REAL-TIME AND NEAR REAL-TIME INTERNET MONITORING OF DREDGING OPERATIONS AND PRODUCTION

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ABSTRACT

Developed in 1997, SAIC's Automated Disposal Surveillance System (ADISS) has successfully monitored and logged over 26,500 offshore scow and hopper disposal events throughout 170 dredging projects and has been utilized nationally within 14 USACE districts and 5 EPA regions. SAIC has worked closely with Corps districts (the New York District in particular) and dredging contractors to develop real-time and near real-time online tools for managing offshore placement activities. ADISS has been used to monitor offshore placement operations for capping and beneficial uses projects and upland projects. In addition to monitoring disposals, the 24 hour data collected from the scows has been used to document dredging productivity. Online data products display the loading, transit, placement, and standby times for each load.

In conjunction with the dredge production information determined from barge loading and transit activities, SAIC has developed an online display of individual bucket position and depth information. With this online tool, the progress of a project can be tracked on a daily basis by simply monitoring the advancements of each bite of the bucket taken over the specified dredge areas. The tool is equipped with a query that allows users to retrieve the bucket depth and positional data. The tool's interface can be modified to filter and color-code the large data set(s) by date or depth. Bucket depth and positional information are available for each bucket load taken throughout the active dredging project. With filters in place, concerned parties can easily monitor potential over-dredging situations and address any concerns in a timely fashion.

These tools along with others such as live real-time internet dredge cameras and near-real time barge, dredge and tug positions allow for simple concise monitoring of dredging operations and production.

Keywords: Internet Cameras, Tracking, GPS, Bucket Positioning, Real-Time Barge Positioning

INTRODUCTION

Since it's inception in 1997, the Automated Disposal Surveillance System known as ADISS has been successfully monitoring offshore and upland disposal activities. Originally designed to monitor the final placement of dredged material at the New York Mud Dump Site, ADISS was composed of a Differential Global Positioning System, draft pressure sensor and an automated, low power logger equipped with an Argos satellite transmitter that sent split-hull scow position and draft data during the Last Call project (Pace et al 1998). The ADISSPlay system of towboat guidance was created soon after the initial project, and included a reporting capability for dredge inspectors (SAIC 1999). The ADISS system was utilized along with bathymetric and side-scan data to monitor placement operations at the Historic Area Remediation Site and at an artificial reef site constructed of material dredged from the Kill Van Kull waterway in New York (Pace et al 2000). Online dissemination of the monitoring data was initiated over the Internet, and automated alarms for changes in draft during transit facilitated the rapid detection of leaking scows and short-dumps. Since then, other sensors have been added to measure the level of material present in the hopper bin and the tilt of scows, allowing the calculation of maintenance material removed from the dredge site (SAIC 2005).

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To date, ADISS has recorded and guided over 26,500 disposal events on dredging projects throughout the nation. Over time, ADISS has developed into an enhanced monitoring system that incorporates scow position, scow draft, scow bin levels, automated leak and short-dump alarms, tug fathometer data, dredge production, dredge bucket x,y,z data, live internet dredge cameras and real-time vessel positioning reports.

In May 2004, the ADISS system was tailored to collect data on a 24 hour basis to meet a variety of USACE contract specifications. This simple modification allowed for more detailed analysis and interpretation of the data. In addition to scow/barge monitoring data, the ADISS system is used to import and display near real-time dredge bucket position and depth data from positioning software packages such as the Cable Arm, Inc. ClamVision^{TM}. Online dredge internet cameras are also be integrated into the ADISS system for contractors and USACE users to monitor active dredging operations.

With these and other newly developed online tools, program managers and regulatory agencies have the capability to view daily production logs, dredging activity, vessel positions, and bucket position and depth. This suite of online tools has streamlined the monitoring of dredging operations and production via the Internet.

DREDGE PRODUCTION TOOLS ONLINE

With the cost of dredging rising every year, dredging production remains a critical key in determining the success of a project. Production analysis allows contractors and regulatory agencies a means to monitor progress and determine if possible setbacks are likely. Collecting and displaying data such as loading positions, production logs and near real-time vessel positions provide a snapshot for determining possible production delays.

Using the existing scow monitoring system, data are "phased" into categories such as loading, idle, dewater, offsite, transit, disposal, unloading and return transit. When the phasing is complete, the categories are automatically assigned durations for each loading and disposal cycle. The time table provides the contractor and regulatory agencies a snapshot of loading times, offshore round-trip times and idle periods due to maintenance or downtime (Figure 1).

Volume and Time Data

Trips	Date	Scow	Calculated Volume (cu yd)	Load (min)	De-Water (min)	Transit (min)	Disposal (min)	Return (min)	Idle (min)	Offsite (min)
Totals										
448	-	-	1,518,861	91519	0	124883	26649	109908	113252	34304
Averages										
-	-	-	3,582	205	0	279	60	246	253	277
1	2/16/2006	GL231	2,302	325	N/A	230	80	205	435	1670
2	2/16/2006	GL230	1,760	195	N/A	235	112	430	1278	510
3	2/16/2006	W257	2,472	530	N/A	205	78	327	965	85
4	2/17/2006	GL231	2,960	215	N/A	210	103	170	95	N/A
5	2/18/2006	GL230	2,302	185	N/A	260	52	220	120	N/A
6	2/18/2006	W264	3,578	405	N/A	249	65	255	370	740
7	2/18/2006	W257	3,753	245	N/A	210	75	226	97	819
8	2/18/2006	GL231	3,792	250	N/A	235	99	210	853	N/A
9	2/18/2006	GL232	1,307	200	N/A	245	59	177	710	127
10	2/18/2006	GL230	2,683	260	N/A	415	151	195	1063	85
11	2/19/2006	W264	4,734	330	N/A	329	162	210	312	269
12	2/19/2006	W257	4,161	230	N/A	629	87	180	492	N/A
13	2/19/2006	GL231	3,378	260	N/A	269	107	180	742	N/A
14	2/19/2006	GL232	370	215	N/A	285	63	295	655	N/A
15	2/20/2006	GL230	4,100	159	N/A	250	120	175	436	N/A
16	2/20/2006	W264	3,258	205	N/A	297	87	200	330	N/A
17	2/20/2006	W257	4,373	280	N/A	295	110	212	43	N/A
18	2/20/2006	GL231	2,313	215	N/A	284	73	282	155	N/A
19	2/20/2006	GL232	1,327	210	N/A	270	57	225	205	110
20	2/21/2006	GL230	3,883	205	N/A	288	61	205	190	N/A
21	2/21/2006	W264	3,578	255	N/A	230	80	265	90	N/A
22	2/21/2006	W257	4,073	210	N/A	334	85	205	51	N/A

Figure 1. Online event time table that illustrates the durations of various phases during each cycle. A cycle is considered from the beginning of loading through to the next beginning of loading. Total and average phase times are arranged at the top of the table for quick inspection.

For example, using the online table in Figure 1, users can quickly determine the average round-trip offshore. Adding the average transit (279 min.), disposal (60 min.) and return transit (246 min.) durations illustrate that an offshore round trip generally took and average of 585 minutes or 9.75 hours.

Loading data are further analyzed to determine progress over a particular dredge area. Representative loading points are selected for each load and displayed over a dredge boundary layout to signify locations of dredging. Currently, the Baltimore Harbor and Channels Maintenance project and the S-Kill Van Kull II project make use of the loading locations data (Figure 2 and Figure 3). In addition to loading positions, each load has a designated volume assigned to it and displayed in tabular form for simple analysis of total volume dredged.

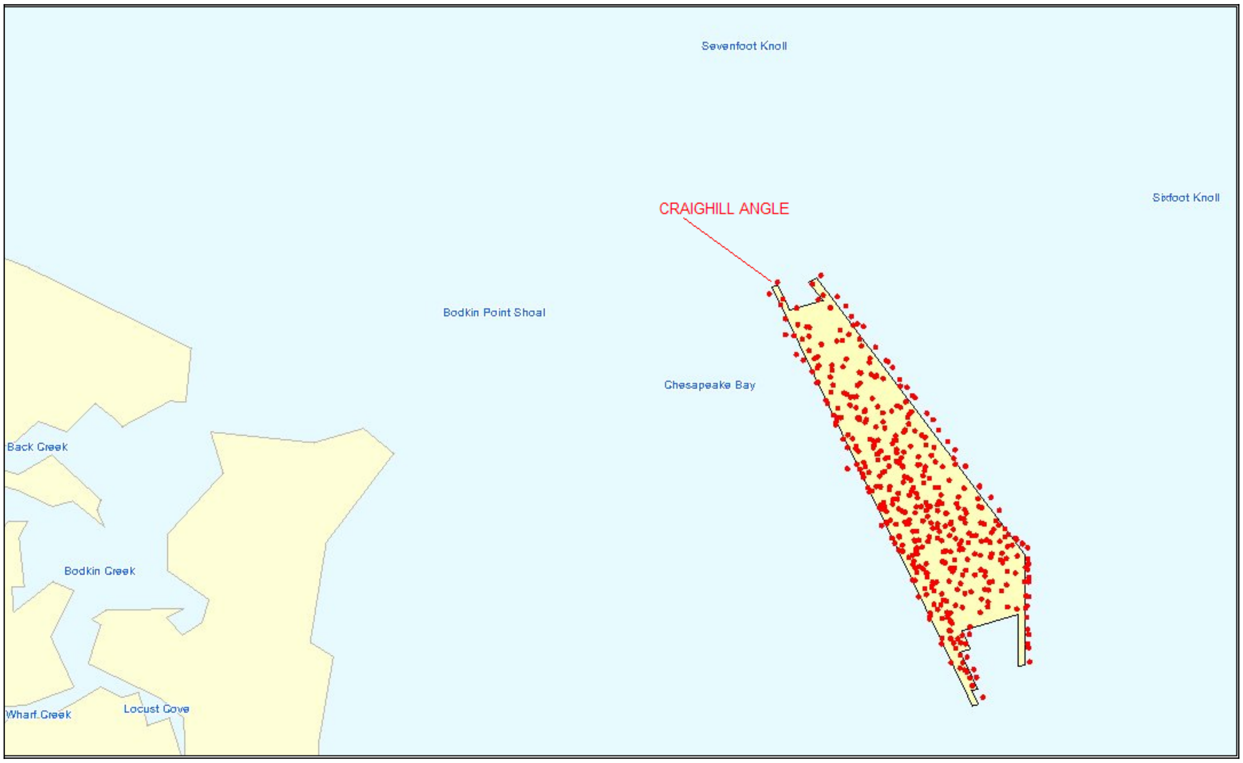


Figure 2. Online view of loading points illustrating scow positions during loading phases. The cumulative plot demonstrates coverage of dredging and exhibits progress over the Craighill Angle dredging area in Maryland.

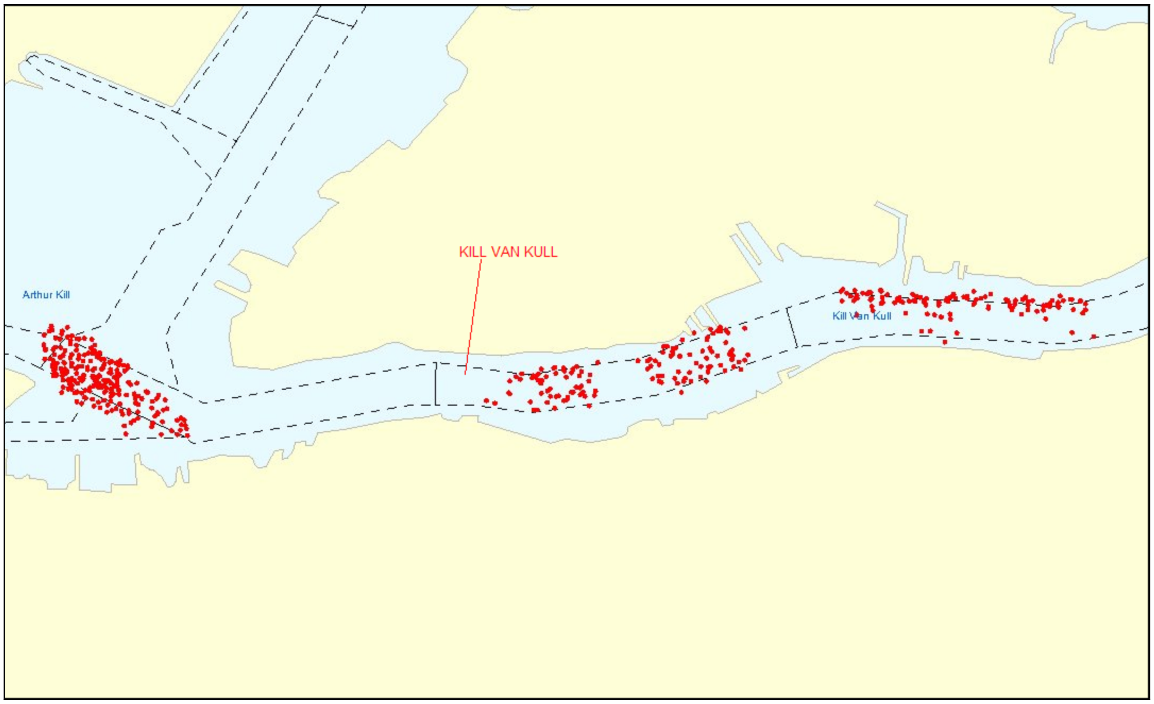


Figure 3. Online view of loading points illustrating scow positions during loading phases. The cumulative plot demonstrates coverage of dredging and exhibits progress over the Kill Van Kull waterway dredging area in New York.

With the use of daily dredge production logs, the ADISS web site was used to present the detailed production information throughout Phase 1 of the 2005 Baltimore Harbor and Channels Maintenance Dredging project (Figure 4 and Figure 5). Daily dredge production logs were recorded to keep track of some of the major dredge cost components (Randall, 2000) as well as minor cost components. Items such as routine maintenance and repairs, major repairs and overhauls, vessel traffic, weather delays, and routine vessel movements were documented on the daily logs.

The online production logs provided a graphical representation of the data in addition to the written hard copies. Review of the logs during Phase I indicated that active dredging occurred 67.5% during the 61 days on location with an average of 5.9 scow loads per day. Figure 4 clearly shows an increase in production between 12/27/05 and 1/27/06 when a second dredge was introduced onto the project.

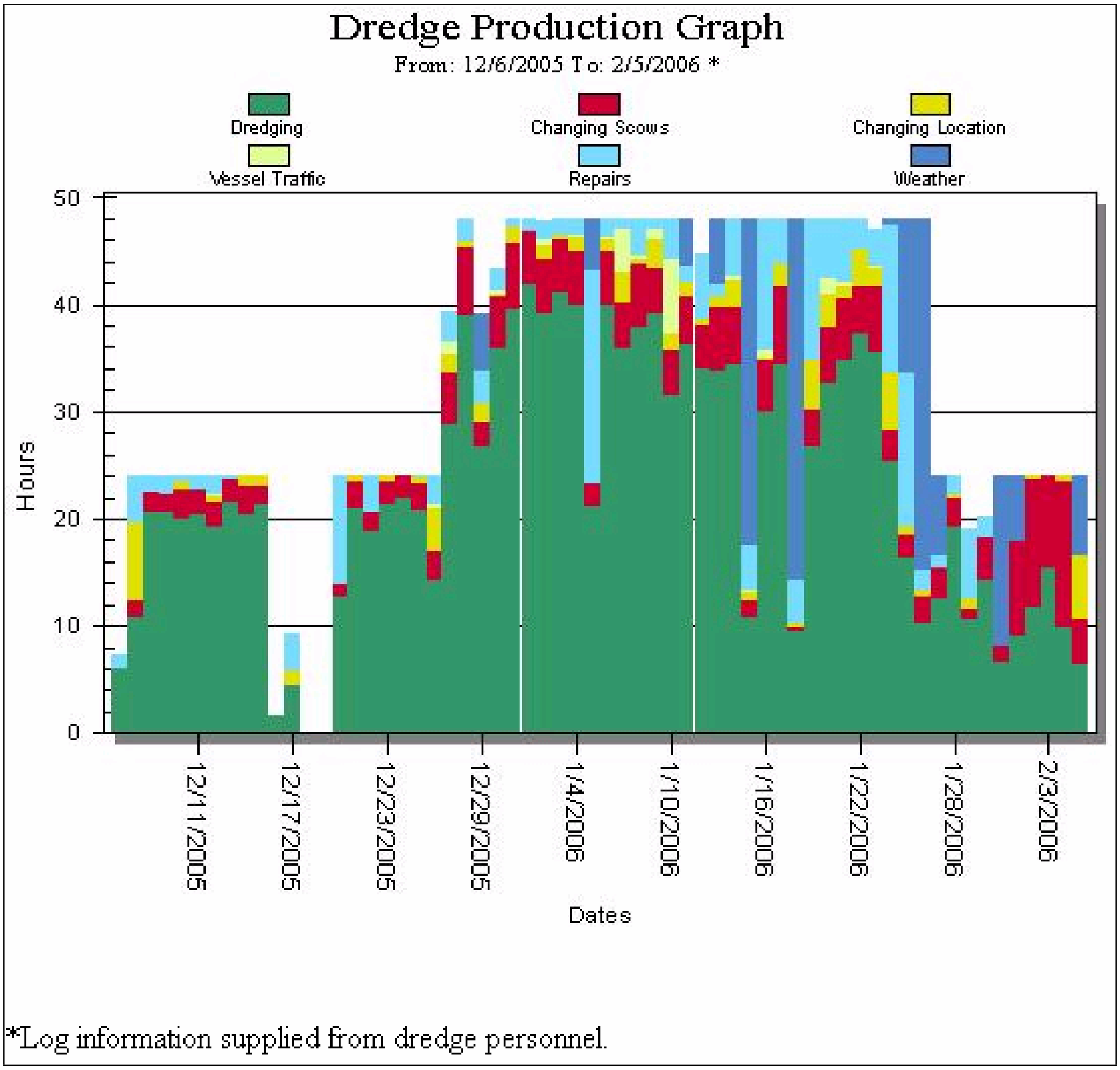
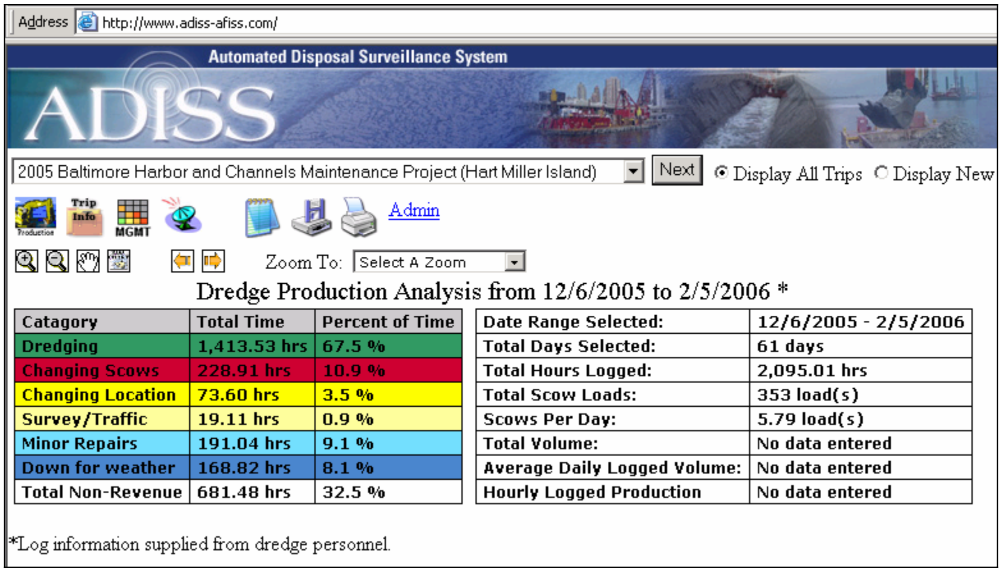


Figure 4. Online dredge production log data presented graphically for the dates 12/6/05 – 2/5/06 for one to two active dredges (24hr/days vs. 48hr/days).



Catagory	Total Time	Percent of Time
Dredging	1,413.53 hrs	67.5 %
Changing Scows	228.91 hrs	10.9 %
Changing Location	73.60 hrs	3.5 %
Survey/Traffic	19.11 hrs	0.9 %
Minor Repairs	191.04 hrs	9.1 %
Down for weather	168.82 hrs	8.1 %
Total Non-Revenue	681.48 hrs	32.5 %

Date Range Selected:	12/6/2005 - 2/5/2006
Total Days Selected:	61 days
Total Hours Logged:	2,095.01 hrs
Total Scow Loads:	353 load(s)
Scows Per Day:	5.79 load(s)
Total Volume:	No data entered
Average Daily Logged Volume:	No data entered
Hourly Logged Production	No data entered

*Log information supplied from dredge personnel.

Figure 5. Online dredge production log data presented in tabular form for the dates 12/6/05 – 2/5/06.

The table displayed in Figure 5 summarizes the production log data over the 61 day period of operations. Additional categories can be added to the system to increase the detail of the analysis.

In addition to production logs, the ADISS website collects and displays near real-time bucket depth and position data. Currently this feature is used to monitor digging operations during the Sand Key Beach Florida Re-nourishment project. Daily dredge position logs, like those created from software packages such as the Cable Arm, Inc. ClamVision™, are imported into the ADISSWeb database for monitoring.

Throughout dredging operations, the contractor and USACE, Jacksonville District have been able to monitor progress and depth restrictions via the online tools that provide a view summary of bucket grabs as well as detailed information for each individual grab (Figure 6).

In addition to summary data, this online tool features the ability to analyze individual dredges and query bucket grabs based on depth. As part of the specifications for this beach re-nourishment project, the Jacksonville District has placed depth restrictions on the dredging that occurs in certain zones within the Egmont Borrow Area outside of Tampa Bay. Color coding the bucket grabs based on depth, provides a simple and intuitive interface that allow the USACE and contractors to monitor the restrictions. With this feature in place, the contractor and USACE have been able to easily monitor the depth requirements in near real-time. With over-dredging concerns rising, the use of online bucket grab monitoring gives interested parties an interface to quickly determine if and where over-dredging may be occurring. With the use of the existing automated alarm technology for detection of short dumps and leaking barges, emails are similarly transmitted automatically upon detection of depth breaches.

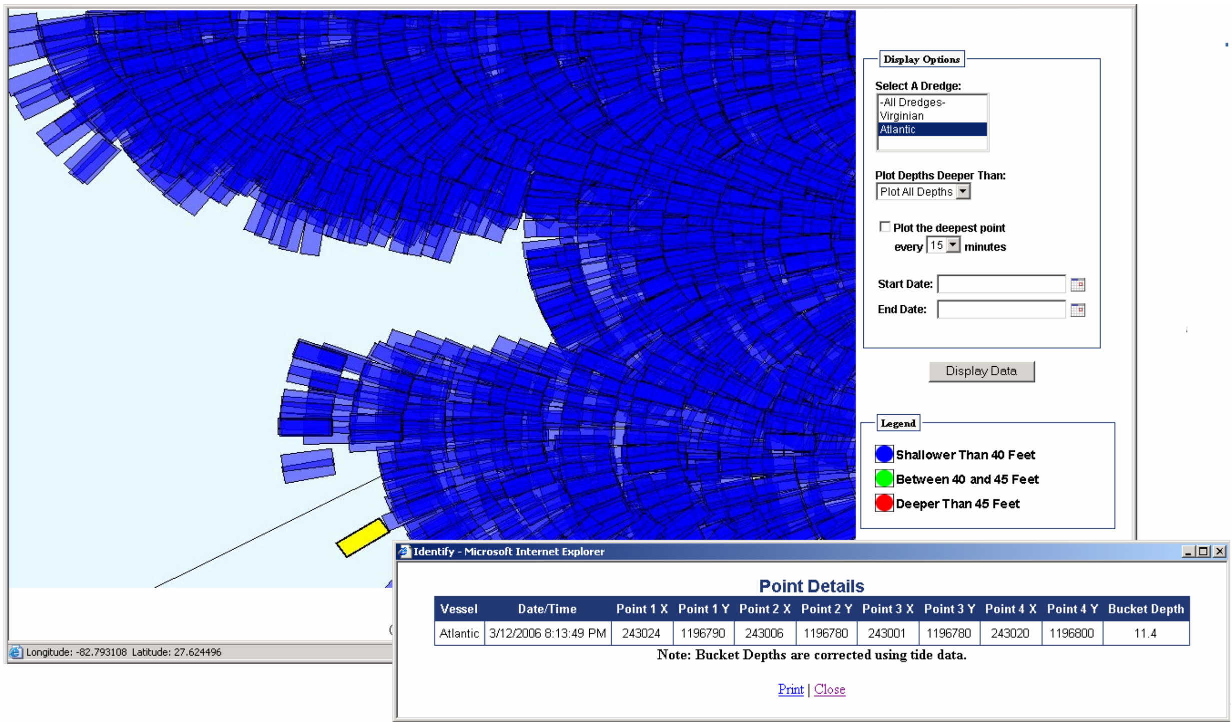


Figure 6. Online view of imported ClamVision™ log data illustrating bucket coverage. Point details are associated with the highlighted bucket sample.

NEAR REAL-TIME VESSEL POSITIONS

Near real-time vessel positions can be used for a more immediate production analysis. The Baltimore district of the USACE is currently making use of near real-time vessel positions during operations on the 2005 Baltimore Harbor and Channels Maintenance project in Maryland. The near real-time vessel position tool has allowed Weeks Marine Inc. and the Baltimore USACE district the ability to monitor the positions of dredges and scows through-out the project (Figure 7).

For simplicity, individual vessels are color coded and identified with initials. A link that provides more detailed information such as position, speed, heading, draft, status and voltage is available for each vessel (Figure 8). With these tools, the contractor can quickly determine if a scow is being loaded, ready for transit, in transit or offsite waiting to be loaded. All incoming data has been archived and can be queried by date and vessel to display a history of vessel positions.

Near-real time vessel positions can be monitored to ensure all designated vessels are on-site and working.

Example 1: If a scow was taken offline for repairs and the contractor is expecting the scow to come back online in one week, the regulatory agencies and contractor home offices can log on and determine the status of the scow in question and conclude if any delays are to be expected.

Example 2: If a scow was involved in an at sea accident, the archived near-real-time data can be queried to determine the scows course, position, speed and heading of the vessel involved at the time of the accident.

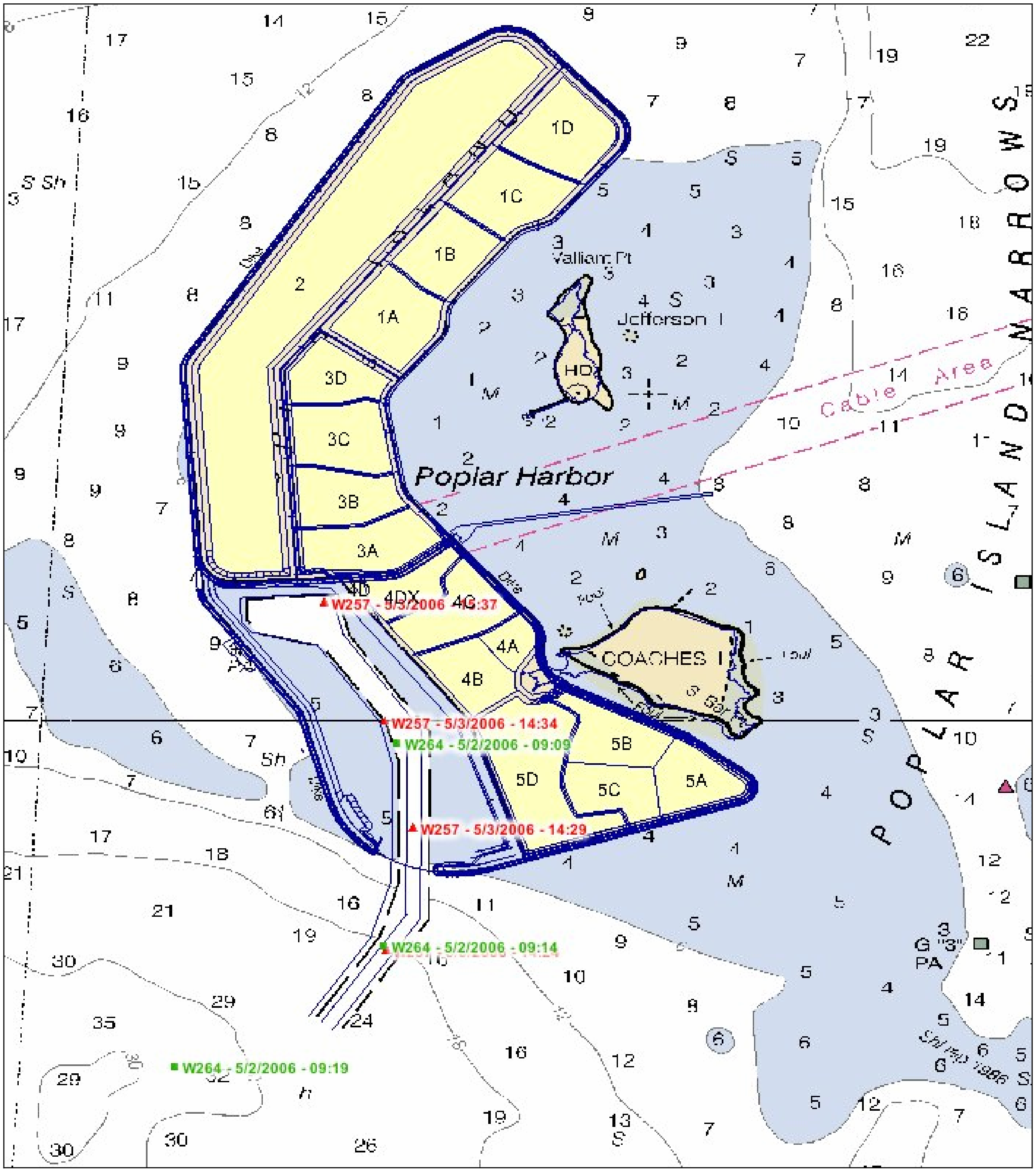


Figure 7. Online view of near real-time vessel positions for the 2005 Baltimore Harbor and Channels Maintenance Dredging illustrating the scows W257 entering the Poplar Island unloading facility and W264 departing.

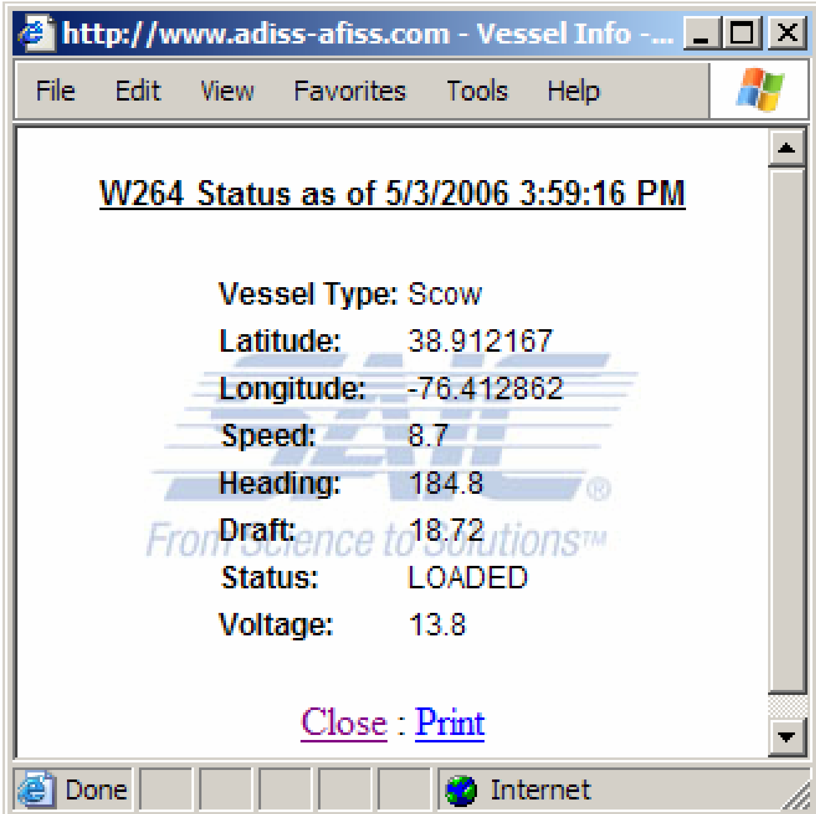


Figure 8. 2005 Baltimore Harbor and Channels Maintenance Dredging near real-time vessel positions details for scow W264 on 5/3/06.

REAL-TIME DREDGE INTERNET CAMERAS

The most real-time online monitoring tool available is the internet ready surveillance camera. The use of internet cameras on the Bean Stuyvesant LLC S-Kill Van Kull Phase II project provide a live feed for the operations of the dredges on location. The web interface gives users the ability to maneuver the camera in all directions to monitor any activity on the dredge. Other controls such as camera speed, focus, iris, zooms and wipers give the user even more precise control. A number of presets have been set for the various dredges that provide quick re-positioning of the cameras. If any users see something of interest on the live feed, than can easily save the image and/or email the image of interest to another party directly from the web interface (Figure 9).

Figure 9. Online live real-time dredge internet camera located on drill barge in New York.

In addition to the live feed that the internet cameras provide, Bean Stuyvesant LLC has requested that images be archived every ten minutes to provide a history. In this case, the cameras are programmed to move to their designated "home" position every ten minutes and take a snapshot. This snapshot is then transmitted to a SAIC server where the web interface can display the images.

With the use of a calendar control, the archive tool allows the user to select a days worth of images (about 144) and caches them into the display window (Figure 10). The VCR controls located below the image allows the user to play, pause, fast forward and rewind images as needed. The speed of the viewer can be adjusted as well. Similar to that of the live feed, any image of interest can be saved and/or emailed to another party directly from the web interface.

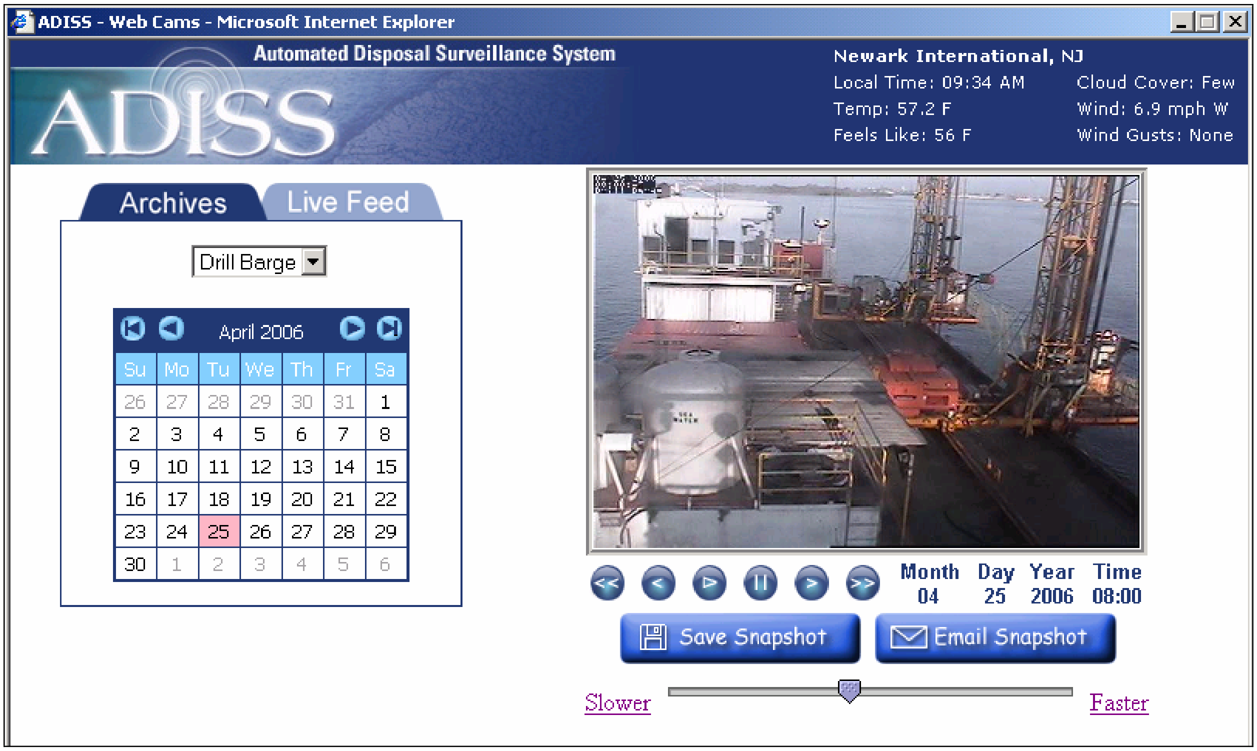


Figure 10. Online view of archived real-time dredge internet camera images from drill barge in New York.

CONCLUSIONS

While dredging costs continue to rise in the industry, there is an ever growing emphasis on increasing production. Real-time online analysis tools offer contractors and regulatory agencies a means to monitor progress and other important issues such as over-dredging. The use of simple online tools as discussed herein has given the contractors as well as regulatory agencies the ability to keep track of project progress from anywhere internet access is available. With the data available online, project management personnel can easily monitor the progress and compliance of their projects while offsite. In addition, the historical archived data may be of use when analyzed to help estimate bids for future maintenance projects that have already been conducted in previous years.

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