# Lead Exposure Analysis

# of the

# Fort Ord Deconstruction Project

A Capstone Project

Presented to the Faculty of Earth Systems Science and Policy

in the

Center for Science, Technology, and Information Resources

at

California State University, Monterey Bay

in Partial Fulfillment of the Requirements for the Degree of

Bachelor of Science

By

David Johnston

May 8, 2000

## Summary/Abstract

This capstone project is an effort to determine whether airborne lead produced during the Fort Ord Reuse Authority's, (FORA) Deconstruction Project will pose any significant danger to neighboring receptors. Working with the Monterey Bay Unified Air Pollution Control District, (MBUAPCD) and FORA, I created a GIS project depicting Ford Ord and neighboring regions. It is to be used as an analytical tool in determining possible lead exposure risk to the public produced during the removal of structures from the former Ford Ord.

The project will also serve as an aid in FORA's Deconstruction Project, which is a full-scale effort to remove structures and clean up hazardous materials while diverting valuable building materials from the local landfill. The project will be used as a communication and record-keeping tool during the 3-5 year building removal project.

Included in the final project are the following GIS layers: a Digital Ortho Quad (DOQ), a Digital Elevation Model (DEM), buildings, roads, and parcel ownership with attached attribute data, and results from an ISCST3 (EPA standard) air dispersion modeling program. In addition, interpolation analysis of the modeling data and combined risk from multiple sources has been performed to show the spatial distributions of the overall concentrations of lead. All of this data has been manipulated to display in an accurate and comprehensive manner in ArcView. From this information, exposure levels are evident and receptors are identified.

The data used to input the ISCST3 model was acquired from preliminary testing on a Pilot Deconstruction Project. The numbers used in the model were the worst-case scenario results and do not represent actual concentration levels. Additional studies need to be made to determine initial lead content for more accurate modeling to be done. At this point, it is undetermined what levels of lead concentration will be suitable to the Air Resources Board. When satisfactory data is released on lead content and specific numbers of acceptability are implemented, the model will be able to clearly determine whether an area is within compliance.

# Table of Contents

## Background and Goals

In the next few years, sections of Ford Ord will be acquired by a number of different recipients in the community. Before redevelopment of the acquired areas can begin, over 2,300 structures must be demolished and disposed of. The Fort Ord Reuse Authority's, (FORA) Deconstruction Project is an effort to remove obsolete buildings and hazardous materials while also saving valuable building materials. FORA is the governing body that oversees the transition of the former Fort Ord to civilian usage (FORA, 2000).

The first area designated for building removal will be the Hayes Park Parcel adjacent to Highway 1, near Seaside High School. It consists of a variety of previously occupied military buildings, mainly bunker type structures. (Fig 1) The developer, Kaufman and Broad, is anticipating construction of high-end housing in Seaside's effort to provide a market driven revitalization and offer a balance of housing products in their community.

Fig 1- Typical bunker

Thirteen local, state, and federal agencies will oversee the demolition process of the former Fort Ord. Stakeholders include the City of Marina, The City of Seaside, Kaufman & Broad, CSUMB, Seaside High School, and local businesses and residents. It is important to determine if these stakeholders will be impacted by the demolition work.

During the removal process, lead from the paint on these buildings has the potential of becoming airborne. The Monterey Bay Unified Air Pollution Control District,

(MBUAPCD) is responsible for monitoring all airborne particulates produced during this building removal operation in order to protect the public's health. The California health & Safety code, section 40000 establishes that local and regional authorities have the primary responsibility for control of air pollution from all sources, other than emissions from motor vehicles (Quentin, 2000).

This project will serve as a visual tool to help these agencies assess the protection and awareness needed in the lead abatement process. It will display the results from an air dispersion model showing how lead concentrations will be dispersed and what receptors will be affected in the area. Due to the complex nature of air modeling and EPA guidelines, the data will first be fed into a modeling program at the MBUAPCD. The project will be able to utilize grid data results from this ISCST3 model and display the information accurately over a view of Fort Ord. The view will also contain pertinent information, such as building locations and usage. From an initial lead content figure, it will be possible to physically see what the exposure levels are around an object. From this analysis, compliance of the California Air Resources Board standards can be easily ascertained. It will also show combined concentrations from multiple source locations determining how much risk workers and neighboring areas will be exposed to. This will be important, as there will be multiple abatement crews working simultaneously.

An initial Pilot Deconstruction effort was made to test the abatement process. Before the demolition, structures were tested for lead content by an independent environmental consultant, White Environment Management, Inc. During the procedure, air samples

were monitored at a number of different hot spots, including on the workers and machinery used to break up the concrete. The samples were later sent to Micro Analytical Laboratories for Atomic Absorption Spectroscopy and tested for lead content. As predicted from the preliminary samples of lead, it was determined that airborne lead was not a significant problem during the Pilot Deconstruction Project (Ramezanzadeh, 2000). However, the specific numbers of acceptability used from the preliminary Air Resources Board draft have not yet been adopted. In addition, further testing will be required of other buildings and different structure types to satisfy regulatory agencies.

In April 1997, the Air Resources Board identified lead as a toxic air contaminant. Due to the departure of the previous methodologies used to estimate non-cancer health effects associated with lead, the Air Resource Board directed that risk management guidelines be developed. In September 1999, preliminary draft guidelines were released and are now undergoing review and refinement. The estimated time to adopt the guidelines was six months after they were proposed (Quentin, 2000). The MBUAPCD does not have specific regulations or guidelines that require a specific course of action to be followed in the demolition process. Rather, their requirements apply to the evaluation of project specific aspects, the determination of the resultant public health risk from the air contaminant emissions, and compliance with acceptable risk criteria.

Numerous studies have linked excessive lead exposure with mental retardation, growth defects, high blood pressure, and various other afflictions (J.T, 1999). Consequently, the United States and many other countries have eliminated lead from gas, paints, window

blinds, and many other products. Lead poisoning remains a problem in certain regions however, especially urban areas with a history of lead based paint use (Murgueytio et al, 1996).

Current research is just now discovering the relationship between lead and how it adversely effects the development of the human brain. "We think lead is binding to the same pockets where calcium ions usually sit." Lead, however, does not trigger synaptotagmin to perform all the molecular actions that calcium prompts (J.T, 1999).

Recent research has shown that lead levels as low as 1-5 mg per dl may affect mental and motor impairment in children under two years old (US Newswire, 1999). It is feared that without proper assessment and engineering controls airborne lead based paint chips could become an exposure problem for children who will inhabit the new homes produced by redevelopment. Another potential pathway for contamination of children is through parents inadvertently bringing lead into the household on their clothes after engaging in improper removal of lead based paint at their work place. Protection from exposure and awareness of lead exposure pathways is very important to both the MBUAPCD and FORA.

Although monitoring lead levels in the blood stream is a good indicator of exposure, it is not without its flaws. If intermittent exposure to lead occurs in several distinct environments, the blood lead concentration reflects both recent and past exposure to lead. Thus, biological effects for populations with the same blood lead concentration may not

be the same since different exposure time scales may have been involved (US Dept H&HS, 1998).

Lead is an important environmental issue throughout the world with varying policies, leaving it in the vague jurisdiction of environmental justice to determine who is protected. Historically, it has been the disadvantaged, under represented and helpless who are at the highest risk of being poisoned through exposure to lead in paint. Lead poisoning is a recognized threat to children living in urban areas of the United States. However, there are few studies available on rural areas suggesting that urban neighborhoods, especially inner city areas and regions near industry, are at higher risk. These areas are often associated with lower class families and minorities. With the exception of superfund sites, little has been done to assess levels of lead or educate people about the potential hazard (Murgueytio et al, 1996).

## Project Description

Multiple layers were acquired and manipulated in the final display of this GIS project. A Digital Ortho Quad (DOQ), a spatially corrected aerial photograph, is the foundation layer showing the area at high quality resolution. To prepare the DOQ, four sections were mosaiced together and resampled to the North American Datum, State Plane Coordinate System. This coordinate system was chosen because it is the most common among government agencies. The DOQ further required georeferencing to align with attributes. These layers were acquired from the instructors and prepared using TNTmips, a software

package from MicroImages Inc. The resulting rasters were exported as .tiff files and then added to the ArcView display.

A Digital Elevation Model, (DEM) shows the elevation of the terrain on Fort Ord. (Fig 2) It is useful in modeling and planning strategies. Vector polygons, created images drawn over the DOQ, outline areas of interest such as parcels and roadways. Attached to these polygons is information about the object, for example name, history, area, etc. This information can be accessed by pointing to a specific object in ArcView, making data appear on the screen in database format. This data was acquired through the U.S. Army Corps of Engineers. The army paid for a study of the area to be carried out by Jones & Stokes Associates in 1998. Building, road, and parcel data were accurate during the time of the study but are constantly changing. For the purpose of this project, the information is sufficiently accurate.

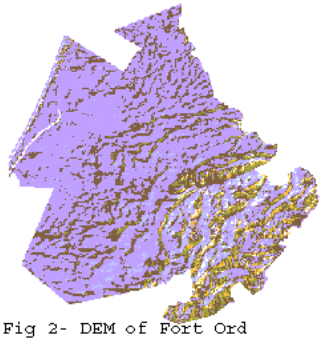


Fig 2- DEM of Fort Ord

Preliminary modeling was done by the MBUAPCD. Lead content data, weather data, and a number of other factors were input into an air dispersion modeling program. The program used is called BEEST designed by BEE-Line Software. It incorporates the ISCST3 modeling code. This modeling code was developed by The Environmental Protection Agency and is the only air dispersion

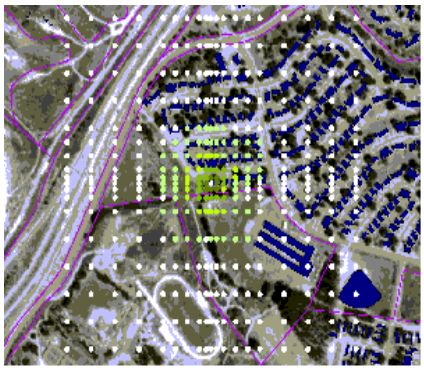
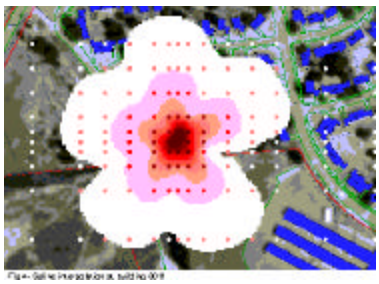


Fig 3- Lead Concentraion Points for Bldg 8011.

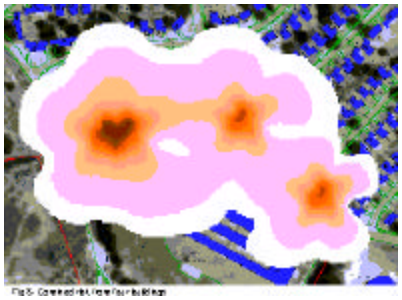
modeling accepted by regulatory agencies. Using worst-case scenario estimates acquired from White Environmental, the model produced concentration points within a 300-meter radius. This grid data was then manipulated and added to ArcView to show the distribution over the Fort Ord area. (Fig 3) The building used in the model, 8011, is closest to Seaside High School, located directly south.

The concentration data was then run through an interpolate grid process. The process,



called spline interpolation named after flexible rulers used by drafters, creates shaded regions. It fits a minimum-curvature surface through the input points, like a rubber sheet that is bent around the samples. This allows shading of regions with similar concentrations for visual interpretation. (Fig 4)

Lead concentrations at three locations were analyzed in the project due to the possibility of multiple crews working simultaneously. When more than one building is undergoing the abatement process, the concentration levels will be cumulative. Using the spatial



analyst extension in ArcView, I added the interpolated grids together to create a new combined concentration grid. (Fig 5) This additional risk analysis will allow compliance to be determined when more than one building is undergoing the abatement process, which most likely will be the case.

These layers are saved in one ArcView project file, with multiple views showing stages of the project. The completed project was recorded onto Compact Disc for distribution to agencies and ESSP faculty.

## Project Analysis

Whether the Deconstruction Project is going to pose any threat to the public, based on Air Resources Board studies, is inconclusive. At this time, there is not accurate enough knowledge of lead content in specific buildings. Further, the Air Resources Board has not released lead concentration acceptability figures.

The project was successful in that it is a working GIS display that shows compliance based on ISCST modeling results. It will provide a solution to the lead exposure question by displaying results of the model over the area of interest. In the display, resultant lead exposure concentrations will be apparent as well as what receptors will be affected. The project is only as good as the data it uses, however. If the modeling data provided by MBUAPCD is flawed, then the projects display will be inaccurate. Possible sources of error during the modeling procedure could come from incorrect input data. The lead based paint content of a building is difficult to determine.

The EPA has been working on the source code used in the model for over fifteen years. It takes into consideration 17 characteristics of weather data acquired every hour of every day of the year. Still, the accuracy of weather modeling is always uncertain.

Another problem with the project is the interpolation process. There are three variables in the process: weight, type, and number of points. All of which are somewhat of a mystery to me. Apparently, they have to do with how tight and smooth the interpolation fits the data. To understand the variables completely would require extensive research. I experimented with various settings; the ones I chose looked the most accurate, but are certainly not the only interpretation.

One of the strengths of the project is that you can see the concentration levels displayed over the area of interest. This is an enormous innovation for the MBUAPCD. Previously, they used grid data on a spreadsheet.

Another strength of the project is its ability to combine multiple source data. This has rarely been done, and is certainly of interest to the MBUAPCD. Finally, I feel the greatest strength of the project is the potential for displaying other types of modeling. I created a system to transfer grid data to accurately display in a GIS program. This project could potentially display modeling results of a variety of other types of studies, for example, MTBE contamination underground, or any type of airborne substance. GIS is a new enough field that most agencies have never seen this capability, and I think it is a very powerful tool.

## Literature Cited

1- http:/www.fora.org/pilot.html, Fort Ord Reuse Authority. Nov 1999.

2- J.T. 1999. A lead on why lead hurts the brain. Science News v156 i19 p303.

3- Murgueytio A.M, Evans R.G, Roberts D, Moehr T. 1996. Prevalence of childhood lead poisoning in a lead mining area. Journal of Environmental Health v58n10p12(6).

4- Quentin D. 2000. Fort Ord Lead Based Paint Issues. Monterey Bay Unified Air Pollution Control District 1-2.

5- Ramezanzadeh, F. 2000. AA Analytical Report, Lead in Air Samples. Micro Analytical Laboratories, Inc 1-4.

6- U.S. Department of Health and Human Services, 1998. Toxicology Profile for Lead. Public Health Service Agency for Toxic Substances and Disease Registry 1:22-23.

7. US Newswire. 1999. NMA: Low Levels of Lead Exposure Linked to Neurobehavioral Effects in Children. US Newswire p1008224n0042.