

Identifying Areas Affected by Air Pollution in Mira Loma

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October 2012 – July 2013

Submission date: 17 July 2013

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### **Acknowledgements**

I acknowledge that this project was supported by a United States Department of Education Grant No. P120A100072-11.

I respectfully acknowledge my advisor, Dr. Robert Phalen, for proposing this project and exposing me to the environmental health science field. I also acknowledge my partner Blair Blokzyl for assisting us with collecting and analyzing data, as well as developing the algorithm to determine dominant wind direction. I thank Boykin Witherspoon (Director of Programs at the Water Resources Institute at California State University, San Bernardino) for his GIS training and his assistance with the project map.

I also thank Dr. David Turner (Professor at the School of Computer Science and Engineering at California State University, San Bernardino) for recommending me to Julie Lappin (Program Manager at Water Resources Institute) as a candidate for this internship.

### **Executive Summary**

The purpose of this project was to identify residential areas in Mira Loma, California that are downwind of major air pollution sources such as intermodal facilities, factories, freeways, and high-traffic roadways. These areas are identified in a map built using geographic information systems (GIS) software. This map will be published and available to the community to view and provide feedback. First, I created the first version of the community GIS map using Esri's GIS software suite, ArcGIS, specifically ArcMap. This map contained information about major air pollution sources and identified the places where we planned to collect data. Later, my advisor, Dr. Phalen, Blair Blokzyl, and I collected local environmental data using monitoring tools, such as anemometers, and particulate detectors. We analyzed the data and developed an algorithm to predict wind speed within the area.

### **Project Objectives**

I am a senior Computer Systems student at California State University, San Bernardino. My concentration is system administration, and my field of study is a Science, Technology, Engineering, and Mathematics (STEM) field. My goal in life is to work as an operations engineer. I want to build and maintain operational, efficient, and reliable systems for companies that take resources and make invaluable products. Although my main focus has been systems administration, I am taking a generalist approach to learning about technical operations. I want to know about many topics in the fields of system administration, networking, database administration, and security. I'm also becoming familiar with multiple technologies. I started this project in October of 2012 because I was interested in learning more about geographic information systems (GIS) and its applications. My initial goals were to learn about GIS and

develop a technical understanding of how to use GIS applications. After meeting with Dr. Phalen and discussing the project he proposed, I shared his goal of performing field work to collect data, analyze it, and share the results with the community using a GIS map which would inform Mira Loma residents and community members about areas affected by pollution. My specific tasks for this project were building the GIS map, conducting field work, inputting the collected data in the map, and using the algorithm for predicting wind patterns to recognize areas downwind of air pollution sources.

## **Project Approach**

### *GIS Map*

I started creating the GIS map after I performed an introductory training using ArcGIS. *The GIS 20: Essential Skills* was my introductory text, which contains projects that focus on the most important skills a beginner needs to develop to use GIS effectively. ArcMap and ArcGIS online were the tools I used the most. I built a map with eight layers, including the basemap layer. The basemap layer, which contains satellite imagery, is a default provided by Esri's ArcGIS online service. I imported the most recent version of a shapefile that contained land use data from the Southern California Association of Governments (SCAG). From this shapefile, I created map layers that contained information about the land uses we wanted to focus on: land that contained freeways, land that contained warehouses and truck terminals, and dirt lots. These areas were sources of pollution. I also created a fourth layer that contained the land upon which residential areas were built. Although these land uses can be seen from the basemap imagery, each layer contains several years of land use codes, and the previous uses of each area of land

(represented as a polygon in the shapefile) can be seen.

This was the first version of the map. I archived it by saving the map as a map package file (.mpk). Packaging the map made archiving it possible because I could unpack the map on another computer with ArcGIS without running into errors regarding the absolute paths of files that comprised the map.

### *Field Work*

After completing the first version of the map, my advisor, project partner, and I performed four days of environmental monitoring, which took place in February and March. We collected data at five sites in Mira Loma. We collected data for ten minutes at each site. We used a thermo anemometer to collect wind speed data and determine the dominant wind direction. We also used a particulate meter, a photoionization detector (PID), a noise dosimeter, and a carbon monoxide detector to collect data about particulates, volatile compounds, noise levels, and carbon monoxide levels, respectively. All instruments were calibrated before the data were collected at the sites.

### **Project Outcomes**

We conducted paired t-tests on the data collected for wind speed and for wind direction. Predicted wind speeds were about double the actual speeds, and there was a strong correlation between actual wind speed and predicted wind speed. Predicted wind directions were not significantly different from the actual direction, and there was little to no association between actual wind direction and predicted wind direction. The results of this study will be submitted for publication in a peer-reviewed journal.

The results of this study were positive and changed what could be done to the map to

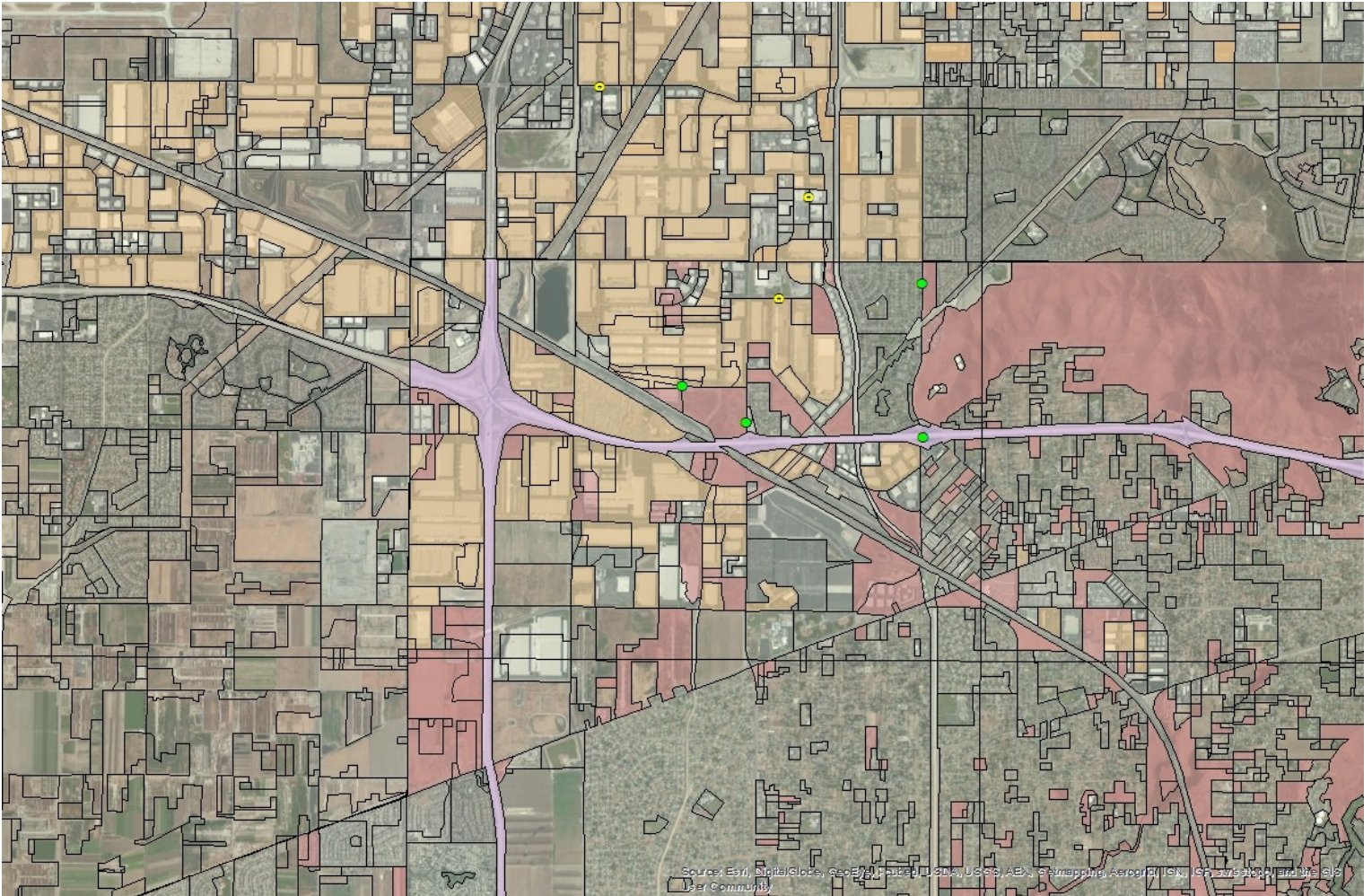
improve its ability as a resource. We knew that we could use this algorithm in the map to predict wind speed from the wind speed data that was collected and put into the map.

### **Conclusions**

Last year, I was interested in learning more about GIS and how I could use it to present information and solve problems. This internship gave me the opportunity to pursue that interest. It has been a pleasure working with a team to address environmental health issues in a local area. I've learned about GIS and acquired important skills for working with GIS tools. I have produced a map that can be published, updated, and improved upon based on new research and the desires of the community. If I work for a company that produces GIS software or supports GIS applications (or both of these things), I have an understanding of what GIS is and what I'll be working with.

I recommend that further research involve collecting more data at the sites we monitored in Mira Loma. We must continue to examine how well the algorithm predicts wind speed, as well as consider whether or not we can predict wind direction with future data or future monitoring practices. In the future, my advisor and I would like to be able to use the map to automatically pinpoint residential areas with significant exposure to air pollution. These areas would be highlighted using wind speed data and measured distances from major sources of pollution (freeways and major roads, warehouses and truck terminals, dirt lots). Also, we would like to survey the community members in areas with significant exposure using a mobile application.

## Appendix A



A picture of the map, showing multiple layers. The locations where data was collected are represented by green dots. The locations of interest collected from the Toxics Release Inventory are represented by yellow dots.