Addendum to the Final Project Report
Multibeam Mapping in Long Island Sound -- LISS Enhancement

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Addendum to the Final Report: Multibeam Mapping in Long Island Sound -- LISS Enhancement (Flood, 2025)

(1) Our multibeam mapping results were uploaded as described in the report to the LIS Data Portal on the Marine Geoscience Data System (https://www.marine-geo.org/collections/#!/collection/LIS#summary). These mapping results are a compilation of the three surveys done in 2022 with the horizontal datum of NAD83(2011) UTM Zone 18N and the vertical datum of NAVD88 as required by the sponsors of this Phase 4A study.

The grids can be found using the following links:
Main page: https://www.marine-geo.org/tools/search/entry.php?id=LIS4A:SBU_Acoustics
Bathymetry/backscatter grids: https://www.marine-geo.org/tools/files/32411, Data DOI 10.60521/332412
LIS4_Backscatter_NAD83_1m.tif
LIS4_Backscatter_NAD83_2m.tif
LIS4_Backscatter_NAD83_5m.tif

LIS4_Depth-NAVD88_NAD83_1m.tif
LIS4_Depth-NAVD88_NAD83_2m.tif
LIS4_Depth-NAVD88_NAD83_5m.tif

Bathymetry hillshade images: https://www.marine-geo.org/tools/files/32412, Data DOI 10.60521/332411

LIS4_NW-Hillshade_NAD83_1m.tif
LIS4_NW-Hillshade_NAD83_2m.tif
LIS4_NW-Hillshade_NAD83_5m.tif
LIS4_NE-Hillshade_NAD83_1m.tif
LIS4_NE-Hillshade_NAD83_2m.tif
LIS4_NE-Hillshade_NAD83_5m.tif

(2) The nicknames LIS4-East, LIS4-West-C, LIS4-West-N and LIS4-West-S were given to our 2022 surveys on the R/V Connecticut in August (LIS4-East), on the R/V Seawolf in September (LIS4-West-C), and on the R/V Seawolf in November-December (LIS4-West-N and LIS4-West-S). For the LIS Data Portal and NCEI, we will use the IDs LIS4-East, LIS4-West-C and LIS4-West-NS as the names for our surveys.

(3) Our report notes that depths of the processed multibeam data from the R/V Connecticut survey in August, 2022, were found to be offset by 0.25 m from adjacent NOAA survey areas and from our R/V Seawolf surveys done in September and November-December, 2022. Our August depth data grid was offset by 0.25 m so that the August depth grid agreed with the adjacent surveys. It was eventually determined that the distance between the water surface and the zero level of the entered in the multibeam system (SWLZ in the kmall files) was in error by 0.25 m. There was no depth offset between the August depths and the adjacent survey depths when the correct sensor offset was used. The updated and corrected sensor offsets for all three of our surveys are reported in Table A1 and the vessel files, in hvf format, that were used to process the multibeam survey data in CARIS HIPS and SIPS, using sound velocity corrections and refraction corrections, are being submitted as part of the data archives.

(4) Additional data processing steps were needed to submit our raw and processed multibeam data to the database of the data archive LIS Data Portal and to the database of the NOAA National Centers for Environmental Information data archive (NCEI; https://www.ncei.noaa.gov/). The mapping results submitted to the LIS Data Portal in item (1) above combined the results of our three surveys into one grid for bathymetry, two grids for hillshade (one shaded from the NE and one shaded from the NW) and one grid for backscatter. Since each of our three surveys resulted from a new equipment installation, it was decided to submit the raw and processed data for each survey, and their gridded results (bathymetry and backscatter only), to the LIS Data Portal and to NCEI separately. However, the results of the

three surveys are identical to the combined results reported in (1) except that here the horizontal datum for the grided data is WGS84 UTM zone 18N rather than being NAD93(2011) UTM zone 18N.

We processed the multibeam bathymetry and backscatter using the program CARIS HIPS and SIPS and that processing created multibeam files in the CARIS proprietary HDCS format. However, both the LIS Data Portal and NCEI requested that the processed data be reported in a data format that could be read using freely available software such as MBSystem (Caress and Chayes, 2017). The multibeam data files that were used to create our data products were exported from CARIS HIPS and SIPS in GSF (Generic Sensor Format) format, which was acceptable. Both our raw multibeam data files (kmall format) and our processed multibeam data files (GSF format) are being submitted to the LIS Data Portal and to NCEI. We also are submitting our HDCS data files to NCEI so that our data can be evaluated more carefully by NOAA if desired. Ancillary files, including SVP casts (thinned and in Kongsberg asvp format), water-level (tide) files and vessel offsets (Table A-1 and in Kongsberg hvf format) are being submitted to both data archives along with the multibeam data files. Gridded data in GeoTiff format for bathymetry and backscatter are also being submitted to both data archives and for bathymetry in both bag and CARIS csar format to the NCEI data archive. The horizontal datum of these grids is WGS84 UTM Zone 18N and the vertical datum of the bathymetry grids is NAVD88.

The data processing for the GSF and HDCS files submitted here differ in a few ways from the data processing that resulted in the gridded results discussed in item (1).

(4a) The results for the August data (LIS4-East) were recalculated August using the corrected offsets mentioned in item (3); however, this did not significantly change the depths reported in the gridded data.

(4b) The edges of the bathymetry grids reported in item (1) were cropped with a polygon in ArcGIS Pro. For the processed data reported here, the individual multibeam data files were edited at the edges of the grids to produce a smooth edge to the gridded depth data and no cropping of the depth grid was done in ArcGIS Pro.

(4c) The backscatter grids created for the individual surveys were not recreated using the newly edited multibeam data because of the difficulty in creating the backscatter grids. Instead, GeoTiff images of the existing backscatter grids were cropped in ArcGIS Pro to match the extent of the bathymetry grids.

(4d) The grids reported to the LIS Data Portal in item (1) used the horizontal datum NAD83(2011) UTM Zone 18N and the vertical datum NAVD88 as requested by the sponsor. The navigation for this survey was collected using the WGS84 horizontal datum (ITRF2014) and

the bathymetry and backscatter grids reported here use the horizontal datum of WGS84 UTM Zone 18N. The vertical datum remains NAVD88.

(4e) Several bathymetry and backscatter grids are reported here for each of the three surveys done for this project whereas the grids reported in item (1) combine all project data of each type into one grid. The targets of the individual grids with 1 m resolution are listed in Table A-2 with grid and survey boundaries listed in Tables A-3 to A-5. The working names of the grids were changed to those shown in Table A-4 and A-5 for data submission. The appropriate individual grids with 1 m resolution are submitted with each of the surveys.

References

Caress, D. W., and D. N. Chayes, (2017), MB-System: Mapping the Seafloor, http://www.mbari.org/products/research-software/mb-system/, 2017.

Flood, R.D, (2025)., Multibeam Mapping in Long Island Sound -- LISS Enhancement, Final Report, CT DEEP, Contract Number NORTHE8361-001, June 6, 2025. 69pp.

Table A-1. Sensor Offsets for R/V Connecticut, August 2022, R/V Seawolf, September 2022 and R/V Seawolf, November 2022													
Multibeam Offsets -- LIS4 Surveys -- August-December 2022				SoMAS, Stony Brook University									
R/V Connecticut, August 2022					R/V Seawolf, September 2022					R/V Seawolf, November 2022			
LIS4-East					LIS4-West-C					LIS4-West-NS			
		value used during survey	*corrected during processing if needed*				*value used during survey*	*corrected during processing if needed*				*value used during survey*	*corrected during processing if needed*
NAVREF	face of transducer				NAVREF	base of moon pool tube				NAVREF	base of moon pool tube		
Forward	X (y)	0			Forward	X (y)	0			Forward	X (y)	0	
Starboard	Y (x)	0			Starboard	Y (x)	0			Starboard	Y (x)	0	
Down	Z (z)	0			Down	Z (z)	0			Down	Z (z)	0	
Seapath Antenna		Seapath	corrected		Seapath Antenna		Seapath			Seapath Antenna		Seapath	
Forward	X (y)	0.04	0.586		Forward	X (y)	-1.347			Forward	X (y)	-1.347	
Starboard	Y (x)	-1.06	-0.02		Starboard	Y (x)	4.25			Starboard	Y (x)	4.25	
Down	Z (z)	-2.276	-8.015		Down	Z (z)	-6.619			Down	Z (z)	-6.619	
Seapath MRU		Seapath			Seapath MRU		Seapath	correct		Seapath MRU		Seapath	corrected
Forward	X (y)	0.043			Forward	X (y)	-0.214	-0.214		Forward	X (y)	-0.214	-0.214
Starboard	Y (x)	0			Starboard	Y (x)	0	0		Starboard	Y (x)	0	0
Down	Z (z)	-0.237			Down	Z (z)	-0.428	0.428		Down	Z (z)	-0.428	0.428

Transducer		kmall			Transducer		kmall			Transducer		kmall	
Forward	X (y)	0			Forward	X (y)	-0.06			Forward	X (y)	-0.06	
Starboard	Y (x)	0			Starboard	Y (x)	0			Starboard	Y (x)	0	
Down	Z (z)	0			Down	Z (z)	0.718			Down	Z (z)	0.718	
Roll	R	0			Roll	R	0			Roll	R	0	
Pitch	P	0			Pitch	P	0			Pitch	P	0	
Heading	H	0			Heading	H	0			Heading	H	0	
ATT 1 (effective)		kmall	corrected		ATT 1 (effective)		kmall	corrected		ATT 1 (effective)		kmall	corrected
Forward	X (y)	0			Forward	X (y)	0			Forward	X (y)	0	
Starboard	Y (x)	0			Starboard	Y (x)	0			Starboard	Y (x)	0	
Down	Z (z)	0			Down	Z (z)	0			Down	Z (z)	0	
Roll	R	0.05	-0.04		Roll	R	-0.05			Roll	R	-0.047	
Pitch	P	0	0		Pitch	P	-0.6			Pitch	P	-0.6	
Heading	H	0.03	-0.25		Heading	H	-3			Heading	H	-2	
Latency	seconds	0	0.007		Latency	seconds	0	0.007		Latency	seconds	0	0.007
POS 1 (effective)	WGS84	kmall	corrected		POS 1 (effective)	WGS84	kmall			POS 1 (effective)	WGS84	kmall	
Forward	X (y)	0.586	0.546		Forward	X (y)	0			Forward	X (y)	0	
Starboard	Y (x)	-0.02	1.04		Starboard	Y (x)	0			Starboard	Y (x)	0	
Down	Z (z)	-8.015	-5.739		Down	Z (z)	0			Down	Z (z)	0	
POS 2	NAD83	kmall			POS 2	NAD83	kmall			POS 2	NAD83	kmall	
Forward	X (y)	0.523			Forward	X (y)	-1.853			Forward	X (y)	-1.788	
Starboard	Y (x)	1.05			Starboard	Y (x)	4.21			Starboard	Y (x)	4.217	
Down	Z (z)	-6.747			Down	Z (z)	-6.745			Down	Z (z)	-6.67	

POS 3	NAD83	kmall	corrected		POS 3	NAD83	kmall			POS 3	NAD83	kmall	
Forward	X (y)	0	0.523		Forward	X (y)	-1.853			Forward	X (y)	-1.788	
Starboard	Y (x)	1.05			Starboard	Y (x)	4.21			Starboard	Y (x)	4.217	
Down	Z (z)	-6.747			Down	Z (z)	-6745			Down	Z (z)	-6.67	
Squat & Settlement		kmall	corrected		Squat & Settlement		kmall	corrected		Squat & Settlement		kmall	corrected
Down	Z (z)	0	0.1		Down	Z (z)	0	0.1		Down	Z (z)	0	0.1
SWLZ		kmall	corrected*		SWLZ		kmall	corrected		SWLZ		kmall	corrected
Down	Z (z)	-1.7	-2.13		Down	Z (z)	-2.08	-2.31		Down	Z (z)	-2.08	-2.31
* intermediate correction of -1.88 used					Forward (m)	X (y)	X = Kongsberg			y = CARIS			
					Starboard (m)	Y (x)	Y = Kongsberg			x = CARIS			
					Down (m)	Z (z)	Z = Kongsberg			z = CARIS			

Table A-2. Names of Bathymetry and Backscatter Grids for LIS4 Surveys

Survey	Target	Bathymetry	Backscatter
(month-year)		WGS84 UTM zone 18N	WGS84 UTM zone 18N
LIS4-East	Entire Survey	LIS4_East_Depth_NAVD88_WGS84_1m	LIS4_East_BScatter_WGS84_1m
(Aug-2022)	Repeat Area	LIS4_East_ReptA_Depth_NAVD88_WGS84_1m	LIS4_East_ReptA_BScatter_WGS84_1m
LIS4-West-C	Entire Survey	LIS4_West-C_Depth_NAVD88_WGS84_1m	LIS4_West-C_BScatter_WGS84_1m
(Sept-2022)	Reference Area	LIS4_West-C_RefA_Depth_NAVD88_WGS84_1m	LIS4_West-C_RefA_BScatter_WGS84_1m
LIS4-West-NS	Northern Portion	LIS4_West-NS-N_Depth_NAVD88_WGS84_1m	LIS4_West-NS-N_BScatter_WGS84_1m
(NDec-2022)	Southern Portion	LIS4_West-NS-S_Depth_NAVD88_WGS84_1m	LIS4_West-NS-S_BScatter_WGS84_1m
	Reference Area	LIS4_West-NS_RefA_Depth_NAVD88_WGS84_1m	LIS4_West-NS_RefA_BScatter_WGS84_1m

Table A-3. Extents of Multibeam Surveys for LIS4 (Degrees)

Survey	Target	West	East	North	South
		WGS84 degrees	WGS84 degrees	WGS84 degrees	WGS84 degrees
LIS4-East	Entire Survey	72.948251W	72.770904W	41.238236N	41.137951N
(Aug-2022)					
LIS4-West-C	Entire Survey	73.094504W	72.926587W	41.220429N	41.065703N
(Sept-2022)					
LIS4-West-NS	Entire Survey	73.030718W	72.931186W	41.225916N	41.009685N
(NDec-2022)					

Table A-4. Extents of Bathymetry and Backscatter Grids for Surveys in LIS4 (UTM Zone 18N)

Survey	Target	West	East	North	South
		WGS84 UTM zone 18N meters	WGS84 UTM zone 18N meters	WGS84 UTM zone 18N meters	WGS84 UTM zone 18N meters
LIS4-East	Entire Survey	672,199.50	686,800.50	4,567,800.50	4,555,999.50
(Aug-2022)	Repeat Area	672,699.50	675,900.50	4,565,200.50	4,563,799.50
LIS4-West-C	Entire Survey	660,099.50	673,800.50	4,547,799.50	4,547,799.50
(Sept-2022)	Reference Area	672,299.50	673,900.50	4,561,700.50	4,560,899.50
LIS4-West-NS	Northern Portion	660,599.50	673,400.50	4,565,900.50	4,558,399.50
(NDec-2022)	Southern Portion	665,599.50	674,700.50	4,552,400.50	4,541,699.50
	Reference Area	672,399.50	673,900.50	4,561,700.50	4,560,899.50

Table A-5. Degree Extents of Bathymetry and Backscatter Grids for Surveys in LIS4

Survey	Target	West	East	North	South
		WGS84 degrees	WGS84 degrees	WGS84 degrees	WGS84 degrees
LIS4-East	Entire Survey	72.948251W	72.770904W	41.238236N	41.137951N
(Aug-2022)	Repeat Area	72.938906W	72.901608W	41.218175N	41.208041N
LIS4-West-C	Entire Survey	73.094504W	72.926587W	41.220429N	41.065703N
(Sept-2022)	Reference Area	72.945711W	72.926406W	41.188397N	41.181141N
LIS4-West-NS	Northern Portion	73.085785W	72.931186W	41.225916N	41.161037N
(NDec-2022)	Southern Portion	73.030718W	72.919535W	41.104109N	41.009685N
	Reference Area	72.944519W	72.926419W	41.188001N	41.181119N