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Approval of this Aerial Imagery Work Plan is for the purposes of obtaining data for the Natural Resource Damage Assessment. Each party reserves its right to produce its own independent interpretation and analysis of any data collected pursuant to this work plan. Each party agrees that 1) all such independent interpretations and analyses of work plan data will be clearly identified as those solely of the interpreting party and 2) they will further clearly indicate that such interpretations or analyses do not necessarily represent the interpretation or analyses of any other party to this work plan.

This plan will be implemented consistent with existing trustee regulations and policies. All applicable state and federal permits must be obtained prior to conducting work. Some of the field work described in this plan is already complete at the time of signature.

The trustees have developed a preliminary conceptual model of the DWH release, potential pathways and routes of exposure, and potential receptors. This preliminary model has informed the trustees' decision to pursue the activities outlined in the work plan. By signing this work plan addendum and agreeing to fund the work outlined, BP is not endorsing the model articulated by the Trustees.

Kevin D. Reynolds — 2/27/2013
Department of the Interior Trustee Representative: Date

[signature] — 3/08/2013
Department of Commerce Trustee Representative: Date

[signature] — 3/15/2013
BP Representative: Date

Prepared by the Aerial Imagery Technical Working Group

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ASSESSMENT PLAN CONCERNING AERIAL IMAGERY IN THE NORTHERN GULF OF MEXICO

Introduction

The Aerial Imagery Technical Working Group (AITWG) coordinates aerial and satellite imagery, remote sensing, and mapping to support and assist the various natural resource Technical Working Groups (TWGs) and other activities in the ongoing Deepwater Horizon Natural Resource Damage Assessment. Once this *Assessment Plan Concerning Aerial Imagery in the Northern Gulf of Mexico* (Plan or Work Plan) is signed, BP and/or its representative will review the development and production of the derivative works (including Quality Assurance) identified in this Plan. The Trustees and BP agree to undertake in good faith all efforts necessary to provide BP or its representative an opportunity to review the development and production of the classifications described in this Plan.

Functions of the AITWG include:

1) determination and responding to the needs of the other TWGs;
2) acquisition of imagery identified by the Trustees and agreed to by the Responsible Party (RP) to be useful for the NRDA;
3) classification of coastal habitats;
4) coordination of geospatial capabilities and needs with the other TWGs; and,
5) making aerial imagery and mapping data available.

This Aerial Imagery Assessment Plan describes the scope of airborne and spaceborne imagery acquisition, classification, and mapping for the Deepwater Horizon /Mississippi Canyon 252 (MC 252) Oil Spill (referred to herein as the "incidents(s)"). This Plan, Assessment Plan Concerning Aerial Imagery in the Northern Gulf of Mexico ("Work Plan" or "Plan") has been developed by the AITWG. BP has participated in a review capacity to the development of this Work Plan.

The Work Plan describes a variety of assessment activities, which for administrative ease, are gathered into this one document. This plan is organized into three sections, with corresponding attachments, where necessary, which contain more detailed descriptions of the subject activity.

<u>Section 1.0: Imagery Acquisition and Management</u>

Attachment A: Imagery Acquisition to Support Submerged Aquatic Vegetation Natural Resources Damage Assessment in Florida Coastal Waters

<u>Section 2.0: NRDA Product Development</u>

Attachment B: QuickLook Imagery: Feature Index

Attachment C: Technical Approach for Land/Water Interface and Habitat Interpretation and Mapping

Attachment D: Mississippi Canyon 252: Chandeleur Islands Hybrid-Mapping Submerged Aquatic Vegetation

The AITWG has been working on data acquisition and preliminary image review since the start of the MC252 NRDA, pursuant to the following approved MC 252 NRDA work plans :

1) *Technical Specifications and Scope of Work for Aerial Imagery Acquisition,*
2) *Mississippi Canyon 252 Oil Spill Submerged Aquatic Vegetation Tier 2 Pre-Assessment Post Spill Exposure Characterization Plan,*
3) *Mississippi Canyon 252 Oil Spill Submerged Aquatic Vegetation Tier 3 Injury Assessment Data Collection Plan Including Addenda, and*
4) *Mississippi Canyon 252 Oil Spill Light Detection and Ranging (LIDAR) Data Acquisition.*
5) *Mississippi Canyon 252 Incident Submerged Aquatic Vegetation Tier 2 Pre-Assessment Low Altitude Aerial Photography of the Seagrass Beds of Southeastern Louisiana and Coastal Mississippi*

Additional data and products may be identified by the MC 252 Oil Spill TWGs through the course of the NRDA for which a separate Addendum or Work Plan will be prepared.

Objectives

The objective of this Work Plan is two-fold: 1) to identify the types of remotely sensed imagery (data) that have been and/or will be acquired to support the NRDA; and 2) to describe the methods that will be used and approaches taken to develop useful remote sensing products and derivatives therefrom for the NRDA.

1.0 Imagery Acquisition and Management

1.1 Pre-Spill Impact Imagery

Several government agencies acquired aerial imagery over portions of the Gulf Coast in the spring and summer of 2010 before coastal areas were exposed to oil (sometimes referred to as "pre-spill"). At this time the AITWG has identified several sets of aerial imagery that are in the public domain that could be used to support the NRDA. These digital aerial images have been made available to the public through the United States Geological Survey Emergency Operations Portal – Hazards Data Distribution System (HDDS) website (http://hdds.usgs.gov). The AITWG will continue to investigate other aerial imagery data which have the potential to meet technical specifications necessary to support the NRDA. In addition to the three primary data sets described below, other aerial imagery datasets are available to use to further support the NRDA (e.g., Louisiana GOHSEP imagery and USDA National Agricultural Imagery Program).

Three sets of available aerial imagery identified for use at this time are:

1) NOAA King Air Acquisition – May and June 2010

   This imagery was collected in stereo during May and June of 2010 with 60% overlap along the line of flight. This collection recognized that not every potential landfall could be collected in a timely approach so the areas of acquisition were prioritized and collected as conditions allowed. Coverage includes the Louisiana coast from Marsh Island to Grand Isle; California Bay to past Pensacola Bay; and Pensacola to Panama City. Between the three distribution groups, there are over 9,800 NOAA aerial image tiles available for download from the HDDS website. The Color infrared band data collected during these flights has been processed by NOAA at the request of the AITWG.

2) USACE Acquisition – April 2010

   The U.S. Army Corps of Engineers (USACE) flew a Compact Airborne Spectrographic Imager (CASI) between April 9 and April 25, 2010. Image characteristics include a 0.3 meter pixel size, 3 band natural color, mosaiced tiles, and georeferencing to the geographic coordinate system—NAD83 datum, and GeoTIFF file format. The coverage area included the Louisiana coast from Grande Isle and Barataria Bay, to the western side of the Mississippi River Delta. The coverage along the Mississippi and Alabama coasts included Cat Island, Ship Island, Horn Island, Petit Bois Island, and Dauphin Island in Alabama. Approximately 750 tiles, 2.5 km across, are available for download through the HDDS website.

3) NASA Acquisition – May and August 2010

   National Aeronautics and Space Administration deployed its ER-2 research aircraft to the Gulf on May 6, 2010. The ER-2 was equipped with JPL's AVIRIS instrument and the Cirrus Digital Camera System (DCS) from the Ames Research Center. The DCS acquired aerial imagery over the Gulf between May 6 and May 25, 2010, and again from August 24 to August 31, 2010. Image characteristics varied with flights, ranging from about 2 to 4 meters in pixel size (changing with flying height), 3 band color infrared, individual frame tiles georeferenced to the geographic coordinate system—WGS84 datum, and GeoTIFF file format. The coverage area is extensive, covering the entire Louisiana and Mississippi coast, Alabama coast (excluding Mobile Bay), much of the Florida coast east to Cape San Blas, and the western coast of the Florida peninsula south of St. Petersburg, including the Keys. There also is extensive coverage over open water in the Gulf. There are over 4,600 tiles available for download through the HDDS website.

1.2 Post-Spill Imagery

1.2.1 Low Altitude Rapid Assessment (LARA) of Submerged Aquatic Vegetation (SAV)

In Fall 2010, the Trustees implemented a work plan to obtain low-altitude rapid assessment images to document SAV conditions along the spill impacted areas of the northern Gulf of Mexico prior to hurricane season, which could produce tremendous compounding changes to the seagrass beds. The images were collected in a time-sensitive manner in case of a tropical storm or hurricane in the Gulf of Mexico while NRDA activities were ongoing.

The LARA collection used a USGS amphibious aircraft (Cessna 185) outfitted with a Nikon D 80 camera (vertically mounted in a fuselage floor observation port) and a laptop computer that actuates the camera. The camera system was provided by Fish and Wildlife Research Institute of Florida. Two altitudes of imagery were planned: 6,000 ft and 2,000 ft. Of these planned flights, all of the photos to be collected at 6,000 ft were acquired. The project attempted to geo-reference each photograph using the aircraft GPS, but this was not possible in all instances. The 2,000 ft altitude collect was incomplete due to budgetary constraints. (For more information please see the signed work plan, Mississippi Canyon 252 Incident Submerged Aquatic Vegetation Tier 2 Pre-Assessment Low Altitude Aerial Photography of the Seagrass Beds of Southeastern Louisiana and Coastal Mississippi).

1.2.2 Satellite Imagery: Worldview 2 for Big Bend area in Coastal Florida

Satellite imagery of sufficiently high resolution will be acquired for use by the Trustees and the RP for the NRDA. Satellite acquired imagery with a minimum spatial resolution of 1 meter or better will be acquired for monitoring sampling sites and supporting reference and restoration sites.

The Hazards Data Distribution System (HDDS) maintained by USGS has most of the satellite data for both pre-spill and post-spill time periods. The USGS Commercial Remote Sensing Data Contract (CRSDC) has been used to purchase existing archived data from the contract vendors and for tasking vendors to acquire new data for selected areas. (See Attachment A for Worldview 2 satellite data acquisition for Big Bend area in Coastal Florida).

1.2.3 High Resolution Aerial Imagery Acquisition

In fall, 2010, the Trustees implemented a cooperative Work Plan with BP to acquire high-resolution imagery for the coastal areas along the northern Gulf of Mexico, *Technical Specifications and Scope of Work for Aerial Imagery Acquisition*. This acquisition includes overflights for a two year period, from Fall 2010 through Spring 2012. This work is ongoing. For more information, please see the Deepwater Horizon NRDA Administrative Record, at http://www.doi.gov/deepwaterhorizon/adminrecord/upload/Technical-Specifications-and-Scope-of-Work-for-Aerial-Imagery-Acquisition-10_11_10.pdf.

1.3 Imagery Management

1.3.1 Hazards Data Distribution System (HDDS)

Due to the extremely large volume of the aerial imagery acquired to support the Deepwater Horizon NRDA, management, archiving and dissemination of pre and post-event imagery collections is a significant task. The Earth Resources Observation and Science (EROS) data center in Sioux Falls, South Dakota will be responsible for loading the images within 1-2 days for on-line review by the SAV and Shoreline TWGs. The data will be geographically retrievable, with standard map projections, metadata, shapefiles, KML/KMZ files, browse along with the original data as provided by the vendors.

This work will be conducted to ingest, archive and manage high-resolution (native resolution aerial imagery that exceeds 1 ft ground sampling distance [GSD]), 4-band (visible color and near infrared [IR]), stereo (all bands), digital photogrammetric frame imagery, ortho-image tiles and seamless mosaics (1 ft GSD, 4-band) for the coastal areas shown in Appendix A. The ingest process includes projecting to a standard map projection, creation of standard metadata, generation of shapefiles and KML/KMZs, generation of browse images, and creation of two sets of compressed imagery for limited bandwidth users. The work will also include the creation of ingest scripts for 16 oil spill datasets to be used as reference imagery by the TWGs. These ingest scripts will provide the same derivative products as listed above for the aerial imagery.

The HDDS registration system will be modified to allow restricted access by subdirectory and user, so that all the imagery may be protected as required.

The Emergency Operations liaisons will provide support to the AITWG by attending teleconferences and meetings. They will also coordinate image deliveries and notifications of availability and handle all necessary coordination with TWGs and contractors.

2.0 NRDA Product Development

2.1 Inventory and Use Matrix of Post-Spill Impact Imagery

As discussed in Section 1.0, in the immediate post- spill period of the Deepwater Horizon Oil Spill, Spring and Summer of 2010, several government agencies acquired aerial imagery over portions of the Gulf Coast. BP also commissioned numerous flights to track the oil spill extent and response activities.

These digital aerial images have been made available to the public through the USGS Emergency Operations Portal – HDDS website (http://hdds.usgs.gov), and through the Emergency Response Management Application portal (http://gomex.erma.noaa.gov/erma.html#x=-86.58325&y=25.27451&z=5&layers=4203+7987+17398+5723+17727+17766).

Objective:
The objective of this activity is to develop an inventory and use matrix to facilitate and guide optimal use of Imagery data acquired, and derived primitives. The inventory and use matrix can be used to determine the following:

1) What imagery (at the individual frame level) is available where, and for what timeframe?
2) What imagery is available at a specific location?
3) Classification of Imagery in terms of on-shore, near-shore, or deepwater /off-shore imagery.
4) The characteristics of the sensor that was used for each imaging mission, and the parameters of each mission, including the following:
   a. Mission Coverage
   b. Sensor Description
   c. Key Sensor Characteristics
   d. Mission Imagery Resolution (expressed in meters and feet)
   e. Overall Characteristics and Quality of the Mission Imagery
   f. A Mission Level Statement of the potential use cases for the imagery
   g. A Mission Level Classification and Statement relating to the potential use of the mission imagery for each Technical Working Group.

The Inventory and Use Matrix, is available at http://gis.aerrometric.net, and may be updated to incorporate new imagery collection related to the Oil Spill and the NRDA.

2.2 QuickLook Imagery

The AITWG anticipated that other technical working groups would need access to imagery information much more quickly than would be available from an individual frame based high-detail/high-accuracy formal mapping. This phase is designed to provide a quick turnaround of the data in the essence of time. The objective of the quick look classification is to review post-spill imagery from the fall 2010 acquisitions.

These imagery datasets include the October 2010 high resolution aerial imagery acquisitions. The QuickLook approach also is intended to be used for review and classification of the aerial imagery acquired in the winter and spring of 2010 (pre-spill impact), spring 2011, and fall 2011.

The AITWG determined that exploitation of the 1:6,000 scale composite maps (Digital Ortho Quarter Quarter Quadrangle or DOQQQ) be conducted to detect a list of features. TWGs were requested to provide a list of features that they were interested in seeing if the features were observable and/or interpretable within the aerial photography. The list of features was compiled from responses from the other technical working groups. All lists were combined as much as possible and the features were searched for in the imagery using a variety of scales, channel combinations, and stereoscopic as well as monoscopic reviews.

These features were identified in an ArcMap geodatabase with a feature location accuracy equivalent to the DOQQQ's. Features are identified as being 'present' but are not measured, delineated, or located by point coordinates. Instead, features are listed within a DOQQQ grid. This is an index, not a map. The documentation for the QuickLook process, feature list, and methods of examination are found in Attachment B.

The quick look products will be shared with the RP.

The primary purpose of the quick look interpretation is to determine, in conjunction with the SCAT maps, sampling data, and NRDA team data of observed oil in the coastal habitats, if

1) What is observed in the field can be interpreted from the imagery
2) What is observed in the field cannot be interpreted from the imagery
3) Areas/shoreline oiled interpreted from the imagery that was not seen in the field

2.3 Classification and Mapping of Baseline Imagery

Baseline mapping will be divided into two components: Marsh/shoreline habitats and seagrass habitats. A habitat baseline map is defined herein as map products derived from pre-oil spill imagery. Habitat maps will be derived from the pre-spill impact imagery to serve as the basis from which changes in the habitat may be measured. Imagery from any date or area post-oil spill arrival will be considered oil spill impact source information. More information on the classification and map generation process is available in Attachments C and D.

2.4 Marsh/Shoreline Habitat Post-Spill Mapping

The mapping classification schema must be detectable and consistently delineated in the imagery. It is proposed that the classification of marsh, scrub-shrub, beaches, and mudflats will follow the FGDC wetlands mapping standard, the *Classification of Wetlands and Deepwater Habitats of the United States*. A signature key will be developed for use in conjunction with the classification scheme. Ground truthing will use existing information that has been acquired in the Oil Spill response and damage assessment activities.

This task will include the development of a set of land/water interface maps and data primitives to be used as the basic background for habitat delineation.

Post-spill field sampling data and SCAT maps and reports will be used as ancillary data to be used as ground-observed information to validate the classification from the imagery. This task relies on field sampling and observations of the other TWGs, in particular SAV, Shoreline/Marsh, Birds, and Terrestrial mammals to continue to provide information and data for input into the mapping for the fall of 2010, , and the fall of 2011.

Using NWI classification categories, habitat maps will be prepared for each successive date. See Attachment D for technical interpretation and mapping process.

2.5 Seagrass Habitat Post-Spill Mapping

The purpose of this activity is delineating the areal extent of submerged aquatic vegetation (SAV) along the length of the Chandeleur Islands, Horn and Petit Bois Islands using advanced imagery analysis techniques. This proposed SAV Imagery Analysis/Classification activity is considered a "hybrid" approach between automated object-based imagery analysis (OBIA) and traditional photo interpretation methods. The OBIA activity is a collaborative effort with co-Trustees with participation by the RP. Products resulting from OBIA effort will be reviewed by USGS photo interpretation team for quality assurance.

This effort will be conducted as a phased approach. The first phase includes performing SAV classification on (2) aerial imagery surveys of the same acquisition specifications for the Chandeleur, Horn, and Petit Bois Islands from Fall 2010 and Fall 2011. Spring 2011 and Spring 2012 imagery from the same locations will be reviewed after the Fall imagery has been processed.

The OBIA processing will be performed on the overlapping aerial photos representing the Chandeleur Islands and Horn and Petit Bois Islands. The primary product resulting from the OBIA imagery analysis will be a fine-scale SAV classification. Approximate minimum mapping unit of the finest mapping level is 4m2. OBIA activity includes deriving interim imagery products and developing a parameterized condition-based algorithm which accounts for illumination and environmental condition-related variation typical of photographic-based imagery classification efforts. The development of this algorithm will be performed in close collaboration with the SAV subject matter experts from USGS and NOAA, including SAV scientists and photointerpreters familiar with SAV character in imagery products in coordination with designated representatives of the RP.

See Attachment D for technical classification and mapping process.

2.6 Chain of Custody

All data collected pursuant to this work plan must adhere to a strict Chain Of Custody (COC) as agreed to by the Trustees and the RP to ensure the utmost integrity of all data, methods, control, and documentation. All data will remain in the documented physical control of the selected contractors at all times. Complete documentation of this COC must follow the standard NRDA COC for aerial imagery including acceptance and release signatures for this physical control chain. Original copies of all documentation will be provided to the signatories, or their designated representative, of this scope of work for aerial imagery acquisition.

3.0 Budget

The total costs for this Aerial Imagery plan, including for the activities identified in the attachments, is $2,037,002 plus associated Department of Interior salary costs. The Parties acknowledge that this budget is an estimate, and that actual costs may prove to be higher. BP's commitment to fund the costs of this work includes any additional reasonable costs within the scope of this approved work plan that may arise. The Trustees will make a good faith effort to notify BP in advance of any such increased costs.

4.0 Data Sharing

At the time of signature, the following imagery identified in this work plan has been distributed to co-trustees and BP and/or its representatives:

- Pre-Spill Impact Imagery: Inventory and Evaluation for Marsh and Beach (land water interface and habitat classification) (Item 1.1)
- Low Altitude Rapid Assessment (LARA) of SAV (Item 1.2.1)
- High Resolution Aerial Imagery Acquisition (Item 1.2.3)
- Fall 2010 Quicklook Product (Item 2.2)

Upon signature and receipt of funding for this Aerial Imagery plan, DOI, on behalf of the Trustees, will cause the following imagery and work products to be provided to BP and /or its representatives:

- Pre-Spill (2008) Impact Imagery and related work products: land/water interface, habitats and mudflats (Item 1.1)
- Satellite Imagery: Worldview 2 for Big Bend area in Coastal Florida Big Bend (Item 1.2.2.)
- Spring 2011 Quicklook (Item 2.2)
- Seagrass Habitat Mapping (Fall 2010) for Chandeleur Islands and Mississippi Gulf Islands(Item 2.5)

Additional imagery and work products generated under this work plan will be timely shared with the co-trustees and BP and/or its representative according to the following schedule:

- Fall 2011 Quicklook Product (Item 2.2): February 15, 2013
- Seagrass Habitat Post-Spill Mapping (Item 2.5): January 31, 2013
- Marsh/Shoreline Habitat Post Spill Mapping (Item 2.4)

Geographic Area	Date of Delivery
Fall 2010	
Lower Mississippi Delta	March 1, 2013
Barataria Bay	April 1, 2013
Fall 2011	
Chandeleur Islands	May 1, 2013
Mississippi Gulf Islands	May 1, 2013
Lower Mississippi Delta	July 1, 2013
Barataria Bay	September 1, 2013

All imagery and work product deliveries to BP and co-trustees will occur via ERMA and/or secure FTP, as appropriate and agreed upon by the technical representatives to the AI TWG for trustees and BP.

5.0 References

Stewart, R.E., Jr., Proffitt, C.E., and Charron, T.M., eds., 2001, Abstracts from *Coastal Marsh Dieback in the Northern Gulf of Mexico: Extent, Causes, Consequences, and Remedies*, U.S. Geological Survey, Biological Resources Division, Information and Technology Report, USGS/BRD/ITR—2001-0003. 31 pp.

Handley, L.R., *et.al*., eds., 2006, *Seagrass Status and Trends in the Northern Gulf of Mexico, 1940-2002*, USGS Scientific Investigations Report 2006-5287, 267 pages.

Cowardin, L.M, *et. al*., 1979, *Classification of Wetlands and Deepwater Habitats of the United States,* U.S. Fish and Wildlife Service, FWS/OBS-79/31, 131pages.

Attachment A

Imagery Acquisition to Support Submerged Aquatic Vegetation Natural Resources Damage Assessment (NRDA) in Florida Coastal Waters

1.0 Introduction

Florida seagrass beds are a valuable ecological resource, and the two largest contiguous seagrass beds in the continental United States are found in the Florida Keys and Florida's Big Bend region. Approximately 2.2 million acres of seagrass have been mapped in estuarine and nearshore Florida waters, but, when deep water seagrass beds growing in water too deep to easily map are included, the total area of seagrasses within Florida waters and adjacent federal waters is likely over 3 million acres. Florida seagrass beds improve water quality and reduce shoreline erosion, but their most important ecological role is to provide food and shelter for many economically important fish and shellfish species. The Deepwater Horizon Oil Spill places large areas of Florida's seagrass resources in jeopardy.

1.1 Current State of Knowledge for Seagrass Resources in Florida

For the past three years, with financial support from NOAA's Coastal Zone Management, the Florida Fish and Wildlife Conservation Commission has developed a statewide seagrass integrated mapping and monitoring program called SIMM. Elements of the SIMM program include: 1) mapping of all seagrasses in Florida waters on a 6-year schedule, 2) monitoring seagrasses throughout Florida annually, 3) publication of an annual report documenting seagrass cover and species composition changes at monitoring stations located throughout the state, and 4) publication of a comprehensive report every six years, combining site-intensive monitoring data and trends with statewide seagrass cover estimates and maps showing seagrass gains and losses.

1.2 NRDA Baseline Assessment of SAV in Florida

For the purposes of a NRDA baseline assessment in Florida, SIMM has a current inventory of seagrass imagery, mapping and monitoring programs throughout the State of Florida. In the following tables, we make the distinction between imagery and maps. Seagrass maps are created from imagery- aerial photos or satellite imagery- by the process of photo-interpretation. Trained photo-interpreters, using a pre-approved classification scheme, delineate polygons in GIS software to produce maps. Classification and spatial accuracy are typically assessed by ground-truthing randomly selected points. The process of making maps from imagery is time-consuming and results in significant lags between imagery collection and map production. Mapping will be postponed until areas are identified as potentially injured by oil and/or dispersants. At that time, seagrass will be mapped at a scale appropriate to determine injury. For that reason, imagery that may be used for baseline SAV assessment must have a resolution of 1.0 m or finer scale.

1.3 Seagrass Imagery and Mapping Status

Table 1 shows imagery that has been acquired for all Florida estuaries and jurisdictional waters in the last ten years. However, several tropical storms have occurred in the last ten years, so, based on likelihood of oil and dispersant impacts and the age of the most recent imagery, the following four areas were selected for baseline assessment imagery collection:

1) The Lower Florida Keys, Marquesas Keys, and Dry Tortugas
2) Florida Bay and the Upper Keys
3) Florida's Big Bend Region
4) The Ten Thousand Islands Region

The areas at greatest risk of oiling by transport in the Loop Current or longshore currents are the Lower Keys, Marquesas and Tortugas, and Florida's Big Bend region, respectively. Additional, high-resolution imagery collection and sampling should be performed in those areas such as Perdido Bay and Pensacola Bay that have been impacted by oil and/or dispersants.

Table 1: Status of MC252 Baseline Mapping and Monitoring Activity in Florida

Table 1: Seagrass Imagery and Mapping Status for Florida

Bay System	Most Recent Imagery	Agency	Most Recent Maps
Perdido Bay	2010	NASA, NOAA	2003
Big Lagoon	2010	NASA, NOAA	2003
Pensacola Bay System	2010	FWC FWRI	2003
Santa Rosa Sound	2010	FWC FWRI	2003
Choctawhatchee Bay	2010	FWC FWRI	2007
St. Andrews Bay	2010	GCCC	2003
St. Joseph Bay	2010	FDEP CAMA	2003
Franklin County	2010	FWC FWRI	1992
Big Bend Region	2006	FWC FWRI	2006
Cedar Keys and Waccasassa	2001	SRWMD	2001
Springs Coast	2007	SWFWMD	2007
Tampa Bay	2010	SWFWMD	2008
Sarasota Bay	2010	SWFWMD	2008
Lemon Bay	2010	SWFWMD	2008
Charlotte Harbor North	2010	SWFWMD	2006
Pine Island Sound	2008	SFWMD	2006
Matlacha Pass	2008	SFWMD	2006
Caloosahatchee Estuary	2008	SFWMD	2006
Estero Bay	2008	SFWMD	2006
Rookery Bay	2009	FDEP CAMA	Unknown
Ten Thousand Islands	2009	None	Unknown
Florida Bay	2004	FWC FWRI	2004
Gulf Upper Keys	2006	NOAA NCCOS	1992
Gulf Lower Keys, Marquesas	2006	NOAA NCCOS	1992
Tortugas	2006	NOAA NCCOS	1992
Atlantic Lower Keys	2006	NOAA NCCOS	1992
Atlantic Upper Keys	2006	NOAA NCCOS	1992
Biscayne Bay	2005	FWC FWRI	1992
Palm Beach County	2009	Palm Beach Co	2007
Southern Indian River Lagoon	2009	SFWMD	1999
Northern Indian River Lagoon	2009	SJRWMD	2007

1.4 Available Imagery Acquired During the DWH Oil Spill and From Other Sources: A considerable amount of imagery was acquired by several state and federal agencies for baseline assessment. As shown in Figure 1, NASA acquired a lot of imagery in one of our principal areas of interest- the Lower Keys and Marquesas. However, Figure 2 shows samples of the imagery acquired, and it is clear that glare and clouds substantially reduce the data's utility.

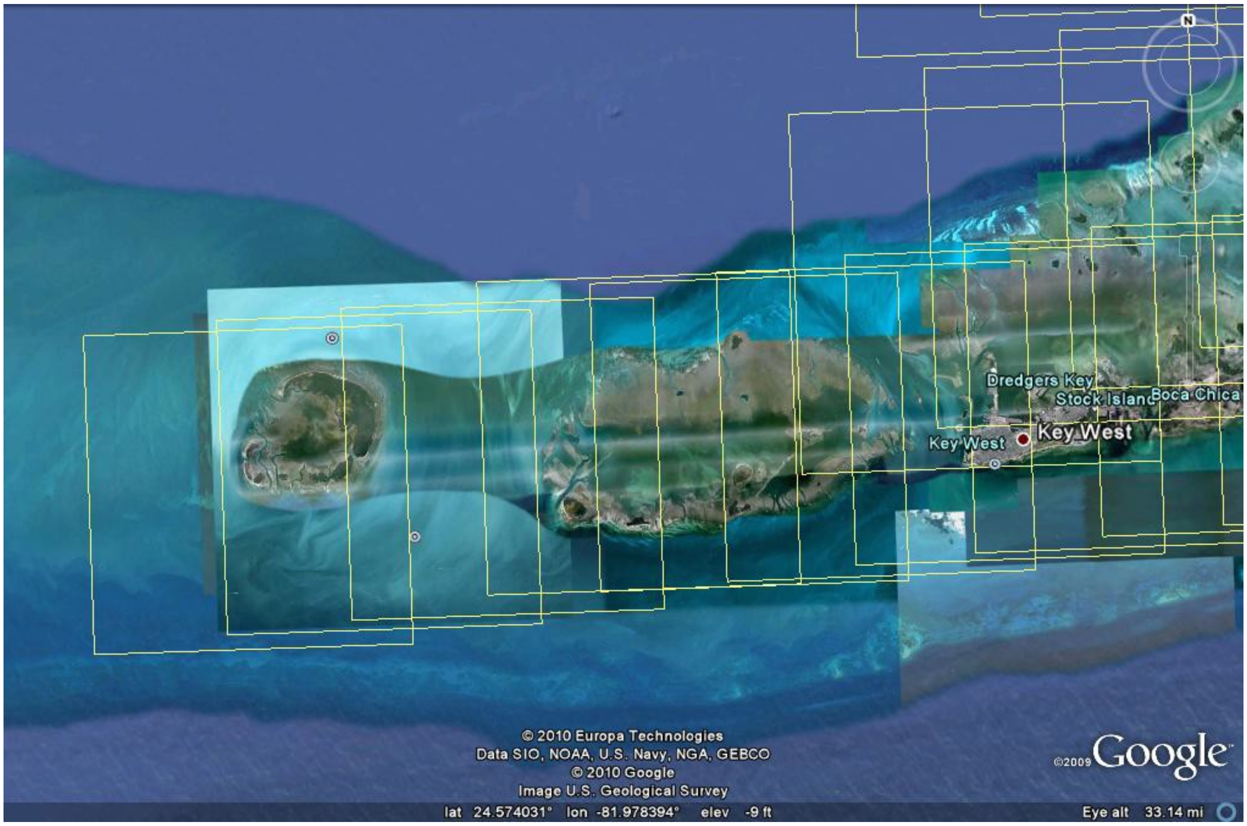

Figure 1: Footprint of NASA imagery for Lower Keys May 2010.

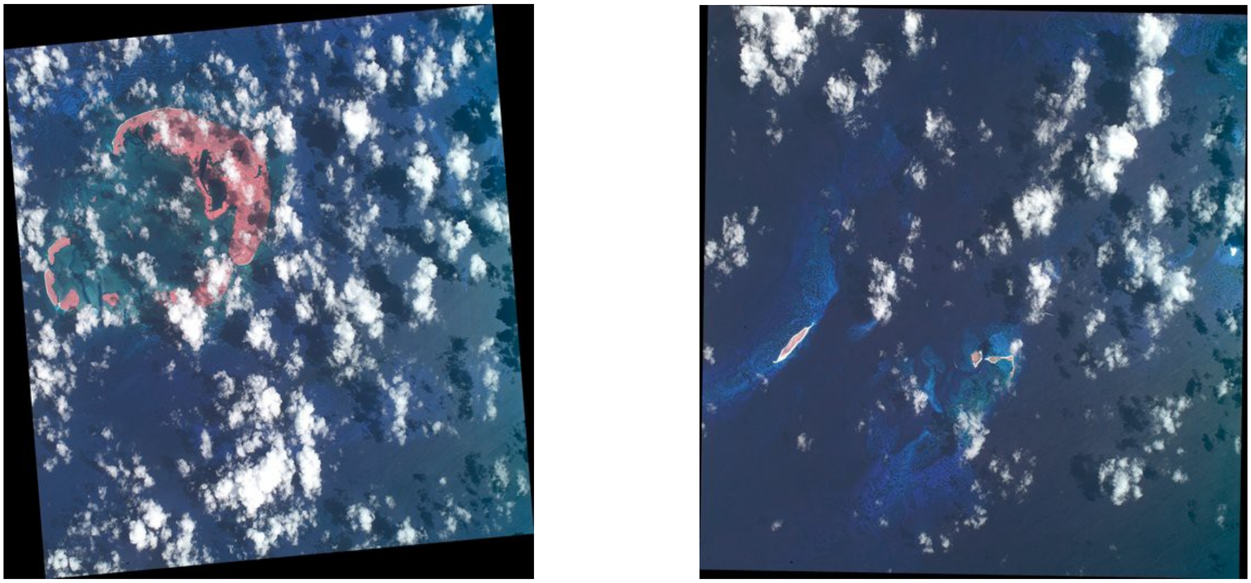

Figure 2: Sample NASA Imagery from Marquesas (left) and Tortugas (right).

1.5 Area of Interest for Imagery Acquisition

The principal area of interest for proposed imagery acquisition is Florida's Big Bend, an area of 4680 km2 (Figure 3).

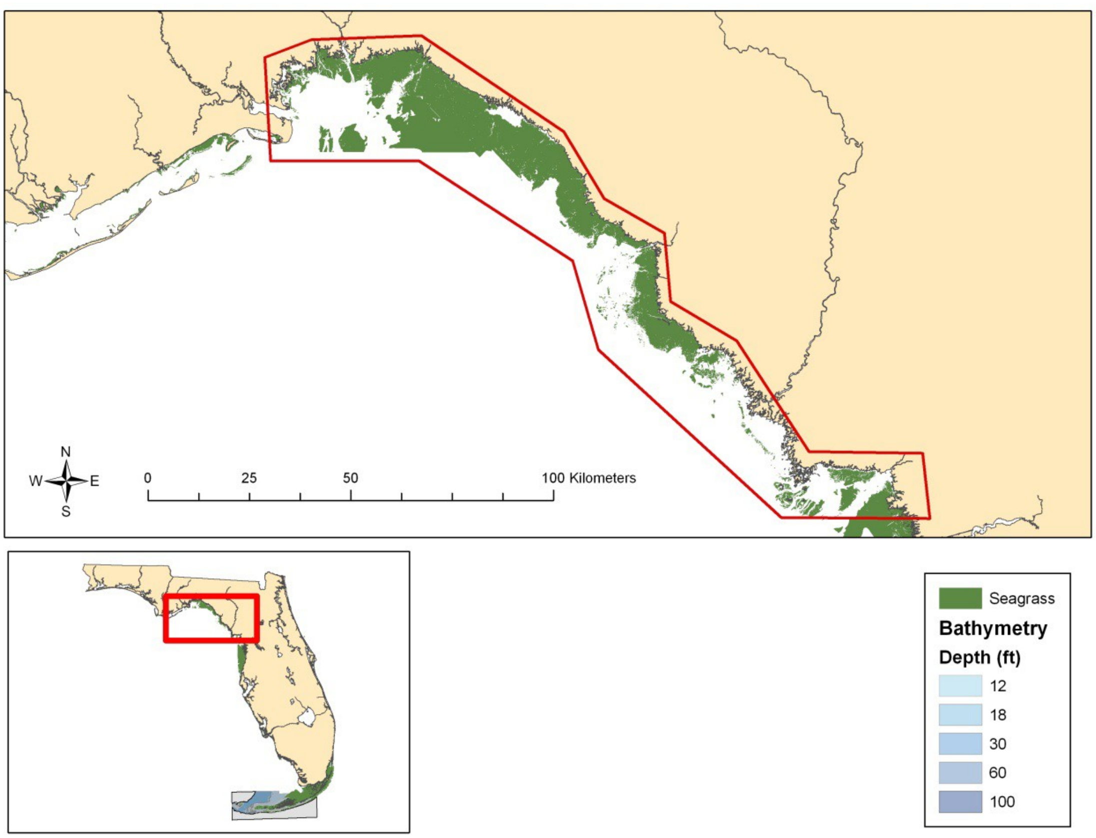

Figure 3. Florida Big Bend AOI

Attachment B

QuickLook October 2010 Imagery: Feature Index

1.0 General Overview

The AITWG anticipated that other technical working groups would need access to imagery information much more quickly than would be available from an individual frame based high-detail/high-accuracy formal mapping. In January 2011 the AITWG determined that an analysis be conducted of the 1: 6,000 scale composite maps (Digital Ortho Quarter Quarter Quadrangle or DOQQQ) to detect a list of features compiled from queries sent to the various technical working groups. These features were to be collected in an ArcMap geodatabase with a feature location accuracy equivalent to the DOQQQ's. Features noted are not measured, delineated or located by point coordinates. Instead, features are listed within a DOQQQ. This is an index, not a map.

1.1 How to use QuickLook 2010

The experience the user has with the QuickLook Index will be greatly enhanced by having knowledge of the features available, understanding of the map indexing system, and some ability with ArcMap software. This document addresses the first two factors. ArcMap training is beyond the scope of this document.

1.2 List of features with definitions

The feature list was derived through querying the individual TWG's for lists of features that may be visible in photography that would be of use to that TWG. Technical Working Groups that provided input during the working session at the January 2011 AITWG meeting or in writing included: SAV, Shoreline, Marsh, Birds, and Turtles. All lists were combined as much as possible and the features were searched for in the imagery using a variety of scales, channel combinations and stereoscopic as well as monoscopic review.

Feature	Definitions /Characteristics
Beach	Tidally exposed, coarse particulate substrate
Marsh	Tidally inundated, or saturated soil vegetated wetland
Spartina	A category of marsh dominated by short-stature grass species. Usually Spartina-dominated.
Juncus	A category of marsh dominated by the rush species. Usually Juncus-dominated.
Mangrove	Tidally flooded saltwater or estuarine forest or scrub-shrub
Phragmites	A category of marsh dominated by very tall grass species. Usually Phragmites-dominated.
Scrub-shrub	Upland or freshwater wetland woody species less than 4 m height
SAV Brackish	Submerged aquatic vegetation, not seagrass. Usually in interior brackish marsh.
Seagrass	Submerged aquatic angiosperm vegetation, usually in seawater.
Water	as named
Birds	as named
Turtles	as named
Marine Mammals	as named
Seagrass Prop Scar	Long-linear, narrow, symmetrical, bright streaks in the dark vegetation signature

Seagrass Boat	Boat in seagrass bed
Boom	as named
Boom Scar	as named
Wrack	Debris cast inland in long lines roughly parallel to wave fronts
Veg Discolor	Mottled brown or consistently brown, mostly nonchlorophyllous vegetation
Marsh Die-Off	Brown-grey marsh vegetation with culms still somewhat intact
Marsh Stubble	Brown-grey marsh vegetation without leaves but rhizomes apparently remain
Marsh Unvegetated	Non-mudflat unvegetated marsh platform
Berms	artificially constructed long-linear walls of unconsolidated sand
Airboat Trails	Vegetation pressed to substrate in long linear to curvilinear to tight-spiral or looped patterns
Dune	as named
Completion	Checked when review on given DOQQQ is completed

1.3 Imagery data structure

The photography collected in October 2010 for the Trustees by Aerometric for BP pursuant to a cooperative work plan is 4 channel (red, green, blue, near infrared), stereoscopic, 1-foot nominal scale with coverage across most of the Northern Gulf of Mexico (Figure 1). The original frame data were orthorectified. The frame imagery data set is most useful for habitat and other feature classification. Under most circumstances frame photography is data overkill for downstream users who are usually more interested in a larger geographical footprint than individual orthophotos provide. Aerometric provided a product of greater general use and geographical extent, the Digital Orthophoto Quarter Quarter Quadrangles or Q3's, which are assemblages of individual frames of photography that have been color balanced and the edges feathered together. And as such, the Q3 imagery has been altered from the initial state of the acquired individual frames.

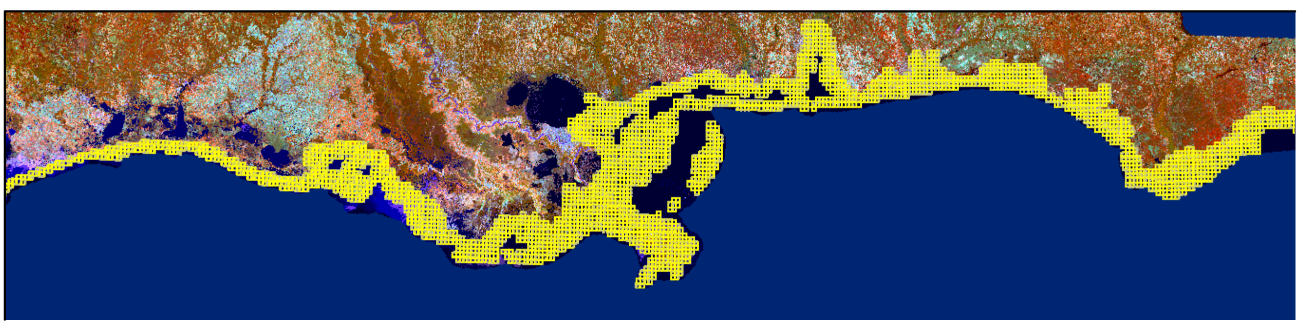

Figure 1: October 2010 aerial imagery footprint.

The objective of the Quick Look was to formulate a grid system using the imagery to identify and tabulate the features mentioned above. The fundamental organizational unit of these data was the 7.5 minute USGS quadrangle index system. Each quadrangle in the United States has a unique index value related to the latitude and longitude of the map. For example, refer to Figure 2, map 2908933, the Wilkinson Bay Quadrangle. The scale is 1:24,000. This map is completely interpreted.

A DOQ is a digital ortho-quadrangle- has the same scale and retains features of the original photography- appearing as a hybrid between a quadrangle and photographs.

The DOQ can be subdivided into 4, 1:12,000 digital-ortho quarter-quadrangles (DOQQ). The map number reflects which quadrant the DOQQ represents in the original 1:24,000 quadrangle. Referring to the quadrangle (Figure 3), the NE quadrant is the quarter quadrangle 2908933NE.

For this imagery the DOQQ is itself divided into quarters, forming DOQQQ's. Figure 4 is the northeast corner of the northeast corner of the Wilkinson Bay Quadrangle, scale = 1:6,000. Note that the label is "2908933NES2". The quarter quad is quartered and labeled s1 – s4, clockwise, beginning in the upper-left quadrant. The basic unit of observation is the DOQQQ. The DOQQQs' will be referred to as "Q3s." Therefore, it takes 16 Q3s to cover the area of the ubiquitous USGS 7.5 minute topographic quadrangle.

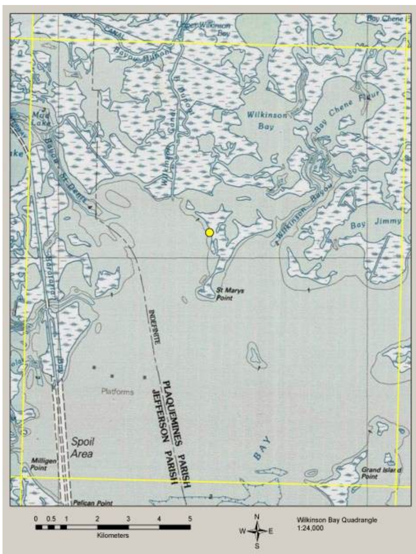

Figure 2: U.S.G.S. Wilkinson Bay Quadrangle. 1:24,000 scale.

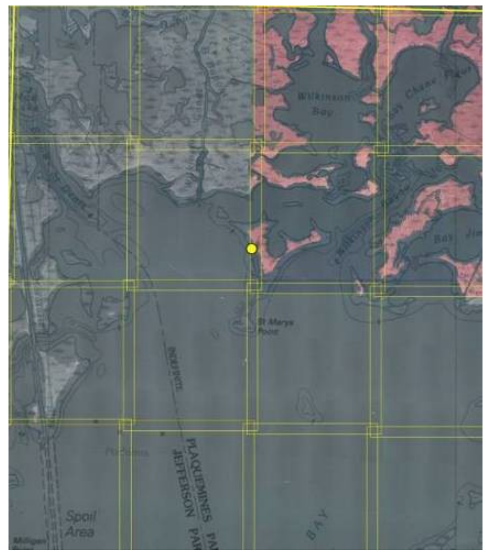

Figure 3: Wilkinson Bay with Quarter-Quarter Quadrangle boundaries

Figure 4. Wilkinson Bay DOQQQ

2908933NES2.

1.4 Geodatabase Structure

Examination of all of the Q3's was conducted in ArcMap 10.0 except when stereoscopic observation was initially required for signature definition, in which case Erdas 2010 was used. All recorded observations were entered into an ArcMap geodatabase with the features as column headers and Q3 observations entered by row. Only positive observations were recorded. Thus, a lack of observation does not definitively reject the possibility that the feature was present; merely that it was not observed. Also, no point locations or aerial measurements are provided. Instead, the QuickLook provides the user with an index to the Q3's reviewed, indicating on which Q3 a given feature was noted. There is a Feature Signature Key available that presents examples of each feature in the Quick Look.

1.5 QuickLook Limitations

This index is not intended to be used for stand-alone analytical purposes. It has not been Quality Controlled nor has it been field-checked. No positional or feature accuracy is intended or implied. As of the writing of this document about 500 Q3's have been evaluated in this process. Future releases will not be corrective. They will include extensions to new Q3's.

Attachment C

Technical Approach for Land-Water Interface and Habitat Interpretation and Mapping

1.0 Introduction

The U.S. Geological Survey (USGS) will coordinate the interpretation and development of digital habitat maps. Digital Orthophoto Quarter Quarter Quadrangles (DOQQQ's or Q3) habitat maps will be developed from the following sources:

> High Resolution Aerial Imagery identified as of sufficient quality with acquisition dates pre-Oil Spill impact (winter and spring 2010), and post-Oil Spill impact (fall 2010, spring 2011, and fall 2011.)

Aerial digital imagery will be the primary medium used in interpreting and delineating land-water interface, marsh, scrub-shrub, mudflats, beaches, and for mapping the habitats. This aerial imagery already exists. The AITWG has identified the aerial imagery to be used and has downloaded the photos. All imagery acquired is indexed through web services at EROS HDDS, NOAA ERMA and gis.aerometric.net showing photo centers for each flight line.

1.1 Methods used for Land/Water Interface Development

Methods define the standardized practices and procedures for creating vector polygons classified as land, water, or other from imagery in support of habitat map production.

Background

The U.S. Geological Survey (USGS) has historical National Wetlands Inventory (NWI) data for 1956, 1978 and 1988 of Coastal Louisiana. Currently, the NWRC is classifying 2008 coastal marshes into NWI wetland habitats and land-water categories. This land-water data has provided a valuable means of identifying change, particularly after environmental disasters such as hurricanes, oil spills, and flooding events. In addition, this land-water data assists in identifying the location of fragile wetlands and determining potential inland-affected areas through bayous, rivers, and other waterways. This land-water data has also been used to plan and design conservation and restoration projects, provide hurricane assessment information, and identify environmental landscape changes.

Due to the complexity of the Louisiana coastal area, the need exists in the development of detailed habitat maps for an efficient means of delineating a consistent and highly detailed land/water interface. The land/water interface is a shoreline, it is not an official shoreline, that is tidally/water level dependent. It is simply the line between water and land/vegetation at the time the imagery was acquired. Once the land/water interface is processed according to the protocol described in this methods documentation, the interface becomes a deliverable, and is provided to the habitat classifiers for use in identifying and delineating habitats according to the habitat mapping protocols being used.

Imagery

Color infrared digital imagery has been acquired using the Z/I Imaging Digital Mapping Cameras (DMC) in the spring of 2010, the fall of 2010, the spring of 2011, and the fall of 2011. The 2010/2011 imagery was acquired at 1 foot resolution in blue, green, red, and infrared bands. The ability exists to view the images (frames) in the Black and White, Natural Color, Color Infrared and Stereo Viewing. Imagery is acquired under cloud, haze, and smoke free conditions and when sun altitude is not less than 30 degrees. The fall 2010 imagery was acquired at an approximate mean normal tide level. The spring of 2011 imagery was acquired at slightly below mean normal tide level. The fall 2011 imagery was acquired at a mixture of an approximate mean normal tide level and at slightly below mean normal tide level.

Protocol for Land-Water Interface Development

Raster

This land-water classification is the initial stage of the photointerpretation process that is designed to be a baseline corrected dataset. The classification is derived from the color infrared digital imagery, using the Q3s grid developed by the AITWG for the Deepwater Horizon NRDA projects.

1) For each Q3, a supervised classification (Erdas Imagine Software), using 10 distinct sample signatures, are used to create a classified thematic layer. Several samples are chosen from unique spectral signatures such as water bodies, forested, open range, crop fields, and marshes.
2) Initial classification results are inspected and determined if additional sample signatures and processing are required.
3) If desired results are not obtained, the signature file is edited or more signatures are added to produce a more suitable classification. Once the desired results are obtained, a clump and eliminate process is run to help clean-up the topology of noise and remove items below the required minimum mapping unit (.02 acres).
4) The finished file is recoded to two classes: Land and Water. The resulting file is then converted to a vector file and imported into an ESRI geodatabase file and is ready for manual editing.

Vector File Editing

1) Vector files are manually corrected using editing tools in ArcGIS. Boundary lines are secured tightly against shoreline. Overhanging tree canopies, marsh shadows along waterways, bridges, boats, and boat docks are edited and classified as water. In addition to land and water, mud flats, aquatic vegetation, and wrack are also delineated. Ancillary data sets from 1998 through 2010 are used to help classify areas that may be difficult to identify. All areas characterized by emergent vegetation, wetland forest, scrub-shrub, or uplands are classified as land, while open water, aquatics and mud flats are classified as water.
2) Once completed, a wetland verification check is run to search for adjacency errors, closed polygons, and dangling nodes.
3) After completion, the GIS Specialist will perform a Quality Assurance self-check of their work.
4) A second GIS Specialist and Photointerpreter will perform a final in-house Quality Control, assuring accuracy and data integrity.

1.2 Habitat Delineation and Mapping

Wetlands will be classified using the national FGDC standard (Cowardin *et al.*,1979) wetland classification system. The acquired high resolution aerial imagery will be classified at 1:6,000 scale (minimum resolution 1 foot) and will be used as basemaps for habitat interpretation and derived data layers. Aerial imagery will be interpreted using the same classification scheme for dates before and after the Deepwater Horizon explosion and oil spill impact. The O3s to be interpreted will correspond to the priority areas selected for the aerial acquisition (Figure 1).

Figure 1: Priority Areas for Mapping as determined by Technical Working Groups.

The individual "raw" digital imagery from the DMC cameras is used for the head's up interpretation on-screen. The images are rectified with a spatial reference specification of 1 meter. The completed land/water interface for the DOQQQ is layered over the color infrared band of the aerial imagery. The required habitats and species are interpreted monoscopically using ArcGIS geographic information system (GIS), and habitat polygons are digitally delineated on a computer screen display and all polygons are labeled using the Cowardin (NWI) wetland classification system with the additional modifiers for the species types. Polygon coverage of habitats are created in ArcGIS.

The mapping involves interpretation and classification of the habitats on-screen from digital aerial imagery. The interpretation will utilize the individual 12-bit imagery frames in the infrared band. The habitat data will be compiled to the Q3 Grid (Figure 2).

Figure 2: Example of delineated fall 2010 Wilkinson Bay, Louisiana DOQQQ.

Mapping protocols will follow the National Wetland Inventory photo interpretation and cartographic conventions and the FGDC Wetlands Classification Standard scheme. The production of digital products and the use of oilspill related sampling site data will be used as ancillary information to validate interpretation, and to provide an accuracy assessment of the habitat data and oil impacts.

- The minimum target identification area for land versus water will be .01 acre
- The minimum target identification area for delineating discrete wetlands types will be .02 acre
- Mapping will include the classification of marsh, scrub-shrub, mudflats, and beach habitats. *Spartina alterniflora*, *Juncus*, and *Phragmites* will be further delineated within the marsh habitats. Mangroves will be delineated from other scrub-shrub habitats.
- Mudflats will not be delineated on the fall 2010 imagery because the water was at mean normal level. The mudflats will be delineated from October –November 2008 aerial imagery acquired at low tide. Mudflats will be delineated as intermittently exposed, regularly flooded, and irregularly flooded.
- Dunes will be delineated as vegetated with more than 10% vegetated cover, otherwise they will be classified as ‘bare’.

- A thematic accuracy assessment will be performed on the maps generated. Using the FGDC Wetlands Mapping Standard, we will adhere to a thematic accuracy of 85% with a minimum target unit of 0.01 acre for delineating the habitats.

- A photointerpretation signature key will be developed to document and assist in the consistent habitat mapping and the assessment of thematic accuracy in the validation phase.

- All draft maps will be developed as digital products.

- The digital maps will be sent to TWG leads for dissemination to TWG members to review the interpretation. All comments will be reviewed by USGS to determine relevance; corrections and additions will be incorporated into the final digital dataset prior to distribution to Trustees and RP.

Attachment D

Deepwater Horizon/Mississippi Canyon 252 Spill

Mississippi Canyon 252 Spill

Chandeleur Islands Hybrid-Mapping

Submerged Aquatic Vegetation

1.0 Objective/Purpose

The purpose of this activity is delineating the areal extent of submerged aquatic vegetation (SAV) along the length of the Chandeleur Islands, Petit Bois and Horn Islands using advanced imagery analysis techniques. This proposed SAV Imagery Analysis/Classification activity is considered a "hybrid" approach between automated object-
based imagery analysis (OBIA) and traditional photo interpretation methods. The OBIA activity is a collaborative effort with co-Trustees. Products resulting from OBIA effort are expected to be reviewed by USGS photo interpretation team with any uncertain SAV determinations noted and potentially corrected. It is not anticipated that any systematic issues will be present in SAV classification due to ongoing collaboration with USGS through the SAV classification process. Any further attribution by USGS, such as species level determinations, may be performed by USGS photo interpretation team.

Scheduled future project imagery acquisition activities will include SAV determinations following acquisition. Therefore, any SAV classification algorithms developed will be designed for maximum flexibility to allow for application of the algorithms to additional imagery events. This type of algorithm development should minimize, though not eliminate, the effort needed to alter imagery parameters to account for the variability in imagery collection conditions.

This activity includes the following topics:

1. *Project Area and Analysis Events*: This section describes the proposed project area to be included in this SAV classification effort. Additionally the included analysis events are identified.
2. *Methodology:* This section describes the overall purpose and general methodology of the Hybrid SAV discrimination approach. Note that the USGS methodology is not represented in this section.
3. *Estimated Analysis Cost:* This section provides an estimate of the cost of implementing the OBIA portion of the Hybrid SAV discrimination approach for each analysis event. Note that the USGS activities are not represented in this estimation.
4. *Deliverables:* This section provides a listing of products to be delivered as part of this task effort
5. *Assumptions:* This section provides a listing of project assumptions on which scope and estimated pricing is based

1.1 Project Area/Analysis Events

The Chandeleur Islands represent an area of nearly 70sqkm (17,300acres) including land area and SAV-environment backwater (Figure 1). This area represents the extent of the Chandeleur Islands SAV hybrid-mapping activity proposed in this workplan. Additional classification will occur on Horn and Petit Bois Islands which jointly represent an analysis area of nearly 64sqkm (15,800acres) including land area and SAV environment backwater (Figure 2). This effort will be conducted as a phased approach. The first phase includes performing SAV classification on (2) aerial imagery surveys of the same acquisition specifications for the Chandeleur, Horn, and Petit Bois Islands from Fall 2010 and Fall 2011. Spring 2011 and Spring 2012 imagery from the same locations will be reviewed after the Fall imagery has been processed.

OBIA processing will be performed on the overlapping aerial photos representing this study area. The primary product resulting from the OBIA imagery analysis will be a fine-scale SAV classification. Approximate minimum mapping unit of the finest mapping level is $4m^2$. OBIA activity includes deriving interim imagery products, developing a parameterized condition-based algorithm which accounts for illumination and environmental condition-related variation typical of photographic-based imagery classification efforts. The development of this algorithm will be performed in close collaboration with the SAV TWG.

1.2 Methodology

The primary deliverable from each analysis event is a binary (present/absent) SAV classification, in GIS format. The project-acquired imagery will be the basis upon which the SAV discrimination is performed. The SAV algorithm will be developed based on the Aerometric October 2010 four-band (blue, green, red, NIR) 12-bit imagery. The SAV algorithm will later be refined in order to optimize accuracy for application to the June 2011 imagery and subsequently for the October 2011 imagery. The June 2011 refinement will be primarily to address seasonal changes in vegetative activity and solar illumination, while both latter events will necessitate fine-tuning of parameters to address conditions unique to aerial imagery acquisition events.

Classification Scheme Development

In order to accurately discriminate and quantify SAV in the project area the project team will collaborate to identify and delineate “samples” representing the range of conditions observed in the imagery. This includes various flora samples (e.g. vegetative and algae) as well as arrange of additional tidal and terrestrial delineation samples. Although the final classification will be SAV-binary (i.e. present or absent), many other classes must be identified in order to be discriminated and removed from consideration as SAV candidates. The project team will obtain any temporally-coincident field survey data from NRDA database, e.g. October 2010 field survey, and work with the NOAA team involved in the survey in order to identify the SAV regions surveyed. The project team will develop a classification key identifying the range of conditions observed and group into classes, working with USGS and NOAA on confirmation of such groupings.

OBIA Hierarchy Development

OBIA classification methodology leverages objects (polygons) derived from the imagery products. Objects are generated at multiple “scales” with the granularity of a scale level based primarily on a “homogeneity” value. The less homogeneity enforced results in more diverse range of features included in the object. As seen in Figure 3, from left to right is a series of object levels with greater enforcement of homogeneity. The OBIA-based SAV classification would be finalized at the approximate scale of the far-right image chip. The higher object levels (more coarse) are leveraged in the classification process in order to reach a classification at the finest level.

OBIA Condition-Based Classification

The developed algorithm will discriminate SAV areas from other features. In order to accomplish this discrimination the wide range of imagery anomalies such as illumination variations, sun-glint, frame-to-frame reflectance deviation and environmental conditions such as water turbidity, surface disturbance, and intrusion into SAV must be programmatically addressed. The OBIA classification process includes an iterative multi-hierarchical categorization process which groups objects into many interim-classes. Class definitions are based on spectral, textural, geometric, and context relationships drive the class groupings. Fuzzy-logic (probability) class definitions will most likely be necessary in order to account for frame-to-frame variations. The final classification process is the assignment of interim subclasses to deliverable classification scheme.

Accuracy Assessment

The accuracy assessment procedure quantifies the overall usability of a classification product. Sources of error for a mapping effort are varied and may include imagery analysis error, field survey in situ interpretation data error, data entry error, as well as temporal error where conditions in the field change between the survey and imagery acquisition events. Accuracy assessment is used to discern usability of map classes rather than judging the performance of the mapmakers. The accuracy assessment reports not only the overall accuracy of map classes but provides information on how error is distributed both spatially and non-spatially.

An ‘‘error matrix’’ evaluation will be applied which organizes the map accuracy information, with various accuracy measures computed from this error matrix. In this error matrix correct classifications are represented by the diagonal entries of the error matrix, and misclassifications are represented by the off-diagonal entries. Commonly used accuracy measures summarizing the error matrix information are overall accuracy (the sum of the diagonal), user’s accuracy (a diagonal entry divided by the corresponding marginal row total), and producer’s accuracy (a diagonal entry divided by the corresponding marginal column total).

Accuracy assessment performed solely on an independent field data set for such an analysis assessment is optimal. For this event though this approach is not feasible if to be rigorous, due to insufficient quantity of field data locations. The Oct2010 NRDA field data collection includes approximately (30) field data locations, with 0-2 field data points per imagery frame. The proposed methodology will utilize the Oct2010 NRDA field data in classification development process.

For the accuracy assessment it is proposed that a stratified random sampling be performed with a target accuracy of 90%. Desired standard deviation will dictate quantity of sampling points by strata (SAV/Non-SAV). Randomly generated sampling points will be independently categorized by USGS photo interpreters with no a priori knowledge of class strata provided. Assessment will subsequently be performed by way of spatial join between independently categorized sample points and OBIA-generated classification polygons. Reporting will be provided in tabular form as below in Table 1 and Table 2 and in spatial form as QC point data.

Table 1	Area Calculation (Oct 2010 Event)
Class Identification	Class (Acres)
Seagrass	XXXX

Table 2	Presence / Absence Accuracy Assessment Matrix			
		Independent Interpretation		
		Seagrass Absent	Seagrass Present	*User's Accuracy*
OBIA Classification	Seagrass Absent	960	20	98%
	Seagrass Present	40	980	4%
	Producer's Accuracy	96%	2%	97%

Un-Weighted Kappa statistic _______%

1.3 NRDA Products

For each analysis event for the Chandeleur Islands and for Horn and Petit Bois Islands, October 2010, June 2011, and October 2011, and the Spring 2012 the OBIA classification will be provided to USGS once the automated discrimination has been optimized for further review and refinement, as necessary, through polygon attribution edits. Deliverable products are to include:

- SAV Classification – Binary Presence/Absence (ESRI File Geodatabase – Polygon Feature class)
- Multi-Level Object Segmentation Levels - (ESRI File Geodatabase – Polygon Feature class layers) – Object segmentation levels, as seen in Figure 3. No classification associated with levels higher (more coarse) than SAV classification.
- Technical Memo – Documentation of project process, methodology overview, and accuracy assessment.

1.4 Assumptions

- The project team, including representatives from NOAA, the RP, and USGS, will work together with appropriate subject matter experts made available as appropriate through the course of the analysis effort.
- The Aerometric imagery products are delivered and accepted as a baseline on this project (but not necessarily for purposes of the injury assessment as part of the NRDA). The spatial accuracy of the Aerometric imagery will serve as the basis for this subsequent analysis.
- The Aerometric imagery products will be similar acquisition specifications for each event:
    - Spatial Resolution: 0.30m cell size
    - Spectral Resolution: 4-band (blue, green, red, NIR)
    - Radiometric Resolution: 12-bit dynamic range

- Collection conditions: Within any areas to be considered for SAV discrimination the imagery will be cloud-free, water clarity (as feasible), calm water surface

Figure 1: Project Area – Chandeleur Islands, Louisiana, Northern Gulf of Mexico

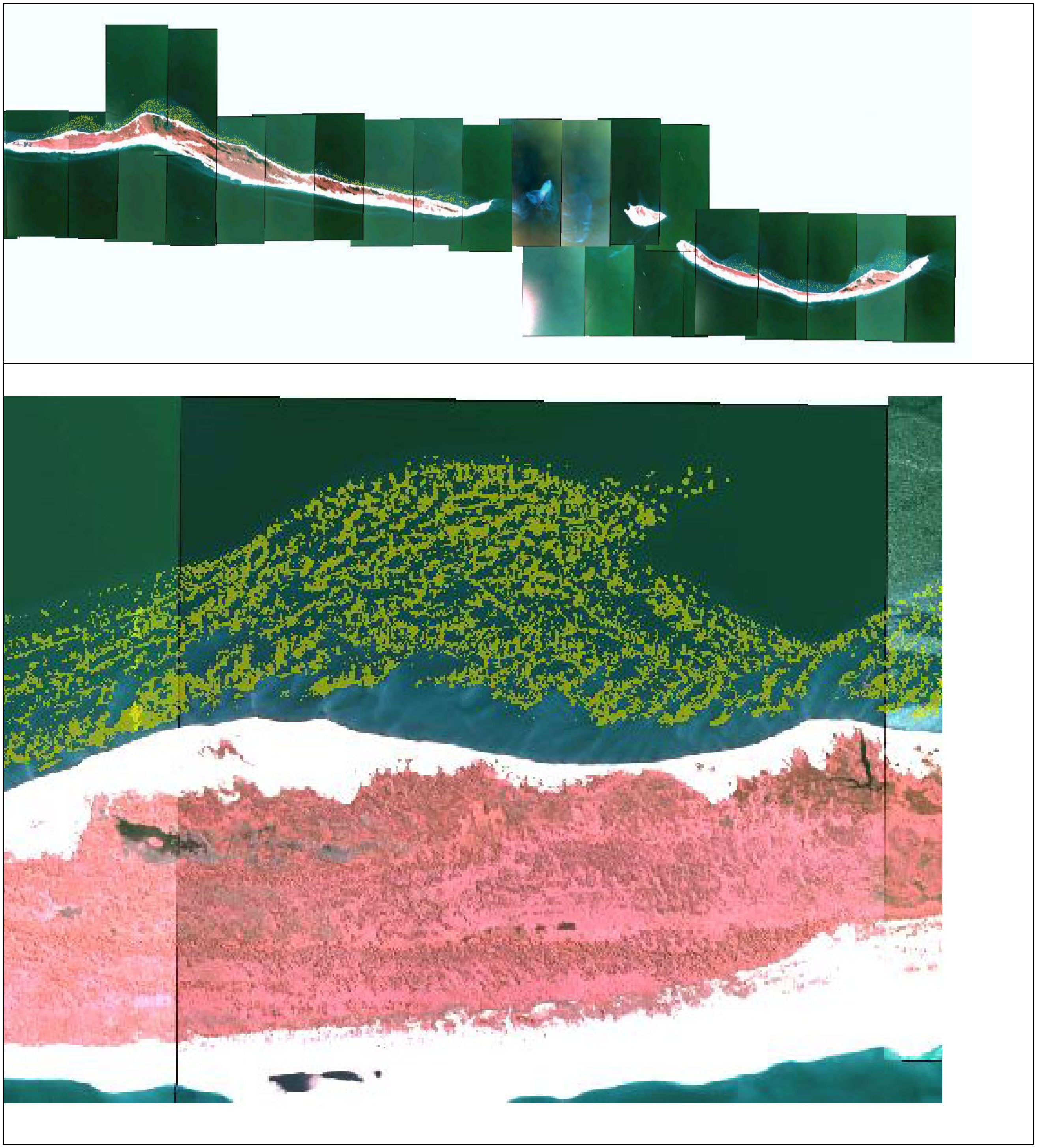

Figure 2: Project Area – Petit Bois and Horn islands, Mississippi, Northern Gulf of Mexico

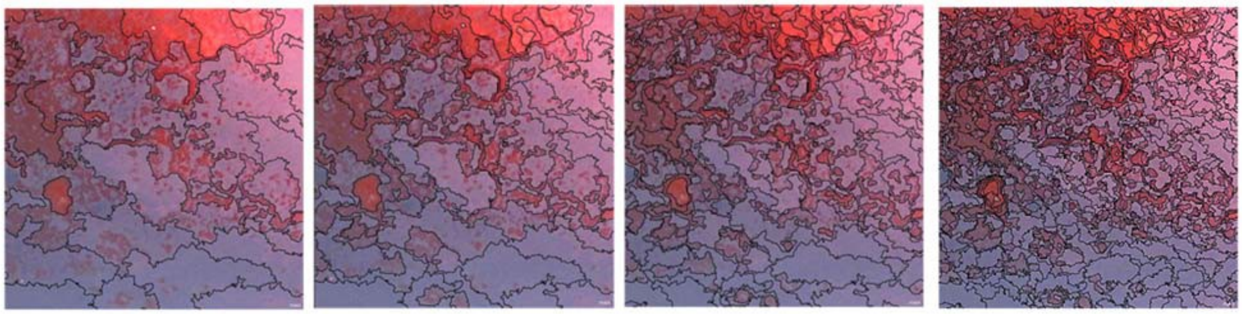

Figure 3: SAV Example of OBIA Segmentation Hierarchy. Left to Right represents increased enforcement of homogeneous pixels contributing to the extent of an image object.