2014 INTERNATIONAL OIL SPILL CONFERENCE

HURRICANE ISAAC DATA MANAGEMENT LESSONS LEARNED AND SUBSEQUENT PLAN DEVELOPMENT

LT Kyle Jellison, Scientific Support Coordinator,
National Oceanic and Atmospheric Administration, 500 Poydras St., Suite 1341,
New Orleans, LA 70130

LCDR Lushan Hannah, Chief, Incident Management Division,
U.S. Coast Guard, Sector New Orleans, 200 Hendee St., New Orleans, LA 70114

Mr. JB Huyett, Response Information Analyst,
GenWest Systems, Inc., 170 W. Dayton St., Edmonds, WA 98020

ABSTRACT 299528:

The 2012 Hurricane Isaac pollution response necessitated identifying, tracking, mitigating, and removing over a thousand potential oil and hazmat containers that were a threat to the public and the environment. A variety of data management challenges arose during the response. Some were related to the difficulties of managing such large volumes of data, and some related to changes in funding to support operations during the course of the response. The Natural Disaster Subcommittee of the New Orleans and Morgan City Area Committees, drawing from data management lessons learned during the Isaac response, drafted a Natural Disaster Response Plan (NDRP) that incorporates a unified strategy for collecting, managing, and disseminating field data during natural disaster responses. The NDRP introduces unique structures to pollution response and is built on a comprehensive and coordinated data management strategy.

INTRODUCTION:

On 28 August 2012, Hurricane Isaac made landfall near the mouth of the Mississippi River, Louisiana, as a Category 1 hurricane with sustained winds of 80 miles per hour and an associated storm surge of 8 to 11 feet. It predominantly affected the Mississippi Delta and areas north to New Orleans and Lake Pontchartrain, with Plaquemines Parish receiving the brunt of the high winds and associated storm surge. Thousands of containers of oil and hazardous materials were scattered throughout the region, including in undeveloped areas comprised of low-lying, inter-tidal marsh, cypress and tupelo swamps, and shallow bays. Tracking the response to these containers and managing the associated data became a key challenge for the response team cleaning up the damage.

The response took place in two distinct phases, each funded through a different funding source and authority. The first phase started immediately after the hurricane and was funded by the Oil Spill Liability Trust Fund (OSLTF) and limited Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) funds. The second phase started once a Stafford Act declaration was made by the President a few weeks later.

The data management processes used during these two phases was different and both provided significant lessons learned for hurricane response in Louisiana. After the Hurricane Isaac response had been completed, these lessons learned were leveraged by the New Orleans and Morgan City Area Committees to develop a Natural Disaster Response Plan (NDRP) built around a unified and comprehensive data management strategy.

In this paper, we evaluate the field data management processes used in the Hurricane Isaac pollution response and how the lessons learned shaped the creation of the NDRP.

BACKGROUND: RESPONSE DATA MANAGEMENT:

In emergency settings, data management plays a central role. That role is becoming more important given the increasing use of internet-based data management and geographic information systems (GIS) solutions that are used to develop tactical response actions.

At present, the three primary frameworks for pollution response—the National Response Framework (NRF), National Contingency Plan (NCP), and Area Contingency Plans (ACP)—provide little guidance for managing field data during an incident. These documents largely outline the structures within response and responsibilities of responders. There are few recommended standards to ensure effective flow and management of information and data between response organizations (U.S. Dept. Homeland Security, 2008a; U.S. Dept. Homeland Security, 2008b; U.S. EPA, 2010).

Managing field data can be challenging during traditional pollution incidents, and that challenge is amplified during the multi-target, multi-jurisdictional scenario of a hurricane pollution response. The general procedure for data management, often developed through trial and error, is similar across missions: 1) field personnel collect specified data, 2) collected data is entered into a data repository, 3) the data is managed and checked for quality, and 4) data is distributed to end-users who then generate needed products (e.g., maps, reports, graphs, and summaries). Depending on the nature and severity of the incident, the complexity of this process can vary greatly.

Field Data Collection:

The final products for data consumers are only as good as the raw data used to create the products. Simply put: garbage in, garbage out. During an emergency response, field data collection personnel are the crucial element on which any successful data management system relies. For those field personnel to succeed, they must have the right tools, clear procedures, and support from subject matter experts.

While a response system must be able to flexibly adapt to unique response challenges, there also must be consistent standards for field personnel to follow from the beginning to the end of the response.

Entering Data into a Data Repository:

Developing an effective mechanism for entering data collected by field personnel into a data repository is not a trivial task. Especially important is the need for field personnel to retain ownership of their data as it is entered into the repository. Enabling field personnel to enter their data themselves is preferable only if that data entry task does not unduly add to their workloads. As an alternative, establishing a data entry team within Operations can increase efficiency, but it is crucial that data entry personnel be co-located with the field teams, since it is the field personnel who fully understand their own field observations.

Data Management and Quality Assurance:

A critical element of the data process is quality assurance and quality control (QA/QC) of the data repository. The products created from data stored in the repository must be as accurate (or as accurate as possible under such emergency response conditions). Otherwise, in the worst-case scenario, the response will fail to address significant threats to the public and environment. To ensure the necessary level of accuracy, field personnel must be actively engaged in the QA/QC process.

Data Distribution:

The Unified Command, Operations Section Chief, Planning Section Chief, and others within the ICS structure require accurate and timely response data which they can easily apply to the development of the best possible Incident Action Plan for the next operational period. External to the response, agency leaders, natural resource trustees, and stakeholders require consumable products to enable them to maintain situational awareness during a response. Whether accurate response data is effectively distributed can greatly affect perceptions of how well the response is being managed.

HURRICANE ISAAC DATA MANAGEMENT:

In part because of changes in funding streams, different data management processes were put into use during the two successive phases of the Hurricane Isaac response. Connecting these two processes to evolve into a common system was important to successfully managing the response.

Phase 1: OSLTF/CERLCA Response:

Hurricane Isaac significantly expanded the scope of day-to-day operations for the U.S. Coast Guard (USCG). To respond to Isaac, Sector New Orleans and its sub-units established a Unified Command and added response personnel. As the storm approached, vessel and barge traffic was cleared from the Mississippi River. For approximately 90 days post-storm, Sector New Orleans response forces maintained expanded operations to address hurricane impacts. Those operations included salvage of deep-draft vessels and barges, recovery of spilled oil and released hazardous materials, and restoration of impacted Coast Guard facilities and communications systems.

The impacted area of operations included the Ports of New Orleans, St. Bernard, Baton Rouge, South Louisiana, Plaquemines, and Fourchon, as well as the Louisiana Offshore Oil Port (LOOP), the nation's only offshore deep-draft oil port. The storm shut down the Lower Mississippi River Port Region as well as the Port of New Orleans, which is the largest port in the United States on a per tonnage basis, and third largest in the world.

The tidal surge and flooding from rainfall scattered orphaned containers throughout the hurricane-impacted area. These containers varied in capacity from 5-gallon containers up to very large above-ground storage tanks (ASTs).

At the peak of the post-Isaac oil and hazmat response operations, the Unified Command consisted of 110 personnel, of which 60 were Coast Guard. The oil and hazardous substance Unified Command facilitated the collection of more than 4,500 barrels of oily water and 1,200 hazardous material containers. Coast Guard personnel applied $9.5 million to the emergency response efforts, while coordinating with multiple local, State, Federal, and contracting agencies. Response forces executed three federally funded projects, including plugging an actively leaking orphan well to prevent a potential significant discharge.

Adopting Standard Practices:

At the time of Isaac's arrival, pollution response personnel had not yet established a formal and exercised system to address multiple, often over a thousand, pollution targets over a large geographic area caused by a natural disaster. To address this challenge, USCG drew from its experience in addressing single-source pollution incidents. The Coast Guard quickly created a Data Unit to receive reports from the National Response Center (NRC) and field personnel, conduct phone investigations, record findings in the USCG's internal MISLE (Marine Information for Safety and Law Enforcement) database for managing case information, and pass pertinent information up the chain of command. The Data Unit developed a custom spreadsheet "on the fly" to track the status of pollution targets and pass this needed information up the response management chain.

As the scale and scope of the response expanded, it became clear that the Data Unit would need a more sophisticated solution to manage the response data. In response to this need, on September 1, the FOSC designated EPA's Response Manager database as the data repository for pollution target data, and determined that NOAA's Environmental Response Management Application (ERMA) would serve as the Common Operational Picture (COP). These two systems were able to serve different, but complementary functions: Response Manager managed information coming in from the field, while ERMA served as a display tool for the information in Response Manager as well as other response-related data.

On Day 2 of the response, the FOSC signed a high-level data management plan to establish the roles and responsibilities of both NOAA and EPA through the duration of the response. In essence, Response Manager would receive field data and push it to ERMA, where it would be displayed graphically.

Response Manager:

Response Manager is a database application developed to support the Natural Disaster Operational Workgroup (NDOW). NDOW was created after the 2008 Hurricane Ike response in Texas as a means to improve coordination between State and Federal Agencies operating under Emergency Support Functions (ESF) 3 and 10. NDOW established standard operational procedures, standardized data quality objectives, developed a consensus-built database system, and created training and exercises for effectively coordinating multi-agency response to man-made and natural disasters. NDOW is a concept of operations, and is not intended to impose new, additional, or unfunded net resource requirements on State or Federal agencies.

Response Manager is a server-side database application that tracks orphan containers and facility/vessel discharges and releases. Users can add data and information to Response Manager via a web browser or desktop application that synchronizes with a single server. ICP and field personnel use a standard form, the Hazard Evaluation Field Data Sheet ESF-10 NDOW Form, to capture data on hazardous substance releases and oil discharges. Use of both Response Manager and NDOW has expanded since 2008, and both play an active role in the Texas response community.

However, use of Response Manager during the Hurricane Isaac response was handicapped from the beginning in part by responders' lack of familiarity with it. Because Louisiana's response community had not previously engaged with NDOW or Response Manager at the time of Hurricane Isaac's arrival, very few Hurricane Isaac responders were familiar with the associated data entry forms, or how to process the incoming data. This lack of familiarity impeded incorporation of the needs of Louisiana's stakeholders into the Hurricane Isaac response process as a whole and, more specifically, into Response Manager data fields.

Use of Response Manager during the Hurricane Isaac response also was impeded by small staff size and by technical and training challenges. The Response Manager support staff initially consisted of just two individuals. They were faced with the following key challenges:

- The web browser version of the software was not available because it had been recently upgraded and was undergoing beta testing.
- IT policy restrictions prevented the desktop version from being installed on USCG standard workstation computers, Response Manager was installed on stand-alone laptops. That installation generally required two days of work because of complications related to Internet connectivity.
- Almost all responders needed training on all aspects of Response Manager and data processing.

As the number of pollution targets increased, more staff was added to process reports from field personnel, input information into Response Manager, and control data quality. The frustrations with data management and suspicions of the data's quality came to a head, requiring a "hard reset." All non-emergency operations were suspended for two days to address the challenges of establishing a “new” data process, while simultaneously gathering data and addressing the needs of data customers. During these two days, all field personnel were trained on the standard data entry form, the database was scrubbed of inaccuracies, and new work assignments were created to validate the scrubbed data. Only after this “hard reset”, did the data begin to represent an accurate picture of the situation in the field so that the response could confidently mitigate pollution threats.

Environmental Response Management Application (ERMA):

NOAA’s Environmental Response Management Application, or ERMA, is a web-based Geographic Information System (GIS) application that displays spatial data. It contains a standard library of thousands of static data layers and dozens of live data feeds. Responders can use ERMA to determine resources at risk, jurisdictional boundaries, infrastructure, response plans, and other information. ERMA can be used during an incident to map spatial data, which could include field team locations, operational grids covering the geographic area of the response, field asset GPS waypoints and track lines, geo-referenced photography, and pollution target locations.

NOAA’s tasking under a Pollution Removal Funding Authorization for the Hurricane Isaac response included providing ERMA, along with two Scientific Support Coordinators and two Information Managers on scene, as well as additional remote scientific support. The remote staff quickly populated ERMA with pollution targets. They used a variety of source data, including the Data Unit’s pollution target spreadsheet (the initial response data management solution), post-storm aerial imagery from NOAA’s National Geodetic Survey, operational grids, geo-referenced photographs, and field personnel track lines. (NOAA, 2014)

Funding Challenges:

Funding challenges slowed down and impeded data collection and management during the Hurricane Isaac response. When a hurricane or other major natural disaster overwhelms a State government’s resources, that State may request Federal response assistance to supplement ongoing disaster relief activities. Reimbursement of funds expended by Federal agencies in support of Federal Emergency Management Agency (FEMA) disaster relief efforts is permitted when that support is provided under a Stafford Act declaration.

A Stafford Act declaration is made by the President and individual Mission Assignments (MA) are issued by FEMA. MAs are typically assigned by FEMA to address actions required under one of the 15 different Emergency Support Functions (ESFs) described in the National Response Framework (NRF). Examples include ESF 1 – Transportation, ESF 9 – Search and Rescue, and ESF 10 – Oil and Hazardous Materials. Orphaned containers containing hazardous material or oil as well as oil and hazardous chemical spill cleanup are generally included in ESF-10 mission assignments. (U.S. Dept. Homeland Security, 2008)

A few weeks after Hurricane Isaac response operations had been initiated, the Governor of Louisiana submitted a request for Federal support in the form of ESF-10 to the President. During the weeks before the Governor’s request was submitted, the response had operated with funding provided under the Oil Spill Liability Trust Fund (OSLTF) and limited Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) funds. These funding sources have entirely different sets of criteria for response actions and management making coordination within the Operations Section difficult during the hurricane Isaac response.

Within 15 days of the start of the response, the CERCLA fund had been drained completely, halting hazardous materials (HAZMAT) mitigation operations and negatively impacting funding for EPA and its START contractors to support the NDOW process and Response Manager. As a result, response operations continued for several weeks without the support of EPA and Response Manager impeding data synthesis for response planning and operations.

Phase 2: Stafford Act Response:

Once the President declared a Stafford Act disaster, FEMA issued a Mission Assignment to USCG and EPA to finish mitigating the orphan containers remaining in southeast Louisiana. Because the funding supplied by FEMA was not sufficient to cover Response Manager or ERMA operations, a low-cost alternative was needed. The Unified Command and General Staff met on Day 1 of the Stafford Act response to determine how an effective data management system could be quickly and affordably implemented.

By the end of Day 1, the data team developed standard operating procedures, built a standard field data collection form in Microsoft Excel, and developed a simple relational database in Microsoft Access. These developments were intended to address and resolve the difficulties experienced during the first phase of the Isaac response. The Louisiana Department of Environmental Quality (LDEQ) dedicated a laptop to keep the response database, supplied data entry and quality assurance personnel, and ensured that daily copies of the database were archived. LDEQ also provided personnel to the GIS Unit to generate Google Earth KML files from the Access Database for use by the response. The Common Operational Picture was a compilation of Google Earth KML files, which were kept on a dedicated laptop.

The data management process was designed to track the life of an orphan container from the field, to the Hazardous Waste Storage Area (HWSA), and through disposal, so that every orphan container was tracked from “cradle to grave.” Once minor issues were resolved during the first week, the response team successfully managed all response data very well from these simple and affordable solutions.

Lessons Learned:

Among the data management lessons learned during both phases of the response to Hurricane Isaac were the following:

- To the degree possible, response data requirements should be specified prior to the response. The response community must work together to ensure that all reporting needs are identified and addressed in a unified plan prior to an incident.
- Technology solutions must be flexible, so that they can be readily adapted to meet the specific needs of each response.

- Technology solutions must be appropriately sophisticated for the type of response.
- All personnel associated with data management (field personnel, data managers, technicians, and consumers) must understand their roles in the data management process and the importance of their contributions.
- Any data management system intended for response use needs to be understood and trained on prior to an actual response.

CREATION OF THE NDRP:

Since Hurricane Isaac, the Louisiana response community has begun to prepare for the next natural disaster. To achieve this goal, the Natural Disaster Subcommittee, a joint subcommittee of Federal, State, and local members under the auspices of the New Orleans and Morgan City Area Committees, has drafted a Natural Disaster Response Plan (NDRP). The NDRP outlines the process for collecting, managing, and disseminating field data based on the lessons learned during the Hurricane Isaac response. (New Orleans Area Committee, 2013) Some of the important elements in the NDRP:

- Data Management Plan
- Hazard Evaluation Form for aerial and surface assets
- Operational Guidance for orphan containers and free product (oil)
- Operational Best Management Practices to mitigate response impact to the environment
- Cleanup Endpoints template
- Pollution target closure procedures

The NDRP also provides a template ISC organization chart that includes a variety of Groups with data collection and management responsibilities, under the direction of the Operations and Planning Section Chiefs. To address differences in potential funding streams, data management lessons learned, and the nuances of hurricane pollution response, unique structures for natural disaster response were developed in the Operations and Planning Sections of the NDRP.

Operations Section:

To address funding challenges such as those experienced during Hurricane Isaac, and to ensure continuity of data management across the whole response, the Operations section is organized differently than in a typical National Incident Management System (NIMS) response. In the NDRP, four groups in the Operations section are under the direction of the Operations Section Chief, as shown in the diagram below.

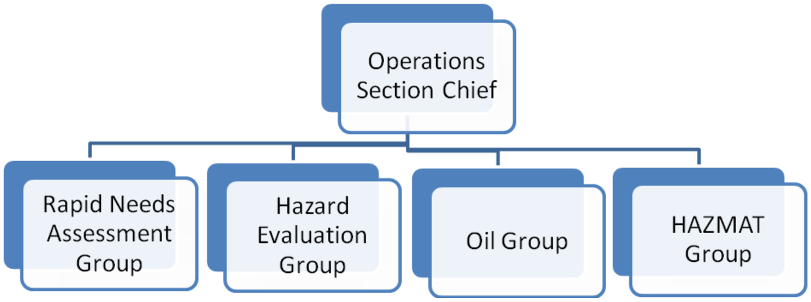

Figure 1: NDRP Suggested ICS Organization Chart - Operations Section

Each of these four groups falls in one of two functional categories: 1) pollution assessment, or 2) pollution mitigation and recovery. Pollution assessment is addressed by the Rapid Needs Assessment (RNA) Group and the Hazard Evaluation Group (HEG). The RNA completes an initial assessment in order to identify major problems to critical infrastructure and public health, and assess the scope and geographical area of the damage. The HEG takes a more focused and granular approach to assessment, and identifies all potential pollution targets. The HEG's job is to identify the potential level of effort and equipment needed to mitigate the pollution sources.

Based on the HEG's assessment, pollution targets are assigned to either the Oil or HAZMAT Groups. These two groups address the second functional category: pollution mitigation and recovery. The Oil Group addresses active or potential releases of petroleum products. The HAZMAT Group deals with hazardous materials, orphaned containers, and other hurricane-related industrial debris.

Potential differences in funding sources are the reason, under the NDRP, petroleum products and hazardous materials are addressed by different groups within Operations. For non-Stafford Act hurricane responses, the U. S. Coast Guard is funded to assess and recover pollution sources through the Oil Spill Liability Trust Fund (OSLTF) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). There are different criteria for using either OSLTF or CERCLA funding depending on whether the pollution is oil or hazardous material respectively. Because of this difference, response action on oil and hazardous materials are conducted based on the funding source. This simplifies management and financial tracking during a non-Stafford Act natural disaster.

Within the NDRP's Operations section, data management is ensured through simple, quick methods that are agreed upon in advance. After Hurricane Isaac, the Operations section, identified the need for concise and simple standards for data collection. The forms and data outlined in the NDRP are the life blood of the response and are designed to ensure effective data management. Data and information standards, such as date/time format, codes for pollution, and information pathways in the response, are outlined in the NDRP so that when a natural disaster occurs these guidelines are already in place. The need to develop such standards prior to an incident was a significant lesson learned from Hurricane Isaac.

Planning Section:

The Hurricane Isaac response highlighted the need for comprehensive, unified data management. Lessons learned from Isaac heavily influenced how all sections are set up in the NDRP, especially the Planning Section. In the NDRP, the backbone of the Planning Section is data management. As with the Operations section, the NDRP prescribes Planning Section units that have been delineated based on experiences from Isaac. In the NDRP, these Planning Section units fall into three functional categories: 1) data input and initial quality control, 2) data translation and deconfliction, and 3) product development and dissemination.

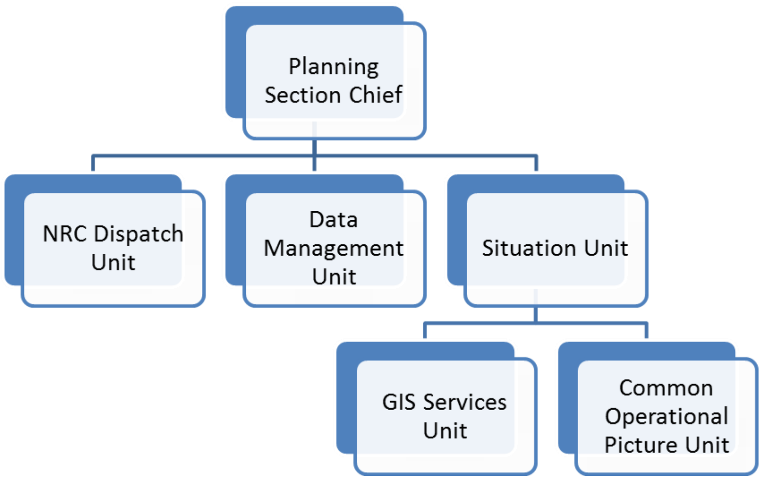

Figure 2: NDRP Suggested ICS Organization Chart - Planning Section

The first functional category, data input and initial quality control, is addressed by the National Response Center (NRC) Dispatch Unit and elements within the Operations Section. The NRC Dispatch Unit's primary role is to monitor the NRC inbox and conduct initial investigations on all reported discharges/releases reported via the NRC. After a natural disaster such as a hurricane, discharges/releases reported by industry or the public often form the initial assessment list for the Operations HEG. After the first few days of the Hurricane Isaac response, the NRC inbox was not closely monitored or deconflicted with the pollution targets found by the response, creating potential duplication of effort. The new NDRP is designed to prevent this potential problem.

Under the NDRP, data can be entered into the response database through the NRC Dispatch Unit and the Groups within the Operations Section. The process for entering data is the first line of initial quality control. Field personnel are the most appropriate to enter initial data into the database, based on the fact that they understand best what was observed. Due to this, the Operations Section may need to include data entry and management staff on personnel requests. Generally, the NDRP recommends that data input and initial quality control occur in the NRC Dispatch Unit and Operations section.

Under the NDRP, the second functional category of data translation and deconfliction is addressed by the Data Management Unit (DMU). The DMU is responsible for compiling data entered by field teams, managing the information pathways among the sections, and overall management of the response database. A week into the Hurricane Isaac response, it became clear that there was little management or consistency of information between the Operations and Planning Sections. A unit was needed to track and ensure quality of information across all sections so the response could plan accurately. Based on this Isaac experience, the NDRP reccommends that this unit (the DMU) be located in the Planning section.

The DMU comprises the secondary level of quality control, and assists with the deconfliction between NRC data and assessments made in the field by Operations personnel. DMU personnel work closely or may be embedded in the Operations Section. The DMU also manages and maintains the response database. This unit acts as the node for information that moves from Operations to the Planning Section and is eventually disseminated as situation reports and mapping products. While the DMU does not necessarily create end-user products, it may assist the Situation Unit to compile real-time response statistics and fix errors in the database.

The third functional category within the Planning Section, product development and dissemination, is addressed by the Situation, GIS Services, and Common Operational Picture (COP) Units. Consistent with NIMS, the processing of information that is collected into products for the Unified Command and Section Chiefs is primarily done within the Situation Unit. Such products can include response statistics, documentation of response efforts, Situation Reports (SitReps), maps, common operational picture information, and other materials. During the Hurricane Isaac response as well as other incidents and drills, it has been determined that two units within the Situation Unit are needed to translate field information into GIS formats and to display that information within a COP. Thus, under the NDRP, the GIS Services Unit is responsible for creating mapping information and developing paper maps for the Operations Section. The COP Unit is responsible for (a) entering and organizing GIS information related to the COP, and (b) displaying the COP at various locations within the command post and during meetings, as needed.

CONCLUSION:

The hurricane Isaac response presented a number of data management difficulties to those responding. The lessons learned have been crucial in developing the NDRP, especially those elements unique to natural disaster response. This is especially true with data management, but extends into funding of response operations and unit structure. A response without strong data and information management will struggle to be effective and justify its actions to stakeholders and the public. As the Hurricane Isaac response made clear, these small details can become bigger problems if not addressed by response planners before future natural disasters. Although on first inspection, data management may appear to be a minor aspect of a large response operation, it rivals in importance other factors such as adequate response personnel, effective communications, and sufficient equipment.

REFERENCES:

National Oceanic and Atmospheric Administration (NOAA) (2014). Environmental Response Management Application (ERMA). Web application. Gulf of Mexico. 02 Apr. 2014. http://response.restoration.noaa.gov/erma/

Natural Disaster Operational Workgroup (NDOW) (2009). Reference Website. Accessed from http://www.ndow.net/.

New Orleans Area Committee (2013). New Orleans Natural Disaster Response Plan (NDRP). Natural Disaster Workgroup. New Orleans, LA.

U.S. Coast Guard (2013). Sector New Orleans Area Contingency Plan. New Orleans, LA. Accessed from https://homeport.uscg.mil/.

U.S. Department of Homeland Security (2008). National Incident Management System. Washington, DC. Retrieved from www.fema.gov.

U.S. Department of Homeland Security (2008). National Response Framework. Washington, DC. Retrieved from www.fema.gov.

U.S. Environmental Protection Agency (2010). National Oil and Hazardous Substances Pollution Contingency Plan 40 CFR 300, Subpart J. U.S. Government Printing Office, Washington, DC.