CASE STUDY

Archaeological survey with multi-channel GPR
Peddocks Island, in Boston Harbor, is home to Fort Andrews, an historical defense outpost mainly active during the second world war. The island represents an interesting archaeological site due to its importance in the past two centuries. Ellen Berkland, a Boston archaeologist with the Department of Conservation and Recreation wanted to know more about the history of the island, but did not know where to begin her research. Of course money and time are always an issue, so being able to pinpoint an area to begin digging would be helpful.
Peddocks Island was used by farmers since 1634. There due to the proximity to the mainland also was a prominent military role. Said to be the site of a patriot infantrymen’s raid on a Loyalist farm, Peddocks also saw over 600 patriot militiamen stationed on the island in 1776, to guard the harbor against the return of British troops. It is one of the many harbor islands known to be used by Native Americans prior to European settlement. Home to Fort Andrews and active in harbor defense from 1904 to the end of World War II, 26 structures remain, including guardhouses, prisoner-of-war barracks, stables, a gymnasium and a firehouse.
GPR is one of the near-surface geophysical methods that is gaining acceptance as a viable means of field study in archaeology. These systems are usually comprised of a single antenna and can be pulled across the ground by a handle or rope, or mounted on a wheeled buggy and pushed along the surface much like a baby stroller. A single line of data is acquired as the antenna moves along the surface. This can be used to look for reflections from underground objects such as burials or rocks and buried debris. The limit of the technology is mainly related to the difficult interpretation of the data acquired and the terrain composition.
In order to resolve the problem and acquire a high definition map of buried remains IDS GeoRadar provided Ellen an opportunity to use the latest technology GPR equipment developed by IDS GeoRadar. Stream X is a vehicle towed, multi-channel GPR comprising 16 dipoles at 200MHZ. The system is able to acquire multiple lines of data simultaneously as the array moves along the surface. Positioning information is normally acquired at the same time which allows every point of data to be placed on a map. Each channel of radar is closely spaced allowing a dense grid of sample points to be created. This grid can be viewed from above much like a map. Once the data is processed, plan views can be displayed consecutively deeper into the earth. As objects come into view, their shape, size and position can clearly be seen, much like a medical image such as a CAT scan or MRI slicing through the human body.
The morning began with a ride on a boat with destination Peddocks Island, then we proceed with setting up the Stream X on a vehicle (ATV-Kubota), which took thirty minutes to complete. Two sites were chosen for acquisition. The Hill where cannons were situated historically was our first choice for the survey. The second location appears to be a plain field in front of the fallen Fort. This used to be the Parade Grounds during the world war two.
In order to run the geophysical survey with a multi-channel array (GPR system) from IDS GeoRadar it required a driver that had to follow the navigation software which was connected to a positioning system (GPS or Total Station) and installed in the acquisition laptop just in front of the vehicle. A second technician had to manage the acquisition software in real time checking the collection of the data.

For areas where the terrain could be uneven the system has an electrical crane which is operated from the cab of the vehicle, so it was easy for the driver, to raise the antenna box and drive the Kubota similar to site 1 (the hill). At Peddocks Island we employed a robotic total station which was quick and easy for the IDS GeoRadar team to setup. We chose the center of the hill for its location. The terrain was not the best area because of many branches, rocks and other debris.
The mechanical kit, for that reason, was set at a certain distance from the terrain in order to limit the damage to the black box underneath the antennas. The acquisition required about 3 hours navigating through the debris and working through the various slopes surrounding the area. The Kubota was the perfect vehicle for such a site. Not surprising was the quality of the data, the results were very impressive and the hill didn’t affect the results. The second site was easier due to the terrain condition and the technicians were able to push the Stream X at more than 10 miles/hour. The entire site (500 x 200 feet) was collected in less than 3 hours. The attendees were really impressed by the ease of use of the system. Meg Watters who is a well-known archaeologist said “This was the best GPR demo I’ve been to, which includes most of my own. There were no problems with equipment once things started; data collection was smooth and preliminary viewing in the field clear.”
ARCHAEOLOGICAL SURVEY WITH MULTI-CHANNEL GPR

The Survey at a glance

The result is a **high definition map** obtained processing the data acquired during the survey. Those maps act as primary data that can be used to guide the placement of excavations, or to define sensitive areas containing cultural remains to avoid. The map was processed **directly in the field**, this is fundamental to check the overall quality of the data and a precise idea of the surveyed area. In the following picture you can see the maps obtained from the second site.