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# A successful case study: The bird control program of Waste Management Outer Loop Recycling and Disposal Facility, Louisville, Kentucky, USA

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**TITLE: A successful case study: The bird control program of Waste Management Outer Loop Recycling and Disposal Facility, Louisville, Kentucky, USA**

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**Abstract of Presentation:**

Landfills and airports have a long history of incompatibility. Birds are attracted to landfills for various reasons including food sources, habitat, and orographic lift. Since landfills can be avian attractants, they are required to be sited at least 10,000 feet away from commercial airports in the United States. Waste Management of Kentucky (WMK) operates a municipal landfill and recycling facility -- the Outer Loop Recycling and Disposal Facility (OLRDF) -- located less than 1.5 miles south of the Louisville Standiford airport which, as the hub airport for United Parcel Service, is the fourth largest cargo airport in the U.S. As part of an expansion permit, the FAA required that WMK implement a comprehensive bird control program. As a result, WMK has developed and maintains an extensive program that includes an advanced avian radar monitoring system, two full-time wildlife biologists, and a multi-faceted harassment program. The bird control program was developed and is overseen by BASH, Inc. and is operated day-to-day by DeTect, Inc. A MERLIN™ Avian Radar System is used to monitor bird activity on and off the landfill. The data to date has demonstrated that this landfill operates at or below background levels of avian activity through WMK's extraordinary efforts and commitment to managing local bird populations. This paper/presentation summarizes how the program was developed, how it is implemented, and results of the radar monitoring program.

**Bios:**

Dr. Russell P. DeFusco is a PhD biologist and BASH expert formerly with the US Air Force (USAF) and currently in private consulting practice operating as BASH, Inc.. He currently supports BASH programs for the USAF, the US Air National Guard, and airport and landfill clients worldwide.

Kevin M. Mieczkowski is a Professional Engineer with Waste Management of Kentucky with oversight responsibilities for engineering, permitting, and regulatory compliance for the WMK operations in the State of Kentucky, including the bird control program at the OLRDF .

Jared Quillen is the wildlife control services manager with DeTect, Inc. He received a B.S. degree in Wildlife and Fisheries from Mississippi State University and has worked as a wildlife extension associate and a nuisance wildlife control biologist.

## **Background**

The Outer Loop Recycling and Disposal Facility (OLRDF) has been in continual operation as a sanitary landfill in Louisville, Kentucky, USA since 1969. The facility is located south of the Standiford Louisville International Airport (SDF). Waste Management of Kentucky, LLC, (WMK) acquired the facility in 1984 and has continued operations since then. By 1985, OLRDF was receiving 71% of the sanitary waste being generated by the Louisville Metro area, and that year, WMK sought approval to expand the landfill.

Changes would include bringing it from 8,000 feet (ft) southeast of the threshold of what was then designated as Runway 1 of SDF, to within 6000 ft southeast of the runway threshold. The Regional Airport Authority stated in a letter to the US Federal Aviation Administration (FAA) that it did not oppose the expansion and observed that “in no instance has the landfill been associated with... [local] bird problems.” (Louisville/ Jefferson County Regional Airport Authority to the FAA Airports District Office, February 21, 1985). A conditional use permit was subsequently issued by the Jefferson County Board of Zoning Adjustment on April 1, 1985, authorizing the landfill’s expansion.

In 1989, the airport began considering major changes to the orientation of its runways. As a part of this planning and development, the Regional Airport Authority commissioned the US Department of Agriculture Animal Plant Health Inspection Service Wildlife Services (USDA-WS) to conduct a study of bird activity at the airport and its surrounding area. The study noted that the two proposed runways “will violate the proximity criterion set forth for landfills in FAA Order 5200.5A.” (Final Report, Avian/Airport Study, Standiford Field, Kentucky, September 18, 1990). The study further observed, however, that a runway may be located within 10,000 feet of an existing landfill operation, if the landfill cannot be closed within a reasonable time and if “acceptable methods of bird control are maintained.” Special attention was paid to the OLRDF as landfills are a potential food source for birds, but the study also noted that the runway construction itself, and the increased amount of paved area, was an attraction to birds.

The FAA in its Final Environmental Impact Statement (FAA/FEIS, April 1990) observed that the current airport/landfill relationship “has been determined acceptable by FAA” and that even though new runways would reorient flight paths over the landfill,

“permanent monitoring of bird activity will support the control program to maintain airport/landfill compatibility.”

In connection with the planned runway construction, the Regional Airport Authority developed a “Strategic Plan for Wildlife Hazard Management” (January 1990). The Strategic Plan established the Wildlife Hazard Management Task Force (WHM) in order to coordinate various local, state and federal agencies and provide a functional framework in which wildlife management activities could be completed. Certain protocols were established among members for responsive actions to be taken after receipt of notice that a wildlife hazard was developing or had developed on or near the airport. In addition, a Wildlife Hazard Management Program was established as a cooperative effort between the Regional Airport Authority and USDA-WS and USDA-WS began managing wildlife hazards at the airport on October 1, 1990.

The new runways (35R and 35L) were completed, and flight operation commenced in October 1995 on runway 35R and in December 1997, on runway 35L. During the final stages of runway construction at the airport, WMK filed a notice with the FAA, regarding a proposed horizontal expansion to add additional capacity within the existing borders of the landfill. The Regional Airport Authority subsequently filed a letter with the FAA noting that the planned expansion would not be an obstruction and that because of an effective bird control program, it would not be a hazard to air navigation either. The FAA confirmed that conclusion and issued its determination that the proposed expansion “would not exceed FAA obstruction standards and would not be a hazard to air navigation.” (FAA Aeronautical Study 94-ASO-0633-OE)

On October 13, 2000, WMK filed a Notice of Proposed Construction of Alteration (Notice) with the FAA, as required by 14 C.F.R. Part 77 for an internal horizontal and vertical expansion. The FAA on January 2, 2002 issued the results of its study that in connection with the filing and determined that the landfill expansion was “presumed to be a hazard to air navigation.” The determination of a presumed hazard was based solely on the location of the landfill within 10,000 feet of the ends of runways 35R and 35L, a situation that existed before the runways came into existence. WMK appealed the FAA’s decision and retained the services of a bird control expert, BASH Inc. to develop a more extensive bird control program than previously existed under the WHM plan. BASH, Inc. developed a program that included constant monitoring and passive and active control techniques, including lethal reinforcement when necessary. The Bird Control Manual (BCM) for OLRDF was first issued August 14, 2002, following a year long study of the site.

Following meetings in Washington, D.C., as well as site visits from the FAA’s Staff Wildlife Biologist, an agreement was reached wherein the FAA agreed that the OLRDF expansion could be proceed as long as the landfill agreed to implement the BCM as a condition of the operating permit. WHK had already been coordinating with USDA-WS to allow toxic bait applications targeting European Starlings for several years prior, and subsequently formalized an agreement with USDA-WS to provide full-time bird control services in starting April 2004 (prior work by the USDA-WS at the OLRDF was done on an “as needed” basis).

WMK implemented their bird control program prior to the requirement in their expansion permit. The BCM (effective May 20, 2004) requires that WMK provide between 4000 and 8000 hours per year of qualified and trained wildlife personnel to fully and effectively implement the manual. From May 2004 to December 2004 one wildlife biologist from USDA-WS was contracted to execute the BCM, and in January 2005, two full-time biologists supported the program for WMK. The use of avian radar was also included as a requirement in the BCM and as a condition of the expansion permit, and in January 2005, DeTect, Inc. delivered a MERLIN™ Avian Radar System to the landfill. The system is used to continuously monitor avian populations on and off the facility and to document the results of the WMK bird control program.

In March 2006, USDA-WS and WMK terminated their contract for bird control services and from March 6, 2005 to the present, DeTect, Inc. has been providing bird hazard management services in addition to the radar monitoring program. BASH, Inc. continues to provide independent review and oversight of the program implementation quarterly. An annual review will continue after three years of quarterly evaluations (the landfill is currently in the third year of the program).

### **OLRDF BCM & Program Methods**

Birds are attracted to the landfill site for three main reasons: the presence of food sources in the waste stream; available habitat for food, shelter, water, and nesting areas; and the physical layout of the facility, which provides perching sites and thermal and orographic lift. The area surrounding the landfill is highly industrialized and the landfill represents the best habitat for birds, regardless of consideration of the landfill operations. The primary species of concern at OLRDF are: Canada Geese (*Branta canadensis*), Mallards (*Anas platyrhynchos*), Turkey Vultures (*Cathartes aura*), Red-tailed Hawks (*Buteo jamaicensis*), American Kestrels (*Falco sparverius*), Great Blue Herons (*Ardea herodias*), Ring-billed Gulls (*Larus delawarensis*), Rock Doves (*Columba livia*), Mourning Doves (*Zenaidura macroura*), American Crows (*Corvus brachyrhynchos*), European Starlings (*Sturnus vulgaris*), and Red-winged Blackbirds (*Agelaius phoeniceus*).

The bird control program for the OLRDF was designed by BASH, Inc. to reduce the attractiveness of the landfill site to bird species hazardous to aircraft operating at the neighboring SDF and is one of the most comprehensive bird control programs in existence. The program includes dedicated WMK oversight of the program; two full-time bird control biologists that are on site from sunup to sundown, six days a week; and, includes use of a wide range of wildlife control methods focused on non-lethal harassment, trapping, habitat management, operational control and avian radar monitoring. Further, at WMK's insistence and in accordance of its corporate mission to "make a positive difference for the environment in every aspect of its business", the OLRDF program stresses use of environmentally sustainable, non-lethal control methods as the preferred approach, with lethal reinforcement used only as a "method of last resort". WMK additionally encourages and supports testing of developing wildlife

management techniques and tools at the OLRDF and is currently supporting several pilot programs to test the effectiveness of new and advanced technologies. By contrast, the adjacent SDF does not have dedicated, full time bird control staff and uses USDA-WS for bird control only on an occasional, periodic basis.

### ***Operational & Habitat Management***

Active landfill area (dumping and compaction area) management and habitat manipulation are important tools when trying to manage bird activities at the landfill. OLRDF utilizes the “cell” method of landfill operation as opposed to the “area” method. The cell method exposes only a small portion of the working face at any one time as compared to the area method, thereby minimizing a potential food source for birds and other animals. The active area’s average surface area is kept at approximately 300 feet x 400 feet and prompt, adequate cover (i.e., soil) is used as necessary. OLRDF also utilizes alternative daily cover (i.e., rejected compost, auto-fluff, and tarps) at the active face. The alternate daily cover has not been shown to attract wildlife species in numbers differently than soil cover.

OLRDF maintains the recommended grass height of 7 to 14 inches on its dormant units. This grass height is maintained to minimize nesting and feeding of grassland bird species, and will support the fewest number of mammals and insects that serve as prey. The site is inspected regularly and mowed several times a year to maintain this height. Sedimentation basins and ditches at the OLRDF are continuously monitored and mowed frequently to ensure that they are not an attractant for waterfowl and wading birds. Standing trees located on dormant units or other undesirable locations are removed to minimize roosting and loafing locations for problem bird species. Additionally, *Phragmites spp.* stands located within mitigation wetlands created on the south side of the OLRDF are removed and treated with various long term control methods. These patches of common reed provided a loafing and roosting refuge for migrating flocks of Red-winged blackbirds.

### ***Non-Lethal Control Techniques***

The majority of harassment efforts are conducted with the use of a 15-mm pistol-style pyrotechnic launcher and commercially available “screamer” and “banger” pyrotechnics. Shotgun harassment, which has a similar effect, is performed with a 12-gauge shotgun and live ammunition. Pyrotechnics are used as a frightening device to disperse flocks of birds from the active area, the wetland areas, or other locations where the birds congregate. Target birds are identified by bird control while driving around the property or while viewing the mobile radar display which provide bird control personnel real-time information as to where bird activity is occurring. Bird control staff exit the vehicle, walk toward the birds using a whistle or shouting, and then use a pyrotechnic to further harass the problem birds. Additionally WMK personnel are trained annually in bird

control harassment methods and engage in harassment actions in concert with the DeTect bird control staff.

Bird control personnel record the number of pyrotechnics used and numbers and species of birds dispersed. The number of pyrotechnics used had decreased from April 1, 2006 to January 2007. This is likely due to the response of the target birds to this technique. Bird control staff has observed a decrease in the number of problem birds, which also means that fewer pyrotechnics are used. During the months of February and March 2007 migrating birds moved through the property and the number of pyrotechnics used went up correspondingly.

Bird control staff also use propane cannons and distress call recordings with good effect against flocks of blackbirds and starlings attempting to feed or loaf around the property. These tools supplement the use of pyrotechnics by providing similar fear stimuli. Propane cannons are used extensively around the active area and more often from the bed of the bird control truck while driving to increase harassment intensity and coverage. They are moved around the property frequently and used for limited times to prevent the birds from becoming accustomed to the sound. Propane cannons have been particularly effective at harassing soaring Turkey vultures. The acoustic distress caller is mounted to the bird control truck, and is utilized chiefly to disperse flocks of starlings.

Additionally, birds are harassed and dispersed by vehicle hazing (including the use of the vehicle horn and lights), use of starter caps only, whistle, clapping of hands, and by walking toward the birds and shouting. Walking, clapping, and shouting are noted to be most effective against waterfowl and blackbirds attempting to roost in the wetlands. The use of a loud whistle began as a safety precaution before using a pyrotechnic around the active area or where staff may be startled by the report. However, bird control staff has noticed it is also useful to disperse flocks without the additional pyrotechnic. Bird control staff has also noticed blackbirds reacting (fleeing) to the sight of the service truck (with flashing safety light) and to the sound of the vehicle and horn. Additionally, in mid-2007, DeTect started using a work dog to herd fledgling waterfowl off the OLRDF property. The dog has also proven useful for harassing wading birds such as herons along the banks of the various ditches and impoundments on the landfill property.

In an effort to reduce the density of raptors onsite, several types of commercially available anti-perching devices were installed on gas well heads during spring 2007. A portion of the OLRDF property was chosen due to the lack of alternative perches on it, as well as the proximity to existing observation points. Plastic and stainless steel "bird spikes" were used on electrical control boxes and horizontal vacuum hoses. "Bird spiders" were also used in several different configurations, mainly on horizontal vacuum hoses and on the tops of the well heads. Differences in the heights of various horizontal vacuum hoses necessitated alternate attachment points. The gas wells were flagged and were visible from one bird survey point, as well as from the MERLIN radar pad and the access road. This allowed for regular observations, as staff frequent these locations. Bird control staff also inspect the devices and the wells for evidence of raptor loafing on a weekly basis. Large raptors perching on the commercial devices has been

infrequent with only one incident in June 2007 when an American Kestrel is thought to have been loafing on the device. Otherwise the commercially available spikes and spiders have been effective at keeping larger hawks from perching on the well heads. Raptor observations in the area were also lower following deployment of the anti-perching devices and Red-tailed hawk loafing has shifted to the large power line towers or smaller power poles located on site. DeTect staff continue to monitor the effectiveness of this program and will install the devices at other locations should this technique prove effective over the long term.

The trial use of a Long Range Acoustical Device (LRAD) began in August 2007. This device allows a user to focus a beam of sound that can be used to harass raptor species and mixed blackbirds. The LRAD system is a product of American Technology Corporation (ATC) originally developed as a long-range hailing and warning, directed acoustic beam device. In 2006 DeTect teamed with ATC to assess and further develop the LRAD technology as a bird deterrent device. The LRAD produces a loud, directional auditory stimulus and has been successfully demonstrated to frighten birds at extended ranges (Florida LRAD Tests, DeTect/ATC Joint Report, 2006). The test protocol for use of the LRAD at the OLRDF includes an initial analysis of the area of coverage and level of sound produced by the LRAD system; development of worker safety protocols; assessment of the effectiveness of the system at dispersing birds at a specified application distances; and development of operational procedures and a sound library.

A specific focus of the LRAD deployment at OLRDF will be to assess the system's effectiveness on raptors in the airspace above a site. DeTect currently is conducting a long-term trial of the system at the OLRDF and other sites worldwide to develop operational protocols, define the system's effectiveness and implement automated bird tracking and direction of the LRAD using a MERLIN Avian Radar System. Using a modified version of the existing MERLIN *detect & deter* software, the LRAD unit will be slaved to the radar and will be able to track targets above a site automatically firing the LRAD to maintain a clear airspace. Field tests are ongoing and are not available to be reported conclusively on for this paper.

### ***Lethal Techniques***

In a two year period, from March 2002 to March 2004, USDA-WS conducted 22 avicide treatments and lethally removed 1,102 European starlings, 226 mixed blackbirds, 187 Mallards, 1 Wood duck, 1 American coot, 2 Horned grebes, 15 Great-blue herons, 9 Yellow-crowned night herons, 8 Black-crowned night herons, 1 Great egret, 36 Red-tailed hawks, 7 Red-shouldered hawks, 8 American kestrels, 11 Great-horned owls, 3 Turkey vultures, 1 Cooper's hawk, 11 American crows, 465 Mourning doves, and 58 Ring-billed gulls. The totals reported in subsequent reports do not indicate species, but list annual take on groupings of birds. From April 2004 to March 2006 an additional 126 waterfowl, 6,418 mixed blackbirds, 1,063 Mourning doves, 104 raptors, and 48 shorebirds were removed by USDA-WS using conventional methods.



Since taking over the daily bird control duties at OLRDF, DeTect, at the direction of WMK, has focused the effort on use of non-lethal methods and has used lethal techniques only to reinforce the non-lethal harassment efforts as a measure of last resort. DeTect personnel have completing Kentucky Fish and Wildlife requirements for Commercial Nuisance Wildlife Control permits, however, under the Federal Depredation order for blackbirds; no federal or state permit is required to take European starlings, Red-winged blackbirds, grackles, Brown-headed cowbirds, House sparrows, or Rock doves. OLRDF also received a renewed federal migratory bird depredation permit in May 2007 to continue lethal control methods on protected bird species as needed. Species listed on the permit include: Red-tailed hawks, American kestrels, Mallards, Canada Geese, Black vultures, Turkey vultures, Ring-billed gulls, Herring gulls, and Mourning doves.

Since taking over the bird control program, DeTect bird control personnel have only rarely needed to use this tactic. Using a 12 gauge shotgun, lethal removal of species is utilized only when flocks of birds do not respond to the use of pyrotechnics, propane cannons or other non-lethal techniques. Other non-lethal methods are used during lethal control to ensure a reinforcement effect on the remaining flocks instead of simply removal of individuals. The use of lethal reinforcement has decreased significantly in part due to the effectiveness and variety of the non-lethal techniques currently being used. Since April 2006 only 12 waterfowl, 1,277 mixed blackbirds, 7 Ring-billed gulls, and 53 Mourning doves were taken on the property. Of those, 6 Mallards, 2 Canada geese, 7 Ring-billed gulls, and all of the mixed blackbirds were taken under permit. No raptors or other shorebirds have been taken since DeTect took over responsibility for the program. The remaining species were harvested during the state specified hunting season.

### ***Visual Surveys***

Population monitoring is an important component to any adaptive management program. The Bird Control Manual for OLRDF outlines a point count method for bird surveys. Bird control personnel perform two observations on a daily basis, 5 days per week, at 5 locations on the landfill property as well as one observation on Saturdays. A morning observation is conducted between approximately 0800 and 1000, and an afternoon observation is conducted between 1400 and 1600. No harassment techniques are used during the observation periods. Each site is visited for approximately 5 minutes, and all species seen or heard within approximately 300-foot radius are recorded. Date, weather, and time are also recorded.

One of the observation stations includes visibility of a City stormwater retention basin located adjacent to the facility. This presents a potential problem for data analysis, due to the presence of an offsite bird attraction that is not under the control of the landfill. Although bird species and numbers are recorded for this observation site, data for the site is separated from analysis as the OLRDF bird control personnel are not able to operate on the offsite property. Bird control staff regularly observes waterfowl and

shorebirds beyond the 300 foot observation radius, but cannot include these observations in data collection and analysis as these birds are not within the OLRDF control area.

### ***Radar Monitoring***

The OLRDF operates a MERLIN™ XS2530i Avian Radar System manufactured by DeTect, Inc. to monitor bird activity on the landfill and the surrounding area to (1) provide real-time information and data to landfill bird control staff, and (2) monitor and record bird activity levels on and off of the landfill property. The MERLIN system uses two radars to detect and track bird targets: a vertically-scanning X-band radar and a horizontally-scanning S-Band radar. Bird targets are continually recorded by the system to a MS Access database and are sized into small, medium, large and flock size categories by the system. The system has been operating near continuously (24-7) since the second quarter of 2005.

The MERLIN bird detection software was specifically developed to detect and track small targets (birds) at distance. MERLIN uses a dual radar configuration to provide simultaneous vertical scanning up to 15,000 feet (ft) above ground level (AGL) and horizontally around the radar out to 6 nautical miles (nm). The system uses modified marine radar sensors with wide-beam, T-bar type antennas for maximum airspace coverage. The system has proven very reliable at the OLRDF, experiencing only minor maintenance and repair costs (under \$2,200 total cost in over nearly 2-½ years of 24 hour a day operation). The dual T-bar antenna was selected as it provides a wider fan-shaped beam angle (20+ degrees) than other antenna types, providing increased area of surveillance and more accurate altitude data on bird targets.

The MERLIN system at the OLRDF uses a 3-centimeter (cm) X-band vertical scanning radar (VSR) with 25 kilowatt (kW) transmit power operating in a windmill-type manner scanning horizon-to-horizon through the vertical plane using the vertical scanning method (Harmata et al., 1999) to provide y-z target data. In this orientation, the radar scans a vertical slice through the atmosphere collecting data on target altitude across the scan width providing y (distance) and z (altitude) locational data on targets. For the OLRDF installation, the vertical radar is aligned in a cross section covering equal parts on the landfill and offsite to the east and west. The vertical radar has been verified to reliably detect small bird targets up to 1.5 nm to either side of the radar. Horizontal bird track information is provided by the Horizontal Surveillance Radar (HSR) that operates in the horizontal providing x-y target data 360 degrees around the radar. The HSR is a 10-cm S-band radar with a 30 kW transmit power and a detection range for small birds has been verified at the OLRDF out to 2 nm and large birds and flocks out to 4 nm.

The system displays bird target and track information in real time on computer monitors at the radar unit as well as at a remote mobile laptop computer monitor. The radar data is transmitted from the radar unit to the remote mobile computer display in real-time using the local WWAN (cellular wireless network). Data are presented at the radar unit on two monitors: one for the VSR (vertical information) and one for the HSR (horizontal)

information. Standard aviation-type radar display formats are used, including various user selectable display options such as color-coded target symbols, target trails and target tags with a range of attribute display options. The HSR (horizontal radar) bird tracks are displayed in real-time in a plan position indicator (PPI) display view providing x-y location data for each target tracked by the system. The radar range setting as currently set is indicated in one nm increment range rings with a custom underlay of the surrounding landfill area features that include the landfill boundary, wetlands resource areas, the local municipal stormwater impoundment, the point count survey sites, the airport runways and other area features for user reference.

Using the remote mobile display, DeTect bird control staff at the OLRDF can ground truth bird track information as well as have site-wide surveillance from the bird control service truck at any location on the landfill. This display allows bird control staff to more effectively target harassment efforts at the landfill as well as develop a robust database of bird activity on the landfill for use in historic modeling and trend analysis.

In addition to the real time display of bird tracks from the radar, the bird track data recorded by the radar is processed daily by DeTect and the number of bird targets counted by the radar on and off the landfill over each 24 hour period for both the vertical and horizontal radars are tabulated and reported. The data is accumulated and analyzed each quarter to compare the bird activity levels on the landfill with the background areas (off the landfill). To date, the radar data indicates that the level of bird activity on the landfill is not significantly greater than that of the surround area. This data is particularly significant in that the landfill represents the best habitat as the area surrounding the landfill is highly industrialized.

## **Results**

Overall, bird populations have been responsive to the variety of primarily non-lethal harassment efforts employed since DeTect took over bird control responsibilities at the OLRDF in 2006. Bird control staffing schedules have been staggered to expand active bird control coverage from dawn to dusk and during the landfill operating hours on Saturdays (generally 7 am to noon). Based on observation data from 2002 until present, the average number of birds observed during the daily point counts is decreasing for most species. The overall trend in raptor observations appears to go up during this period, however when analyzed from April 2006 to present, the trend is decreasing. The same conclusions can be drawn from point count data, and all bird groups of concern at OLRDF are decreasing.

The number of pyrotechnics used against target species is also decreasing, possibly due to the responsiveness of the birds. Fewer birds are also resident on the landfill, therefore the need for pyrotechnics has accordingly decreased over the past 18 months (there was a slight increase in spring 2007 due to native birds migrating through the area). Additionally, the number of propane cannon minutes has decreased. Use of lethal methods has been significantly scaled back since DeTect took over the bird control activities.

### ***Radar Data – Real-time & Archived***

The radar data are being used daily to assess the level, location, and timing of bird activity, and to plan daily bird control efforts. Each morning the previous day's data is downloaded and analyzed for trends. Decisions can then be made for the bird control staff to alter schedules and/or targeted harassment locations. Bird control staff are also utilizing the remote real-time radar display on a daily basis. Using the horizontal surveillance radar display, the bird control can observe bird activity across the entire site while making rounds in the bird control service truck. This functionality saves time when determining the need to initiate harassment efforts.

The value of the radar data archived record was demonstrated in the fall of 2006 when, over a two night period, the airport's largest tenant, United Parcel Service (UPS), experienced 14 bird strikes. In an email to the airport, UPS attributed the cause of the strikes to be related to the presence of the landfill proximate to the airport (DeTect Report on UPS Birdstrikes, Sep 19, 2006). Upon receipt of a copy of the UPS email, WMK notified DeTect. DeTect queried the archived radar data for the reported strike periods (all radar data is recorded and maintained in a permanent archive) and extracted and analyzed the bird activity as tracked by the MERLIN radar during the strike times (between 11:45 PM and 12:55 AM on September 13 and 14, 2006).

The radar data clearly showed moderate to heavy migratory bird activity at higher altitudes (250+ ft AGL) for these nights, starting each night at around 1900-2000 (7-8 PM local) and continuing through around 0300-0400 (3-4 AM local). Based on review of the data, the evidence indicated that the strikes resulted from activity not related to and not controllable by the landfill (seasonal night migration). The radar data and analysis was presented, without rebuttal, at the wildlife management meeting held by the airport in October 2006 that included representatives from the airport, UPS, USDA-WS, the Kentucky Air National Guard (ANG), Northwest airlines, WMK, BASH, Inc., and DeTect. The benefit of having the radar system was very evident. As follow-up to the meeting, representatives of UPS and the ANG toured the landfill to see WMK's bird control program in action and expressed an interest in having the radar information provided to their respective operations centers in real time. After the tour, the Headquarters ANG representative stated unequivocally that the WMK program was the most comprehensive bird control program he had ever seen.

Yearly trends in bird activity are also assessed with the radar to support and evaluate continued bird control efforts at OLRDF. The 2005 and 2006 radar data were statistically analyzed to determine if there was a significant difference between the numbers of biological target tracks over the landfill compared with similar areas located off of the facility (comparable areas were selected to minimize changes in the probability of detection due to distance from the radar). The vertical radar data was limited to a maximum altitude of 1000 feet above ground level (the airspace upper limit controllable by the landfill). Data were compiled into daily track totals (a track is defined as a target that has been identified and correlated for at least 3 out of 4 consecutive scans) and

onsite samples compared to offsite samples (the total number of target tracks per day provides a reasonable index of the level of biological activity associated with a given area).

Statistical analysis of the vertical radar data for both 2005 and 2006 did not indicate any statistical difference between the average numbers of radar tracks recorded on the landfill facility compared with tracks recorded off of the facility, indicating that the level of bird activity on the landfill is not greater than the background level of bird activity of the area surrounding the landfill. Data sets were compared using both parametric and non-parametric analyses (T-Test and Mann-Whitney [Wilcoxon] W test) with none showing any statistical significance. Variances of each sample group were homoscedastic, but data were significantly skewed, suggesting the non-parametric analysis.

Analysis of horizontal scan data showed a statistically significant difference between the onsite sample area and the offsite sample area in both 2005 and 2006. In 2005, the average number of daily horizontal tracks was greater for the onsite sample area (average = 23.1, median =16) compared with the offsite numbers (average = 13.8, median =11). A non-parametric comparison (Mann-Whitney Wilcoxon W Test) indicated a statistically significant difference between the onsite and offsite groups ( $W=-5196.5$ ,  $P=0.0000005$ ). In 2006 the trend was reversed with the offsite sample group having a significantly higher median radar track count than the onsite sample site. The average off-site count was 80.5 (median = 69) and the onsite average was 57.9 (median = 53). The median number of radar tracks off-site was significantly higher than the on-site sample site (Mann-Whitney Wilcoxon W Test,  $W=7561.5$ ,  $P= 0.0000114$ ).

Overall, the statistical analysis indicates that the level of bird activity on the landfill is not statistically greater than the background level of bird activity in the area surrounding the landfill. Additionally, the radar data do not indicate that the landfill is attracting birds at greater numbers than the surrounding areas. Most notably, the decrease in on-landfill horizontal radar bird target counts relative to the off-landfill counts beginning in March 2006 corresponds with a greatly expanded bird control effort at the landfill that included sunrise to sunset and Saturday operational hour coverage and a more aggressive application diverse, non-lethal harassment methods (with a significant reduction in lethal methods). The data for 2007 will undergo detailed statistical analysis as part of the year-end reporting process, however data to date indicate a continued downward trend in the over levels of bird activity on the landfill.

## **Conclusion**

WMK's OLRDF is committed to operating in a manner that significantly reduces its attractiveness to birds and is undertaking efforts far beyond those of other stakeholders in the area. The airport and the landfill share a long history as adjacent land users without conflict. By implementing a comprehensive, state-of-the-art bird control program with a detailed program of measuring, WMK has demonstrated that the two land uses are not necessarily incompatible.

The results of the first two years of the program show that by employing various passive and active bird management and control techniques, OLRDF bird activity is being maintained at or below background levels. Additionally, recent control efforts since 2006 have show that this success can be maintained using predominantly non-lethal control methods meeting Waste Management’s mission to “make a positive difference for the environment in every aspect of its business”. Similar success may not be possible at every landfill with a neighboring airport, however the lessons learned at OLRDF could help both landfill and airport managers develop and apply comprehensive bird control strategies that work – for both landfills and airports.