APPROVED

Enbridge Line 6B MP 608
Marshall, Michigan Pipeline Release

Supplement to the
Response Plan for Downstream Impacted Areas
and the
Source Area Response Plan

Commonly Referred to as the
"Aerial Imagery Work Plan"

Enbridge Energy, Limited Partnership
Line 6B Incident, Marshall, Michigan

March 14, 2011
Revised: March 28, 2011
Revised March 30, 2011

TABLE OF CONTENTS

ATTACHMENTS:

APPROVED

SECTION 1 INTRODUCTION

This Supplement to the Response Plan for Downstream Impacted Areas and the Source Area Response Plan Commonly Referred to as the “Aerial Imagery Work Plan” is in response to the requirements of the United States Environmental Protection Agency (U.S. EPA) Notice to Enbridge dated March 7, 2011. The notice directs Enbridge to perform assessment activities pursuant to the Administrative Order issued by the U.S. EPA on July 27, 2010 and a Supplement to Order for Compliance under Section 311(c) of the Clean Water Act issued (“Supplement”) by the U.S. EPA on September 23, 2010. Paragraph 6 (Item 18.k) of the Supplement requires that Enbridge submit this detailed plan to the U.S. EPA for reassessment of the source area, Talmadge Creek, Kalamazoo River and downstream impacted areas for the presence of oil, sheen, and/or oil/sheen that threatens navigable waterways.

This work plan includes the provisions and details for collecting aerial imagery data of areas affected or suspected to be affected by the spill. Collection of aerial imagery data will include the source area, Talmadge Creek, and the Kalamazoo River to Morrow Lake Dam. The assessment area for all the proposed imagery acquisition will encompass all areas inundated at the time of the spill as defined by the United States Geological Survey (USGS) Inundation Model (for most of Calhoun County) and the Federal Emergency Management Agency 100 year flood elevation (for the portion of Calhoun County and Kalamazoo County not included in the USGS model). The purpose of collecting aerial imagery data, as stated by U.S. EPA, is to provide a basis for comparison with earlier imagery; confirm topography and update the USGS Inundation Model; and use the best available technology to attempt to detect remaining oil in the submerged sediments, shorelines, and in downstream impacted areas. The imagery information will be incorporated into the existing Global Information System (GIS) and be used, with other collected data (poling, Shoreline Cleanup Assessment Technique, etc.) to develop base maps and figures. The aerial data will allow for the evaluation of re-growth and restoration of vegetative cover and wetlands compared to subsequent aerial imagery. Enbridge has consented to additional imagery flights (under the Department of Environmental Quality Consent Order). This work plan also includes a proposed schedule for implementation. A detailed plan for using other methods (e.g., visual assessment/inspection, poling, coring, etc.) to evaluate the impacted waterways (including sediment and soil), shorelines and downstream impacted areas will be provided to U.S. EPA as a separate work plan. Together, the work plans will meet the directive as detailed in the Notice.

SECTION 2 POLARIMETRIC IMAGERY (PI)

PI, Enhanced High Resolution Aerial Imagery, is an enhanced high definition video with still frame capture that uses sunlight and non-visible light to enhance the image. PI will be performed within the floodplain from Morrow Lake to the release site encompassing the FEMA 100 year flood plain. The PI camera system and one operator will utilize a helicopter that will traverse the targeted area in two flights within the same day. The second flight will be performed with emphasis on the results from the first flight. The PI system also has real-time capability, as areas of interest are identified based on polarimetric signatures, the operator can zoom-in and direct the flight crew to hover or orbit to collect additional data

The PI sensor captures data at video rate and the focal length range is from 22mm to 1760mm. The video collected will undergo literal analysis, i.e., suspect PI signatures on the water surface and on the river banks, will be identified and documented. During the data collection the contrast stretch will be manually optimized to discriminate suspect PI signatures that are observed. The data will not undergo any mapping transformations and will remain in the geometric perspective in which it was originally acquired. The following table shows collection parameters for the nominal 2000 ft. altitude and 1 mile standoff configuration anticipated for this collection:

FOCAL LENGTH	FIELD OF VIEW	GROUND SAMPLE DISTANCE	HORIZONTAL GROUND FOOT PRINT
200mm	2.75°	3.39”	271.0 Feet
400mm	1.38°	1.69”	135.5 Feet
800mm	0.69°	.85”	67.75 Feet
1600mm	0.34°	.42”	33.90 Feet

An analysis of the data will be presented in an end of day brief detailing collection results and recommendations. An additional in-depth report will also be provided. The end of day brief will contain in-flight PI snapshots of potential areas of interest. The snapshots and the geographic coordinates will be downloaded at the mid-day refueling and provided to the ground crew and will include any ground truth from the day. A subsequent report will include a comparison of the airborne data results to ground survey data (e.g., what was found when sites of potential interest identified from the air were visited on the ground) and an assessment of the utility of airborne PI for this application (summary of all results).

The PI data will be compared to existing data including, but not limited to SCAT data, previous aerial imagery (August 2010), and poling data.

SECTION 3 LIGHT DETECTION AND RANGING (LIDAR)

LIDAR, (remote laser transmitting and sensing system) integrates lasers, GPS, and Inertial Navigation System into a single system capable of acquiring data to produce accurate digital elevation models. LIDAR will be performed as requested within the entire floodplain encompassing all areas inundated at the time of the release. The data collection and presentation will allow for the generation of a 1 foot contour model and will be conducted pursuant to the FEMA Accuracy Memo 61 for LIDAR and the National Map Accuracy Standards. This imagery will provide the following:

- Geo-referenced digital line index of images from the flight.
- A rigid block of photography related to the ground control by analytical aerial triangulation.
- Data will be processed to support the generation of mapping to six-inch contours.
- A database that, when used in combination with a high precision Global Positioning System (GPS), the data becomes spatially relevant.
- Digital data generated from the LIDAR system will be delivered via DVD or external hard drive. This data will be compatible with many programs including GIS and Autocad®.
- Information collected from the LIDAR will be presented to the USGS for incorporation into their Inundation Model and used by Enbridge to assist in response activities.

The aerial imagery and LIDAR data will be remotely controlled through the use of Airborne Global Positioning and Inertial Measuring unit devices. This control is used in conjunction with the supplemental field control surveys provided from the Enbridge to formulate an aero-triangulation solution to control the imagery. The internal aero-triangulation and field surveyed check point information will be provided.

LIDAR intensity images will be used to create stereo mates from which break line data to support hydro enforcement can be facilitated. This "evaluation" is completed through a number of different suites of software.

Note that a related ground survey of control and quality control check points will be performed as a reference for the aerial survey. This information will be included with the submission of the digital imagery data report to the U.S. EPA. To supply information to complete the inundation modeling efforts, Enbridge will complete additional survey tasks as requested and directed by the USGS. This additional survey work will include rive cross sections, bridges, culverts, and other structures. In an effort to complete multiple tasks during a single field event, this survey effort will be conducted with the collection of the quality control checks.

3.1 Fluorescent LIDAR System (FLS)

Fluorescent LIDAR System, which is a laser emitting technology that is capable of detecting a spectral fluorescent signature associated with residual oil, will be performed to assist the oil recovery/cleanup effort. The FLS can theoretically detect oil below the water surface in the source area, Talmadge Creek, and Kalamazoo River. The plane will fly at an altitude of 200 meters (up to 300 meters if necessary to avoid urban restrictions) capturing a 40 meter path width on the ground.

Real-time alarming will not be feasible (the sensitivity setting on the instrument would have to be set so high that interferences from other organics would result in too many false positives). Detailed analysis of survey results for areas where alarms occurred will be completed.

APPROVED

The application of FLS to the Marshall spill is considered experimental by FLS experts because of the silt that has settled in the waterway since the spill occurred. Samples of the crude oil (from the pipeline restart as well as overbank areas along the river) will be provided to the contractor to determine if and how the oil fluoresces. The results of this evaluation will be used to determine if the FLS technology is applicable for this site. FLS experts will provide the results of this evaluation prior to implementation. The results of the evaluation will be provided to the U.S. EPA. The initial evaluation of crude oil taken from the pipeline during the restart has been completed and is attached. The result of the evaluation has indicated that the "fresh" crude oil does weakly fluoresce. Additional evaluation of weather crude collected from the overbanks of the river will be completed prior to the flights.

The FLS investigation area will encompass all areas inundated at the time of the release. Data will be processed after the flights with results being provided within 7 days. All data is geo-referenced and is available in any format required to integrate with other survey data.

Digital data generated from the FLS system will be delivered via DVD or external hard drive. This data will be compatible with many programs including GIS and Autocad®. The data set will also be presented as a detection profile overlay.

SECTION 4 SCHEDULE

The work outlined above is proposed to commence after receipt of an approved work plan. The U.S.EPA will be notified of the specific start date with the objective of completing the data collection prior to Spring 2011 vegetation/leaf emergence. Due to the requirements of the data collection (altitude, type of platform, etc.) the LIDAR, FLS, and PI may not be conducted concurrently and will require separate flights.

Commencement of the proposed activity will ultimately be determined by weather and seasonal river conditions. Based on the request of the Notice, the goal will be to collect the data during normal or near normal water elevations. The LIDAR and PI tasks are dependent upon good weather – relatively low wind speeds and clear skies. The FLS task can be completed as long as safe flying conditions are present. Should weather or river conditions create an adverse obstacle to completion of the subject activities, U.S. EPA will be notified of such conditions and their impact on completion of proposed activities. Contingencies will include the rescheduling of specific activities based on current and forecasted weather and river conditions. The results of the imagery activities (e.g. raw data) will be provided to the U.S. EPA, as soon as possible with the goal of five business days following collection or by April 22, 2011. A comprehensive final report documenting the imagery work performed will be prepared and submitted to the U.S. EPA as per the attached schedule. This report shall include, at a minimum: specific activities performed, problems encountered, imagery results, findings, and conclusions.

A proposed schedule is attached based on an anticipated start date of April 11, 2011 to initiate aerial imagery. Proposed revisions to the schedule (based on weather and river conditions) will be communicated with the U.S. EPA prior to initiating the work.

ATTACHMENT

FLS EVALUATION OF UNWEATHERED CRUDE OIL

Bench scale tests with Enbridge oil sample

Oil sample: black, heavy, viscous crude oil.

Equipment: SFS analyzer of optically dense samples *Instant Screener® Compact*, SFS analyzer for optically transparent samples *Fluo-Imager®*; Hyperspectral LIF lidar - *FLS®-SUV lidar* (excitation wavelength – 308 nm).

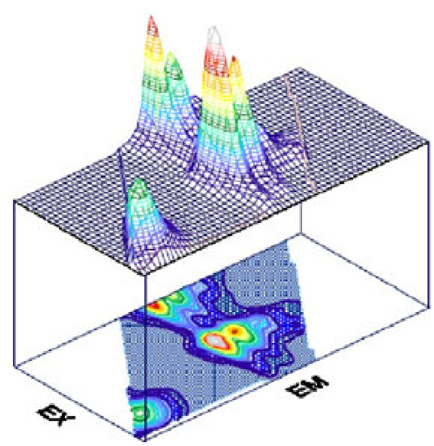
Measurement conditions: in water, on water surface, on the ground.

Measurement time: immediately after sample preparation and repeated in 24 hours with the same sample stored at normal environmental conditions.

1. SFS analysis

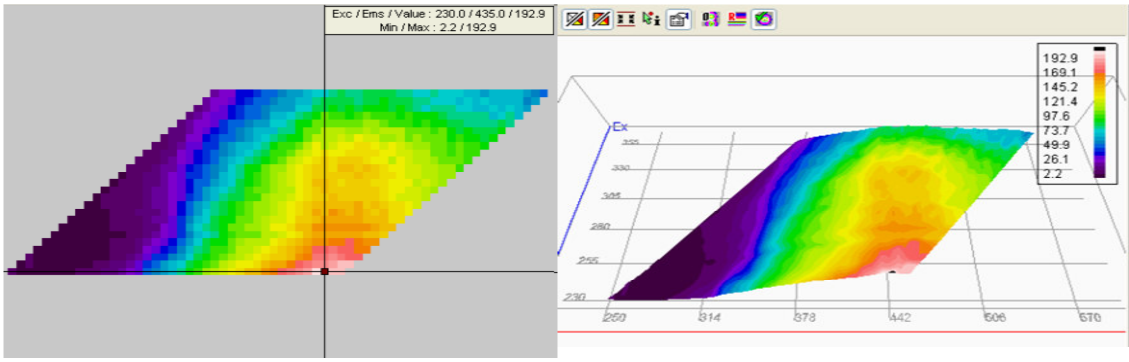
SFS technology:

The SFS Analyzer detects the presence of various organic compounds in liquid and solid samples based on Spectral Fluorescence Signature (SFS) technology. The SFS is a matrix of fluorescence intensity of a sample in coordinates of excitation and emission wavelengths (see Fig.). The SFS can also be presented in two dimensional plots, where the different colors represent the fluorescence intensity levels. SFS technology considers specific spectral patterns characteristic for different substances for substance identification, and the intensity of fluorescence serves as a measure of substance quantity.

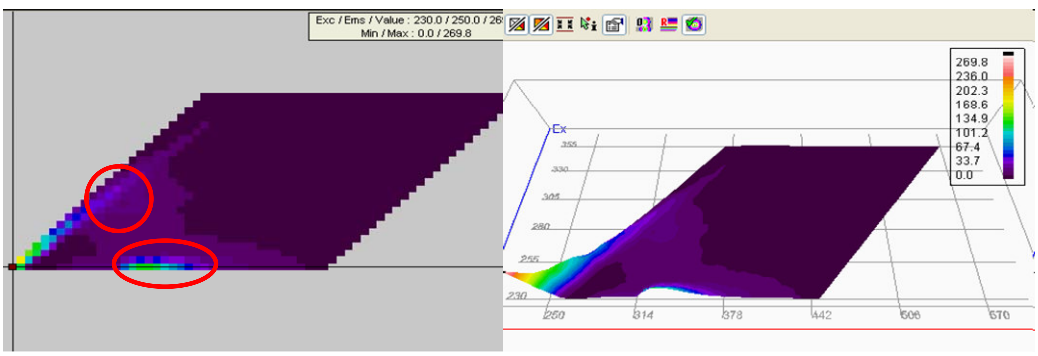


Sample preparation and spectra:

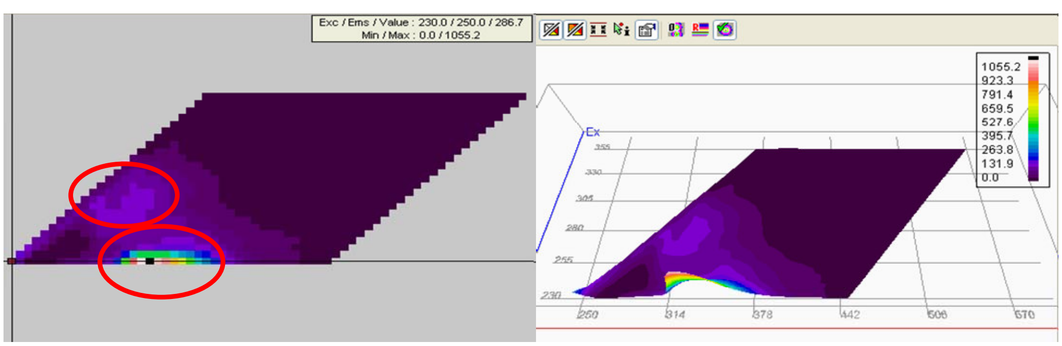
3. <u>Simulation of oil on the solid ground</u>. Reference crude oil measured with Instant Screener Compact: 2-D SFS (left) and 3-D SFS (right) indicate the characteristic spectral pattern of oil.



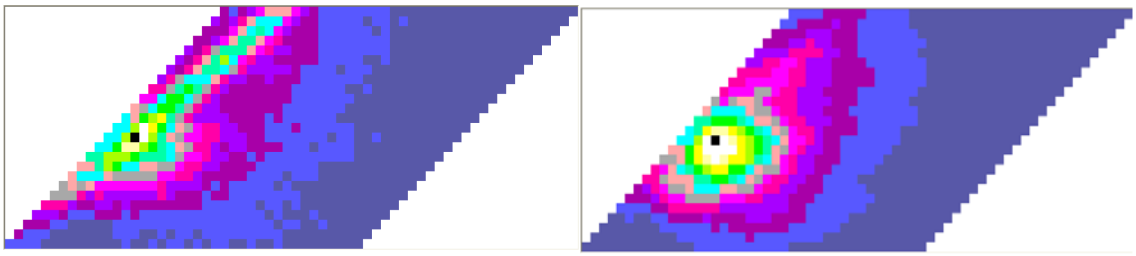
3. <u>Simulation of oil contamination in water – front face measuring geometry.</u> Drop of crude oil dissolved in water and then measured with Instant Screener Compact: 2-D SFS (left) and 3-D SFS (right) indicate the characteristic spectral pattern of oil emulsion in water (marked with red circles).



The same sample measured again with Instant Screener Compact after 24 h: the spectral pattern of oil remains the same while the fluorescence intensity increased 5 times due to extraction of oil into water with time.



3. Simulation of contamination in water – volume measuring geometry - measured with Fluo-Imager. Development in time: maximal fluorescence intensity of oil in water was initially 319 (left SFS below), and increased up to 1457 (right SFS below) in 24 hours due to extraction of aromatic compounds in water.



2. Laser Induced Fluorescence (LIF) analysis

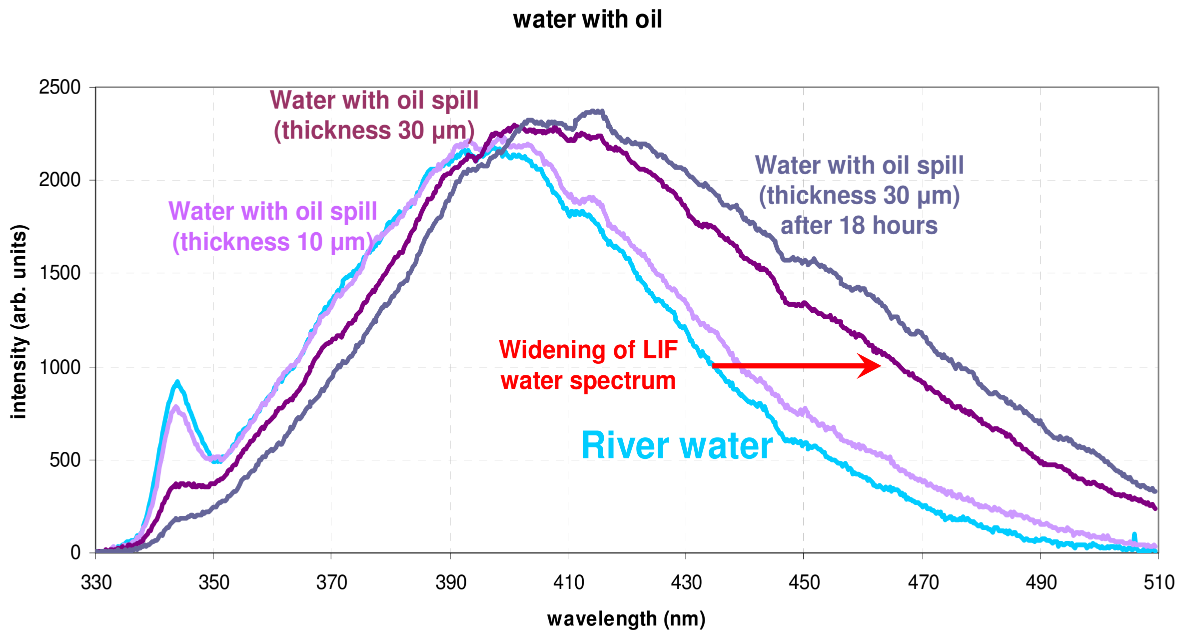
LIF technology:

LIF analyzers are based upon the capture and analysis of spectra of fluorescence response, induced in the target object by illumination with monochromatic laser emission at one or more wavelengths. LIF reading is a composite of fluorescence responses of individual compounds present in the target object. As such molecular responses are deterministic for many compounds, and vary according to concentration level in the sample. As a result, many objects of study have a specific shape of LIF spectra, which can be used for remote identification and characterization.

LIF spectra of water:

LIF spectrum of water consists of Raman scattering line of laser light on water molecules, fluorescence of natural organic compounds and fluorescence of oil. Diagnostics of oil pollution in water differs by measurement conditions. Oil films on the water surface change the shape of LIF spectra as compared to clean water spectra by simultaneous increase of fluorescence intensity and decrease of the Raman-line intensity. Oil emulsion in water causes the change in the shape of LIF spectrum.

For the specific oil sample used for the test addition of oil to water leads to the widening of LIF spectrum comparing with clean water. Thus the width of the LIF spectrum can serve as an oil indicator. Spectra of clean and contaminated by specific oil water are shown in Figure below.



3. **Conclusion for the tests with specific crude oil sample provided:**

SFS analyzers are able to detect specific oil in water and ground samples:

- Specific signal of crude oil was detected with in the tests;
- Difference between natural water organic and crude oil in water was established;
- Intensity of fluorescence of solutions measured 24 hours later had increased almost 5 times.

LIF analysis allows detection of:

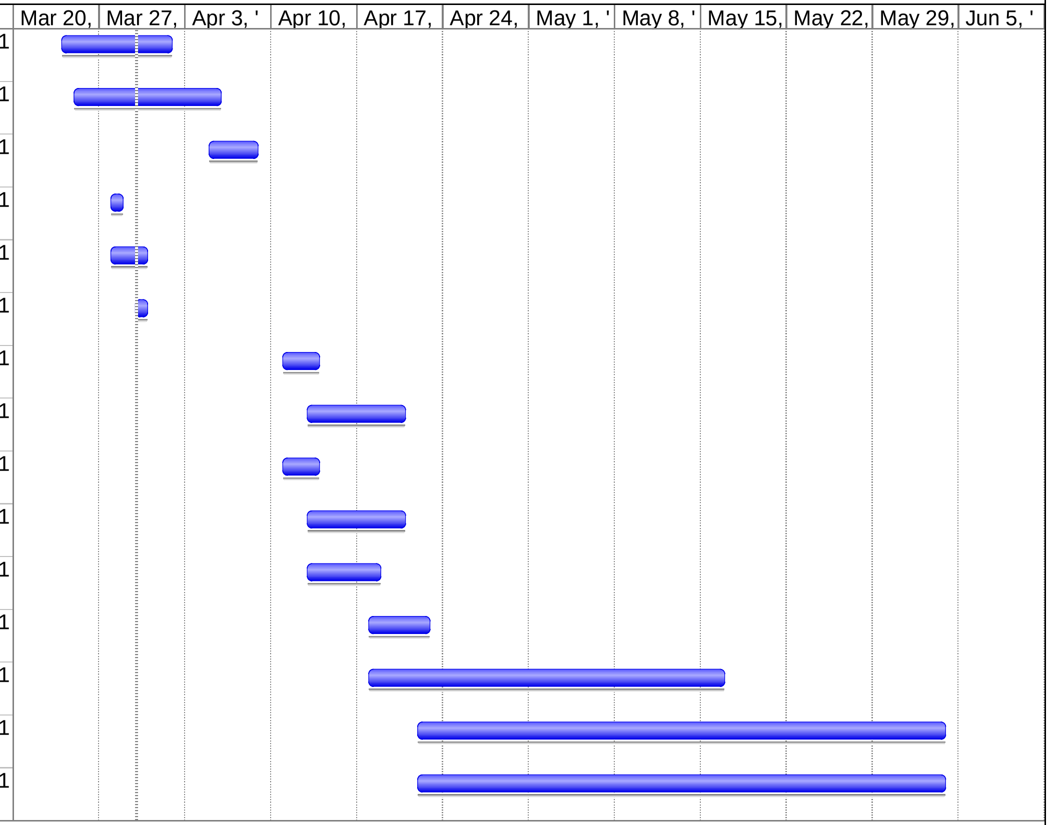
- Specific oil on water surface;
- Specific oil emulsion in water;
- Specific oil on the solid ground (without vegetation).

ATTACHMENT

ANTICIPATED IMPLEMENTATION SCHEDULE

Anticipated Implementation Schedule

ID	Task Name	Duration	Start	Finish
1	Oil standards collection/acquisition	7 days	Thu 3/24/11	Fri 4/1/11
2	Oil evaluation	8 days	Fri 3/25/11	Tue 4/5/11
3	Review results of evaluation	4 days	Tue 4/5/11	Fri 4/8/11
4	Final plan submission	1 day	Mon 3/28/11	Mon 3/28/11
5	Plan review by agencies	3 days	Mon 3/28/11	Wed 3/30/11
6	Final plan approved	1 day	Wed 3/30/11	Wed 3/30/11
7	FLS data collection	3 days	Mon 4/11/11	Wed 4/13/11
8	FLS preparation of Raw Data	7 days	Wed 4/13/11	Wed 4/20/11
9	PI data collection	3 days	Mon 4/11/11	Wed 4/13/11
10	PI preparation of Raw Data	7 days	Wed 4/13/11	Wed 4/20/11
11	LIDAR data collection	5 days	Wed 4/13/11	Mon 4/18/11
12	LIDAR preparation of Raw Data	5 days	Mon 4/18/11	Fri 4/22/11
13	Survey Control Network	21 days	Mon 4/18/11	Mon 5/16/11
14	Data Compilation QA/QC	31 days	Fri 4/22/11	Fri 6/3/11
15	Aerial Imagery Final Report	31 days	Fri 4/22/11	Fri 6/3/11



Project: Tentative Aerial Imagery Work Plan Schedule
Date: Wed 3/30/11