



TASK 8 INTRODUCTION

Moffatt & Nichol (M&N) is pleased to present this scope of work and fee estimate for services needed to progress the Town's Multi-Decadal Master Plan from the completion of its Year 1 services (under a prior task order) through the first part (Phase 1A) of additional field investigations needed to characterize offshore sand borrow areas suitable for consideration in the Master Plan as being usable for future beach nourishments.

M&N has partnered with subconsultants whom we have worked with successfully on recent prior beach nourishment planning and engineering projects to conduct necessary field investigations:

Geodynamics, LLC (Geodynamics), a subconsultant to M&N, will conduct the hydrographic survey, sidescan sonar, and sub-bottom profiles of locations of planned geotechnical investigations to characterize the borrow area. It is noted that the subsequent geotechnical investigations are not included in this scope of work but will be forthcoming. This Phase 1A project is being proposed to work within current Town budget cash flow and to jump start the field investigations which need to be completed by early fall before increased seasonal weather downtime would be likely to increase the cost of these investigations.

It is expected that this Task 8 scope of services can be completed within approximately two months, with the field work anticipated to be completed within the early- to mid-summer of 2021. This Task 8 scope of services does not include the full scope of field investigations and analysis to support the remainder of the Master Plan process, and additional complementary field investigations will be proposed in a separate future scope of work following evaluation of the results of these Task 8 field investigations.

TASK 8 SCOPE OF WORK

A series of field investigations, data processing and professional evaluations, and laboratory testing and reporting are required to establish compliance with state and federal regulations for using sediments for as beach nourishment material. These investigations are being proposed in stages, or Phases, for alignment with available Town resources. This present Scope of Work defines Phase 1A of the field investigation services, to be initiated in June 2021 and completed (weather depending) within June and July of 2021. The Phase 1A field investigations will be performed within the presently identified offshore sand borrow area identified previously by the US Army Corps of Engineers (USACE) as "S1" and shown in Figure 1.

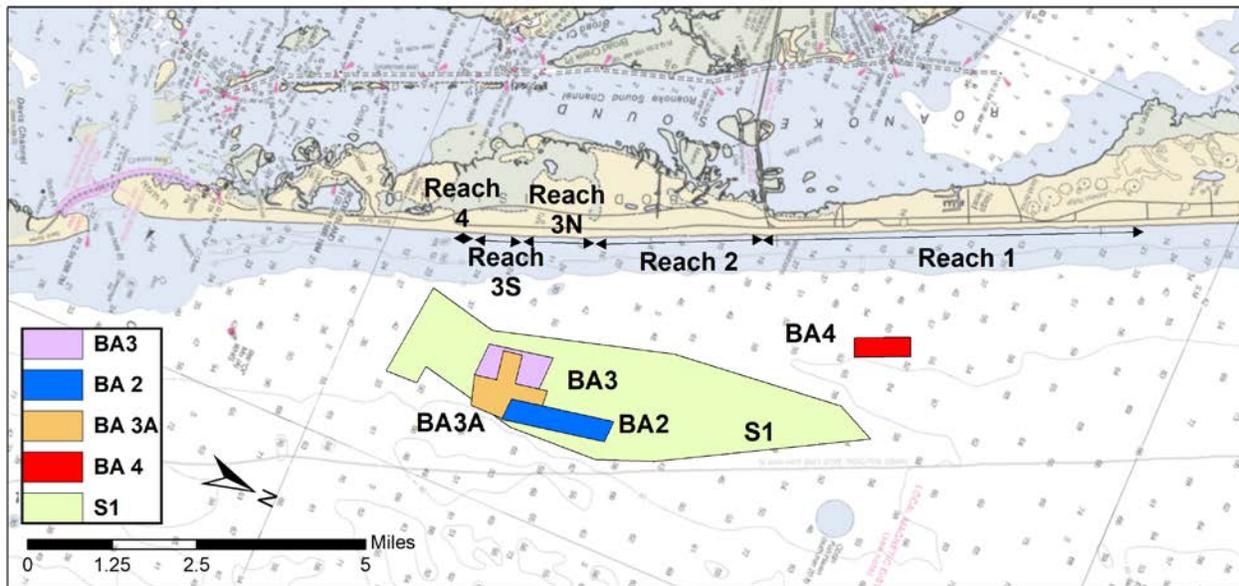


Figure 1. Location of borrow area S1 in relation to prior permitted borrow areas and the Town's beach nourishment reaches

8.1 Borrow Area Field Investigations and Analysis – Phase 1A

In order to confirm the locations and depths of sufficient sand borrow area resources – information that is required for the master plan engineering report and environmental documentation – field investigations will be conducted within the borrow area identified previously by the US Army Corps of Engineers (USACE) as “S1” and shown in Figure 1. In order to obtain the various required information in a cost-effective manner, M&N proposes to conduct the field investigations in two phases. Phase 1A (this Task 8.1) consists of the field investigations (over water operations) to capture hydrographic multibeam surveys and sidescan sonar over the entirety of area S1. In Phase 1A, sub-bottom profiling and archeological (magnetometer) surveys will be collected on a grid of vibracore locations spaced approximately 1,000 feet apart throughout area S1. Details of the anticipated and budgeted Phase 1A borrow area field investigations are provided in the attached scope and fee proposals from Geodynamics. The Phase 1A multibeam, sidescan, sub-bottom profiling and magnetometer survey data will support identification of available sand resources within S1.

Phase 1A does not cover the in-office data processing, analysis and evaluation, and reporting related to the collected field data. Those tasks will be included in a separate, future proposed scope and fee for Phase 1B and Phase 2 of the borrow area field investigations. This Phase 1A scope of work does not include the vibracoring or the detailed engineering analysis by M&N to assess the suitability of sediments within the borrow area for use as future beach nourishment materials or to assess the overall volume available for long-term beach nourishment planning. Those engineering analyses and related work would be conducted under a separate future scope and fee as part of the remaining Master Plan development work.



For Information Only: Borrow Area Field Investigations and Analysis – Phase 1B and Phase 2 (TO BE INCLUDED IN A FUTURE SCOPE OF WORK)

A separate future scope and fee proposal will include Phase 1B and Phase 2 field investigations. Phase 1B will consist of the analysis of the collected Phase 1A field investigations data that is required in order to obtain permissions to conduct Phase 2 field investigations. Phase 2 field investigations are expected to include geological (vibracores with laboratory analyses to meet the requirements of N.C. Division of Coastal Management (DCM) requirements for characterizing beach fill borrow areas. It is also expected that additional sub-bottom profiling and magnetometer surveys and analysis – beyond those conducted in Phase 1A (Task 8.1) above – will be needed to meet N.C. State Historical Preservation Office (SHPO) requirements for dredging the borrow areas. Phase 2 would also include detailed engineering analysis by M&N to assess the suitability of sediments within the borrow area for use as future beach nourishment materials or to assess the overall volume available for long-term beach nourishment planning. Those additional investigations and engineering evaluations are not included in this scope of work and fee.

TASK 8 PROJECT COST

The total estimated fee for the project for Summer 2021 Borrow Area Field Investigation – Phase 1A tasks is a lump sum of **\$192,295.70**.

M&N proposes to invoice the Town monthly on a percent complete basis by Task. The fees for Task 8 are summarized below:

Task 8: Master Plan Summer 2021 Borrow Area Field Investigations – Phase 1A	M&N Fee
Task 8.1. Borrow Area Field Investigations and Analysis – Phase 1A	\$192,295.70
Total for Task 8	

TASK 8 PROJECT SCHEDULE

It is noted that the Phase 1A borrow area field investigations are on the critical path for the Master Plan process as both the Phase 1A and 1B surveys and interpretation as well as the Phase 2 vibracore investigations require summer weather to complete efficiently. It is thus proposed to schedule the Phase 1A field investigations to be initiated in June 2021 and completed within the June – July 2021 timeframe (weather depending), pending an early- to mid-June authorization by the Town to proceed with the work.

Nags Head Geophysical Surveys - Phase I
Survey Scope of Work (SSOW)
Summer 2021

1.0 PROJECT SUMMARY

1.1 Client(s)

Moffatt & Nichol / Town of Nags Head

1.2 Description of Work

This SSOW pertains to geophysical surveys (Phase I) for Moffatt & Nichol in support of future re-nourishment efforts on Nags Head, NC. These surveys are enclosed within a single area inside of the 3 nmi state waters area which strictly follows North Carolina Department of Coastal Management (NCDQM) guidelines (see guidelines attached). These surveys will make use of multibeam sonar (MBES), side-scan sonar (SSS), marine magnetometer (MAG), and sub-bottom profiling (SBP). This work entails a full survey report and geophysical assessment of the data acquired.

1.3 Survey Area

Surveys will take place at a single potential borrow area directly offshore Nags Head, NC. The potential borrow area survey site is oriented in the north-south direction and ranges from ~4000ft to ~2.9NM offshore. The Phase I component consists of sub-bottom profile, magnetometer, and side-scan imaging on a 1000' x 1000' grid throughout the survey area, as well as full coverage multibeam bathymetry for initial vibracore clearance purposes.

2.0 SURVEY CONTROL

2.1 Horizontal Coordinate System

NC State Plane (NAD83-2011)

2.2 Horizontal Coordinate System Units

US Survey Feet

2.3 Vertical Coordinate System

NAVD88 (Geoid12b – Grid 8)

2.4 Vertical Coordinate System Units

US Survey Feet (Elevations)

2.5 Methodology

Realtime horizontal and vertical corrections will be provided using a Real-Time Kinematic Global Navigation Satellite System (RTK-GNSS) with Marinestar G2+ as a backup. RTK-GNSS corrections will be provided using either a locally operated base station or utilizing the North Carolina Continually Operating Reference Station (NC CORS) Real-Time Network. MBES data corrected in post-processing by POSPac. Towed sensors will be positioned by layback techniques.

2.6 Standards/Requirements

Requirements for data acquired in North Carolina state waters (inside 3nmi) are directed by the 15A NCAC 07H .0312 “Technical Standards for Beach Fill Projects”. All bathymetric elevation shall be compliant with Standards of Practice for Land Surveying in North Carolina (21 NCAC 56.1600) and follow guidelines as specified in the IHO-S44 for Special Order surveys.

All geophysical data collection will comply with the criteria of the National Historic Preservation Act of 1966 (Public Law 89-665), the National Environmental Policy Act of 1969 (Public Law 11-190), Executive Order 11593, the Advisory Council on Historic Preservation Procedures for the protection of historic and cultural properties (36 CFR Part 800), the updated guidelines described in 36 CFR 64 and 36 CFR 66 and survey guideline requirements adopted by the North Carolina Department of Natural and Cultural Resources (NCDCCR).

3.0 SURVEY COMPONENTS

3.1 Survey Method: Multibeam Sonar

3.1.1 Purpose

MBES data is being acquired to determine accurate depths at the potential borrow area and aid in SBP data processing (vertically align the seafloor surface of the sub-bottom profile to the bathymetry). The survey design will be developed to provide full coverage bathymetry with acoustic imagery (backscatter) of the seafloor.

3.1.2 Accuracy Requirements

MBES survey shall follow guidelines specified in the 15A NCAC 07H .0312 “Technical Standards for Beach Fill Projects” and follow guidelines specified in the IHO-S44 for Special Order surveys.

- Patch test performed and documented during MOB
- Full Coverage MBES delivered at the highest possible resolution
- Minimum 2 sound velocity profiles/day
- Minimum 1 cross-line / day

3.1.3 Coverage Requirements

3.1.3.1 Phase I

The purpose and mission of Phase I is to acquire all MBES and geophysical data on 1000' survey lane spacing to meet guidelines specified in the 15A NCAC 07H .0312 "Technical Standards for Beach Fill Projects" and the ability to "clear" vibrocore locations of any cultural resources. To maximize the mobilization and demobilization costs for Phase I, and to reduce the time necessary to acquire the full 100' NCSHPO archeological requirements for final borrow site permitting, Geodynamics will fill in the 1000' spaced survey design with 200' lines.

Line spacing shall provide enough overlap as to acquire ~130% coverage and density to support a full coverage surface. Sonar range should generally be no greater than 73° for full coverage areas. This will allow us to meet the 100% MBES coverage required in Phase II, the ability to quickly offset any core location if targets are identified, and to reduce the field effort of Phase II.

3.2 Survey Method: Side Scan Sonar

3.2.1 Purpose

Side scan data is being acquired for object detection, identification of hard bottom areas and general characterization of the seafloor. Side scan data will be used in concert with the MAG data for determination of objects and cultural assessments.

3.2.2 Accuracy Requirements

SSS survey shall follow guidelines specified in the 15A NCAC 07H .0312 "Technical Standards for Beach Fill Projects" and will generally follow guidelines as specified in the BOEM "Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585".

- Layback calculated positions based on RTK-GNSS corrections
- Object position check performed during MOB / testing
- Collect dual frequency (600/900 kHz)

3.2.3 Coverage Requirements

3.2.3.1 Phase I

- Line spacing of 1000ft x 1000ft
- Fill in spacing of 200'

3.3 Survey Method: Marine Magnetometer

3.3.1 Purpose

Magnetometer data is being acquired for object detection and cultural resources assessment. MAG data will be used in concert with the SSS data for determination of objects and cultural assessments.

3.3.2 Accuracy Requirements

MAG survey will generally align to guidelines specified in the BOEM “Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585”.

- Magnetometer sensitivity should be 1.0 gamma (γ), or one nanotesla (nT), or less
- Data sampling interval should not exceed one second
- Background noise level should not exceed 3 γ peak-to-peak
- Object position check performed during MOB / testing
- MAG will be towed at altitudes generally no greater than 6m and guided by the SSS altitude

3.3.3 Coverage Requirements

3.3.3.1 Phase I

- Line spacing of 1000ft x 1000ft

3.4 Survey Method: Sub-bottom Profiling

3.4.1 Purpose

Sub-bottom profiler data is being acquired to determine the shallow sediment distribution and identify subsurface features.

3.4.2 Accuracy Requirements

SBP survey shall follow guidelines specified in the 15A NCAC 07H .0312 “Technical Standards for Beach Fill Projects” and will generally follow guidelines as specified in the BOEM “Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585”.

- Feature position check performed during MOB / testing

3.4.3 Coverage Requirements

3.4.3.1 Phase I

- Line spacing of 1000ft x 1000ft

4.0 DELIVERABLES

4.1 Data & Reporting Deliverables

Listed below are deliverables associated with each type of data acquisition and cumulative components for the project. This project contains full processing, analysis, GIS package, and reporting.

Data Type	Data Product	Data Format	Notes
Bathymetry Data			
	Bathymetric Elevations	ASCII TXT XYZ Data	2 decimal precision (ft)
	Bathymetric Contours	ESRI Feature Class	Contour interval TBD by data quality (~3ft)
	Bathymetric Surface	ESRI Arc Grid	Resolution TBD by data quality / density (~5ft)
	MBES Survey Navigation	ESRI Feature Class	Polyline
Magnetometer Data			
	MAG Anomalies	ESRI Feature Class / ASCII TXT XYZ Data	Include: latitude/longitude, eastings/northings, sensor reading, sensor depth, size when applicable, and interpretation
	MAG Navigation	ESRI Feature Class / ASCII TXT XYZ Data	All processed MAG data including latitude/longitude, eastings / northings, sensor reading
	MAG Anomaly Surface	ESRI Arc Grid	Resolution determined in processing
	MAG Anomaly Contours	ESRI Feature Class	Polyline
Side Scan Sonar Data			
	Raw SSS Data	XTF / JSF	Utilize files with layback
	SSS Navigation	ESRI Feature Class	Polyline
	SSS Targets	ESRI Feature Class linked with SSS target PDF sheets	Include: latitude / longitude, eastings / northings, range, depth, height above seabed, size, and interpretation
	SSS Mosaic	GeoTiff	3 Band
Sub-bottom Profile Data			
	Raw SBP Data	SEG-Y / JSF	Utilize files with layback
	Processed SBP Data	SEG-Y	Polyline
	SBP Navigation / Tracklines	ESRI Feature Class / ASCII TXT XYZ Data	
	SBP Line Start/End Points	ESRI Feature Class / ASCII TXT XYZ Data	
	SBP Lines	PDF	Illustration of SBP data with contacts and navigation map
	Isopach Surface 1	ArcGIS Grid / Grid XYZ Data	Isopach Surface from digitized reflector
	Isopach Surface 2 (if needed)	ArcGIS Grid / Grid XYZ Data	Isopach Surface from digitized reflector
	Isopach Surface 3 (if needed)	ArcGIS Grid / Grid XYZ Data	Isopach Surface from digitized reflector
	Isopach Surface 4 (if needed)	ArcGIS Grid / Grid XYZ Data	Isopach Surface from digitized reflector

Cumulative GIS Files (when applicable)			
	Point Features of Interest	ESRI Point Feature Class	Include: latitude / longitude, eastings / northings, and interpretation
	Line Features of Interest	ESRI Line Feature Class	Include: length and interpretation
	Polygon Features of Interest	ESRI Polygon Feature Class	Include: area and interpretation

4.2 Processing Specifications / Notes

- MBES Data should be post-processed for improved navigation and GPS Tides
- MAG data will be processed / analyzed by Tidewater Atlantic Research (TAR)
- SBP data will be “snapped” to the NAVD88 MBES Bathymetry

4.2.1 Horizontal Coordinate System and Units

All data will be provided in NC State Plane (NAD83-2011) US Survey Feet coordinates. Navigation and point files should list both NC SPF Easting/Northing and WGS84 Geographic Lat/Long (decimal degrees).

4.2.2 Vertical Coordinate System and Units

MBES and SBP data will be vertically referenced to NAVD88 (Geoid12b – Grid 8) and provided in US Survey Feet.

4.3 Reporting

- Full Survey and interpretive report including description of findings for each survey component and cumulatively for each region.
- Report to contain QA-QC documentation including but not limited to MBES cross-line analysis, MBES chart comparison, SSS and MAG feature alignment as well as the ancillary QA-QC components listed below in section 4.4, and identification of any SBP artifacts / multiples that need descriptions.

4.4 Ancillary Components

- Survey Daily Notes for MBES-SBP, SSS-MAG
- SSS Position Verification documentation
- MAG Position Verification documentation
- MBES Patch / Verification documentation
- SBP Setup documentation
- Vessel & Equipment Specs / Integration documentation

4.5 Delivery

Data will be delivered on portable hard disk drive(s) and made available via secure file transfer if necessary. Raw MBES, SSS, MAG, and SBP data will be maintained by Geodynamics and made available upon request.

5.0 LOGISTICS

5.1 Points of Contact

Brian Joyner, PE (Main POC and project delivery)

bjoyner@moffattnichol.com

Moffatt & Nichol

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Gordon P. Watts, JR., PH.D, RPA (Archaeological / Cultural Investigation)

Tidewater Atlantic Research (TAR)

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Ben Sumners (Survey Team Lead)

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Geodynamics

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M 252-475-4710

5.1.1 Additional Relevant Contacts / Information:

To Be Determined

5.2 Dates of Importance

5.2.1 Project Contracted

To Be Determined

5.2.2 Survey Notice to Proceed

To Be Determined

5.2.3 Survey Complete By

To Be Determined

5.2.4 Deliverable(s) Due

20 Days after receipt of data at Tidewater Atlantic Research, Vibracore Clearance Report due.

30 Days after final data collection: initial survey logs, maps illustrating survey data extents, and vessel survey area navigation data.

60 Days after final data collection, final data and reporting deliverables.

6.0 Cost breakdown for project initiation

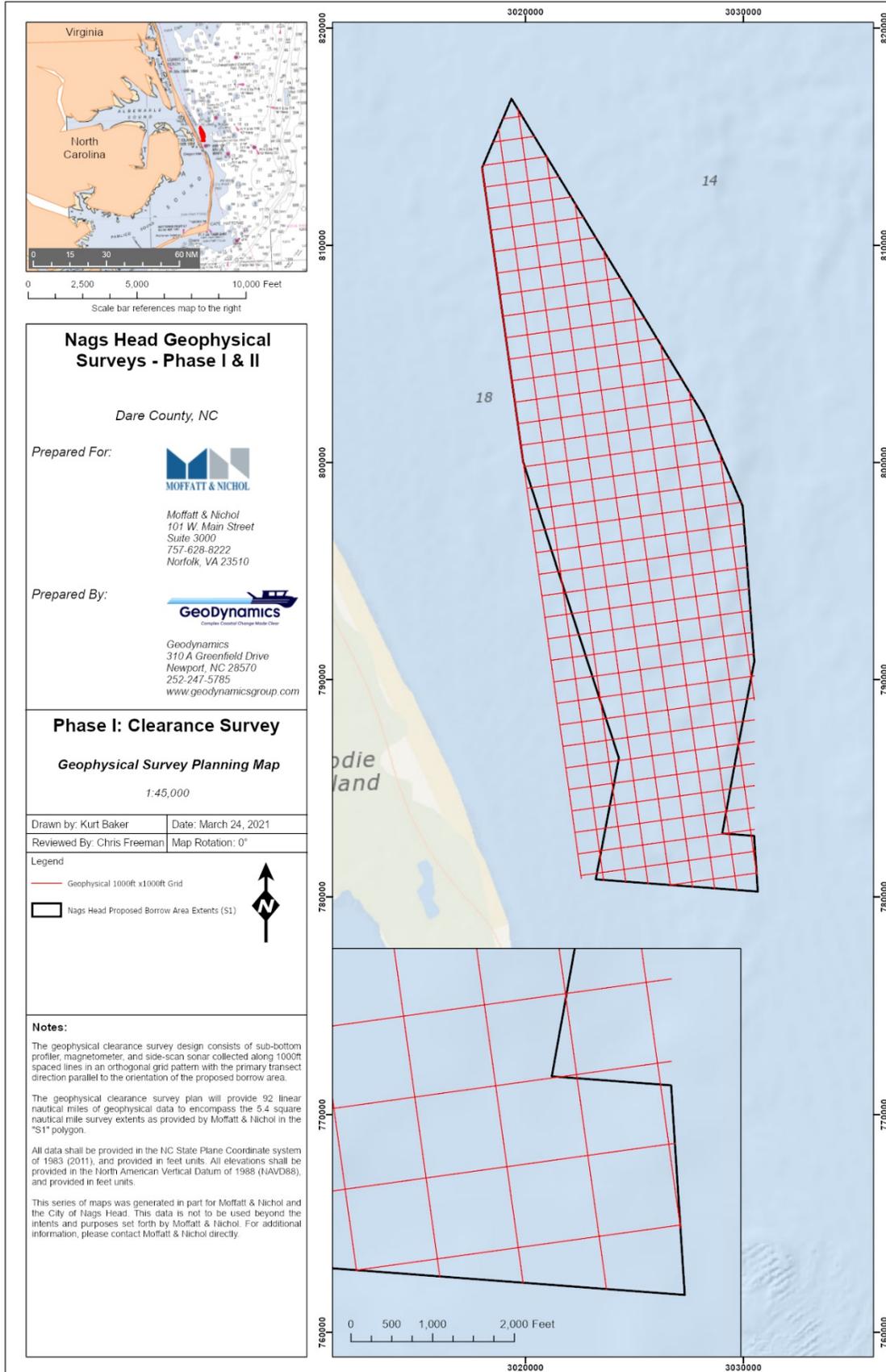
In order for the project to be initiated in June and completed in an expeditious manner, Geodynamics' fee for Phase I may be broken into two parts. Survey work for each part will be initiated upon official Notice to Proceed with that part.

Phase 1A services

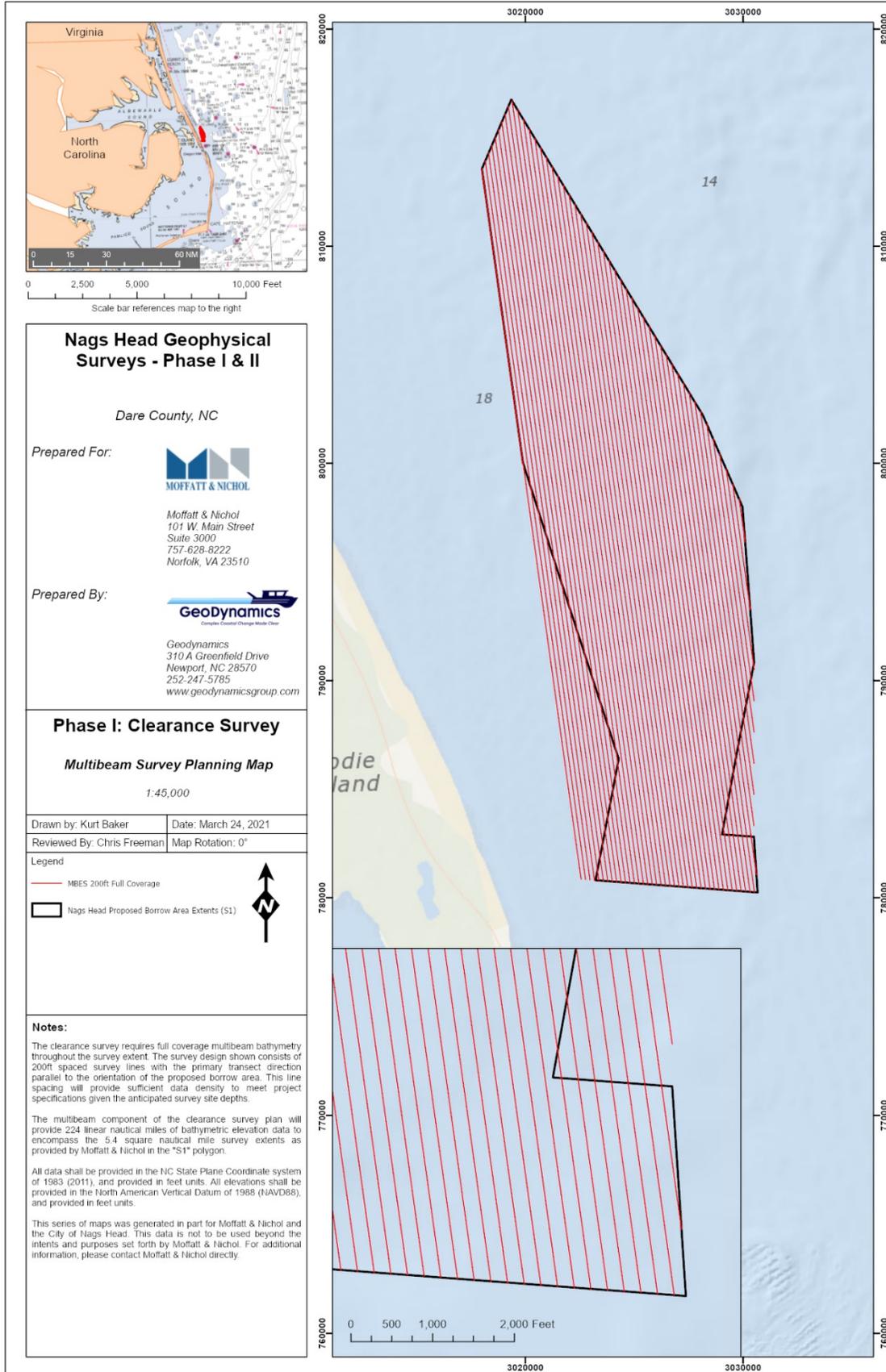
Field Survey Work Initiated in June 2021	\$192,295.70
Survey and Data Analysis Initiated in July 2021	\$166,609.30
Total Project Cost	\$358,905.00

7.0 IMAGES

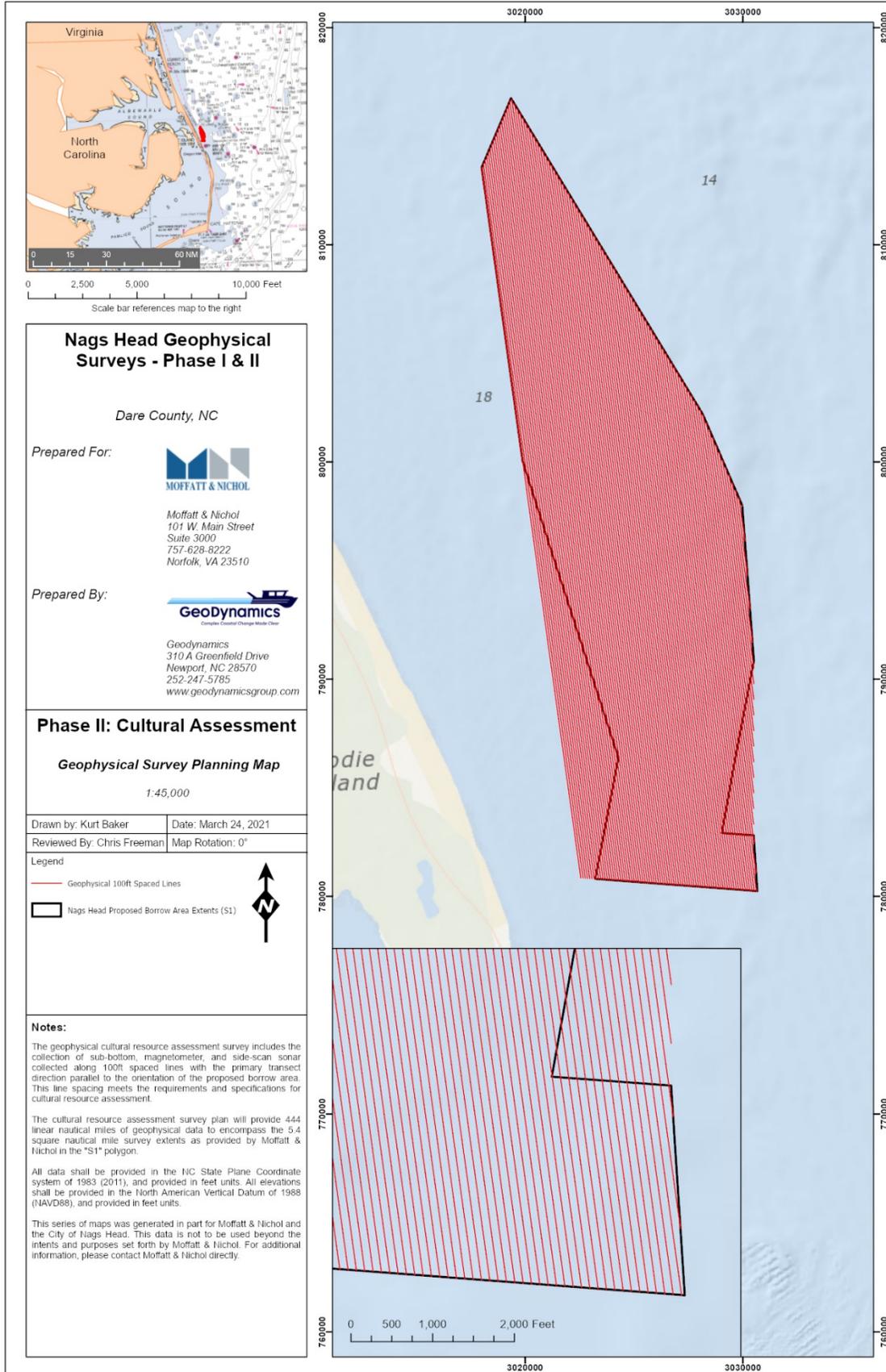
Nags Head Geophysical Surveys - Phase I & II
 Survey Scope of Work (SSOW)



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