Quantifying Public Perception of Odors in a Community - Utilizing Telemarketing Protocol

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ABSTRACT

With today's increasing levels of development, odor nuisance has become a major environmental issue among neighborhood communities, local municipalities, state agencies, and national governments around the world. Citizen complaints about odors caused by landfills, waste water treatment plants, industrial processes, and other sources have created a chain reaction through all levels of government as officials search for a sufficient odor regulation which creates consistent ways of defining, investigating, and enforcing a violation. Current trends show a shift from regulations based on sampling to a rule with a community impact approach based on citizen involvement.

This paper discusses a two year community odor annoyance study conducted in the neighborhoods surrounding the Metropolitan Waste Control Commission - Metro Waste Water Treatment Plant in St. Paul, MN. The study quantified the public perception of all odors in the community through a telephone survey utilizing telemarketing protocol. The neighborhood impacts were examined further using a computer model. Methods, results, and conclusions of the study are each discussed.

INTRODUCTION

Globally, people have become more environmentally aware over the past ten years. With this awareness, individuals create stronger personal definitions of the type of environment in which they wish to live. Citizens now know that they want clean air, clean water, no noise, and no objectionable odors. With the encroachment of residential areas on industrial zones, communities strive for these desires by becoming involved in the improvements and developments of the immediate environment in which they live.

Increased community involvement has forced governments and facility owners/operators to take a more serious approach to the odor nuisance issue. Governments are modifying rules and ordinances to protect citizens by clearly stating the definition of an odor nuisance and determining sufficient testing and modeling methods. At the same time, facility owners/operators are protecting themselves by beginning to reach out to neighboring communities in order to completely understand how they are impacted.

Presently, governments around the world are struggling with the odor regulation issue. The existing rules and ordinances have been found to be inconsistent and, in many cases, insufficient in defining, investigating, and enforcing violations. Different governments have different rules and ordinances, yet there is a current global trend showing the implementation of major community involvement, individually and as a whole, in regulatory steps. This trend can be seen in regulations being proposed and promulgated in Europe, Australia, and North America.

One method of creating community involvement is through a citizen survey. An "Odor Annoyance Index" community telephone survey was conducted over two years in the neighborhoods surrounding the Metro Waste Water Treatment Plant in St. Paul, MN. The survey gave the Metropolitan Waste Control Commission quantified results which informed them of the degree of annoyance experienced by the neighboring citizens.

COMMUNITY SURVEYS

Survey Uses

Currently, there are three main methods used by facilities to determine the impact of their odors on the surrounding community. These include: odor dispersion modeling, neighborhood "drive throughs" by facility operators, and community complaints.

Community surveys can benefit a facility by using them in conjunction with and/or instead of the other previously mentioned methods. First, the survey can be used to validate dispersion modeling. The survey can give testimony for or against a model's predictions of the odor impacts on a community. This would give a certain confidence level in the model data and allow for the facility to make better decisions about which model scenarios to follow in order to reduce their odor impact.

Second, the survey can be used to identify the sources of odors. It could identify sources both specific to the facility and those generated at other facilities in the neighborhood. This would allow the facility to identify the processes which are affecting the community most and help prevent them from receiving the blame for odors produced by another facility. These results are not concrete since characterization of odors is dependent on the vocabulary of descriptors used, however, in extreme cases it could prove to be very effective.

Further, the survey can help to determine if the odor impact is wide spread over many sections, scattered between a few sections, or limited to a small area of the neighborhood. The survey can also help identify regions around the facility that are heavily impacted by odors but may not have produced any complaints. The absence of complaints in a section of the neighborhood could be due to zoning, real estate values, or other socioeconomic factors. While some areas are equally impacted by the odors, there is a certain tolerance level which causes some neighborhoods to simply "live with" the problem. These areas are simply a latent odor problem to the facility which could be a *stink bomb* waiting to explode when it is least expected.

Types of Surveys

Two types of surveys used most often include telephone questioning and mail-in questionnaires. Each of these surveys can be varied in different ways depending on the depth of the study and the availability and involvement level of the community.

Mail-In Questionnaires. The mail-in questionnaire can be used to investigate the history of community annoyance or to gather data on a series of current odor events. The advantage of this survey is that it allows the citizen to record events more completely and accurately. However, as with the dependence of citizen complaints, this method of data collection is at the mercy of the citizens for they must be annoyed enough to take the time to return the questionnaire.

Telephone Surveys. Like mail-in surveys, the telephone survey can be conducted in order to investigate the history of the odors in a community or they can be used to gather data on a series of current odor episodes. At least one survey has even incorporated calling citizens and obtaining the immediate status of odors by asking the citizen to step outside and describe what they smell. The telemarketing approach gives the citizen the open invitation to praise or condemn the odor conditions in the neighborhood without having to fill out any forms. Unfortunately, one negative of this survey is the intrusion felt by the citizens when they are interrupted from their daily routine to answer the questions. There are many telemarketing groups that contact citizens for sales, donations, and frivolous surveys. It is these calls which cause citizens to counteract the telemarketers by screening callers with answering machines, voice mail, and caller I.D. For this reason it is beneficial to obtain a sample of volunteer citizens who will accept the periodic telephone calls.

MWCC METROPOLITAN WASTE WATER TREATMENT PLANT - - A CASE STUDY

The Metropolitan Waste Control Commission (MWCC) Metro Waste Water Treatment Plant (MWWTP) is a large municipal sewage treatment plant located in downtown St. Paul, Minnesota on the Mississippi River. The plant contains a number of sources which could potentially emit odors. These are sources such as incinerator exhaust stacks, odor scrubbers, and aeration basins. The facility has historically received odor complaints from a small number of citizens in the community. As a part of a larger project to identify the sources of significant odors at the Metro plant, a community annoyance telephone survey was conducted and computer odor dispersion modeling was performed. The following case study is an overview of the investigation.

The community survey was conducted in order to define the awareness of the citizens and to determine the types of odors which are impacting the community. The survey was used to identify the most heavily impacted locations in the surrounding neighborhood. These data could then be compared with the computer modeling data.

The computer odor dispersion modeling was run for 38 source groups at the Metro plant with five years of fall season meteorological data. The ISCST2 model gave the odor concentrations of odor episodes at each predetermined receptor. These data were then used to determine the receptors with the greatest impact from the odors.

Methodologies

The Survey. The initial survey was scheduled to be a three month study in the fall months of 1993 with citizens being contacted every two weeks. This gave a total of six call cycles throughout the months of August to November. The survey was then repeated during the same months in 1994 in order to gather more data and to investigate reproduciblity.

The survey area was selected by identifying the census tracts, from 1990 census data, which were in contact with a two mile radius around the waste water treatment facility. Through census data, the population of each tract was found. For the study, 0.25% of the total population was selected as a sample population goal. This was a goal of 189 citizens. The citizens were located and contacted by obtaining phone numbers and addresses from the *Cole Directory for St. Paul* and *Hudson's Street Atlas of the Twin Cities.* The citizens were randomly chosen from different areas of each tract in order to get a dispersed cross section of the community. The 1993 recruitment process yielded 196 citizens, thus exceeding the goal and allowing room for citizens to be absent from a call cycle. One half of the citizen volunteers accepted the request to repeat the survey in 1994. The locations of the 1993 surveyed citizens are displayed in Figure 1.

For the initial recruitment of the citizens, a script prompted the caller to introduce him/herself and give a brief explanation of the survey. If the citizen agreed to volunteer for the survey, then the caller would first record referencing data for the citizen on a data sheet. This referencing data included: name, address, phone number, census tract, *Cole Directory* page number, and the *Hudson's Map* page number and map coordinates. The caller then investigated the citizen's awareness of odors in the community by asking three questions:

1.) Do you know where the Metro Waste Water Treatment Plant is located?

2.) Have you ever noticed odors in your neighborhood you attribute to the MWWTP?

3.) Have you ever noticed odors from any other sources? Where?

These questions were only asked during the initial recruitment and were only used to show the awareness of the sample population. Next, the caller asked the main survey questions, thanked the citizen, and then moved on to place the next call.

The target questions asked during the telephone survey were created to investigate the community's awareness and annoyance of odors in their neighborhood without taking up a great amount of time. This was done by asking each citizen a maximum of four questions during each calling period. This helped the caller aim to keep each call under ten minutes in duration which is a common guideline in telemarketing.

The citizens were first asked if they had smelled any odors in their neighborhood in the two weeks since the previous call. If the response was "No," then the call was complete and they were contacted during the next call cycle. However, if the citizen responded "Yes" to the question, they were then asked when they noticed the odor, how annoying was the odor, and what the odor smelled like. After these responses were given, the call was considered complete and the citizen was contacted during the next call cycle.

The degree of annoyance was measured by each citizen on a five point scale with the choices:

1.) Not Annoying
2.) A Little Annoying
3.) Annoying
4.) Very Annoying
5.) Extremely Annoying

These five terms were then used to rate the annoyance from 0-100 by assigning numerical weighting factors of 0, 25, 50, 75, and 100, respectively, to the five categories of annoyance. This ranking was then used to help determine the annoyance index of different regions of the community by averaging each regions responses.

The character of an odor describes what an odor "smells like." This data was collected in order to identify which community odors were affecting the citizens. The citizens were asked to describe the odor that they were annoyed by during the specific event they had identified. If citizens had trouble responding, they were presented with a list of descriptors to help them put a word to their experience. This list consisted of, inclusively, but not exclusively: acrid/pungent, ammonia, burnt, chemical, mold/musty, putrid/rotten, rotten eggs, and sewage like.

All of the collected data were organized using popular data base software, Paradox for Windows by Borland International. With a properly constructed data base format, this software made entering, manipulating, and retrieving the data very simple.

Results

Figure 2 displays the percentage of citizens who noticed odors at some point in the two week period between calls during both 1993 and 1994. The data shows consistency between the two years. Figure 3 then shows the frequency of each annoyance level given by the citizens in 1993 and 1994. The frequency is split to distinguish whether or not it was the sewage like odors that caused the annoyance. In the survey sewage like odors refers to any of the following characters: sewage, sewage like, sulfur, and rotten eggs. Figure 4 is a comparison of the character descriptors given for the odor episodes during the two years. The "other" category consists of all descriptors representing less than 5% of the annoyances. Again, there is consistency between surveys of 1993 and 1994.

The computer model was run for each of the 38 source groups. Receptors were identified by locating the center of coordinates in the *Hudson* street atlas. These receptors were also used to group the citizens into a smaller, localized subsets. The locations of the receptors are plotted in Figure 5. Historically, the neighborhoods directly north of the plant yield the most complaints. The map shows that the survey identified neighborhoods other than the complaint neighborhoods as being annoyed.

The annoyance index values for each receptor were tabulated over the six call cycles of both years. The average value for all annoyed citizens was then calculated for each data set. The largest average values of the annoyed citizens were then plotted on the neighborhood map, Figure 6. The dots represent all receptors with an average annoyance greater than 50. This means all receptors that experience an average annoyance of annoying, very annoying, or extremely annoying.

The results from the computer model were listed in odor concentrations for each episode at each receptor. The concentrations were averaged and any receptor with an average concentration of greater than two odor units was then plotted on the neighborhood map, Figure 7. Two odor units was chosen because it gave a best fit comparison with the survey data. The map shows that the model predicted impacts in neighborhoods other than complaint neighborhoods.

The survey results and the odor modeling results were combined and presented on a single map which is Figure 8. The X's represent the survey data and the dots represent the modeling results. The map shows that the modeling underpredicted the annoyed areas.

CONCLUSIONS

As citizens become more involved in the quality of their environment, facilities must strive to confront the odor nuisance issue. A facility must protect itself from nuisance lawsuits or from possible violation of a community odor rule. The international trend is for the citizens to become specifically involved in the odor problems in the community.

The results of this study show that while modeling has its place in comparing different facility scenarios, only a community survey can give the actual odor impacts on the surrounding neighborhoods. When performed correctly and efficiently the survey can give extremely useful information to help the facility make the neighborhood a better place to live.

ACKNOWLEDGEMENTS

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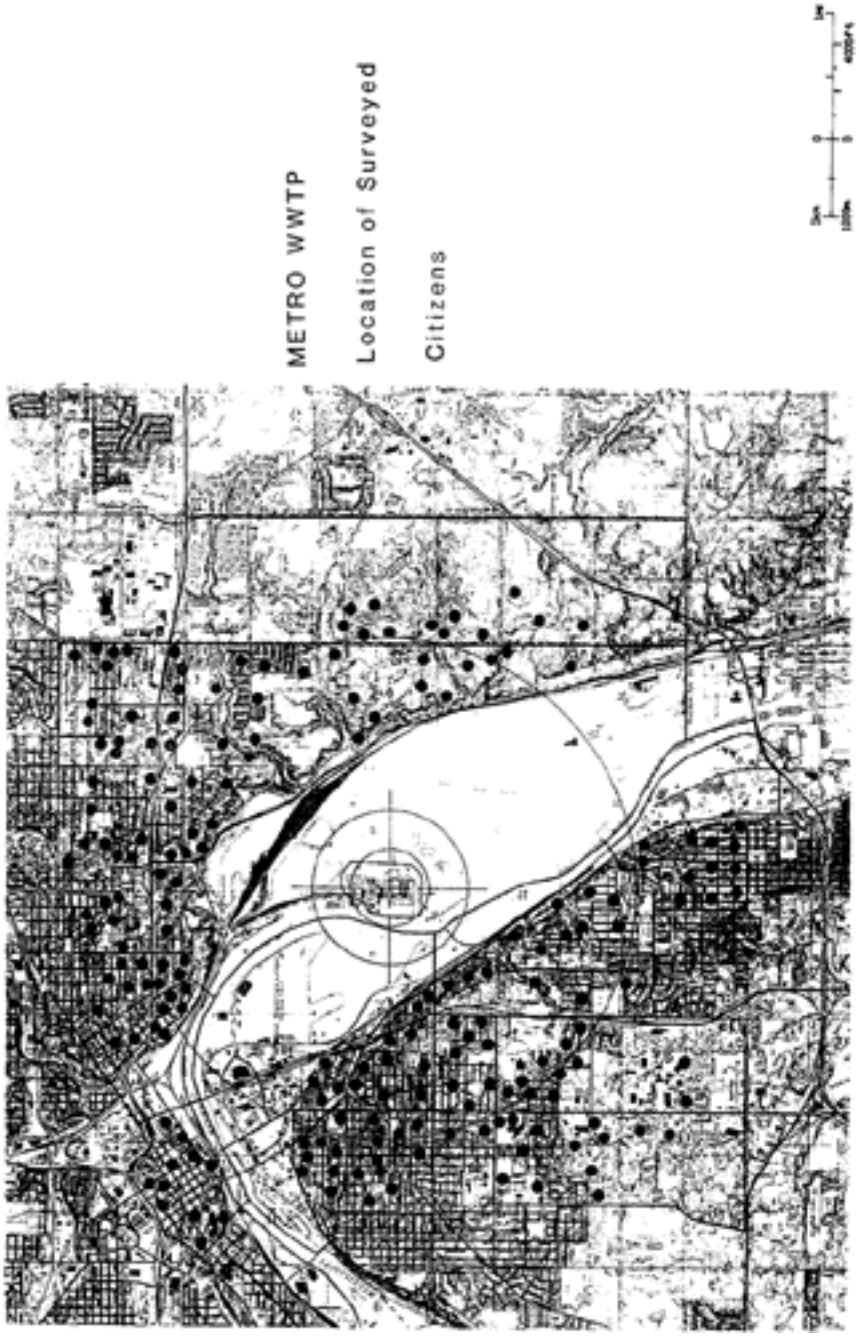
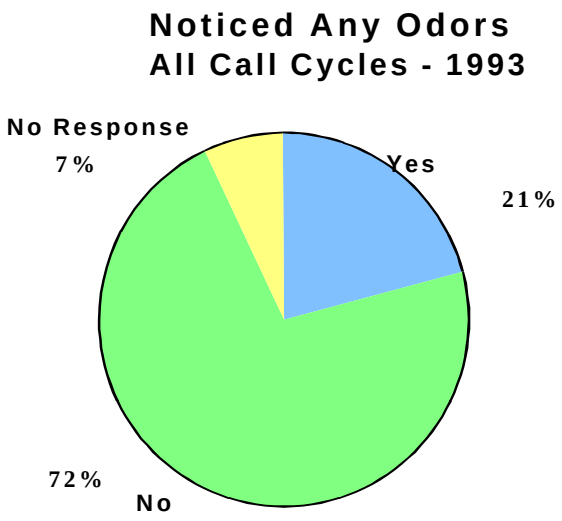


Figure 1. Map of the Metro Waste Water Treatment Plant. The map displays a two mile radius around the facility, the census tracts incorporated in the study, and the locations of the surveyed citizens.



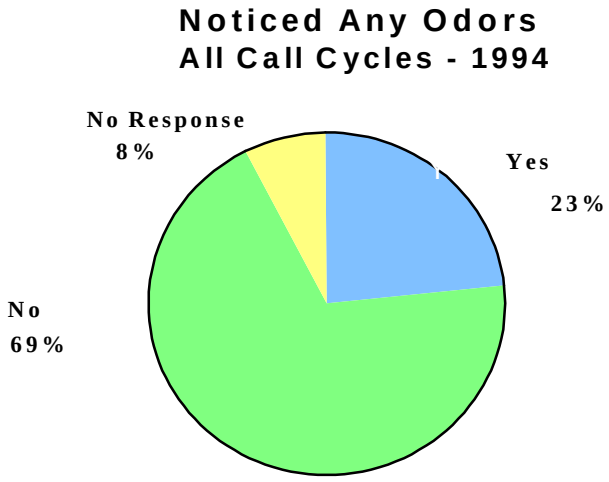
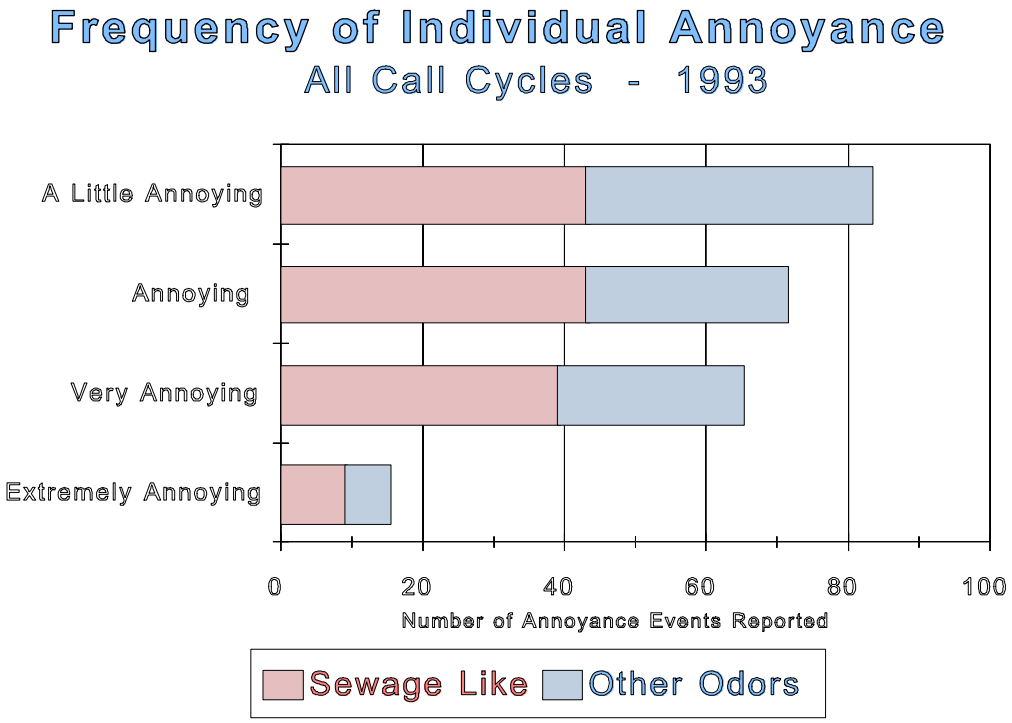


Figure 2. Results of the 1993 and 1994 Citizen Annoyance Index Survey. Those who noticed any odors during all call cycles.



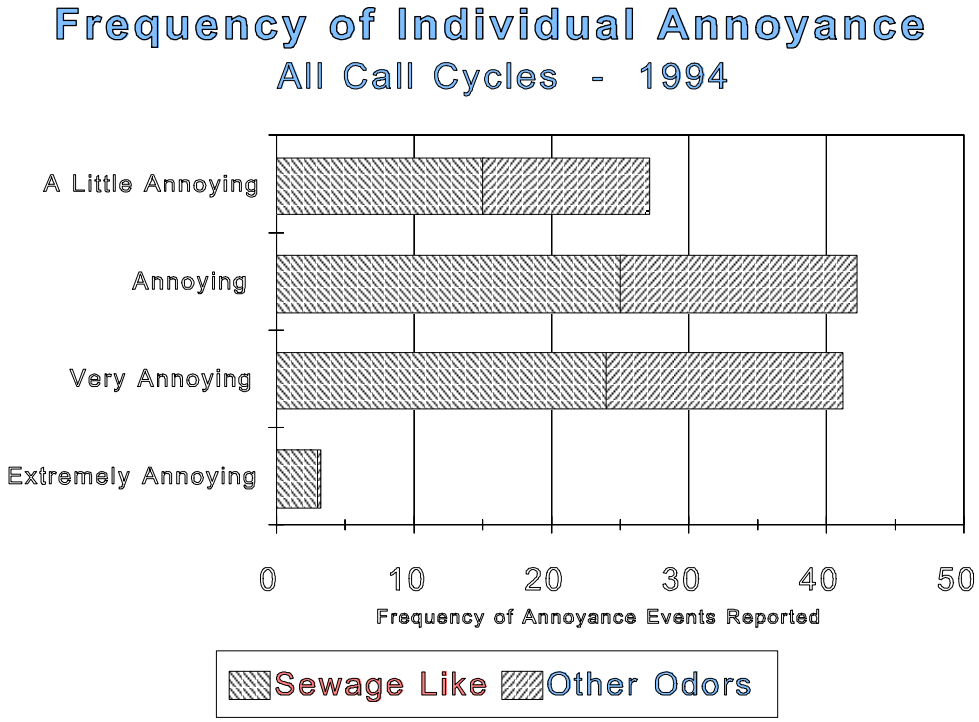
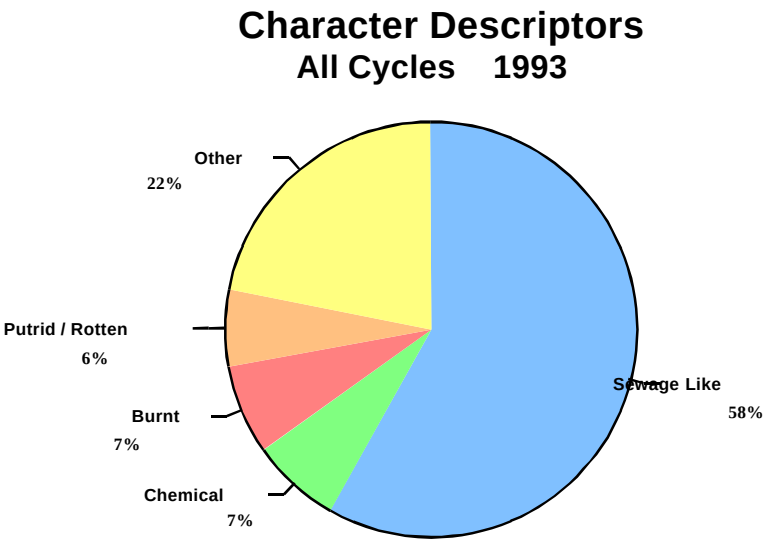


Figure 3. Results of the 1993 and 1994 Citizen Annoyance Index Survey. Frequency of individual annoyance of both sewage odors and all other odors recorded during all call cycles.



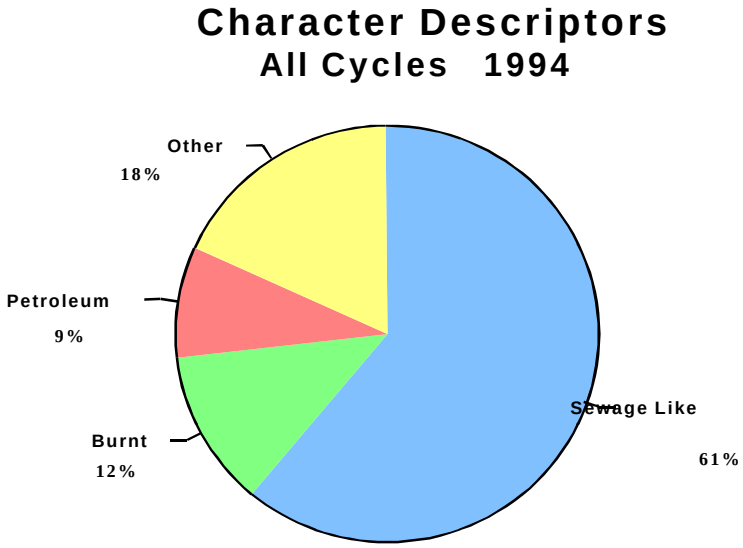


Figure 4. Results of the 1993 and 1994 Citizen Annoyance Index Survey. Character descriptors identified during all call cycles.

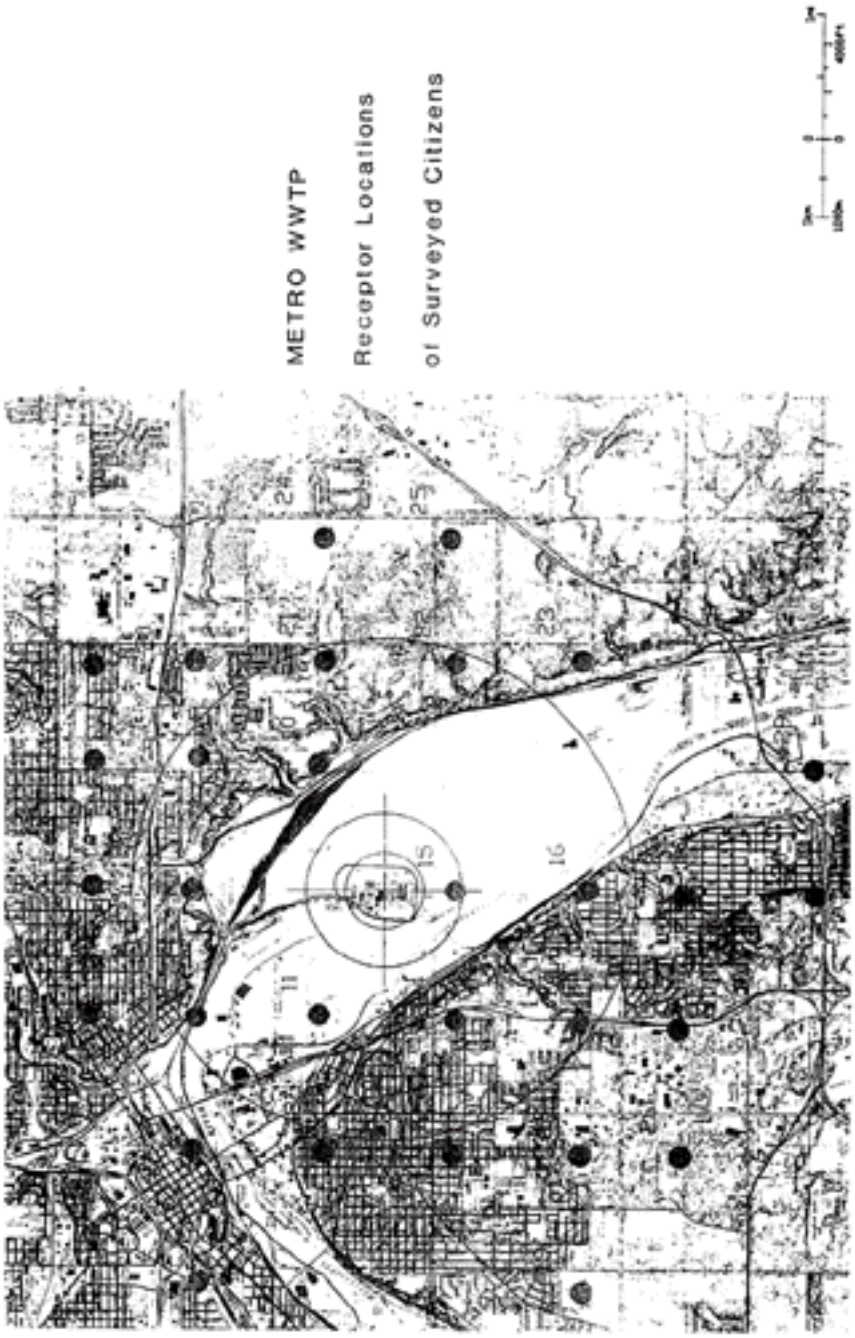


Figure 5. Map of the Metro Waste Water Treatment Plant. The map displays the receptor locations dispersed around the facility.

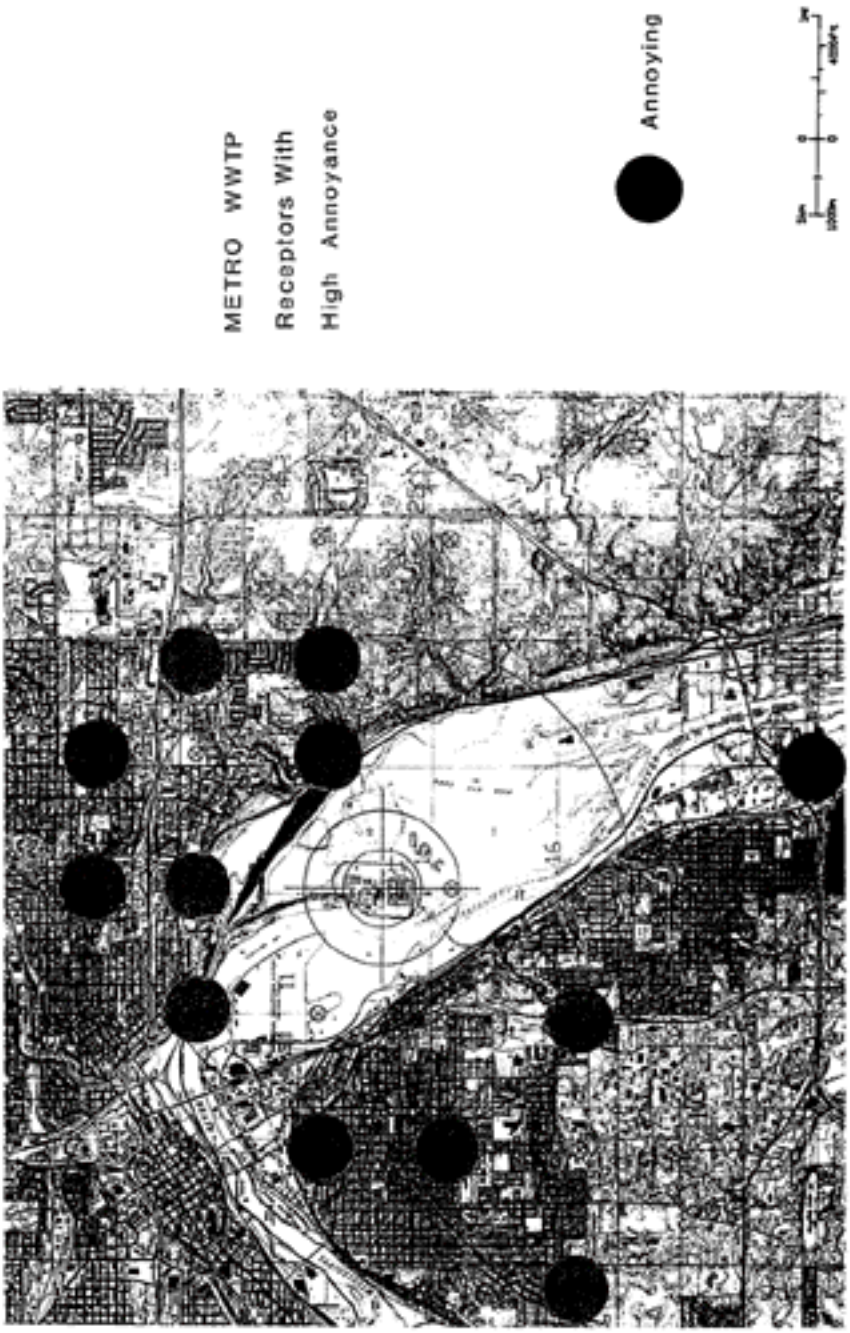


Figure 6. Map of the Metro Waste Water Treatment Plant. The map displays the receptor locations with an average annoyance index greater then 50 ("Annoying").

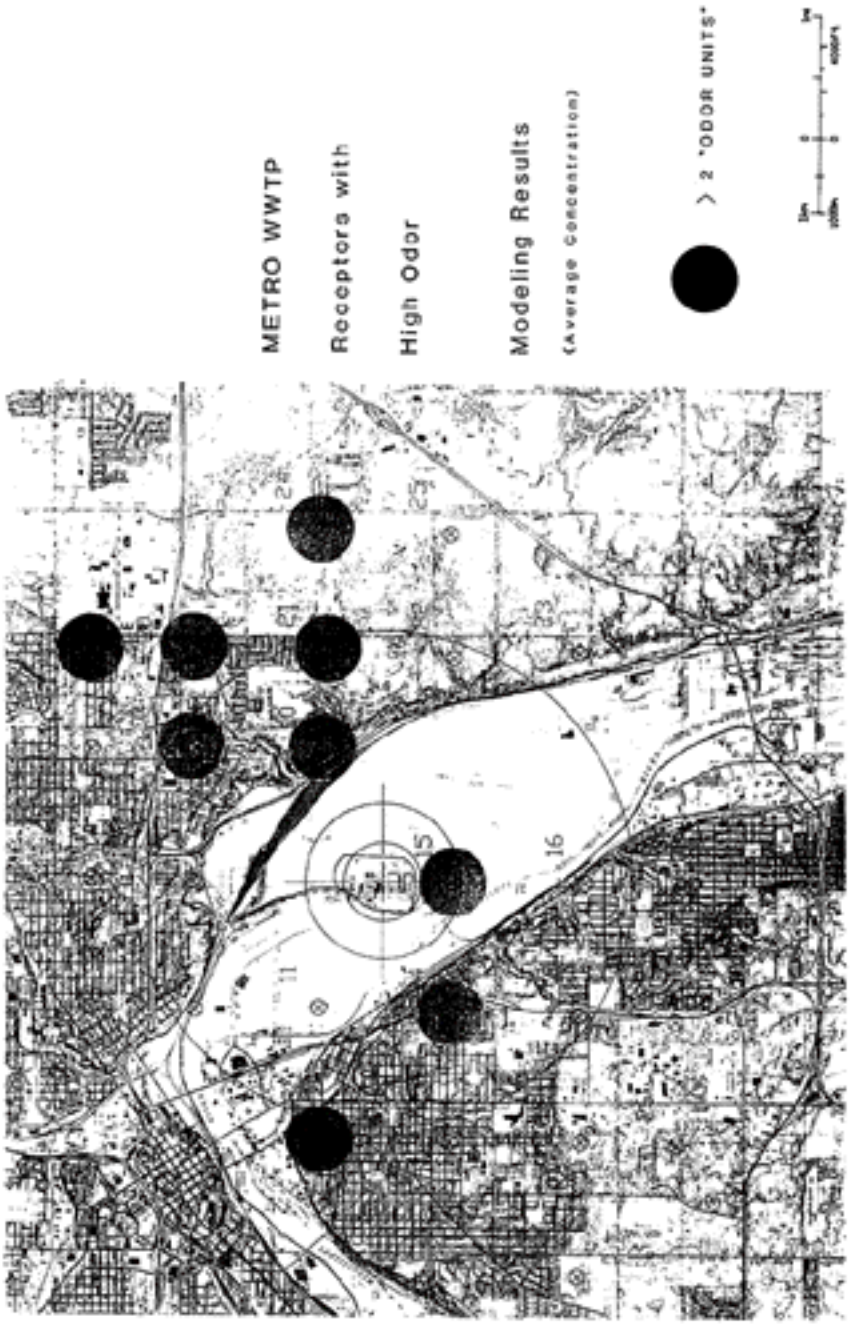


Figure 7. Map of the Metro Waste Water Treatment Plant. The map displays the receptor locations with modeling results of an average odor concentrations greater than two odor units.

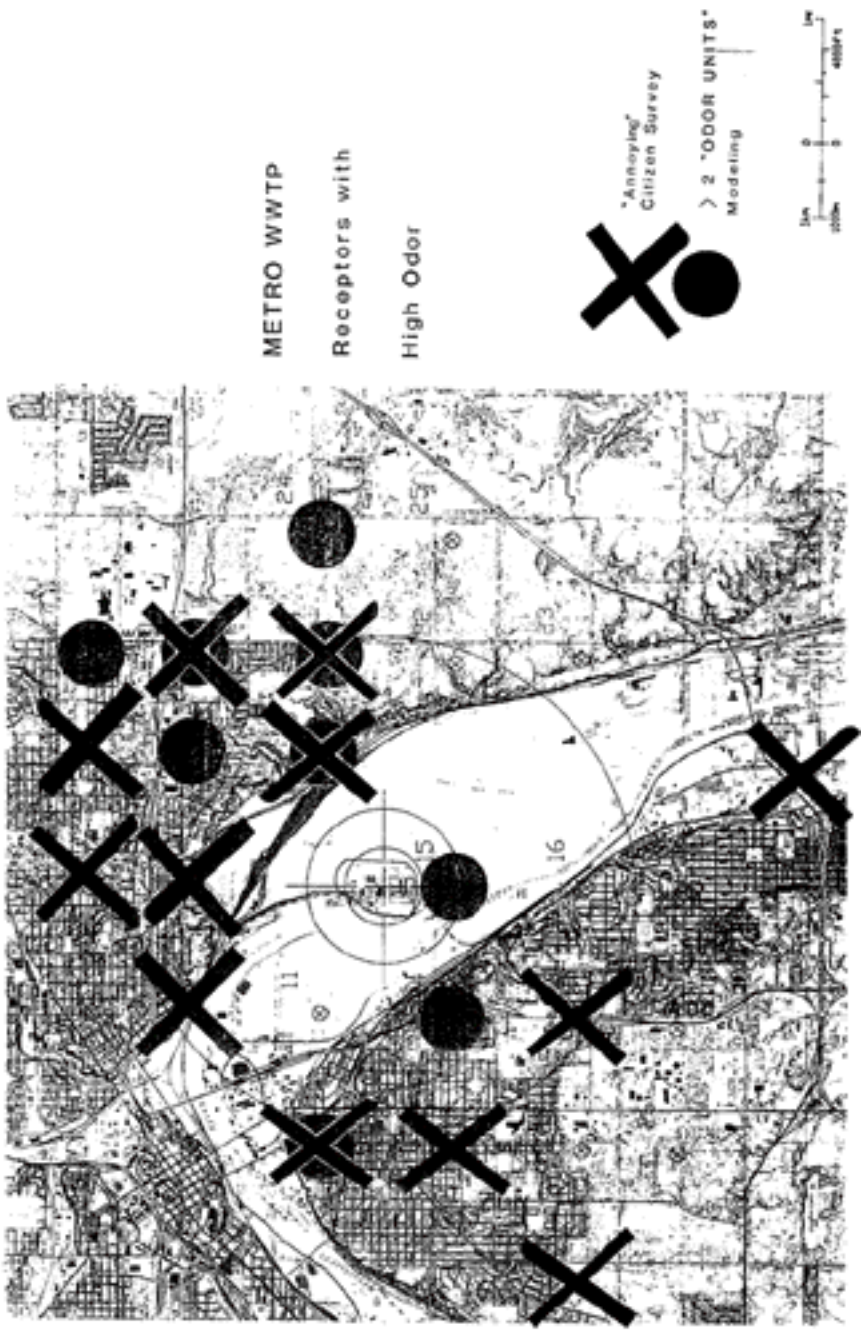


Figure 8. Map of the Metro Waste Water Treatment Plant. The map displays the receptor locations with an annoyance index greater than 50 ("Annoying") and modeling concentrations of greater than two odor units.