to increase cable awareness to protect cables and fishermen's fishing gear from cable snags.					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours			Yes	Yes
Hillshades				
Slope maps			Yes	Yes
Aspect maps			Yes	Yes
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

Taylor Shellfish Farms

Taylor Shellfish Farms has farmed high-quality, sustainable shellfish in the Pacific Northwest since 1890, working to maintain and improve water quality through practices which address water quality issues such as ocean acidification and reduce contributions to plastic debris. Taylor Shellfish Farms maintains farming areas in the South Puget Sound, Hood Canal, Samish Bay, Willapa Bay, Little Skookum Inlet, Totten Inlet, and Oakland Bay, WA.

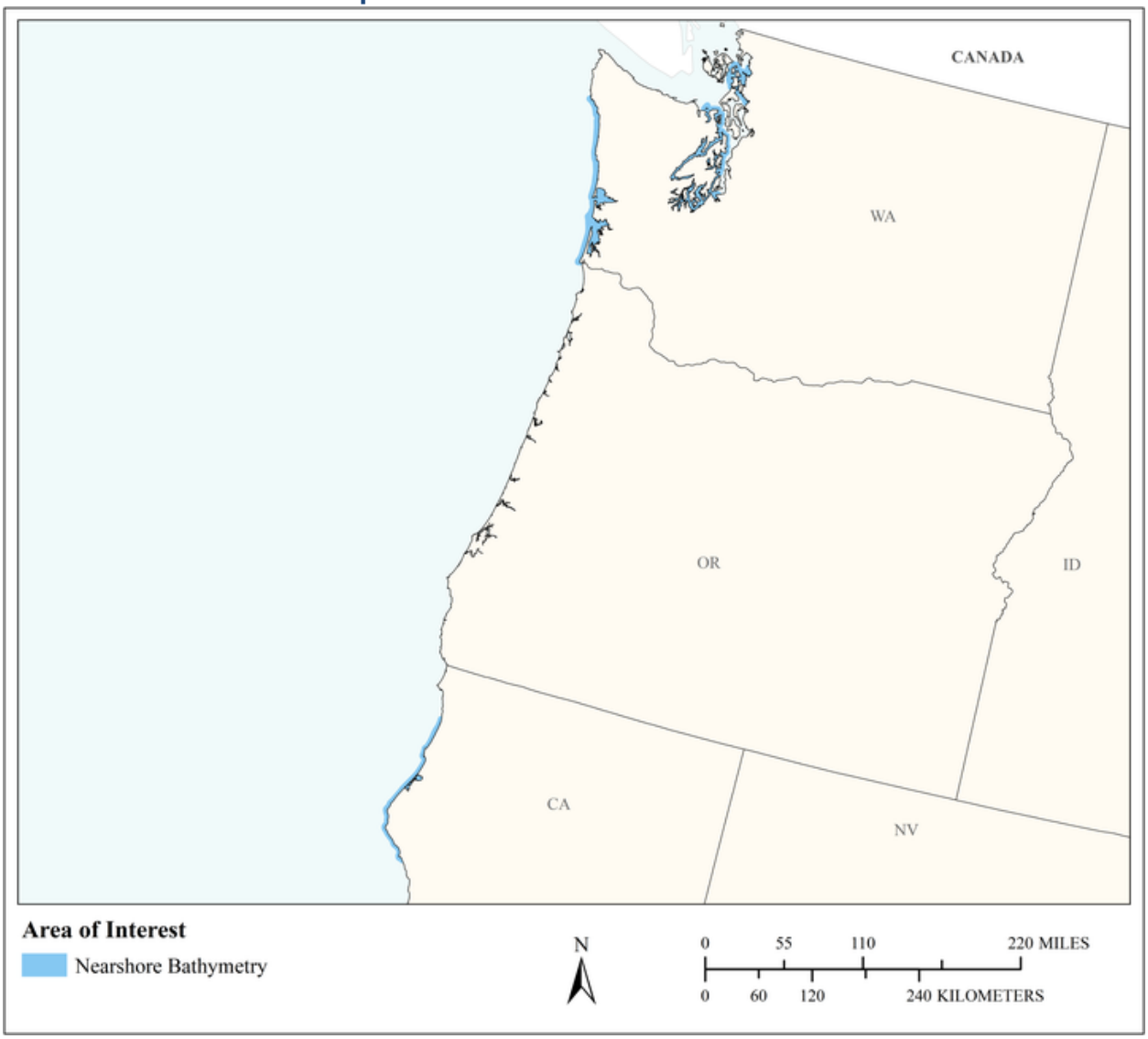
Bathymetric data are used to develop sustainable aquaculture using best management practices. The data help maintain and improve local water quality by allowing identification of installed farm potential to contribute to plastic pollution, minimizing those risks, and addressing any occurrences. Bathymetric data also provide information regarding existing habitat features and conditions that supports species recovery under a Habitat Conservation Plan,

Taylor Shellfish Farms has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 09 – Fisheries Management and Aquaculture	Taylor Shellfish Farms	32774	Sustainable Aquaculture	Nearshore Bathy	QL0B	4-5 years	$102,412	Unable to quantify	Moderate	Moderate	None

MCA Title: Sustainable Aquaculture



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	
Geographic Area Requirements			Nearshore areas along the coast off one or more states, territories, or counties (including Great Lakes states)	
Sub Area Requirements			Pacific, Grays Harbor, Skagit, Mason, Pierce, Thurston, Jefferson, & Kitsap Counties, WA and Humbolt County, CA	

MCA Description	Response
Mission Critical Activity	Sustainable aquaculture using best management practices. Maintaining and improving local water quality by identifying installed farm potential to contribute to plastic pollution, minimizing those risks, and addressing any occurrences. Bathymetric data also provide information regarding existing habitat features and conditions that supports species recovery under a Habitat Conservation Plan,
MCA Title	Sustainable Aquaculture
MCA ID	32774
Organization Type	Private or Commercial
Organization Name	Taylor Shellfish Farms
Sub-Agency or Division	
Organization Mission	Farming high quality, sustainable shellfish in the Pacific Northwest since 1890.
Program Name	Maintaining and improving water quality through practices which identify installed farm potential to contribute to plastic debris and develop a plan to reduce risk and address contributing factors.
Total Annual Program Budget	
Primary Business Use	BU 09 - Fisheries Management and Aquaculture
Secondary Business Use	BU 01 - Water Supply and Quality
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Not required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Highly desirable

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	We are looking at farm size extent, scalable to individual features which can be overlaid with farm gear and critical area features for monitoring and management.

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			QL0B	
Update Frequency			4-5 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Acceptable Horizontal Error			The best horizontal accuracy achievable for the vertical accuracy I need	
Acceptable Vertical Error			Less than 10 cm	
How far onshore needed			To cover the beach slope	
How far down the beach profile needed			Below MLLW	
Tide correction requirement			MSL	
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Highly desirable			
Entire AOI under same environmental conditions			Highly desirable			
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Highly desirable			
DEM for entire AOI needs to be seamless			Highly desirable			
Amount of acceptable vertical manipulation to achieve spatial seamlessness			Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Not required	
DTM			Not required	
DEM			Required	
Raw point cloud data			Nice to have	
Classified point cloud			Not required	
Edited/cube XYZ			Not required	
Full waveform			Highly desirable	
Bathymetric Attributed Grid (BAG)			Not required	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	
Tide Predictions			Highly desirable	
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	
Intensity imagery/sidescan imagery			Highly desirable	
Ground control/ground truthing			Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	
Nautical and/or navigation charts			Highly desirable	
Acoustic imagery of the seafloor			Highly desirable	
Aerial and/or satellite imagery			Highly desirable	
Underwater videography			Nice to have	
Bottom texture			Highly desirable	
Bottom type			Nice to have	
Submerged features			Not required	
Subbottom characteristics			Not required	
Geologic and seismic data			Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Highly desirable	
Tide/wave heights			Not required	
Sea ice conditions			Not required	
Habitat distribution and classification			Nice to have	
Boundaries			Not required	
Routes			Not required	
Offshore cadastral			Not required	
Lease areas			Not required	
Fixed obstructions			Not required	
Floating observation/navigation systems			Nice to have	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates			Nice to have	
Land use/land cover			Nice to have	
Wetlands			Not required	
Estuaries			Highly desirable	
Inland surface water features			Nice to have	
Bridges/culverts				
Landmark features			Nice to have	
Cultural resources			Nice to have	
Coastal and riverine structures			Nice to have	
Overhead structures			Not required	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			Best available	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories			Yes	
State repositories used			University of Washington, WADNR	
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			None	
Cost savings/cost reduction			None	
Cost avoidance			None	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Increased revenues			None	
Mission-driven performance improvements			None	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			None	
Improved response or timeliness			None	
Improved customer experience			None	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			None	
Environmental			None	
Public safety, including life and property			None	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							Major	Annual dollars saved/realized	$2,412			
Time savings description							Consultant hours would be reduced. Field verification would still be required and routine. If the information is available and in a useable format, we would be able to expand applications which we don't incorporate now. Minimal.					
Cost savings/cost reduction							Minor	Unable to provide				
Cost savings/cost reduction description							Dependent on regulations.					
Cost avoidance							None					
Increased revenues							Moderate	Annual dollars saved/realized	$100,000			
Increased revenues description							Improved accuracy for farm and species placement to maximize crop footprint in prime growing areas.					
Mission-driven performance improvements							Major	Annual percent improvement	20%			
Mission-driven performance improvements description							Opportunity to overlay farm data with current bathy conditions to note changes in environment or survivability of product.					
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							I don't know	Unable to provide				
Improved response or timeliness							I don't know	Unable to provide				
Improved customer experience							Minor	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							Moderate					
Education or outreach description							More complete picture of aquaculture benefits in the environment.					
Environmental							Moderate					
Environmental description							Accurate representation of environmental changes based on resource inputs.					
Public safety, including life and property							None					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)			Yes	
Contours			Yes	
Hillshades			Yes	
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps			Yes	
Hydrologic Flow Direction Grids			Yes	
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)			Yes	
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	2
Update frequency	1

TCarta

TCarta is both a producer of source bathymetry data from satellite imagery as well as a user of bathymetric products to produce derivative products and spatial analysis for project-based work.

As a consumer of bathymetric survey products, adequate source bathymetry data is vital to the compilation of derivative products and services that TCarta creates. The lack of modern bathymetry in coastal areas has significant impact on the quality of the composite products and analysis we can provide clients for modeling purposes and there would be considerable time savings and better answers provided with a more complete bathymetric source.

As a producer of Satellite Derived Bathymetry, more modern coastal bathymetry is required for in situ comparisons and as a baseline to be used to determine if change has occurred. The accuracy of the Satellite Derived Bathymetry products TCarta provides would be significantly improved and our accuracy would be better understood with more modern in situ information available.

Improved bathymetric information, including information on source data, vintage, and uncertainty of the survey is critical in the compilation of multi-source bathymetric data products to be used in spatial modeling. Topographic bathymetry data products are of increasing demand and a critical piece of information for coastal zone management. “Good” bathymetric information is the hardest geospatial component to source in the compilation of these products. A more complete and modern National Bathymetric Database with a regular update plan will allow more time to be spent on analysis rather than data compilation, lead to better models and better analysis, and improve TCarta’s Satellite Derived Bathymetry production workflows and final product quality.

TCarta’s services, all of which depend on elevation data, include the following:

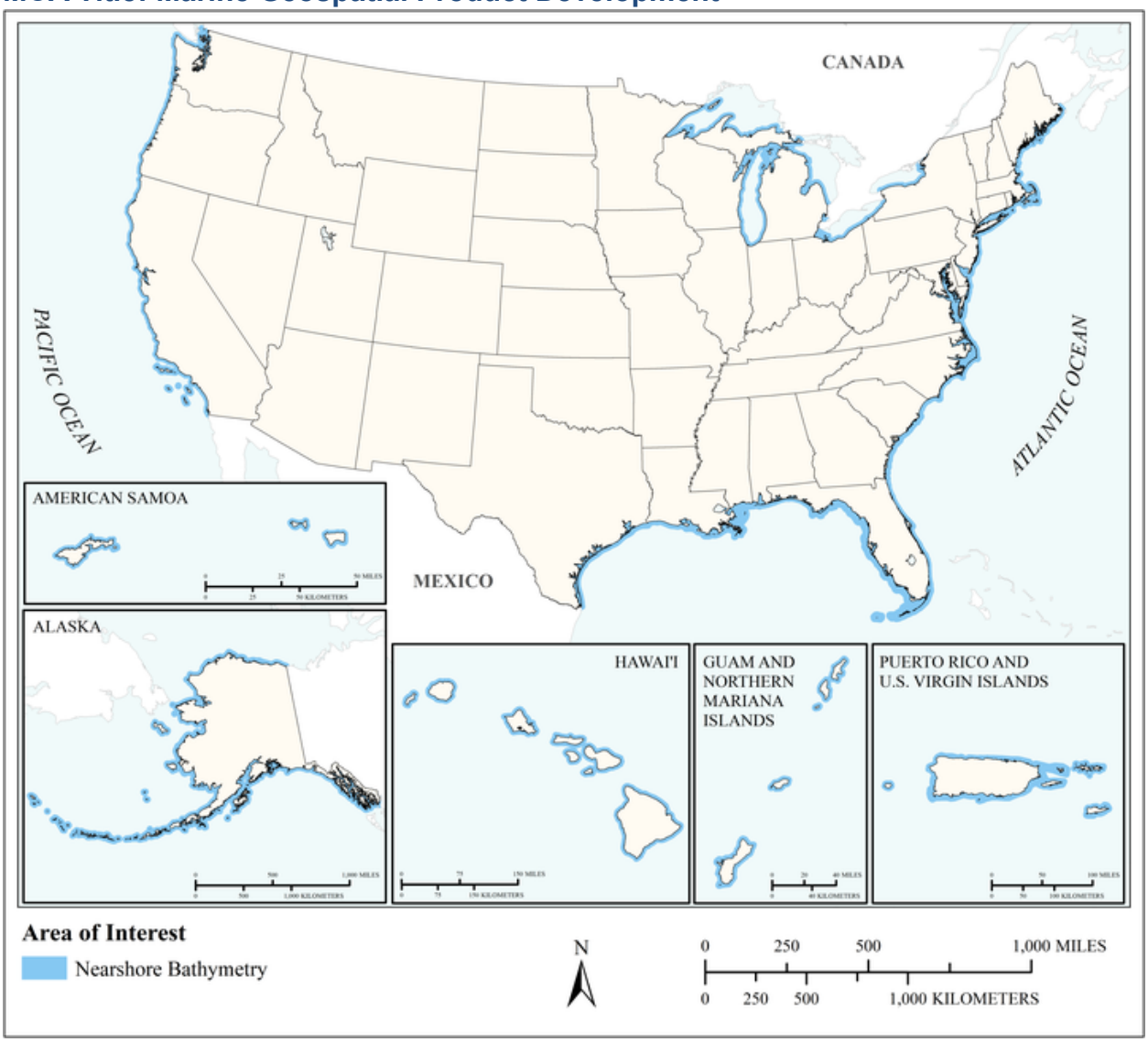
- Engineering and Infrastructure Design to include site selection, port development, and hydrodynamic modeling.
- Geospatial Intelligence to include terrain analysis, situational awareness, and operational and tactical planning.
- Hydrographic Surveying and Charting to include disaster response, route planning, and remote reconnaissance.
- Environmental Monitoring to include change detection, coastal classification, and health assessment.

TCarta has identified a Business Use and Mission Critical Activity that relies on bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	TCarta	21842	Marine Geospatial Product Development	Nearshore Bathy	Coarser bathymetric data satisfies my needs	Annually	Unable to quantify	Unable to quantify	None	None	None

MCA Title: Marine Geospatial Product Development



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type			Required	
Geographic Area Requirements			States and/or Territories	
Sub Area Requirements			Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	

MCA Description	Response
Mission Critical Activity	Coastal hazard modeling, marine navigation, and engineering planning. Coastal zone management, Satellite Derived Bathymetry production.
MCA Title	Marine Geospatial Product Development
MCA ID	21842
Organization Type	Private or Commercial
Organization Name	TCarta
Sub-Agency or Division	TCarta Marine
Organization Mission	Our primary goal is mapping the world's littoral zone utilizing three methods of satellite derived bathymetry: Wave Kinematic, stereophotogrammetry, and multispectral retrieval. From these raw data and other data sources TCarta produces a wide variety of marine and terrestrial geospatial products.
Program Name	Marine Geospatial product development
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Tertiary Business Use	BU 13 - Oil and Gas Resources

What Needs to be Measured in 3D	Response
Bare earth ground	Nice to have
Tops of buildings, structures, objects	Nice to have
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Highly desirable
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Highly desirable
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Required

General Geographic Area and Size	
Average geographic extent of day-to-day area	25,000 sq mi - 74,999 sq mi (e.g. medium state or large multi-county region)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	We are interested in marine hazards down to 1m size

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order			Coarser bathymetric data satisfies my needs	
Update Frequency			Annually	
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error			Up to 5 meters	
Acceptable Vertical Error			Up to 1 meter	

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
How far onshore needed			>1 kilometer inland	
How far down the beach profile needed			To MLLW	
Tide correction requirement			MLLW	
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season			Not required			
Entire AOI under same environmental conditions			Not required			
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless			Not required			
DEM for entire AOI needs to be seamless			Highly desirable			
Amount of acceptable vertical manipulation to achieve spatial seamlessness			Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM			Nice to have	
DTM			Highly desirable	
DEM			Highly desirable	
Raw point cloud data			Required	
Classified point cloud			Required	
Edited/cube XYZ			Required	
Full waveform			Highly desirable	
Bathymetric Attributed Grid (BAG)			Required	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening				
Additional breaklines for hydro-enforcement of culverts				
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	
Tide Predictions			Required	
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	
Intensity imagery/sidescan imagery			Required	
Ground control/ground truthing			Required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	
Nautical and/or navigation charts			Required	
Acoustic imagery of the seafloor			Required	
Aerial and/or satellite imagery			Nice to have	
Underwater videography			Nice to have	
Bottom texture			Highly desirable	
Bottom type			Highly desirable	
Submerged features			Highly desirable	
Subbottom characteristics			Required	
Geologic and seismic data			Required	
Water column properties - Physical			Highly desirable	
Water column properties - Chemical			Highly desirable	
Water column properties - Biological			Highly desirable	
Currents			Required	
Tide/wave heights			Required	
Sea ice conditions			Required	
Habitat distribution and classification			Required	
Boundaries			Required	
Routes			Highly desirable	
Offshore cadastral			Highly desirable	
Lease areas			Highly desirable	
Fixed obstructions			Highly desirable	
Floating observation/navigation systems			Highly desirable	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates			Required	
Land use/land cover			Required	
Wetlands			Highly desirable	
Estuaries			Highly desirable	
Inland surface water features			Required	
Bridges/culverts				
Landmark features			Highly desirable	
Cultural resources			Highly desirable	
Coastal and riverine structures			Highly desirable	
Overhead structures			Highly desirable	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used			We produce satellite derived bathymetry at both 2m and 10m resolution for nearshore bathymetry mapping. We use imagery from last 1-2 years. Vertical uncertainty of ~10% is acceptable for our usage and end client requirements for modern nearshore bathymetry.	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI			Yes	
Open Topography				
NOAA nautical charts				
USACE navigation charts			Yes	
USGS Inland Waters server				
USGS data series				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings			Moderate	
Cost savings/cost reduction			Moderate	
Cost avoidance			Major	
Increased revenues			Major	
Mission-driven performance improvements			Major	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services			Major	
Improved response or timeliness			Major	
Improved customer experience			Major	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach			Moderate	
Environmental			Moderate	
Public safety, including life and property			Moderate	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings							Moderate	Unable to provide				
Cost savings/cost reduction							Minor	Unable to provide				
Cost avoidance							Major	Unable to provide				
Increased revenues							Major	Unable to provide				
Mission-driven performance improvements							Major	Unable to provide				
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services							Moderate	Unable to provide				
Improved response or timeliness							Major	Unable to provide				
Improved customer experience							Major	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach							None					
Environmental							None					
Public safety, including life and property							None					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours			Yes	
Hillshades			Yes	
Slope maps				
Aspect maps				
Curvature maps				
Cross sections			Yes	
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness			Yes	

Importance of 3D Data Requirements	Response
Geographic coverage	3
Vertical accuracy	1
Update frequency	2

TerraSond

TerraSond provides terrestrial and marine geospatial and geophysical surveys for its clients in the oil and gas, pipeline, engineering, construction, dredging, mining, transportation, power and communications, and renewable energy sectors, as well as government agencies including charting authorities, port authorities, and those responsible for environmental management.

TerraSond's services include:

- Hydrographic Surveys - TerraSond provides oceanographic measurements of the sea floor, lake, or river bottoms using a full range of single beam, multibeam, and side scan sonar systems. Projects often require a customized integration of other measurements such as water levels, currents, wind, waves and water quality.
- Marine Positioning Surveys - TerraSond performs realtime positioning for marine projects both above and below the surface for positioning of vessels, barges and other structures on the surface, as well as divers, Remotely Operated Vehicles (ROVs), or towed sensors or other specialized equipment below the surface. These technologies and techniques are used for projects such as recovery of sunken assets, investigation of wrecks, installation of pipelines and cables, positioning of oil drilling platforms, installation of pipelines and cables, dredging and construction support.
- Marine Geophysical Surveys - TerraSond performs marine geophysical services for investigation and geologic interpretation of subsurface conditions in lakes, rivers and offshore for multiple industry sectors. Using sub-bottom profiling, high resolution multi-channel/multi component seismic, magnetometers and gradiometers, resistivity, seabed samplers and other tools, TerraSond determines sea floor structure to support design or geohazard assessments. These efforts and tools assist in locating submerged pipelines and cables, lost or misplaced assets, as well as being able to locate released oil, both sunken and in the water column.
- Land Geophysical Surveys - TerraSond supports the engineering, environmental, renewable energy and mining exploration industries with geophysics, geologic and hydro geologic characterizations, geoengineering and geoenvironmental investigations. TerraSond's available technologies include, but are not limited to, electromagnetic, magnetic, and resistivity profiling, borehole logging, ground penetrating radar, gravity and microgravity, and magneto-telluric surveys.
- Land Surveys - TerraSond also provides traditional land surveying services.

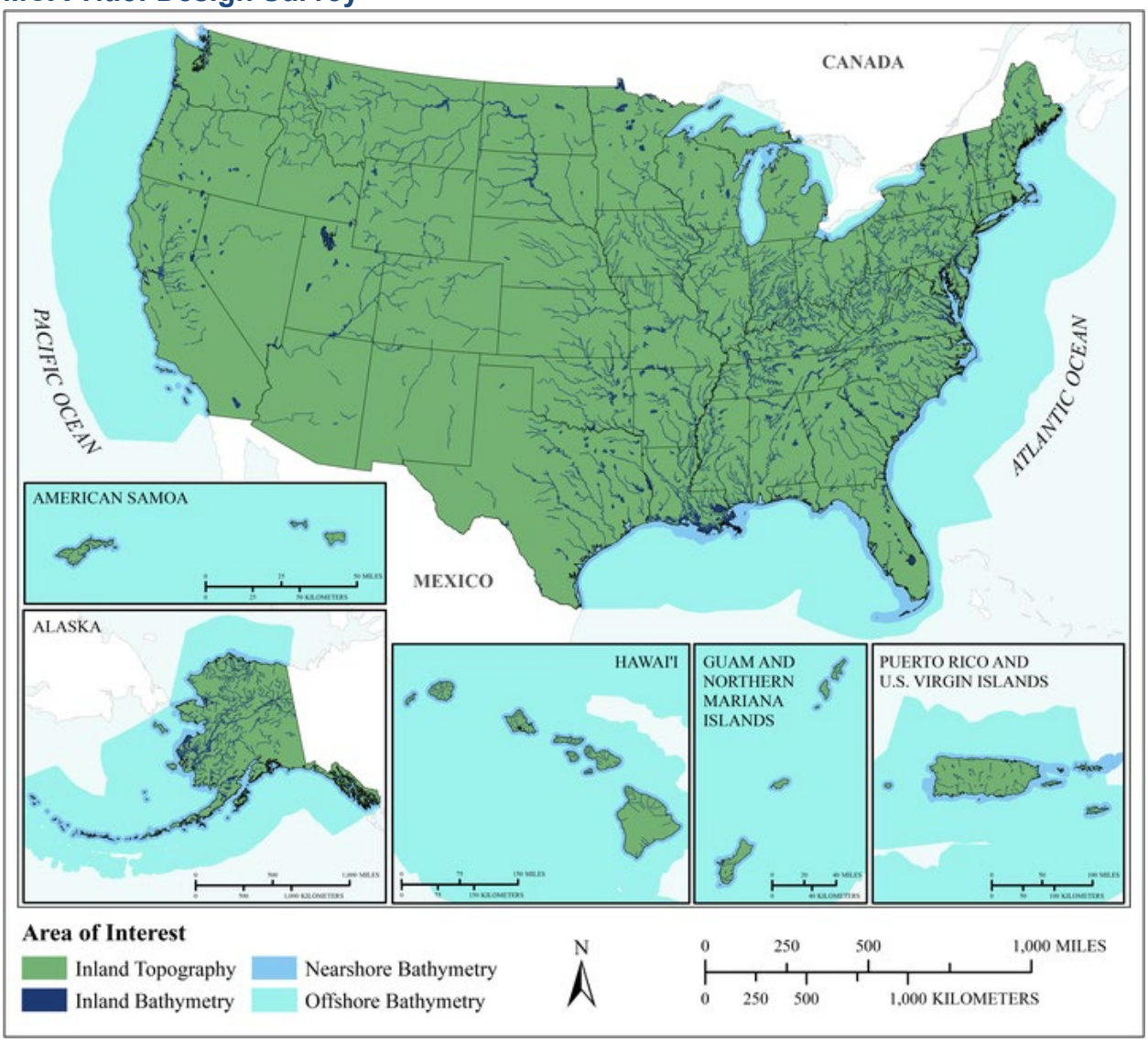
Available high-quality bathymetry helps to foster science based environmental management and to de-risk marine projects such as cables, pipelines, dock facilities, marine transportation, oil and gas installations, renewal energy installations and marine mining for example. Available high-quality bathymetry allows projects to make feasibility and cost decisions without the risk of spending money on a survey only to find the seafloor characteristics do not support the project.

TerraSond has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	TerraSond	22075	Design Survey	Inland Topo	QL2	Event driven	Unable to quantify	Unable to quantify	Minor	Major	Major
				Inland Bathy	QL0B	Event driven	Unable to quantify	Unable to quantify	Minor	Major	Major
				Nearshore Bathy	QL0B	Event driven	Unable to quantify	Unable to quantify	Minor	Major	Major
				Offshore Bathy	Order 1	>10 years	Unable to quantify	Unable to quantify	Minor	Major	Major

MCA Title: Design Survey



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required	Required	Required
Geographic Area Requirements	States and/or Territories	States and/or Territories	All study waters	Custom description
Sub Area Requirements	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau	Areas not shown on map: U.S. Minor Outlying Islands, Federated States of Micronesia, Marshall Islands, Palau		All study waters out to 5km depth

MCA Description	Response
Mission Critical Activity	Construction Survey; wind farm siting; shipping route planning; survey planning; route planning for pipelines, cables, outfalls; Ocean Thermal Energy Conversion (OTEC) planning.
MCA Title	Design Survey
MCA ID	22075
Organization Type	Private or Commercial
Organization Name	TerraSond
Sub-Agency or Division	
Organization Mission	To provide professional services including terrestrial and seafloor mapping and shallow geophysics.
Program Name	Offshore Windfarm Surveys
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	BU 10 - Geologic Assessment and Hazard Mitigation
Tertiary Business Use	BU 12 - Renewable Energy Resources

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Highly desirable
Ocean/sea bottom (>10 m deep)	Required
Other	Required
Other description	Full ocean depth, full coverage

General Geographic Area and Size	
Average geographic extent of day-to-day area	50 sq mi - 999 sq mi (e.g. small county or County Equivalent, District of Columbia, etc.)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Objects smaller than one meter cubed. Suitable for planning for cables, pipelines, ship routing etc.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Not required
10 - 50 ft	Highly desirable
51 - 100 ft	Highly desirable
101 - 500 ft	Highly desirable
501 - 2,500 ft	Highly desirable
Greater than 2,500 ft	Highly desirable
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Highly desirable
½ - 1 acre	Highly desirable

Inland Bathy Feature Size Requirements	Response
1.1 – 2 acres	Highly desirable
2.1 – 5 acres	Highly desirable
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Highly desirable

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL0B	QL0B	Order 1
Update Frequency	Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.	Event driven only – Data need to coincide with a specific event.	>10 years
Event type(s)	A new project, also a flood, hurricane, earthquake, new construction, etc. that causes a change to the surface.	A new project, also a flood, hurricane, earthquake, new construction, etc. that causes a change to the surface.	A flood, hurricane, earthquake, new construction, etc. that causes a change to the surface.	
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	Up to 1 meter	Up to 1 meter	Up to 1 meter	Up to 5 meters
Acceptable Vertical Error	Up to 20 cm	Up to 20 cm	Up to 20 cm	Up to 1 meter
How far onshore needed			>1 kilometer inland	
How far down the beach profile needed	To MLLW		Below MLLW	
Tide correction requirement			MLLW	MLLW
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Not required
Hydro-enforcement	Not required
Hydro-conditioning	Not required
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Required	
Temporal Seamlessness						
Entire AOI in same acquisition season	Not required	Not required	Not required	Not required	Not required	Not required
Entire AOI under same environmental conditions	Not required	Not required	Not required	Not required	Not required	Not required
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Required	Required	Required	Required	Required
DEM for entire AOI needs to be seamless	Required	Required	Required	Required	Required	Required
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Required	Required	Required	Required
DTM	Highly desirable	Highly desirable	Highly desirable	Highly desirable
DEM	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Raw point cloud data	Nice to have	Nice to have	Nice to have	Nice to have
Classified point cloud	Nice to have	Nice to have	Nice to have	
Edited/cube XYZ		Highly desirable	Highly desirable	Highly desirable
Full waveform	Nice to have	Nice to have	Nice to have	Nice to have
Bathymetric Attributed Grid (BAG)		Required	Required	Required

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Not required	Not required		
Additional breaklines for hydro-enforcement of culverts	Not required			
National Vertical Datum Transformation Tool (V-Datum)			Required	Required
Tide Predictions			Required	Required
Tidal Constituent And Residual Interpolation (TCARI)			Nice to have	Nice to have
Intensity imagery/sidescan imagery	Nice to have	Nice to have	Nice to have	Nice to have
Ground control/ground truthing	Nice to have	Nice to have	Nice to have	Nice to have

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Required	Required
Nautical and/or navigation charts			Required	Required
Acoustic imagery of the seafloor			Highly desirable	Highly desirable
Aerial and/or satellite imagery	Nice to have	Nice to have	Nice to have	Nice to have
Underwater videography			Highly desirable	Highly desirable
Bottom texture			Highly desirable	Highly desirable
Bottom type			Highly desirable	Highly desirable
Submerged features			Required	Required
Subbottom characteristics			Highly desirable	Highly desirable
Geologic and seismic data	Nice to have	Nice to have	Highly desirable	Highly desirable
Water column properties - Physical			Nice to have	Nice to have
Water column properties - Chemical			Nice to have	Nice to have
Water column properties - Biological			Nice to have	Nice to have
Currents			Highly desirable	Highly desirable
Tide/wave heights			Required	Required
Sea ice conditions			Required	Required
Habitat distribution and classification			Highly desirable	Highly desirable
Boundaries			Highly desirable	Highly desirable
Routes			Highly desirable	Highly desirable
Offshore cadastral			Required	Required
Lease areas			Highly desirable	Highly desirable
Fixed obstructions			Required	Required
Floating observation/navigation systems			Required	Required

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Highly desirable	Highly desirable	Required	
Land use/land cover	Highly desirable	Highly desirable	Highly desirable	Highly desirable
Wetlands	Highly desirable	Highly desirable	Nice to have	Nice to have
Estuaries			Nice to have	Nice to have
Inland surface water features	Highly desirable	Highly desirable	Nice to have	
Bridges/culverts	Highly desirable	Highly desirable		
Landmark features	Highly desirable	Highly desirable	Nice to have	
Cultural resources	Highly desirable	Highly desirable	Nice to have	
Coastal and riverine structures	Highly desirable	Highly desirable	Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available and self-generated	Best available and self-generated	Some from NGDC, some generated ourselves.	Best available and self-generated
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes	Yes	Yes	Yes
NCEI			Yes	Yes
Open Topography				
NOAA nautical charts			Yes	Yes
USACE navigation charts		Yes		
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Other	Yes	Yes	Yes	Yes
Other description	Self-generated	Self-generated	Self-generated	Self-generated
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Major	Major	Major

Benefits of Currently Used Elevation Data	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Cost savings/cost reduction	Major	Major	Major	Major
Cost avoidance	Major	Major	Major	Major
Increased revenues	Minor	Minor	Minor	Minor
Mission-driven performance improvements	Minor	Minor	Minor	Minor
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Minor	Minor	Minor	Minor
Improved response or timeliness	Moderate	Moderate	Moderate	Moderate
Improved customer experience	Moderate	Moderate	Moderate	Moderate
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	None	None	None	None
Environmental	None	None	None	None
Public safety, including life and property	Minor	Minor	Minor	Minor

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Cost savings/cost reduction	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Cost avoidance	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Increased revenues	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Mission-driven performance improvements	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Improved response or timeliness	I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide		I don't know	Unable to provide	
Improved customer experience	Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide		Moderate	Unable to provide	
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Minor			Minor			Minor			Minor		
Environmental	Major			Major			Major			Major		
Public safety, including life and property	Major			Major			Major			Major		

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes	Yes	Yes
Contours	Yes	Yes	Yes	Yes
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	1
Vertical accuracy	2
Update frequency	3

Tetra Tech

Tetra Tech is a leading provider of consulting and engineering services, supporting government and commercial clients by providing innovative solutions focused on water, environment, infrastructure, resource management, energy, and international development. Tetra Tech's mission is to be the premier worldwide consulting and engineering firm, focusing on water, environment, infrastructure, resource management, energy, and international development services.

For projects involving infrastructure asset management, elevation data are used for a variety of purposes including water, sewer, or power line planning and vegetation analysis; infrastructure assessment; and military planning. Point clouds or DEMs are used to get manhole inverts, also to assess powerline or tree clearance around critical facilities. Available data that meet needs are used although more recently, field collection with UAV or mobile lidar scanner is taking precedence. Field collection is required for Ground Penetrating Radar (GPR) so collecting ground markings for GPR at the same time as the imagery or lidar is more efficient. Having historic data available that reflects pre-project or pre-disaster conditions is helpful.

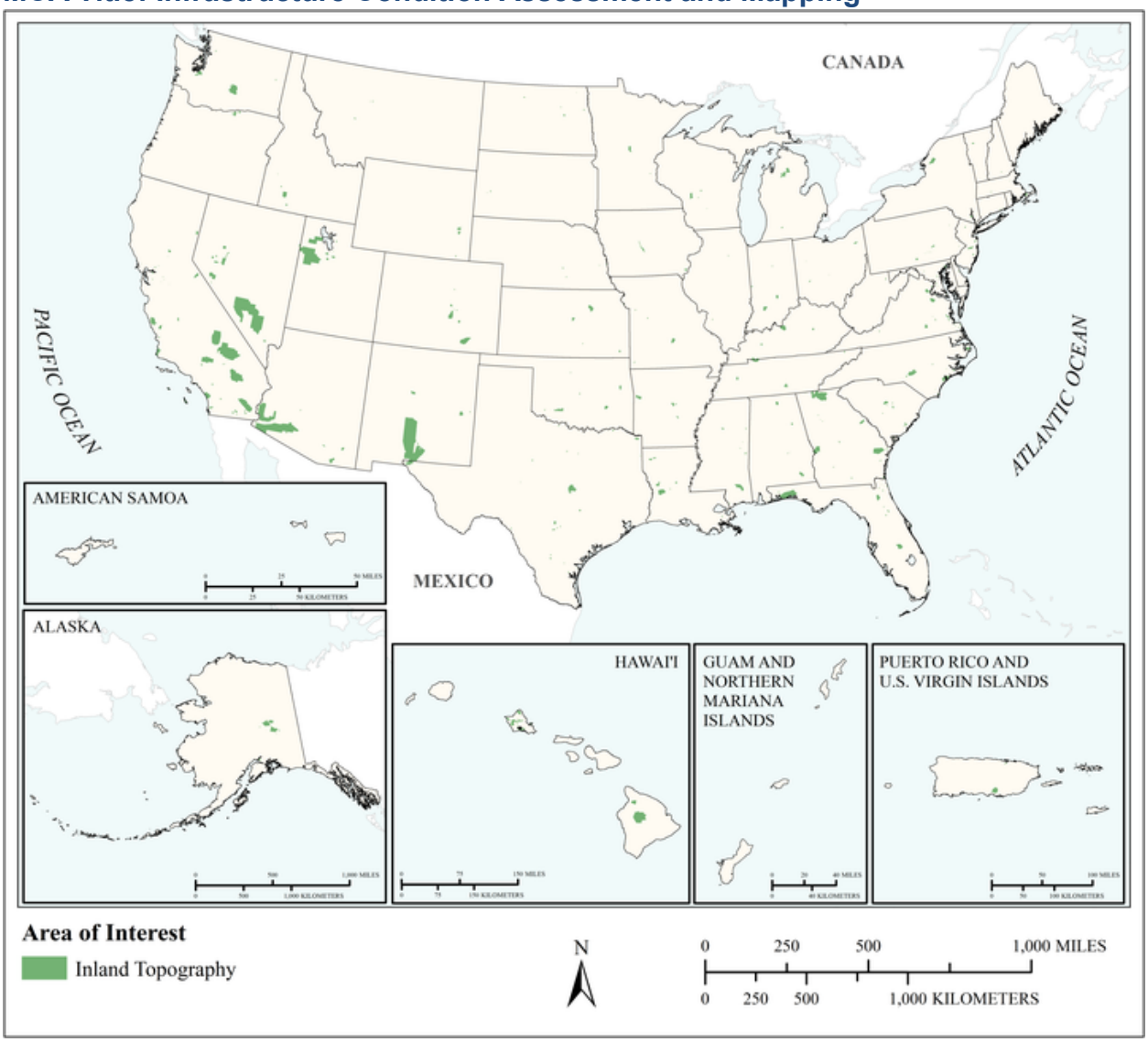
Other groups within Tetra Tech's many divisions use elevation data for many other purposes. Mobile lidar technology is used for BIM applications – mostly for indoor as-built modeling. Lidar and bathymetry are used for floodplain mapping for FEMA. Many others have different 3D data needs than those defined by the projects described herein.

Tetra Tech has identified a Business Use and Mission Critical Activity that relies on elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 22 – Infrastructure Management	Tetra Tech	22485	Infrastructure Condition Assessment and Mapping	Inland Topo	QL0 HD	2-3 years	Unable to quantify	Unable to quantify	I don't know	I don't know	I don't know

MCA Title: Infrastructure Condition Assessment and Mapping



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required			
Geographic Area Requirements	Federally-owned lands nationwide, all lands of U.S. Tribes, or select large land holding agencies			
Sub Area Requirements	DOD			

MCA Description	Response
Mission Critical Activity	Water, sewer, or power line planning and vegetation analysis. Infrastructure assessment. Military planning. Point clouds or DEMs are used to get manhole inverts, also to assess powerline or tree clearance around critical facilities. Available data that meet needs are used although more recently, field collection with UAV or mobile lidar scanner is taking precedence. Field collection is required for Ground Penetrating Radar (GPR) so collecting ground markings for GPR at the same time as the imagery or lidar is more efficient. Having historic data available that reflects pre-project or pre-disaster conditions is helpful. Other groups within Tetra Tech use mobile lidar technology for BIM applications – mostly for indoor as-built modeling as well as lidar for floodplain mapping for FEMA.
MCA Title	Infrastructure Condition Assessment and Mapping
MCA ID	22485
Organization Type	Private or Commercial
Organization Name	Tetra Tech
Sub-Agency or Division	
Organization Mission	Engineering
Program Name	Infrastructure Condition Assessment and Mapping
Total Annual Program Budget	
Primary Business Use	BU 22 - Infrastructure and Construction Management
Secondary Business Use	
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Highly desirable
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Not required
River/lake bottom	Not required
Nearshore elevation (<10 m deep)	Not required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	Less than 1 sq mi (e.g. plot, acre, small study area)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Manholes, Inlets, and Drop Structures

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL0 HD			
Update Frequency	2-3 years			
Event type(s)				
Quality Level and/or update frequency variability across AOI				

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Acceptable Horizontal Error	Less than 20 cm			
Acceptable Vertical Error	Less than 5 cm			
How far onshore needed				
How far down the beach profile needed	To MHW			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Highly desirable
Hydro-enforcement	Highly desirable
Hydro-conditioning	Nice to have
No Treatment	Not required

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable					
Entire AOI under same environmental conditions	Highly desirable					
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Highly desirable					
DEM for entire AOI needs to be seamless	Highly desirable					
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Up to the required Total Vertical Uncertainty (TVU) at the 95% confidence level					

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Highly desirable			
DTM	Required			
DEM	Highly desirable			
Raw point cloud data	Highly desirable			
Classified point cloud	Highly desirable			
Edited/cube XYZ				
Full waveform	Nice to have			
Bathymetric Attributed Grid (BAG)				
Breaklines required for standard hydro-flattening	Required			
Additional breaklines for hydro-enforcement of culverts	Required			

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable			
Ground control/ground truthing	Required			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Highly desirable			
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Nice to have			
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				
Shorelines – current, historic, change rates	Nice to have			
Land use/land cover	Nice to have			
Wetlands	Highly desirable			

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Estuaries				
Inland surface water features	Highly desirable			
Bridges/culverts	Highly desirable			
Landmark features	Nice to have			
Cultural resources	Not required			
Coastal and riverine structures	Highly desirable			
Overhead structures				
Lowest Floor Elevation of Buildings	Nice to have			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available lidar DEMs or point cloud data			
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast	Yes			
NCEI	Yes			
Open Topography	Yes			
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major			
Cost savings/cost reduction	Moderate			
Cost avoidance	Moderate			
Increased revenues	Moderate			
Mission-driven performance improvements	Minor			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Minor			
Improved response or timeliness	Minor			
Improved customer experience	Minor			
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Minor			
Environmental	Minor			
Public safety, including life and property	Minor			

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	I don't know	Unable to provide										
Cost savings/cost reduction	I don't know	Unable to provide										
Cost avoidance	I don't know	Unable to provide										
Increased revenues	None											
Mission-driven performance improvements	I don't know	Unable to provide										
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	I don't know	Unable to provide										
Improved response or timeliness	I don't know	Unable to provide										
Improved customer experience	I don't know	Unable to provide										
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	I don't know											
Environmental	I don't know											
Public safety, including life and property	I don't know											

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours	Yes			
Hillshades				
Slope maps	Yes			
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes			
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				
Other (please specify)	Yes			
Other description	Point cloud only			

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	1
Update frequency	3

Vitus Energy

Vitus Energy manages the delivery of fuel from international and domestic sources to a wide variety of customers in Alaska. Its customers include marine and shore-based distributors, utilities, and aviation companies. Vitus Energy ships critical diesel and gasoline from refineries on the Pacific Rim to destination along Alaska's west coast and interior rivers. Vitus Energy also has fuel terminal and road distribution business in several hub locations in Western Alaska.

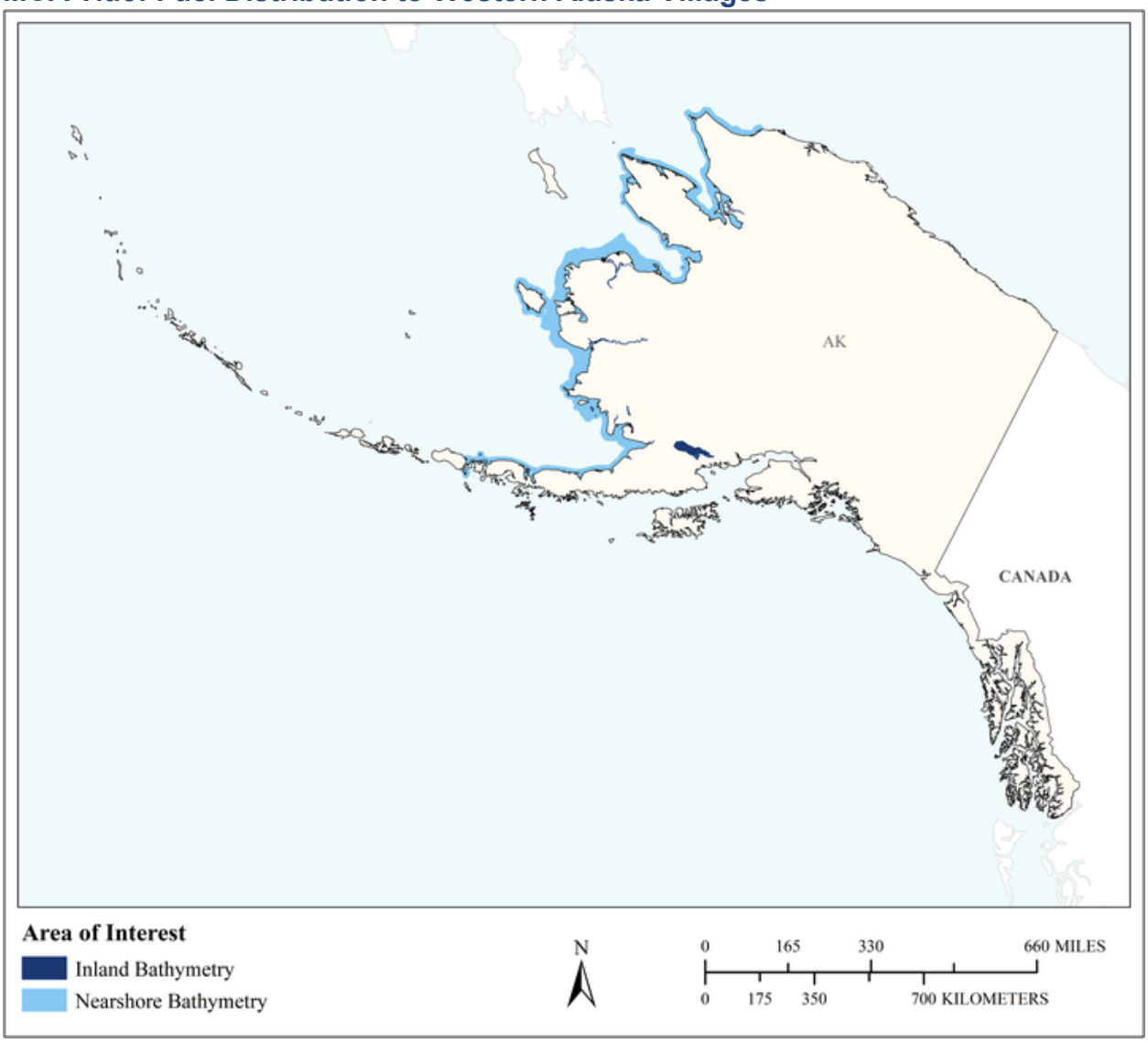
Better charting of the transition zone from Mean Low Water (MLW) to Mean High Water (MHW) is very important to Vitus Energy in Western Alaska. With tugs and tows navigating in less than 1-meter depths at high tide delivering critical fuel and dry cargos, data are needed up to MHW. With tidal variations playing such an important part in navigation, better transition zone mapping is required. Related to mapping, tidal influence in transition zones is subject to geography and hydrography as wind speed and intensity changes. Gathering water height data and correlating to weather would be very nice.

Vitus Energy has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				Requirements			Future Operational Benefits	Future Customer Service Benefits	Future Societal Benefits		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 20 – Marine and Riverine Navigation	Vitus Energy	32708	Fuel Distribution to Western Alaska Villages	Inland Bathy	QL4B	4-5 years	$903,979	$1,000,000	I don't know	Major	Major
				Nearshore Bathy	QL4B	6-10 years	$903,979	$1,000,000	I don't know	Major	Major

MCA Title: Fuel Distribution to Western Alaska Villages



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type		Required	Required	
Geographic Area Requirements		Custom description	Custom description	
Sub Area Requirements		Inland rivers of western Alaska with villages on shore. Illiamna Lake, Aleknagik Lake, Selewik Lake, and Johnson River Lake	Western Alaska from False Pass to Point Lay.	

MCA Description	Response
Mission Critical Activity	Vitus Energy ships critical diesel and gasoline from refineries on the Pacific Rim to destination along Alaska's west coast and interior rivers. Vitus Energy also has fuel terminal and road distribution business in several hub locations in Western AK. All population centers need to have a definitive navigation chart from "open water" to their local water's edge. Additionally, tidal datum and wind direction are very important. NOAA nautical charts often do not include information shallower than 3 meters below mean low water. The Alaska near-shore approaches to villages are almost exclusively shallower than that. Lacking good shallow water bathymetry, we self-collect on-the-fly using sounding skiffs to identify depths as our ships are navigating waters.
MCA Title	Fuel Distribution to Western Alaska Villages
MCA ID	32708
Organization Type	Private or Commercial
Organization Name	Vitus Energy
Sub-Agency or Division	
Organization Mission	Fuel delivery to Western Alaska by land and sea.
Program Name	NOAA Charts for Navigation
Total Annual Program Budget	
Primary Business Use	BU 20 - Marine and Riverine Navigation and Safety
Secondary Business Use	BU 19 - Land Navigation and Safety
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Not required
Tops of vegetation	Not required
Tops of submerged structures, objects	Required
Tops of submerged vegetation	Highly desirable
Subcanopy of vegetation/understory	Not required
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Required
Sea surface	Nice to have
Ocean/sea bottom (>10 m deep)	Highly desirable

General Geographic Area and Size	
Average geographic extent of day-to-day area	75,000 sq mi - 199,999 sq mi (e.g. large state or medium multi-state region)
Smallest 3D features needed	Small features (e.g. individual shrub, tree, car, mooring anchor, small dock, etc.)
Description of smallest 3D features	Hazards to navigation that are in-surveyed because they are in the near-shore transition zone. This could be a 2' diameter boulder. Rocks and boulders ~100 cm size.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Required
Rivers and Streams	
Less than 10 ft	Not required
10 - 50 ft	Not required
51 - 100 ft	Not required

Inland Bathy Feature Size Requirements	Response
101 - 500 ft	Required
501 - 2,500 ft	Required
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Not required
½ - 1 acre	Not required
1.1 – 2 acres	Not required
2.1 – 5 acres	Not required
5.1 – 10 acres	Not required
Greater than 10 acres	Not required
Other	Required
Other description	Illiamna Lake and Aleknagik Lake and Selewik Lake and Johnson River Lake (~15 miles west of Bethel)

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order		QL4B	QL4B	
Update Frequency		4-5 years	6-10 years	
Event type(s)				
Quality Level and/or update frequency variability across AOI			Silt outflows change some areas quickly	
Acceptable Horizontal Error		Up to 5 meters	Up to 5 meters	
Acceptable Vertical Error		Up to 80 cm	Up to 80 cm	
How far onshore needed			To Mean Higher High Water (MHHW)	
How far down the beach profile needed			Below MLLW	
Tide correction requirement			MHW	
Cross sections and/or transects meet needs			Partial	
Cross section/transect requirement			In areas with deepest approach depth to area of interest	

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness						
Temporal Seamlessness						
Entire AOI in same acquisition season		Not required	Not required			Not required
Entire AOI under same environmental conditions		Nice to have	Nice to have			Nice to have
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless		Nice to have	Nice to have			Nice to have
DEM for entire AOI needs to be seamless		Not required	Not required			Not required
Amount of acceptable vertical manipulation to achieve spatial seamlessness		I don't know	I don't know			I don't know

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM		Not required	Not required	
DTM		Highly desirable	Highly desirable	
DEM		Required	Required	
Raw point cloud data		Not required	Not required	
Classified point cloud		Not required	Not required	
Edited/cube XYZ		Not required	Not required	
Full waveform		Not required	Not required	
Bathymetric Attributed Grid (BAG)		Highly desirable	Highly desirable	
Breaklines required for standard hydro-flattening		Not required		
Additional breaklines for hydro-enforcement of culverts				

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
National Vertical Datum Transformation Tool (V-Datum)			Highly desirable	
Tide Predictions			Required	
Tidal Constituent And Residual Interpolation (TCARI)			Required	
Intensity imagery/sidescan imagery		Nice to have	Nice to have	
Ground control/ground truthing		Highly desirable	Highly desirable	
Other		Required	Required	
Other description		Correlation to winds (direction)	Correlation to winds (direction)	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data			Highly desirable	
Nautical and/or navigation charts			Required	
Acoustic imagery of the seafloor			Not required	
Aerial and/or satellite imagery		Required	Required	
Underwater videography			Not required	
Bottom texture			Highly desirable	
Bottom type			Highly desirable	
Submerged features			Required	
Subbottom characteristics			Not required	
Geologic and seismic data		Not required	Not required	
Water column properties - Physical			Not required	
Water column properties - Chemical			Not required	
Water column properties - Biological			Not required	
Currents			Required	
Tide/wave heights			Required	
Sea ice conditions			Required	
Habitat distribution and classification			Not required	
Boundaries			Highly desirable	
Routes			Required	
Offshore cadastral			Nice to have	
Lease areas			Not required	
Fixed obstructions			Required	
Floating observation/navigation systems			Required	

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates		Required	Required	
Land use/land cover		Not required	Not required	
Wetlands		Not required	Not required	
Estuaries			Highly desirable	
Inland surface water features		Required	Required	
Bridges/culverts		Highly desirable		
Landmark features		Highly desirable	Highly desirable	
Cultural resources		Not required	Not required	
Coastal and riverine structures		Required	Required	
Overhead structures			Required	
Lowest Floor Elevation of Buildings				

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used		None	Low quality and often outdated NOAA Charting.	
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map				
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts			Yes	
USACE navigation charts				
USGS Inland Waters server				
USGS data series				
Marine Minerals Program GIS				
State Repositories				
State repositories used				
Data that meet my needs are not available		Yes		
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings		Inland bathy data not available	Moderate	

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cost savings/cost reduction		Inland bathy data not available	I don't know	
Cost avoidance		Inland bathy data not available	Minor	
Increased revenues		Inland bathy data not available	Minor	
Mission-driven performance improvements		Inland bathy data not available	Minor	
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services		Inland bathy data not available	Minor	
Improved response or timeliness		Inland bathy data not available	Minor	
Improved customer experience		Inland bathy data not available	Minor	
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach		Inland bathy data not available	None	
Environmental		Inland bathy data not available	None	
Public safety, including life and property		Inland bathy data not available	Moderate	

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings				Major	Annual dollars saved/realized	$3,980	Major	Annual dollars saved/realized	$3,980			
Time savings description				Would avoid waiting for low tide to observe physical bottom characteristics. Higher Captain confidence would mean less precautionary delays.			Would avoid waiting for low tide to observe physical bottom characteristics. Higher Captain confidence would mean less precautionary delays.					
Cost savings/cost reduction				Moderate	Annual dollars saved/realized	$750,000	Moderate	Annual dollars saved/realized	$750,000			
Cost savings/cost reduction description				Daily vessel charter is ~$150,000 per day - based on a 5 day projected savings.			Daily vessel charter is ~$150,000 per day - based on a 5 day projected savings.					
Cost avoidance				I don't know	Unable to provide		I don't know	Unable to provide				
Increased revenues				I don't know	Unable to provide		I don't know	Unable to provide				
Mission-driven performance improvements				Major	Annual percent improvement	4%	Major	Annual percent improvement	4%			
Mission-driven performance improvements description				10 vessel days over ~150 day season. Faster, and fewer delays.			10 vessel days over ~150 day season. Faster, and fewer delays.					
Other operational benefits				Moderate	Annual dollars saved/realized	$150,000	Moderate	Annual dollars saved/realized	$150,000			
Other operational benefits description				Better able to match vessel drafts to destinations. Vessel Tonnage Yield Improvement.			Better able to match vessel drafts to destinations. Vessel Tonnage Yield Improvement.					
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services				Moderate	Annual dollars saved/realized	$1,000,000	Moderate	Annual dollars saved/realized	$1,000,000			
Value added to products or services description				All customers would enjoy lower prices if there were less navigation risks.			All customers would enjoy lower prices if there were less navigation risks.					
Improved response or timeliness				I don't know	Unable to provide		I don't know	Unable to provide				
Improved customer experience				Minor	Unable to provide		Minor	Unable to provide				
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach				I don't know			I don't know					
Environmental				Major			Major					
Environmental description				Less risk of marine casualty and associated damages			Less risk of marine casualty and associated damages					
Public safety, including life and property				Major			Major					
Public safety, including life and property description				Less risk of marine casualty and associated damages			Less risk of marine casualty and associated damages					

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)				
Contours		Yes	Yes	
Hillshades				
Slope maps				
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids				
Hydrologic Flow Accumulation Grids				
Hydrologic networks (e.g. streams, lakes)				
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints				
Breaklines for road edge-of-pavement				
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	1
Update frequency	3

Wilson & Company

Since 1932, Wilson & Company has provided engineering, architecture, planning, environmental, survey and mapping, and construction management services. These services include:

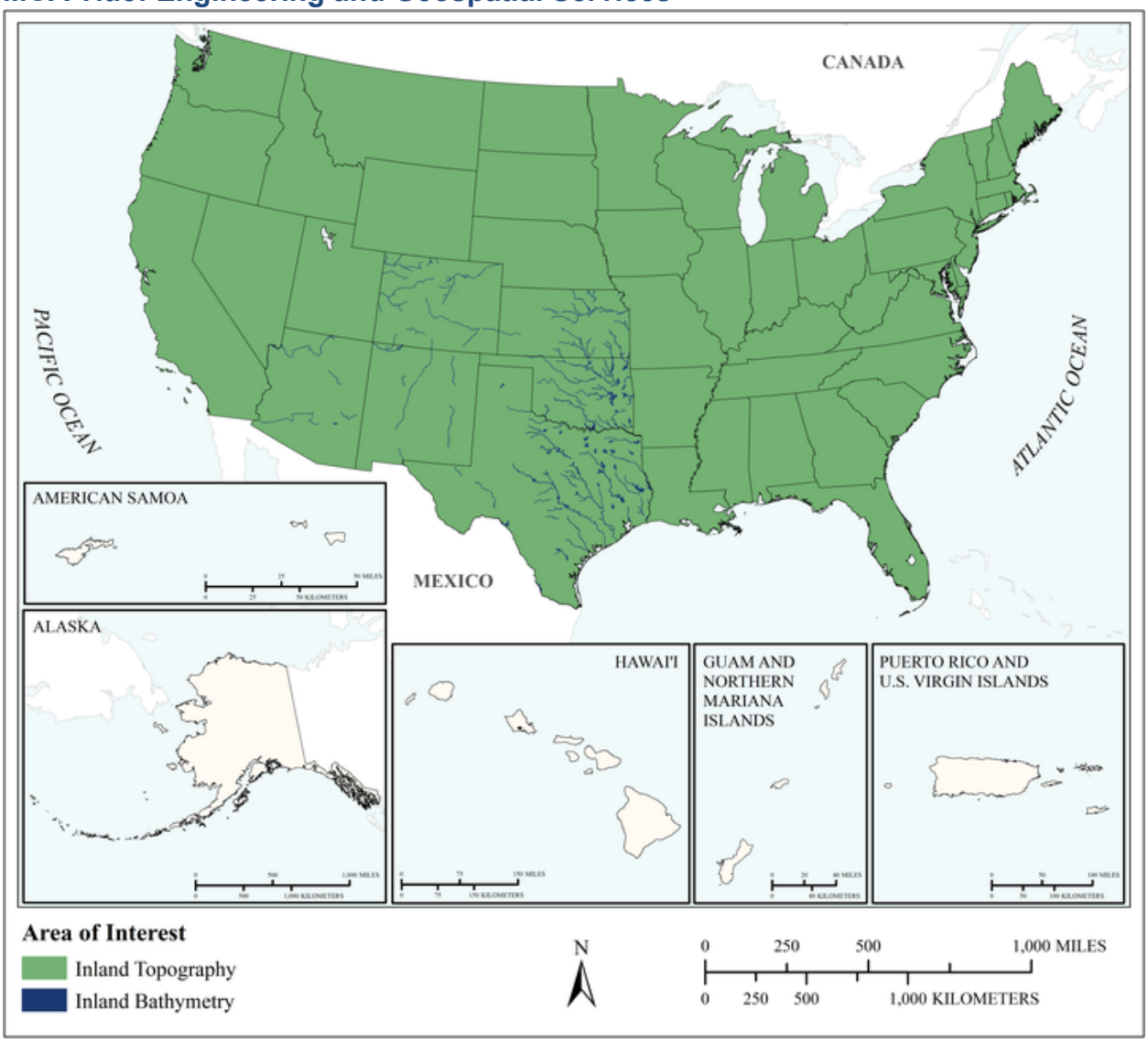
- transportation design to include bridges, structures, roadways, and intersections;
- oil, gas, and pipeline mapping and routing;
- environmental assessments and remediation, natural resources and wetlands studies, floodplain mapping, and disaster response;
- land development planning and design;
- hydrographic surveying and mapping, geospatial extraction for collection of planimetric and topographic features, terrestrial and airborne lidar collection, and aerial imagery collection; and
- construction engineering and management.

Wilson & Company has identified a Business Use and Mission Critical Activity that relies on topographic and bathymetric elevation data and would benefit from enhanced elevation data. Summarized details of elevation data requirements and benefits received from the enhanced elevation data are provided in the following pages.

Summary Table

MCA Description				**Requirements**			**Future Operational Benefits**	**Future Customer Service Benefits**	**Future Societal Benefits**		
Primary Business Use	Agency/ Organization Name	MCA No.	Mission Critical Activity	Data Type	QL/Order	Update Frequency	Total Reported Future Annual Operational Benefits	Total Reported Future Annual Customer Service Benefits	Education or Outreach	Environ-mental	Public Safety
BU 15 – Flood Risk Management	Wilson & Company	21487	Engineering and Geospatial Services	Inland Topo	QL2	4-5 years	Unable to quantify	Unable to quantify	Moderate	Moderate	Major
				Inland Bathy	QL2B	4-5 years	Unable to quantify	Unable to quantify	Moderate	Major	Major

MCA Title: Engineering and Geospatial Services



MCA Area of Interest	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Data Type	Required	Required		
Geographic Area Requirements	Nationwide, inland areas	One or more states, territories, or counties		
Sub Area Requirements				

MCA Description	Response
Mission Critical Activity	Current existing topographic conditions relating to civil engineering. Engineering, architecture, planning, environmental, survey & mapping, and construction management services.
MCA Title	Engineering and Geospatial Services
MCA ID	21487
Organization Type	Private or Commercial
Organization Name	Wilson & Company
Sub-Agency or Division	
Organization Mission	For more than eight decades, clients have chosen Wilson & Company to help them move from concept to completion, unused spaces to productive places, underutilized to efficient facilities, and rural to urban challenges to achievable solutions. We provide engineering, architecture, planning, environmental, survey and mapping, and construction management services. We focus on your specific needs to deliver high-quality professional services with lasting Higher Relationships in mind; discipline, intensity, collaboration, shared ownership, and solutions.
Program Name	Survey, Geospatial and Remote Sensing
Total Annual Program Budget	
Primary Business Use	BU 15 - Flood Risk Management
Secondary Business Use	BU 22 - Infrastructure and Construction Management
Tertiary Business Use	

What Needs to be Measured in 3D	Response
Bare earth ground	Required
Tops of buildings, structures, objects	Highly desirable
Tops of vegetation	Nice to have
Tops of submerged structures, objects	Nice to have
Tops of submerged vegetation	Not required
Subcanopy of vegetation/understory	Nice to have
River/lake bottom	Required
Nearshore elevation (<10 m deep)	Highly desirable
Sea surface	Not required
Ocean/sea bottom (>10 m deep)	Not required

General Geographic Area and Size	
Average geographic extent of day-to-day area	1 sq mi - 49 sq mi (e.g. small city/town, Census Tract, Voting District, Zip Code, etc)
Smallest 3D features needed	Survey-level features (e.g. sign, curb, road line, mailbox, rock, etc.
Description of smallest 3D features	Curb and gutter, head walls, detail sufficient to create 1' to 2' contour intervals.

Inland Bathy Feature Size Requirements	Response
Navigable channels (as defined by USACE)	Nice to have
Rivers and Streams	
Less than 10 ft	Not required
10 - 50 ft	Not required
51 - 100 ft	Nice to have
101 - 500 ft	Nice to have
501 - 2,500 ft	Highly desirable

Inland Bathy Feature Size Requirements	Response
Greater than 2,500 ft	Required
Waterbodies (Reservoirs, lakes, ponds)	
Less than ½ acre	Not required
½ - 1 acre	Not required
1.1 – 2 acres	Nice to have
2.1 – 5 acres	Nice to have
5.1 – 10 acres	Highly desirable
Greater than 10 acres	Required

Requirements	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Quality Level/IHO Order	QL2	QL2B		
Update Frequency	4-5 years	4-5 years		
Event type(s)				
Quality Level and/or update frequency variability across AOI				
Acceptable Horizontal Error	The best horizontal accuracy achievable for the vertical accuracy I need	The best horizontal accuracy achievable for the vertical accuracy I need		
Acceptable Vertical Error	Up to 10 cm	I don't know		
How far onshore needed				
How far down the beach profile needed	Not applicable			
Tide correction requirement				
Cross sections and/or transects meet needs				
Cross section/transect requirement				

Hydrologic Processing Required	Response
Hydro-flattening	Required
Hydro-enforcement	Highly desirable
Hydro-conditioning	Highly desirable
No Treatment	Nice to have

Seamlessness Requirements	Within Inland Topo Data	Within Inland Bathy Data	Within Nearshore Data	Within Offshore Data	Between Inland Topo and Inland Bathy	Between Topo, Topobathy, and/or Bathy
Importance of Seamlessness					Highly desirable	
Temporal Seamlessness						
Entire AOI in same acquisition season	Highly desirable	Required			Highly desirable	
Entire AOI under same environmental conditions	Nice to have	Required			Highly desirable	
Spatial Seamlessness						
Point cloud for entire AOI needs to be seamless	Required	Required			Required	
DEM for entire AOI needs to be seamless	Required	Required			Required	
Amount of acceptable vertical manipulation to achieve spatial seamlessness	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer			Whatever it takes to achieve seamlessness, including changes to the older, previously accepted dataset if it is proven to be less accurate than the newer	

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
DSM	Nice to have	Highly desirable		
DTM	Required	Required		
DEM	Highly desirable	Required		
Raw point cloud data	Not required	Nice to have		
Classified point cloud	Highly desirable	Required		
Edited/cube XYZ		Nice to have		
Full waveform	Nice to have	Nice to have		
Bathymetric Attributed Grid (BAG)		Highly desirable		

Importance of 3D Products	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Breaklines required for standard hydro-flattening	Highly desirable	Highly desirable		
Additional breaklines for hydro-enforcement of culverts	Highly desirable			
National Vertical Datum Transformation Tool (V-Datum)				
Tide Predictions				
Tidal Constituent And Residual Interpolation (TCARI)				
Intensity imagery/sidescan imagery	Highly desirable	Highly desirable		
Ground control/ground truthing	Nice to have	Nice to have		

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Hydrographic survey data				
Nautical and/or navigation charts				
Acoustic imagery of the seafloor				
Aerial and/or satellite imagery	Required	Required		
Underwater videography				
Bottom texture				
Bottom type				
Submerged features				
Subbottom characteristics				
Geologic and seismic data	Not required	Highly desirable		
Water column properties - Physical				
Water column properties - Chemical				
Water column properties - Biological				
Currents				
Tide/wave heights				
Sea ice conditions				
Habitat distribution and classification				
Boundaries				
Routes				
Offshore cadastral				
Lease areas				
Fixed obstructions				
Floating observation/navigation systems				

Importance of Integration with Other Datasets	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Shorelines – current, historic, change rates	Not required	Nice to have		
Land use/land cover	Highly desirable	Highly desirable		
Wetlands	Nice to have	Highly desirable		
Estuaries				
Inland surface water features	Nice to have	Highly desirable		
Bridges/culverts	Highly desirable	Highly desirable		
Landmark features	Highly desirable	Nice to have		
Cultural resources	Nice to have	Nice to have		
Coastal and riverine structures	Highly desirable	Highly desirable		
Overhead structures				
Lowest Floor Elevation of Buildings	Highly desirable			

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Current dataset used	Best available, 3DEP, drone capture for specific projects	Best available, 3DEP, drone capture for specific projects		
Where current elevation data are accessed	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
National Map	Yes			
Digital Coast				
NCEI				
Open Topography				
NOAA nautical charts				
USACE navigation charts				
USGS Inland Waters server				
USGS data series		Yes		
Marine Minerals Program GIS				
State Repositories	Yes	Yes		
State repositories used	NM RGIS and others	NM RGIS and others		
Data that meet my needs are not available				
Current Operational Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Time savings	Major	Major		
Cost savings/cost reduction	Major	Major		

Benefits of Currently Used Elevation Data	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Cost avoidance	Major	Moderate		
Increased revenues	Major	Moderate		
Mission-driven performance improvements	Major	Moderate		
Current Customer Service Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Value added to products or services	Major	Major		
Improved response or timeliness	Major	Major		
Improved customer experience	Major	Major		
Current Societal Benefits	**Inland Topo**	**Inland Bathy**	**Nearshore Bathy**	**Offshore Bathy**
Education or outreach	Major	Moderate		
Environmental	Major	Major		
Public safety, including life and property	Major	Minor		

Future Benefits if Elevation Data Requirements Are Met	Inland Topo			Inland Bathy			Nearshore Bathy			Offshore Bathy		
Future Operational Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Time savings	Major	Unable to provide		Major	Unable to provide							
Cost savings/cost reduction	Moderate	Unable to provide		Major	Unable to provide							
Cost avoidance	Major	Unable to provide		Major	Unable to provide							
Increased revenues	None			Moderate	Unable to provide							
Mission-driven performance improvements	Major	Unable to provide		Moderate	Unable to provide							
Other operational benefits				Major	Unable to provide							
Other operational benefits description												
Future Customer Service Benefits	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**	**Benefits**	**Units**	**Amount**
Value added to products or services	Major	Unable to provide		Moderate	Unable to provide							
Improved response or timeliness	Major	Unable to provide		Major	Unable to provide							
Improved customer experience	Major	Unable to provide		Major	Unable to provide							
Societal Benefits	**Benefits**			**Benefits**			**Benefits**			**Benefits**		
Education or outreach	Moderate			Moderate								
Environmental	Moderate			Major								
Public safety, including life and property	Major			Major								

3D Derivatives Needed	Inland Topo	Inland Bathy	Nearshore Bathy	Offshore Bathy
Triangulated Irregular Network (TIN)	Yes	Yes		
Contours	Yes	Yes		
Hillshades				
Slope maps	Yes	Yes		
Aspect maps				
Curvature maps				
Cross sections				
Height-Above-Ground maps				
Viewshed maps				
Hydrologic Flow Direction Grids	Yes	Yes		
Hydrologic Flow Accumulation Grids	Yes	Yes		
Hydrologic networks (e.g. streams, lakes)	Yes	Yes		
Hydrologic Units (Watershed Boundaries) (e.g. surface water drainage to a point)				
Building footprints	Yes	Yes		
Breaklines for road edge-of-pavement	Yes	Yes		
Rugosity/Surface Roughness				

Importance of 3D Data Requirements	Response
Geographic coverage	2
Vertical accuracy	3
Update frequency	1