

April 2007

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

# hawk infrared camera

aerial survey of the mississippi river industrial corridor

# aerial survey of the mississippi river industrial corridor using the hawk infrared camera

April 2007

R. Bruce Hammatt  
Administrator & Senior Technical Advisor  
Louisiana Department of Environmental Quality  
Office of the Secretary  
P.O. Box 4301  
Baton Rouge, Louisiana 70821-4301  
[www.deq.louisiana.gov](http://www.deq.louisiana.gov)

# introduction

**The Baton Rouge area** is currently classified as being in marginal nonattainment for the Clean Air Act eight-hour Ozone Standard. Prior to the one-hour standard being revoked, the five-parish Baton Rouge area was in severe non-attainment with the national ambient air standard for ozone. The area is now in attainment for the one-hour standard, but must continue to make improvements in air quality to achieve attainment with the eight-hour standard. The Louisiana Department of Environmental Quality staff has conducted extensive investigations to identify emission sources that may have contributed to the ozone exceedances. While a specific cause for some episodes has been identified, in many cases there has been no specific event identified to explain ozone exceedances.

Surprisingly, several exceedances within the last two years occurred on days when ozone was not expected to be a problem. A concerted effort has been directed to compare known ozone precursor chemicals of concern with the reported releases in the area. The DEQ Surveillance staff has also conducted numerous inspections of the area's petrochemical facilities in the five-parish area to look for possible unreported releases. The inspections of fixed sites did not reveal the causes of these unsuspected ozone exceedances. However, DEQ still believes there are releases in the area that are not being reported or properly identified. If the five-parish area is to be successful in attaining the eight-hour standard, a full accounting of the emissions data is necessary for input into the photochemical grid modeling and planning process.

In addition to fixed industrial sites, DEQ is also looking at transportation industries with an emphasis on the barge and rail traffic along the Mississippi River industrial corridor. Monitoring the transportation of raw and refined products associated with industries is a prime target for answers needed to reduce the frequency and severity of these high ozone readings. There have been several recent incidents involving the release of hazardous materials from barges on the Mississippi River, some of which resulted in evacuations in communities along the river. The DEQ has teamed with the U.S. Coast Guard to better quantify the amount and location of loading and off-loading of chemical tank barges along the river.

# the demonstration study

**The use of infrared imaging technology** for the discovery of hydrocarbon leaks along pipeline routes has been used for many years. The DEQ proposed a demonstration study and received a grant from the U.S. Environmental Protection Agency Region 6 to use this proven technology to discern the amount of leakages of organic vapors from tank barges and railcars traversing the Mississippi River. Also, there has been great interest in fixed hydrocarbon storage tanks along the Mississippi River industrial corridor near Baton Rouge. We wanted to determine if the Leak Surveys, Inc. Hawk infrared surveying camera mounted on a helicopter flying low over the barges, storage tanks and railcars would be able to detect emissions that were otherwise unknown to DEQ. Based on discussions and documentation from LSI, while flying low in a helicopter over the potential sources, we expected to detect most hydrocarbon releases into the air in the 5,000 – 10,000 parts per million range.

## study area

The demonstration study area was identified as the industrial corridor along the Mississippi River starting on the north end of East Baton Rouge Parish above the city of Baton Rouge and going south to the Sunshine Bridge which crosses the Mississippi River just below the southern end of Ascension Parish east of Donaldsonville. This stretch of the meandering Mississippi River encompasses about 70 river miles from River Mile 240 down to River Mile 170.

This area includes:

- 19 major marine terminals
- 16 barge fleeting operations
- numerous pipeline crossings
- chemical and refinery facilities
- railroad lines and yards
- highways

Each offers opportunities for chemical exposures in the event of an unplanned release. Any releases would contribute to the overall reduction of air quality that prevents the five-parish area from reaching the ozone attainment status.

## study preparations

With the assistance of the agency's GIS Center, maps were made with the names of all known fixed facilities, rail yards, rail lines, barge fleeting areas, electrical power lines and buried pipelines. These maps were invaluable in pinpointing where the survey team was as it flew over the region.

The plan included both a ground and helicopter crew. The ground crew was made up of DEQ Surveillance Division field investigators and an LSI employee with a hand-held Hawk camera. EPA staff also accompanied the field crew to assist with the overall study effort. The helicopter crew was made up of the LSI pilot, an LSI employee operating a helicopter-mounted Hawk camera and digital camera and Bruce Hammatt, Hawk technical advisor. DEQ maps and digital cameras were used to document locations of releases found during three days of scheduled flights.



*The Hawk camera can be mounted to survey barges, rail cars, and industrial facilities from the air. Photo by DEQ*

## pre-flight notifications

Several public announcements were made to alert area residents and facilities of the planned low-flying helicopter flights. The USCG was informed so they could notify their constituents as well as make announcements over the marine radio system. State and local Homeland Security offices were notified and a press release was disseminated to the local media. In addition, the Louisiana Chemical Association and the Louisiana Mid-Continent Oil and Gas Association were advised so they could notify their members of the planned operations. Photos of the helicopter, dates of planned flights and a demonstration of the capabilities of the Hawk camera were included in the announcements.

Because of safety considerations, flights over oil and chemical storage tanks included only those not located adjacent to process areas of fixed facilities. The helicopter would be flying at slow speeds and at a low altitude so flares, towers or other sources that might jeopardize the safety of the helicopter crew or workers at the facilities were avoided.



*Bruce Hammatt, DEQ's Hawk technical advisor, interviews with a local television station. Photo by DEQ*

## results

Flights were made on three days. An actual count of chemical tanks or other sources examined was not made; however, estimated quantities were 3,000 railcars, 300-500 chemical storage tanks and 100 tank barges. All significant releases detected with the Hawk camera were documented by written records and photography.

The original intent was to notify the field crew when the flight crew detected a significant release from the air so people on the ground could make a site visit, document the release(s) using the hand-held Hawk camera and take any air quality samples deemed necessary at the time. However, it became immediately apparent that the number of releases found using the helicopter-mounted Hawk camera was far greater than anticipated and that the ground crews would not be able to maintain the pace. For example, six leakers (chemical releases detected by the Hawk camera) were found within the first few minutes after leaving the airport in Baton Rouge. The ground crew spent most of the morning at this single location while the flight crew continued to find other leakers.



*The color photo of this barge shows what the human eye sees. The black and white photo shows the Hawk detecting a hydrocarbon leak. Photo by Leak Surveys, Inc.*

A leaker or leak could be a permitted or non-permitted release. It could be a manufactured design release or something completely unknown to the manufacturer or operator of the actual source. Therefore, for the purposes of this demonstration project, a detected leaker or leak may or may not be a violation of any state, federal or local law or regulation.

Although several thousand railcars were checked from the helicopter, none were found to be leaking during the project. However, based on earlier work, such leaks had been anticipated. At this time, it is uncertain if there were no leaks or if leaks from railcars were not detectable with the Hawk camera from the air.



*The Hawk detects a leaker at a tank farm at an industrial facility which is identified by the black and white photo. Photo by Leak Surveys, Inc.*

A considerable number of fixed bulk storage tanks were identified as leakers at petrochemical facilities located along the river. In many instances, the field crew was able to meet with company representatives on the same day to make sure they were aware of the leaks. All facilities were encouraged to take appropriate actions to address leaks found using the Hawk camera to ensure they were compliant with applicable laws and regulations. Within the limited time allotted for this project,

we were unable to determine if leaks were violations or not.

During the three-day study, a high number (more than 10 percent) of chemical tank barges were found to be releasing large amounts of organic vapors into the environment. The Hawk camera was highly effective in visually detecting leaks from barges. When one leak from a barge was encountered, additional large leaks were often found from that same barge.

A few weeks after the study was completed, the agency held an “open house” at the DEQ headquarters in Baton Rouge where the results of the Hawk demonstration study were presented. The results of the study, as well as future plans, were explained to a packed audience of government officials, media, environmental groups, private companies and other interested parties.

## conclusion of demonstration study

An EPA demonstration grant allowed the DEQ to look at numerous potential sources of chemical releases along the Mississippi River industrial corridor that might contribute to the area’s ozone non-attainment problems. The helicopter-mounted Hawk infrared camera operated by Leak Surveys, Inc. proved to be an extremely valuable tool in quickly locating and identifying a large number of hydrocarbon releases that had previously been unknown to the DEQ. Some releases were from fixed facilities. However, the ever-increasing numbers of tank barges that are frequently used to transport large volumes of volatile organic chemicals along the Mississippi River were found to pose a potentially significant problem.



*A team from Leak Surveys, Inc., inspects various sections of a gas processing plant in north central Texas. The Hawk looks for leaks in compressors, control valves, flanges, and unions. Photo by Leak Surveys, Inc.*

# the follow-up study

**The DEQ received an EPA grant**, #A-96617801-0, to continue its efforts to determine the extent of chemical releases from tank barges, while working with the American Waterway Operators and barge owners to reduce those emissions.

DEQ is working with the U.S. Coast Guard's Chemical Transportation Advisory Committee and the local barge transportation industry to address the types of large tank barge releases found during the study.

## study focus areas

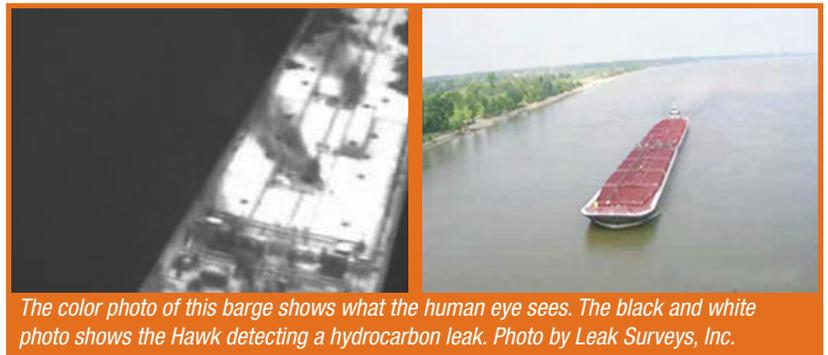
There are three primary focus areas identified with the project:

1. Work with the industry and governmental representatives that routinely deal with tank barges to ensure they are aware that a problem does exist.
2. Provide an avenue to educate the various employee groups that have access and may actually cause inadvertent releases from the tank barges.
3. Continue the flights using the Hawk infrared camera in the marine industrial corridors in south Louisiana.

## industry & governmental interaction

The American Waterway Operators is a national trade association for the U.S. tugboat, towboat, and barge industry. They represent the vast majority of the tank barge industry in the state. In August 2005 a meeting was held at the DEQ office with the AWO, the USCG and several tank barge companies to review the results of the demonstration study and to begin the process of determining the extent of the problem in Louisiana. Another topic at the meeting was reducing inadvertent releases from these tank barges. A commitment was made by all attendees to work together to accomplish the stated goal of reducing the releases of chemicals into the state's environment.

The Chemical Transportation Advisory Committee provides advice and consultation to the USCG with respect to the marine transportation of bulk hazardous materials. On November 8, 2005, DEQ made a presentation at a CTAC meeting held in Galveston, Texas. Based on the presentation and the Hawk camera flight videos showing the plumes of organic releases from numerous tank barges in the Baton Rouge area, CTAC members voted to create a Barge Emissions and Placarding Work Group under their Outreach Subcommittee. The DEQ has been participating in the CTAC and work group meetings since that date.



In the summer of 2006 the collaborative effort resulted in the approval of a document entitled "Recommendations for Best Management Practices to Control and Reduce Inadvertent Cargo Vapor Emissions in the Tank Barge Community." The collaborative effort between the USCG, CTAC, DEQ, AWO and the Texas Commission on Environmental Quality is a compendium of best management practices that, if implemented, should significantly reduce the emissions from the tank barges that may be adversely impacting the environment.

## ongoing education activites

The air releases detected from tank barges using the Hawk technology appear to be generally unmonitored. Although there are regulations dealing with restricting releases from these vessels while being loaded at the dock, once the vessels are in transport, it is generally agreed the releases as seen by the Hawk are unregulated. The bulk of the existing federal regulations deal with releases from tank barges in the context of safety as it relates to fires, explosions and keeping the contents from escaping into the water. They do not apparently consider these types of air releases as it relates to other environmental protection measures.



*The Hawk scans a sector looking for leaky rail cars.  
Photo by DEQ*

Most of the releases seen so far using this new technology appear to be easily preventable. There are several groups of individuals that have access to tank barges from the time it is loaded until the contents are off-loaded at another location. These include the tugboat/barge handling crews, gauging crews for the product owners and buyers, inspectors and shipyard crews. Each has the potential of creating an opening whereby the content vapors can escape. If they are not careful these open valves, gauges, hatches, etc. can result in chemical releases for an extended period of time.

It is anticipated by many that the "Best Practices" manual should result in a marked reduction of chemical releases from these tank barges. However, because of the significant number of individuals that may

have access to the tank barges, it may be difficult to determine which one caused the release. A chemical release could be caused by an error of one of these individuals or by a malfunction of the various physical components of the vapor control devices on the barge itself such as a valve, gasket or seal. Regardless, it is generally recognized that an education program aimed at the various groups should result in significant decreases in the number and severity of releases found.

## ongoing flights with hawk

The DEQ has continued surveying the waterways to look for chemical releases from tank barges. Two three-day flights were conducted in 2006 and two additional flights are planned for the first half of 2007. Both sets of flights in 2006 originated out of the Baton Rouge airport and were focused on tank barges found on the Mississippi River, the Intracoastal Waterway and the Calcasieu River system. It is still relatively easy to find chemical tank barges leaking on the state's waterways. Although the weather was inclement during the three-day flight in July, leaking tank barges in all three waterways were located as were leaking tanks at fixed facilities in the Baton Rouge area.

The agency received a request to have a CTAC member accompany us on a flight in the Baton Rouge area. Although it caused some complications in dealing with helicopter load capacities, etc., a decision was made that the potential benefits would outweigh any misgivings. The effort proved to be very valuable. Most of the subsequent flights had a representative of the tank barge industry present to assist us in pinpointing the source of the visible leaks as seen through the lens of the Hawk camera.

Although efforts to have DEQ Surveillance staff members visit the fixed facilities with leaking tanks during the original demonstration study, the agency made no attempt to board any of the tank barges. However, during this follow-up study, Surveillance staff and accompanying industry representatives were standing by in the event we found leaks from tank barges. Efforts were made to pre-stage the field teams based on anticipated helicopter flight schedules and paths. On several occasions the crew was able to board the vessels with the barge owner representatives and located the specific source of the leaks. In both the Baton Rouge and Lake Charles areas the field crews in boats were so close to the leaking barges that hand signals could be given from the helicopter to the boat crews to advise them of the location of the leaking tank barges. The field crews were then able to board the vessels and address the source of the visible leaks.

The efforts have indicated a host of varying organic products contained in the leaking tank barges including:

- Unleaded gasoline
- Crude oil
- Pyrolysis gasoline
- Aviation fuel
- Various light cycle gas
- Raffinate
- Acetone
- Natural gas

Sources of the leaks have included hatch cover leaks, leaking vent stacks, failed gaskets and valve packing seepages.

## are things improving?

It is extremely difficult to determine if the number of leaking tank barges have decreased to date. There are varying environmental and practical factors that can skew the numbers of leakers found with the Hawk camera from one day to another. Environmental factors include the amount of moisture in the air, the angle of the sun relative to the camera angle and cloud cover. All of these can make a difference between seeing a leaker and missing one. For example, we have had incidents where an obvious leak was seen from a given barge flyover and then have it miraculously disappear for several moments while a cloud prevents the sunlight from hitting the barge deck. Once the cloud moves, the leak is found again on a subsequent flyover. It is apparent the leak was actually occurring the entire time; however, the combination of environmental factors, the camera operator and the helicopter pilot can all interact to allow you to actually see the leak or not.

Obviously the DEQ does not control:

- the number of tank barges in the river systems on any given day, or travel along the system that we are surveying on that day.
- how long a specific barge is moored at a given location or when the barge moves to allow access to one of the adjacent barges by the tugboat making up a tow.

The DEQ cannot tell:

- if a tank barge found in the river while flying overhead in a helicopter is empty and gas-free,
- empty with residual product still in the tanks,
- half full of product, or
- completely full of product.

Although it can generally be determined if a tank barge on the river is sitting high in the water, it cannot be determined if there is still residual product in the tanks. If the tank barge is sitting low in the water, we may assume the tank is full; however, the agency cannot determine what the product is or if the barge contains a volatile organic product whose potential emissions might be detected with the camera.

## follow-up study

During the demonstration study the agency did not track, or count, the number of tank barges surveyed with the camera. During the follow-up study an attempt was made to count the barges and make a determination whether the barge was full or empty. On most flights, we had two people count the number of barges we visually surveyed and generally came up with the same number of tank barges, but there were some minor differences. Based on the author's memory of the demonstration flights and these subsequent flights, it appears a fewer percentage of leaks were found during the follow-up flights in 2006. However, because of the conditions which can and do impact the ability to compare results, it cannot be said with any degree of confidence that things are getting better. What can be said is that leaking tank barges continue to be found along the state's waterways.

## a final word

The video presentations of the chemical vapor clouds, that prior to this technology were unknown, are quite dramatic. The general consensus of the observers viewing the videos is that a concerted effort to reduce these unwanted releases is a must. However, there are exceptions. Some within the water transportation industry believe the bulk of these apparent releases may simply be: 1) minor releases from designed safety devices on the barges (pressure relief valves); 2) the releases are very sporadic and inconsequential as far as general air quality in the area is concerned; and 3) very regional in scope (eg. may be a quirk restricted to Louisiana, Texas and other generally warmer “Southern” states).



*A team from Leak Surveys, Inc. inspects various sections of a gas processing plant in north central Texas. The Hawk looks for leaks in compressors, control valves, flanges and unions. Photo by Leak Surveys, Inc.*



[www.deq.louisiana.gov](http://www.deq.louisiana.gov)