Louisiana Transportation Research Center

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Identifying Local Transit Resources for Evacuation

by

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16. Abstract

The purpose of this project was to establish an inventory of transit vehicles used by special needs and human services organizations in coastal Louisiana, and to incorporate the information into a GIS that would allow queries on the data base. The data was collected by means of a mail out/mail back survey within the context of transportation needs in an emergency. Online ArcGIS was used to allow quick assessment of transit resources and transportation demand that will arise in an emergency. Transportation demand from the general public was estimated recognizing the daily migration of the population and their location at different times of the day. The study found that the organizations surveyed were, in general, not enthusiastic about establishing an inventory of special needs and human services transit resources (a survey response rate of only12% was obtained). However, the vehicles they have at their disposal represent a substantial resource of specialized transportation. In addition, their drivers are a valuable resource in that they are generally well trained in catering to the special needs of their clients, and approximately one-half of them are prepared to provide their services in an emergency. The study concluded that means must be found to obtain greater participation of these organizations in establishing a full inventory and cooperating with each other during emergencies.

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Project Review Committee

Each research project has an advisory committee appointed by the LTRC Director. The Project Review Committee is responsible for assisting the LTRC Administrator or Manager in the development of acceptable research problem statements, requests for proposals, review of research proposals, oversight of approved research projects, and implementation of findings.

LTRC appreciates the dedication of the following Project Review Committee Members in guiding this research study to fruition.

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Louisiana Transportation Research Center

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ABSTRACT

The purpose of this project was to establish an inventory of transit vehicles used by special needs and human services organizations in coastal Louisiana, and to incorporate the information into a GIS that would allow queries on the data base. The data was collected by means of a mail out/mail back survey within the context of transportation needs in an emergency. Online ArcGIS was used to allow quick assessment of transit resources and transportation demand that will arise in an emergency. Transportation demand from the general public was estimated recognizing the daily migration of the population and their location at different times of the day. The study found that the organizations surveyed were, in general, not enthusiastic about establishing an inventory of special needs and human services transit resources (a survey response rate of only12% was obtained). However, the vehicles they have at their disposal represent a substantial resource of specialized transportation. In addition, their drivers are a valuable resource in that they are generally well trained in catering to the special needs of their clients, and approximately one-half of them are prepared to provide their services in an emergency. The study concluded that means must be found to obtain greater participation of these organizations in establishing a full inventory and cooperating with each other during emergencies.

ACKNOWLEDGMENTS

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IMPLEMENTATION STATEMENT

The system developed in this study cannot be implemented because the participation rate of organizations in the inventory was too low. Implementation should be delayed until greater participation can be established.

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INTRODUCTION

In addition to the large urban area transit systems, there are hundreds of small "on demand" public transit systems that provide transportation to various categories of riders: the elderly, low-income, veterans, disabled, and those needing access to jobs. These are funded through at least eight different state agencies with over 60 different federal funding programs with little centralized coordination. There is no single means of identifying all these local resources (drivers and vehicles). The result is a disconnected system of services that cannot be leveraged for hurricane evacuation or to realize numerous benefits of routine transportation service year round.

A Working Group was established by the Louisiana legislature to establish statewide coordination of all these agencies and providers, but the agencies did not see sufficient benefit to themselves to put their full weight behind the coordination effort. However, if the call to collaboration is to provide life-saving support during an emergency, and they see personal benefit for themselves, these agencies may be motivated to commit more earnestly. Inventorying and assessing the capabilities of the various human services transportation providers operating in the state would aid in coordinating resources during and after evacuation events, support transportation efficiencies and mobility year round, and could result in significant cost savings to the state and local authorities.

On the coordination issue, it is useful to observe what level of collaboration has been achieved in other states. In reviewing practice in other states, it is also useful to investigate the potential of incentives to promote collaboration. However, the legality of any proposed initiative and use of incentives in Louisiana would have to be investigated.

Beyond transit supply, the location of people by different time of day, day of week, and season of the year is useful in estimating likely demand, and particularly, in identifying no-notice or short-notice evacuation demand. Data provided by the Census Bureau typically shows population by home location and does not account for the migration that occurs during the day. The spatio-temporal location of the population during an emergency is important information for emergency managers, transportation providers, and emergency agencies such as the Red Cross.

OBJECTIVE

The objectives of this project were to:

1. Determine if procedures exist or can be developed to secure the use of transportation assets from the public, private, and state sectors during an emergency or disaster.
2. Determine the appropriate compensation or incentives for the use of transportation assets from the public, private, and state sectors during an emergency or disaster.
3. Consolidate information on transportation assets in the public, private, and state sectors to facilitate the movement of and transportation support for special needs or human service transportation to citizens in Louisiana's 20 coastal parishes during an emergency or disaster.
4. Identify the number of passengers currently served by special or human service transportation services and estimate the proportion who are likely to rely on transportation from these transit services during an evacuation.
5. Incorporate information from the third and fourth points above into a Geographic Information System (GIS) capable of querying evacuation demand and transit supply by geographic area in the 20 coastal parishes of Louisiana.

SCOPE

In order to keep this study to manageable proportions, it was decided to limit the survey establishing the inventory to the 20 coastal parishes in Louisiana. The survey was limited to human service and special needs organizations that provide transit service to their clients so regular urban transit systems such as commuter rail, streetcars, and buses were excluded from the study. School buses were also excluded.

The coastal parishes in Louisiana, as determined by the Louisiana Department of Natural Resources, are shown in Figure 1. The coastal region boundary is shown by the black line in Figure 1. It envelopes all or part of the following 20 parishes: Ascension, Assumption, Calcasieu, Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion.

Figure 1

Boundary of coastal parishes

(Source: Department of Natural Resources, State of Louisiana)

METHODOLOGY

Introduction

The prime objective of this study was to establish an inventory of transit vehicles used by human services and special needs organizations in the coastal region of Louisiana. A secondary objective was to identify the demand there would be for such transit vehicles if an emergency arose. Thus, there was both a demand and supply aspect to the study.

On the supply side, an inventory of transit resources was established using a mail-out, mail-back survey to organizations registered with the Louisiana Departments of Health and Human Services, Child and Family Services, and Transportation and Development. Retirement organizations and the Veterans Administration were also surveyed. In the questionnaire, organizations were asked to provide information on vehicles, drivers, physical location, number of riders in both normal and emergency situations, any restrictions on the operation of the transit system, degree of cooperation with other organizations, and information on a contact person. The complete survey questionnaire, code book, and metadata are provided as Appendices A, B, and C, respectively, to this report.

On the demand side, the number and location of regular transit patrons for both regular and emergency conditions were determined. During an emergency, an organization would serve their regular customers, but may also be called upon to serve the general population as well if the emergency is very acute, they are well positioned to provide assistance, and other transportation service is not available. Another possibility is the transportation needs of those who have to remain in shelters because they are unable to return to their homes but need transportation to meet basic needs such as buying groceries, accessing medical care, or getting to work.

Literature Review

Local Transit Coordination

The drive to establish coordination among human services transportation providers is not new and has been sought for at least 30 years *[1]*. Recently, a study was conducted to develop tools to guide coordination among rural community transportation services *[2]*. The U.S. Department of Health and Human Services has also developed a toolkit to assist emergency managers in incorporating the transportation of people with disabilities into an evacuation plan *[3]*. In February 2004, Executive Order #13330 on Human Service Transportation directed 11 Federal department and agencies to cooperate in establishing

seamless, comprehensive, and accessible transportation services. The executive order also established the Federal Interagency Transportation Coordinating Council on Access and Mobility (CCAM) to simplify access to transportation for people with disabilities, lower incomes, and infirmity due to age. Locally, the Regional Planning Commission in New Orleans developed a plan to coordinate human services transportation in their region *[4]*. Following Hurricane Katrina in 2005, the issue of effective use of transit in emergencies arose. The U.S. Congress requested the U.S. Department of Transportation and the U.S. Department of Homeland Security to review and assess evacuation plans for catastrophic events in the Gulf Coast region with the specific request that the assessment include "(1) all safe and practical modes of transportation available for evacuation; (2) the extent to which evacuation plans are coordinated with neighboring states and adjoining jurisdiction…" *[5]*. However, despite all the calls for coordination among transit providers, little has been accomplished *[6]*. For example, in a recent national survey, Seekins et al. found that 54% of section 5310 transit providers did not participate in any kind of coordination at all and only 5% pooled all their transit resources to provide a joint service to the entire community *[6]*.

A study was recently conducted to assess the emergency preparedness of transit systems in rural coastal communities in the North Gulf Coastal Region *[7]*. The study included a survey conducted among 46 public, private, and school transportation agencies in coastal areas of Florida, Alabama, Mississippi, and Louisiana. Among the findings was "(1) funding for evacuation-related operations and capital expenses for transit was the most significant and frequently cited concern related to emergency planning, (2) concern for families and personal well-being had prevented transit employees from reporting to work during an evacuation in the past, and (3) school bus systems emerged as a critical resource, because they were safe, reliable, and readily-available resources for rural evacuation operation".

Challenges and Barriers of Coordinating Local Transit Resources

Some efforts have been made to mobilize school bus and local transit buses in emergency situations through Memoranda of Understanding (MOU). However, oft-quoted challenges that arise when public transportation gets involved in evacuation are: "(1) infrastructure and communication; (2) coordination of local, state and federal agencies; (3) legal and social barriers; (4) federal guidelines and funding; and (5) incorporation of evacuation in regular planning" *[7]*.

Challenges in Coordinating Rural Community Transportation Services.

Burkhardt et al. mention the following challenges regarding coordination of rural community transportation services: "(1) problems in dealing with the various requirements of a large variety of Federal funding programs; (2) not being certain that coordination is allowed or

authorized; (3) problems with accountability, cost allocation, paperwork, and reporting; (4) funding issues including matching requirements for Federal funds, funding cycles, and lack of sufficient funding; (5) perceived incompatibility of goals, needs, or client eligibility; (6) expectations of no significant benefits from coordinated operations; (7) regulatory requirements (such as prohibitions on crossing local or state boundaries); and (8) lack of concerted Federal effort to encourage or require coordination" *[2]*.

Reported Barriers to Cooperation by section 5310 (Elderly and Disabled) Recipients. Section 5310 funds focus on elderly and disable people's mobility needs. From a nationwide survey, seven aspects were identified as barriers to coordination: no need, no other local providers, insurance and liability, others unwilling to cooperate, organizational policy precludes cooperation, prohibitive state regulations, and other reasons *[6]*. For transportation providers' concerns, challenges include "loss of service for their clients, loss of control over services and finances, increased demand on their vehicles, and the lack of any incentive to make the effort….One obstacle is the simple cost of the administrative effort…" *[6]*.

Challenges in Human Service Transportation Coordination Plan of the Greater Baton Rouge Area. The Capital Region Planning Commission (CRPC) Human Services Transportation Plan reports two major challenges to coordination of services: (1) the benefits of coordination are insufficient and are not likely to accrue to the agencies themselves; (2) the number of agencies who agree to participate in the coordination program may be so small that setting up coordination may not be worthwhile *[8]*. Other, more specific, challenges are also stated in the plan: "(1) the institution of a new program can be more expensive and/or more difficult; (2) the initial planning process necessary for coordination may be perceived as more time consuming compared to the status quo; (3) the planning and coordination process may take time from managers whose time requirements are already stretched, especially in small non-profits of small private providers; (4) the federal government needs to reconcile the regulations and funding requirements among various government programs that support transportation; (5) lack of perceived benefit to the stakeholder in spending the time and resources necessary for coordination; (6) perceived loss of control by stakeholders; (7) communication both at the human level and the technical level can be a problem; (8) conflicting regulations between funding agencies; (9) different data collection requirements and process; (10) different levels of priority for the provision of transportation services; (11) although increased efficiencies can result in a decrease in unmet needs, individual agencies do not necessarily see an increase in funds available to meet their primary missions; (12) the coordination process can be difficult when there are agencies and/or individuals involved

who are antagonistic to the process; (13) coordination requires an ongoing commitment that can be hard to maintain as leadership and regulations change; (14) turf issues; (15) unable to predict next year's funding from programs when the State or Federal government has control over fund allocation; (16) finding local funds to cover expenses and/or match that is not covered by State and Federal funds; (17) coordinating multiple jurisdiction and programs funded by multiple federal and/or state agencies." *[8]*.

Reason for Lack of Coordination in Human Service Transportation of New Orleans Metropolitan Area. The Regional Planning Commission in New Orleans conducted a study aimed at improving transportation service for disadvantaged persons, such as low-income, elderly, and disabled persons *[4]*. They concluded that there is a lack of coordination between "transit operating agencies, human service providers, state agencies, municipal governments, funding agencies, and others" *[4]*. They feel the main reasons for this condition are "differences in funding eligibility, varying fee structures, and lack of communication…" *[4]*.

Potential Incentives to Promote Coordination

According to the literature, the following incentives are likely to promote cooperation and coordination among human services and special needs transit providers.

Motivation of Transit Agencies. Chaudhari et al. state that the "best management practice" is to provide "financial assistance to transit agencies and school bus systems to allow them to equip their agencies with advanced communication systems, fueling facilities, electric generators, and to insure agencies while serving in emergency events" *[7]*.
For coordination of Section 5310 recipients, several states provide incentives in their State Management Plan (SMP) [1]. Concluded from the survey, stated incentives mainly include: (1) coordination is mandatory if funds are applied; (2) agencies who claim coordination will be given priority; (3) if standards (for example, hours of service) cannot be satisfied, then coordination is required; (4) money set aside only for projects that exemplify multi-agency coordination.

Motivation of Employees of Transit Agencies. Chaudhari et al. came up with several provisions to revise employment policies: "(1) prepare a plan to assist staff members' families in emergency events; (2) establish emergency call notification plans; (3) provide temporary housing for displaced employees so they can return to work quickly; (4) compensate employees for serving in an emergency; (5) clarify employee roles and responsibilities; (6) obtain emergency service/prior pledge forms signed by employees" *[7]*.

Based on discussions with the Project Review Committee, the most promising candidate incentives in Louisiana include state-provided liability insurance for drivers and vehicles during an emergency, provision of a card to fuel vehicles during evacuation, recording of services in a form that facilitates claims for reimbursement after the event, and accommodation, meals, and extra compensation for drivers.

Inventory Survey

Sources of Data

Secondary Data. The National Transit Database (NTD) provides data on transit providers who receive Federal Transit Administration (FTA) section 5307 Urbanized Area Formula Program and section 5311 Non-Urbanized Area Formula Program funding.

The Coordinated Human Services Transportation Plan was prepared for Baton Rouge area in 2007. As a part of the plan, a survey was sent to all providers listed under section 5307 (urban), 5310 (elderly and disabled), and 5311 (non-urban) Federal funding programs *[8]*. However, questions on vehicles were not included in the survey, thus making the findings of that survey of little use to this project.

A presentation on Louisiana's public transportation systems by Beck in 2013, states the number of providers under section 5310 (elderly and disabled), section 5311 (non-urban), and section 5317 (Job Access/Reverse Commute, JARC) was 104, 32, and 7, respectively, statewide in 11/12 FY *[9]*. No further information on vehicles was provided in the presentation beyond the total number of available vehicles.

Public transportation provider information was collected in the New Orleans Metropolitan area, but it only included information from conventional urban transit systems such as city bus and street cars *[4]*. Other transportation providers, such as special needs and human service providers, were not included in the study.

In addition to transit resources identified above, there are hundreds of small local "on demand" public transit systems that provide transportation to various categories of riders: the elderly, low-income, veterans, disabled, and those needing access to jobs. Following are the data sources of transit providers and sponsors who were surveyed in this project.

Department of Health and Hospitals (LA DHH). The Health Standards Section (HSS) licenses health care facilities and certifies these facilities for participation in Medicare and Medicaid. Organizations they license include clinics, adult residential care, emergency

medical transportation, home and community based service providers (HCBS), non-emergency medical transportation (NEMT), nursing homes, and pediatric day health care facilities *[10]*. A list of organizations licensed by HSS is published online and this was used as a data source in this study *[10]*. Based on judgment, organizations on the list which were not likely to provide transit service were excluded for the purpose of this study.

Department of Children and Family Service (LA DCFS) or Louisiana Department of Education (LDE). Child care facilities were licensed by DCFS before September 30, 2014. Following that, licensing functions were transferred to the Louisiana Department of Education (LDE). The types of facilities licensed by the Residential Care and Special Population Licensing Section in LDE include child residential facilities, maternity homes, child placing agencies (including foster care services, adoption services, and transitional placing services), and juvenile detention facilities *[11] [12]*. Data cleaning was conducted to clean unrelated organizations from the list for the purpose of the inventory survey conducted in this study.

Department of Transportation and Development (DOTD). Data from the Transit Resources Guide were also included in this survey. This contains a list of all section 5310 and 5311 transit organizations receiving financial assistance from DOTD *[13]*.

Department of Veterans Affairs (LA DVA). The name, location, and contact information of Veteran Homes was collected. This data source contains only 5 organizations in the whole of Louisiana and only one within the coastal parishes.

Human Service Transportation (HST). This is a data resource of transportation for individuals with disabilities. It divides Louisiana into 8 regions and provides contact information of organizations within each region *[14]*.

RetireNet.com. This is a website which provides an online record of active retirement, independent living, assisted living, nursing care, home health, home care, and home and community based retirement services in all 50 states in the union *[15]*.
As data were collected from different sources, duplication of some organizations were encountered in the combined file and, subsequently, purged. They were identified through checking the name of the organizations, their street address, telephone number, and name or email of the contact person. A summary of all the data sources used in compiling the sample frame of the inventory survey is shown in Table 1.

Table 1

Sources of data to identify local transit resources for evacuation

Source	Type	Contact	Address	Zip	E-mail	Tel.	Number	Fleet size
DHH NEMT	Transit Provider	Person	Yes	Yes	No	Yes	State (139) Coastal (35)	Indicate they have data
LA DOTD (TRG)	Transit Provider	Person	Yes	Yes	Yes	Yes	State(164) Coastal(75)	Yes
DCFS	Daycare facilities for children	Person	Yes	Yes	No	Yes	State(1751) Coastal(861)	Indicate whether have vehicles
DHH HSS HCBS	Health care facilities	Person	Yes	Yes	Yes	Yes	State(662) Coastal(275)	No
DHH HSS	Health facilities	Agency	Yes	Yes	No	Yes	State(3002) Coastal(1255) Out-State(3)	No
Veterans Administration	Health facilities	Person	Yes	Yes	No	Yes	State(5) Coastal(1)	Indicate whether have vehicles
Retirenet.com	Retirement homes	Agency	Yes	Yes	No	No	State(668) Coastal(229)	No
Transportation Louisiana	Transportation stakeholders	Person	Yes	Yes	No (Some)	Yes	State(319) Coastal(124)	No

Survey Method

Observing the contact information in Table 1, it is noted that email addresses are available for contacts at only two of the eight sources listed. Thus, sending the survey (or a link to the survey) by email or recruiting through email was not a practical method of establishing contact with the candidate organizations. Telephone numbers are relatively complete in the data file but not available for all organizations. The mailing address was the only form of contact that was available to all organizations in the list of sources. Based on this fact, as well as the cost of conducting a telephone survey among approximately 2,000 organizations, it was decided to use a mail-out, mail-back form of survey. The mailing addresses were cleaned and verified by the United States Postal Service (USPS).

Survey Instrument

The information gathered in the survey included the following information:

1) fleet size;
2) characteristics of each vehicle in the fleet;
3) location where vehicles are kept when not in use;
4) drivers, type of license, and availability during an emergency;
5) number of passengers served under normal circumstances;
6) estimated number of passengers who require transportation in an emergency;
7) restriction on the area or riders that the organization may serve;
8) funding source;
9) number of overnight or permanent residents;
10) existing arrangement with another organization that comes into effect when an emergency arises;
11) whether there is coordination on transit operation with other organizations; and
12) contact person information;

Since a limited amount of information is required in the survey, and the authors wanted the survey to appear limited, the questions were compiled into a small booklet. The booklet was made with three two-sided printed letter size pages, which were folded in half. After the booklet of the sample questionnaire was made, it was reviewed by the PRC and revised in response to their comments. The revised version was also tested in a pilot survey and amended once again as reported in the chapter on Discussion of Results.

Estimating Demand

The demand for service that special needs and human services transit agencies will face in an

emergency is the need for transportation of their own clients and, when other transit is not available and the need is urgent, service to the public. In serving the public, the form of service most likely to arise is providing urgent evacuation capability. As mentioned earlier, another quite different need is when evacuees are required to remain in public shelters for extended periods because they are unable to return to their homes, and need transportation to conduct normal activities such as grocery shopping, getting medical attention, or going to work. In addressing these different demands on transit, it is noted that the inventory survey includes questions estimating the demand for transportation among an organizations' regular clients. Regarding those who are forced to stay on in shelters, the need will be very situation-specific and can only be established as a particular situation develops. On the other hand, urgent need of the public and the magnitude of the demand is not known and is integrally related to the daily migration of the public.

Past studies show various ways in which the spatial, temporal, and population breakdown of the population can be estimated. For example, some studies estimate the temporal distribution of a single population group, such as tourists, on a monthly or seasonal level using statewide or regional surveys *[16] [17]*. Other studies have considered smaller spatial areas and shorter temporal variation. This has usually required the analyst's judgment in supplying the information or it has relied on special surveys to acquire the information. For example, Zhang et al. developed a spatio-temporal model using building category as the spatial classification factor and divided the day into 17 time periods *[18]*. Though the spatial classification was relatively detailed, the population density of each building category by time period was based on subjective assessment. To achieve more objective results, Ahola et al. conducted a survey to estimate population density as a function of building category, time of day, and age of the respondent *[19]*. The period of a week was divided into 14 periods. In each time period, the population of 10 age-based categories were expressed as a percentage of the total population. However, most of these percentages were based on user judgment because the survey was unable to provide reliable estimates for all categories. Bell used a parking space survey for daytime population estimation in each block *[20]*. LandScan Global, a world-wide land cover database developed by Oak Ridge National Laboratory, uses a Geographic Information System (GIS) and Remote Sensing to estimate global population distribution *[21]*. The spatial dimension used in LandScan Global is approximately 1 km resolution, which is useful to distribute population at global level but is too coarse to distribute population within a metropolitan area.

As regards the temporal dimension, most studies consider only a rough breakdown: nighttime and daytime of a single day. The nighttime population is usually considered to be the resident population. Studies vary in terms of daytime population breakdowns. The Environmental

Systems Research Institute (ESRI) offers a thematic map of "USA Daytime Population" which only considers workers in an area. McPherson and Brown, researchers at Los Alamos National Laboratory, developed daytime distributions based on worker data and population remaining home during the daytime *[22]*. They further improved their study by introducing fractions of people indoors and outdoors *[23]*. Later, they added population exchange elements into their study *[24]*. Population exchange elements are the proportion of residents who live in one zone and work in another zone, and the proportion of workers who work in one zone and live in another. Workers and students are typical subsets of the population considered in daytime population distributions, such as in the studies of Freire, Freire and Aubrecht, Sleeter and Wood *[25] [26] [27] [28] [29][30]*.

Regarding the spatial dimension, study areas vary from local to global levels, and sometimes even involve multiple levels *[31]*. The method usually used to disaggregate the population is the areal interpolation method. This involves disaggregating the population on area alone. A second common method is pycnophylactic interpolation, where a smooth mathematical function is used to provide areal weighting to the areal interpolation method *[32]*. Kobayashi et al. used this method in their study *[33]*. Another method is dasymetric mapping, or intelligent dasymetric mapping, which disaggregates the population in accordance with ancillary data such as length of street centerline or square feet of certain land uses within the area. Freire, Freire and Aubrecht, and LandScan use this method in their research *[25] [26] [27] [28]*.

This study uses the dasymetric mapping method with some modifications. Dasymetric mapping is an areal interpolation method that uses ancillary spatial data in its interpolation. Land cover/land use maps are most often used as ancillary data. Holloway et al. *[34]* assumed a fixed proportion of the population for each land cover type based on subjective judgment. Land cover types used in their study included urban, open, agriculture and forest, and uninhabited. Mennis *[35]* combined land cover sampling with areal-based weighting in their dasymetric mapping procedure. In that research, land cover types were based on urbanization level, which included uninhabited, non-urban, low-density residential, and high-density residential. For each land use, population density values were sampled using a survey. The population was then distributed based on a weighting factor related to population density values and area percentage of each land cover type within one geographic unit. Later, Sleeter and Gould *[36]* developed an ArcGIS-based Dasymetric-Mapping Extension (DME) procedure based on the Mennis *[35]* theory. Limited land cover types and subjective judgment on the relative importance of each land cover type are two problems that limit the usefulness of the aforementioned methods.

Another issue is that, in most past studies, tourists and shoppers have been ignored as population subgroups with distinct spatio-temporal patterns. Even though Bhaduri and Bhaduri et al. consider tourists in the LandScan USA study, they do not consider the seasonal variation and the peaking in attendance during festivals or other special events *[32] [37]*. To a large extent, shoppers have been ignored in past studies even though national travel studies such as the National Household Travel Survey (NHTS) show that shopping trips make up approximately 26% of a household's daily travel and generate distinct travel patterns.

In this study, the population is broken into six groups: residents, workers, students, shoppers, stay-at-homers, and tourists. On the temporal dimension, a day is divided into daytime and nighttime; a week into weekday, Saturday; and Sunday; and a year into four quarters corresponding to the four seasons of the year. Special consideration is also given to periods when festivals or other special events occur in the area under consideration. For the spatial dimension, the Traffic Analysis Zone (TAZ) polygon layer, commonly used by Metropolitan Planning Organizations (MPOs), and the National Land Cover Database (NLCD) land use converted polygon layer are intersected to establish a new set of spatial units to which population groups are assigned.

The NLCD provides the land cover of 30m by 30m geographic areas across the entire United States. Its one disadvantage is that while four of its 20 land cover categories refer to developed land by level of intensity, it does not distinguish between residential, commercial, and industrial activity within each intensity classification. To overcome this disadvantage, residential density and employee data are collected from other sources to distinguish between the land uses of different population groups.

Method of Estimating Spatio-Temporal Population Distribution

Input Data. The first task in developing a spatio-temporal estimate of the population of an area is to identify the source and geographic level at which input information on the characteristics of the population are available. That is, where can data on population, employment, students, tourists, commerce, and industry be obtained and at what geographic level is it available? In this study, data from the Census Transportation Planning Package (CTPP) was used to provide information on population and employment at TAZ level. Data from the National Center for Education Statistics (NCES) was used to provide student numbers by educational institution. The National Household Travel Survey (NHTS) was used to estimate shopping frequency and the time of day when shopping occurs. County Business Pattern (CBP) data of employment in the retail and hospitality industry were used to improve the precision of distributing shoppers to the shop end of their travel and the location of tourists at night. Information from Convention and Visitor Bureaus (CVBs), as well as

information extracted from local newspaper articles, were used to estimate the number of tourists, their distribution by city and season, and their peaking at the time of regularly scheduled festivals. Table 2 summarizes the sources and geographic level of data used as input in this study.

Table 2

Spatial data sources

Group	Data/Ancillary data source	Data level	Data type
Household population	CTPP-residence	TAZ	Polygon
Household employment	CTPP-residence	TAZ	Polygon
Household school enrollment	CTPP-residence	TAZ	Polygon
Worked at home	CTPP-residence	TAZ	Polygon
Stay-at-homer (basic)	CTPP, NCES[1]	TAZ	Polygon
Worker at workplace	CTPP-workplace	TAZ	Polygon
Student at school/university	NCES	Specific address	Point
Shopper at home-end	NHTS	State	Polygon
Shopper at shop-end	CBP	Zip code	Polygon
Daytime tourist	CVB, local newspaper	Parish	Polygon
Nighttime tourist	CBP	Zip code	Polygon
Land cover/land use map	NLCD		Raster

1. Stay-at-homers = residents minus students minus workers.

Estimating Residents. Residents are assumed to be at home at night. During the day, some residents participate in out-of-home activities and therefore reduce the daytime residential population. For example, workers and students are assumed to work and attend school during the day on weekdays. During the day on weekdays, stay-at-homers are estimated by subtracting workers and students from residents with allowance made for some stay-at-homers who go shopping during the day. During the day over weekends, stay-at-homers are estimated by subtracting shoppers from residents. At night, stay-at-homers are assumed to equal the number of residents.

Estimating Shoppers. The temporal distribution of the shopping activity is based on NHTS data which provides home-based shopping trip start and end times of person trips across the country. The person expansion factor is also provided so the percentage of people who go shopping in one state or even over the whole country during different times of the day or day of the week can be calculated. In this study, a day is divided into daytime and nighttime periods. For daytime shopping, shopping was assumed to occur between 10 am and 6 pm as evidenced by the time distribution of shopping in the NHTS data in Figure 2. Shopping activities in this time period averaged about 66% of an entire weekday's shopping activities. From the NHTS data it was also determined that the proportion of the population

who go shopping on any particular day are 4.6% of the population on weekdays, 0.9% on Saturdays, and 0.6% on Sundays.

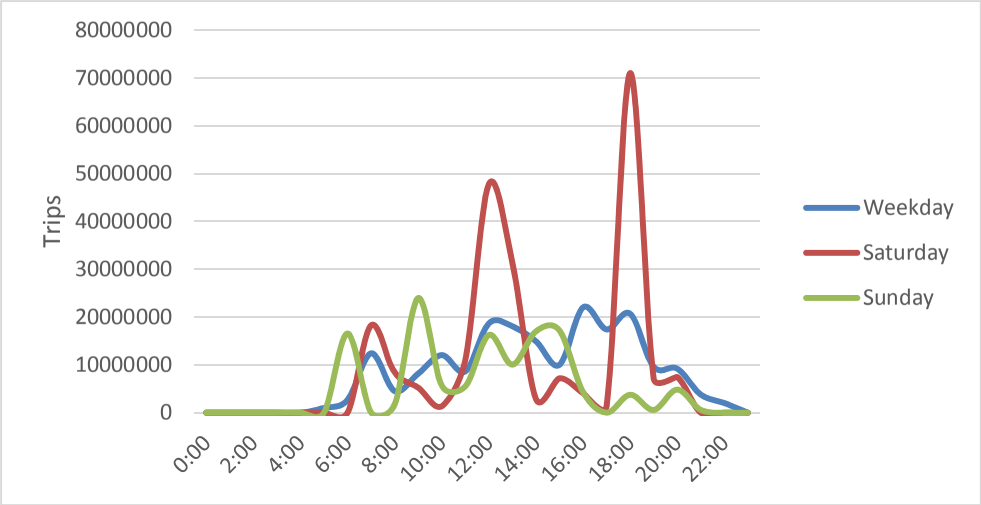


Figure 2
Temporal distribution of shopping trips

People are assumed to go shopping during the daytime only. Shoppers were estimated as a proportion of stay-at-homers during the week and a proportion of the whole population during the weekend.

The distribution of shoppers at the home end is based on the proportion of residential area in each TAZ. For the shop end, if data from the NLCD land cover maps are used in the distribution process, shoppers could be disproportionally distributed to residentially concentrated areas instead of main commercial areas as they both belong to the same high intensity land cover type in the NLCD classification. So, more ancillary data are needed to improve the assignment process. In this study, based on a constant service/customer ratio assumption, it is assumed that the number of shoppers is proportional to the number of retail employees. Retail employee data are collected from CBP. At ZIP code level, the original data file only provides the number of establishments and the range of number of employees. The midpoint of each range was used for the number of employees in this study. However, since specific retail employee data is available at parish level, balancing was done to match the estimated retail employees at ZIP code level to the values at parish level. Following this, the total shoppers at the shop end were assumed to be equal to the total shoppers at the home end. Shoppers were then distributed proportionally to the number of retail employees in each ZIP code area. By doing this, the precision of shopper distribution was controlled at least at ZIP code level. Within a ZIP code area, the modified dasymetric mapping method described

below was used to distribute shoppers to each kind of land use.

Estimating Tourists. Tourist data is usually only available at state level with seasonal variation. Spatial ancillary data such as the share of tourism going to major areas within the state can help distribute tourist to each parish more precisely. Temporal ancillary data like festival news reports in local newspapers can help in estimating high volumes for festival periods and low volumes for non-festival periods in each season. In this study, festival participants of a season were summed and averaged by festival days of that quarter. As an average number is used in this study, actual attendance during peak periods of major festivals may exceed this average number but in the absence of knowing daily attendance at individual festivals, this is a practical solution. Tourist numbers on non-festival days were estimated by subtracting total festival participants from the total number of tourists of that quarter and averaged over the non-festival days.

In order to improve the precision of nighttime tourist distribution, hotel employee data were collected from CBP. And similar to the distribution of shoppers to the shop end, nighttime tourist were distributed proportionally to the number of hotel employees. Thus, the number of tourists were controlled at ZIP code level.

Modified Dasymetric Mapping Method. The National Land Cover Database 2011 (NLCD 2011) classifies land cover into 20 land cover types in land parcels of 30m × 30m. In each land parcel, only one land cover type is recorded. Of the 20 land cover types, only 4 relate to land cover supporting human activity; the others are forest, vegetated areas, water, marsh, cultivated fields, barren land, etc. The 4 land cover types associated with human activity are “developed open space” (stated as being related to land use such as parks, golf courses, or very low density residential development), “developed low intensity,” “developed medium intensity,” and “developed high intensity” land. No indication is given of the land use in each land cover category. For example, high intensity developed land could be high density residential, industrial, or commercial land use. One way to distinguish industrial areas from the rest is to use the fact that industrial areas have low residential density. This was applied in this study by calculating the residential density of high intensity land use areas at the TAZ level, and noting their densities. Densities of some known industrial areas were then reviewed to set up a threshold below which areas are clearly industrial. TAZs with density values above the threshold were considered residential or commercial.

Relative Importance of Land Use. Instead of using subjective judgment to establish the percentage of population to be assigned to each land use type in dasymetric mapping, linear regression can be used to find the relative importance of each land use. If, at the TAZ

level where population and the areas of different land uses is known, population is taken as the dependent variable and the areas of the different land use types are taken as independent variables, the coefficients of the independent variables in that regression express the population associated with each land use type per unit area. Thus, knowing land use areas at a fine spatial level will allow the spatial dispersion of population at that level. This approach was used to distribute population within each geographic unit (i.e., TAZ, ZIP code, and parish) according to the land use identified in the 30m × 30m land parcels identified by the NLCD. For each population group (resident, worker, student, etc.), an estimate of the population in each 30m × 30m land parcel was obtained by distributing the population in the geographic unit in proportion to the land use associated with that population group as shown in equation (1).

$$Pop^{p}_{GULU_i} = Pop^{p}_{GU_j} \times \frac{coeff^{p}_{LU_k}.area_{i,k}}{\sum_{k=1}^{20} coeff^{p}_{LU_k}.area_{i,k}.\delta} \quad (1)$$

where,

$Pop^{p}_{GULU_i}$ = Number of persons estimated to belong to population group p in intersection polygon i. The intersection polygon is the result of intersecting the geographic unit layer and the land use layer of 30m × 30m land parcels;

Pop_{GU_j} = Number of persons belonging to population group p in geographic unit polygon j. Intersection polygon i is within geographic unit polygon j;

$coeff^{p}_{LU_k}$ = Parameters of land use type k estimated in the regression equation for population group p. Intersection polygon i has land use attribute k;

$area_{i,k}$ = Area of land use type k in intersection polygon i;

δ = 1 when land use type k appears within geographic unit polygon j, 0 otherwise.

Time Elements

Using equation (1) for each population group (e.g., worker, student, etc.), the population in each geographic unit (e.g., TAZ, census tract) was distributed to the intersection polygons within it. For each time period, related data is summed for all population groups to get the total population distribution. For example, an estimate of the first quarter festival weekday population in an area would be the sum of the following for all intersection polygons in the area:

Weekday nighttime population = nighttime resident (household population) + nighttime

tourist of the first quarter festival

Weekday daytime population = worker + student + weekday stay-at-homer + weekday shopper + daytime tourist of the first quarter festival

The difference between a weekday and a day during the weekend is the daytime population distribution. Take a Sunday in the first quarter as an example:

Sunday daytime population = Sunday stay-at-homer + Sunday shopper + daytime tourist of the first quarter festival.

In this study, for a whole year, 32 different time periods are finally calculated. For example, there are 8 time periods in each quarter, in which 6 are in the daytime and 2 are at night. The 6 daytime periods are determined by whether the day is a festival day or not, and whether it is a weekday, Saturday, or Sunday. The 2 nighttime periods are only distinguished by whether it is a festival day or not.

Graphical Display of Information

One of the objectives of this study was to portray the information gained in the inventory survey in a convenient manner. It was also required that queries on the information in the data base be conducted easily and quickly. It was decided that a Geographical Information System (GIS) would serve that purpose best, provided it could be accessed by emergency officials during an emergency and that queries could be initiated without extensive training in the use of the software.

After reviewing various alternatives of how to host a GIS that contained the inventory data and was accessible to emergency personnel, it was decided by the study team, and endorsed by the Project Review Committee, to use a web-based system. Two alternatives presented themselves in this regard. One was to host the information on the GIS system at the Louisiana Department of Transportation and Development. The GIS at DOTD operates within the department's Web Application Development System. The system was developed by DOTD's IT Section and has implemented standards for all web applications. Any web application developed for DOTD must comply with their software standards consisting of at least 16 items in addition to State of Louisiana Office of Information Technology standards. Systems that do not comply with these standards cannot be assimilated into the DOTD IT system. Access to the DOTD-based system by outside users proved to be difficult to accomplish.

The second option was to host the information on ArcGIS Online, a commercial entity providing ArcGIS service online. A local portal to ArcGIS online is available at LSU making access to the system convenient. Multiple users are permitted on ArcGIS Online and access by outside users is gained without difficulty. ArcGIS Online was selected for use in this study.

Features of ArcGIS Online

In contrast to the DOTD GIS system, ArcGIS Online has few user requirements and is easy to use. It operates on a computer housed at ESRI headquarters in California with user access to the system through the Internet. LSU is a licensee of ArcGIS Online and has a server which manages local use and authorizations to perform different functions on the system such as use of ArcGIS Online, storage of data, sharing of information, and providing access to other users. Data can be hosted in ESRI's secure cloud or on our own server. Multiple layers of security protect data from unauthorized access. Ownership of data is maintained and the user controls who can access data and maps. The user does not need to concern him/herself with software, hardware, security, or maintenance of the system. Each user gets an account and may share data or collaborate with other users on joint projects. Users also have access to ready-to-use apps, maps, templates, and other content so they can become productive quickly. The system allows the monitoring of events, activities, and assets through interactive dashboards using maps, images, and scenarios. Information may be shared with others or combined to provide enriched information. ArcGIS Online includes ready-to-use base maps, demographics, imagery, and map layers. They are created with authoritative content from commercial data providers and contribution from the GIS user community. Of particular value to the project addressed in this study are tools such as geocoding and the ability to extract data with web maps and apps. Developers can access them by using ArcGIS API's and SDK's to build web and mobile applications that meet specific workflows such as evacuation strategies planned in this project.

ArcGIS Online allows customization of roles or privileges assigned to members within a single account. This administrative capability allows the assignment of roles that specifically fit the needs of this project. For example, there might be some members who need access to maps and apps but do not need to create groups. Or there might be other members who need to publish features but not files.

Using ArcGIS Online

Users access the system from the internet and, therefore, can access it from any location where access to the internet can be obtained. Users must be authorized to use the system and

an official within DOTD will be given authority to authorize legitimate users of the system. Access is gained through the ArcGIS online website.

Each license for ArcGIS Online has an administrator tasked with managing the account. Each account can have multiple users, viewers, and publishers, but only one administrator. Publishers are permitted to add data files to the account but users and viewers are not. Data files remain stored in the system but may be withdrawn, amended, or replaced by the publisher. Each account is allotted a certain amount of computing time as part of the purchase agreement. If the initial allotment is exceeded, additional time can be purchased.

Query of Information. In ArcGIS online, queries can be established as customized popup windows to show specific attributes of interest. For example, when a user wants to query a specific feature to get some information about it, all they have to do is click on that feature and a pre-customized attribute popup window will appear on the screen and will show the attributes associated with that specific feature on the map such as shown in Figure 3.

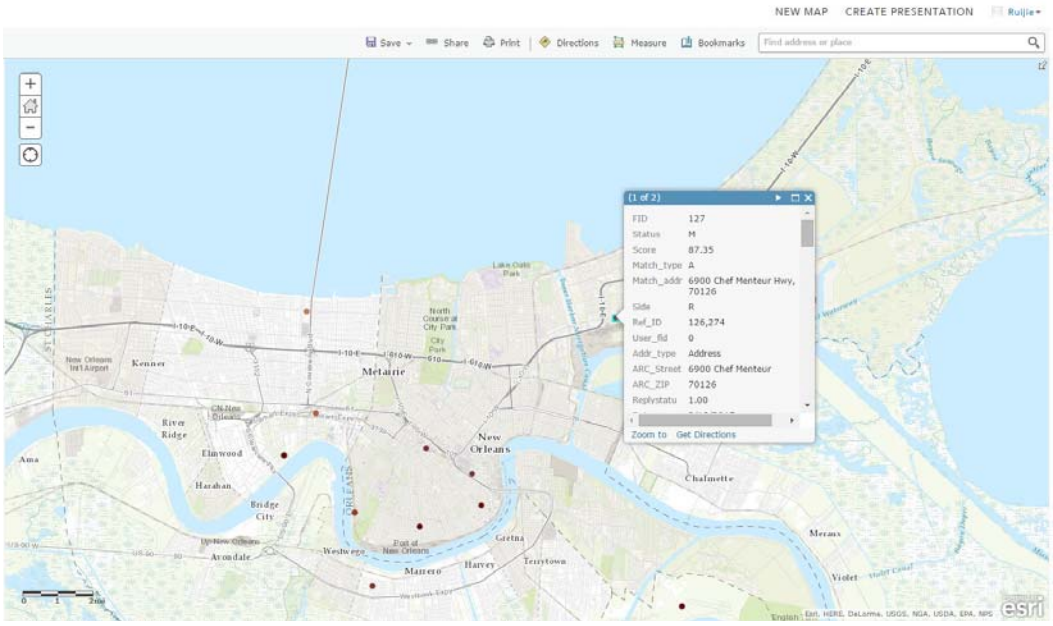


Figure 3

Query on transit vehicles at a location

The information and attributes that appear on the query popup window are drawn from the attribute table associated with the feature layer. For example, a user can view the attribute table of any layer with the feature associated with it. If close attention is paid to Figure 4, the attribute table of the organizations and the location of each feature can be seen on the map as well.

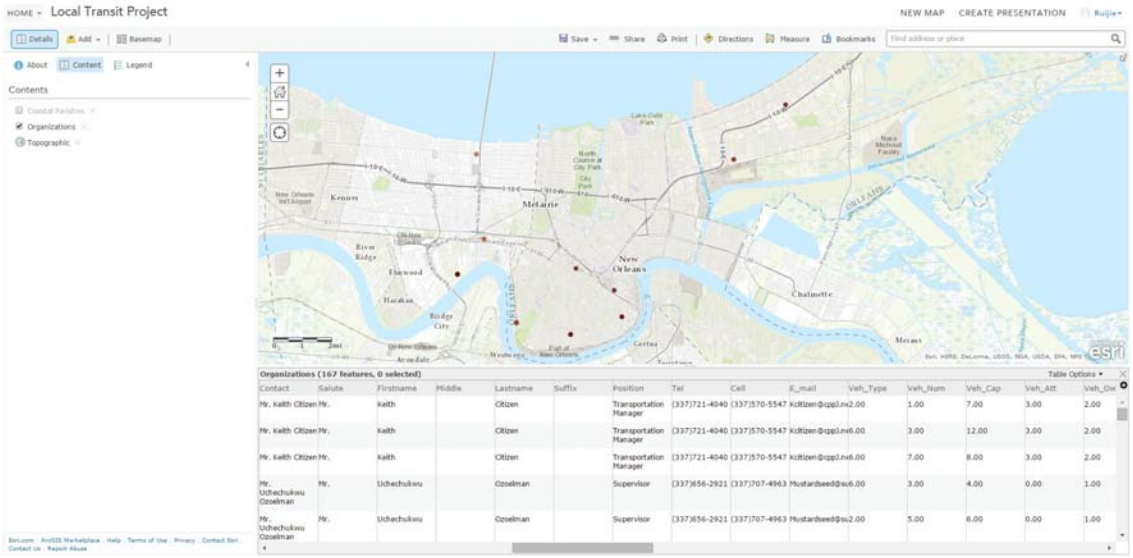


Figure 4

Viewing the attribute table of a layer

The user can clip data by extract data tool from the analysis tools to get the number of vehicles surrounded by a polygon in specific area for example. As an example, Figure 5 shows the result of a user querying the number of vehicles in a specific area drawing a polygon around the area and extracting the attributes of the features inside the polygon. The specific steps are: click on the layer that needs analysis > click *Perform Analysis* > click *Manage Data* > click *Extract Data* > select *Clip Features* > draw a shape according to the needs > click on *Run Analysis*.

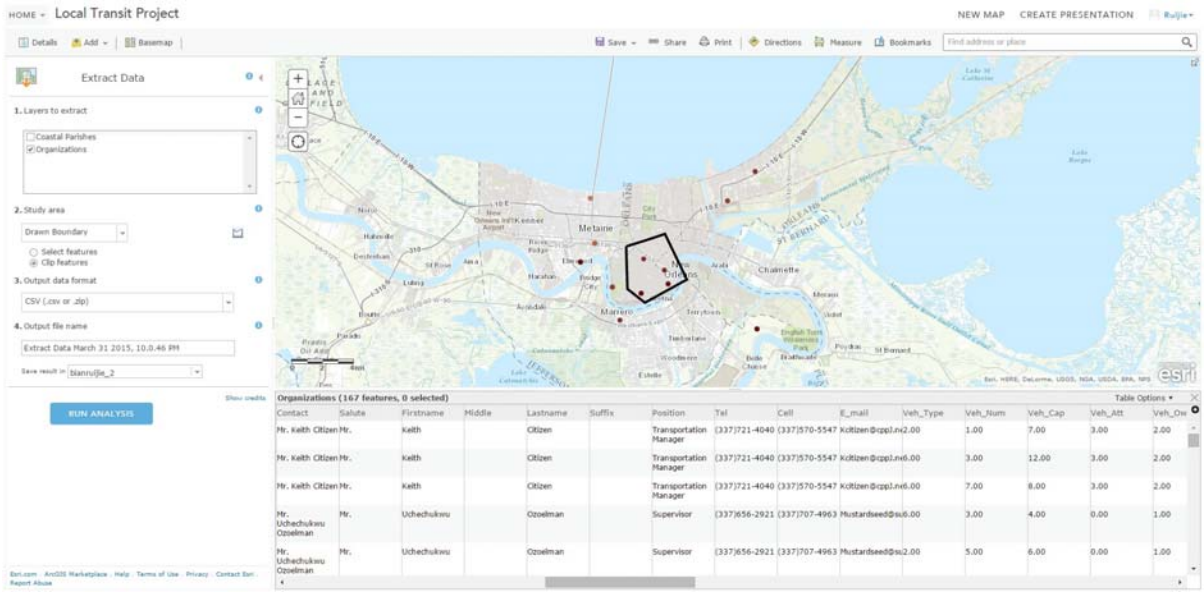


Figure 5
Attributes of an area

The data is extracted to Comma Separated Value (CSV) format and can then be displayed in a spreadsheet program such as Excel. Further analysis can be conducted on the data such as applying the summation function to the vehicle column to get the number of vehicles in the polygon.

Review of Laws Pertaining to Use of Local Transit for Evacuation

One of the needs in this study was to identify any statutory restrictions that may restrict the use of special needs or human services transit (HST and SNT) in an emergency. This was achieved by reviewing federal, state, and local legislation related to the use of local transit for evacuation in Louisiana. The goal was to identify the constraints, responsibilities, and requirements imposed by law that potentially could affect the use of these services during a natural or man-made disaster.

Federal Laws

MAP 21. MAP 21 ("Moving Ahead for Progress in the 21st century") is the current law authorizing expenditure from the Highway Trust Fund. It authorizes expenditure on highways, safety, transit, and other transportation programs that promote and maintain surface transportation systems in the country. The part of MAP21 that is of interest in this study is provision for *emergency* transportation. The Act includes a Public Transportation Emergency Relief Program and Title 49 of the United States Code (USC) lists regulations

governing the financing of evacuation, rescue, route service adjustment, and route service restoration *[38]*.

The Stafford Act. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 USC 5121-5207) authorizes the President of the United States to declare a state of emergency in an area suffering from a major disaster or emergency. The President's declaration allows federal funding to flow to the area affected. The following chronology summarizes the sequence of events triggered by a disaster or emergency declaration:

1. President declares a state of emergency
2. FEMA coordinates a Federal Response Plan by rallying relief organizations (section 309) and private transportation firms (section 307), and providing financial and physical assistance to state and local governments.

State, tribal, and local governments, as well as certain private nonprofit organizations, can receive such federal assistance during an emergency. Some of the types of public assistance that can be funded are:

1. Repair, reconstruction, and replacement of infrastructure and recreational facilities
2. Emergency protective measures
3. Emergency communications
4. Transportation as well as loans to replace lost revenue or meet federal cost-sharing requirements.

The Stafford Act states in Sec. 201: 42 USC 5131(a) and sec. 503: 42 USC 5193 that grants administered by order of the President can cover:

- Up to 75% of costs
- Up to $5,000,000
- Up to $50,000 yearly to any state
- Remainder must come from local resources

Any additional money must be approved by Congress. New state programs can be granted up to $250,000, while existing programs may receive up to 50% of the cost. In order to qualify, program applicants must demonstrate that funding will help prevent (or cover costs of) damages associated with at least 4 different types of hazards. Types of hazards include, but not limited to flood, hurricane, tornado, and earthquake. Under MAP-21, however, it is stated in 49 USC 5324 that the Office of Homeland Security's Secretary may "make grants and enter into contracts and other agreements" for public transportation equipment's operation and maintenance/replacement costs. Such grants cannot exceed 80% of the total

costs; the remainder constitutes a "non-federal share." However, the non-federal share can be waived by the Secretary under certain conditions.

Sec. 408 (42 USC 5174) states that the President, in consultation with the Governor may provide federal assistance to individuals and households to address transportation-related expenses. Sec. 419 and 425 (42 USC 5186) explains that the President himself can provide transportation for communities in affected areas, that is, to administrative buildings/centers, to alternative residences, or back to pre-disaster residences.

Recent amendments were made to the Stafford Act by the Department of Homeland Security Appropriations Act of 2007, the Pets Evacuation and Transportation Standards Act of 2006 and the Security and Accountability for Every Port Act of 2006 [39]. Amendments to the Stafford Act through the DHS Appropriations Act of 2007 included funding the administration of emergency response, provision for the President of the United States to provide accelerated Federal assistance in emergencies even if not specifically requested provided states are promptly notified of the action taken, and special provision for people with limited English proficiency, disabilities, or special needs. The Pets Evacuation and Transportation Standards Act of 2006 modified the Stafford Act by adding the requirement that all emergency plans had to take into account household pets and service animals in advance of, during, and following a major disaster or emergency. Amendments to the Stafford Act in the Security and Accountability for Every Port Act of 2006 included federal assistance of 50% of a local authority's operating costs up to $5 million if they lost more than 75% of their normal revenue in the year in which a major disaster occurred, and to expedite payments from the Federal government for claims made by state, local authority, or private non-profit organizations for legitimate expenses associated with a disaster or emergency.

State Laws

The Louisiana Homeland Security and Emergency Assistance and Disaster Act documented in Louisiana Revised Statutes RS 29:721 through 728, lists the state's responsibilities in instances of disaster and emergencies by office and/or authority figures, as well as penalties for violations. RS 29:724-726 states that the Governor and the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) have the following responsibilities:

1. Declare a state of emergency (such statement must, however, be acknowledged by federal authorities in order to qualify for funding) after consulting with experts in the area of concern (climatology, seismology, etc.)
2. Designate the area determined to be in a state of emergency (specific parish, city, municipality, subdivision, etc.)

3. Suspend provisions of any regulatory statute (allow momentary deviation from legal specifications)
4. Collect, transfer, and re-direct any resources necessary in order to restore the affected areas to their pre-disaster state.

The Office of the Governor delegates authority to individuals and agencies in order to tend to the needs of the people and their property through GOSHEP. GOSHEP and FEMA also train workers of several sectors, including educators, through certification programs for emergency preparedness.

Act 295 of the Louisiana legislature was passed in 2009 and enacted in R.S. 29:735.3.1 to provide immunity for volunteers assisting in a state of emergency. Provided assistance is provided in coordination with the state or its political subdivisions and does not represent gross negligence or willful misconduct, volunteers providing assistance are exempt from liability for injury, death, or damage to property resulting from such assistance.

Local Laws

Louisiana's Revised Statute 29:727 designates the parish president as the person primarily responsible at the local level during an emergency. City mayors are also authority figures, but when it comes to receiving funding for transportation programs, the parish president has more authority. Parish presidents are responsible for establishing a parish "homeland security" office as well as an emergency preparedness program. As per RS 29-727, the parish president has authority to redirect local government human and non-human resources and private property to cope with the emergency. The parish president also has authority to initiate and manage evacuation to shelters for the population affected via routes and by transportation they prescribe within their jurisdiction. Table 3 summarizes duties and responsibilities during a disaster at the local level as per RS 29:724-730.

At the local level, RS 29:733, Article 8, states that a state rendering aid in another state may be reimbursed by the state receiving aid (including transportation) for any loss or damage. Nevertheless, the U.S. government may relieve the state receiving aid from liability and proceed to reimbursement.

Table 3

Duties and responsibilities during a disaster

Regulation	Who?	Task
§727 (6), (8)	Parish president	Prescribe evacuation routes, vehicles, and destinations within the local jurisdiction; suspend/limit the sale or carrying of alcoholic beverages, firearms, explosives, and combustibles.
§729	Parish homeland security and emergency preparedness agency	Determine pet evacuation
§730.3	Residents	Leave and relocate to safer locations

Federally Funded Programs

Examples of federal funding of emergency operations include FEMA-designed and operated grant programs such as the:

- Transit Security Grant Program (TSGP): Provides financial support (over $80,000,000 in 2013) to owners and operators of transit systems to help protect critical surface transportation infrastructure as well as passengers in terrorism-related emergencies.
- Intercity Passenger Rail Security Grant Program (IPRSGP): Focuses on financing the protection of infrastructure (trains, subway trains) against acts of terrorism, with an emphasis on those that involve the use of explosives.
- Intercity Bus Security Grant Program (IBSGP): Funds are provided to create a program that protects intercity bus systems and their passengers from acts of terrorism by assisting operators of intercity and charter bus services to get security resources (safer equipment and facilities equipped with security systems)
- Trucking Security Program (TSP): Grant funding is centered mainly on financing tractor and trailer tracking-related equipment.
- Freight Rail Security Grant Program (FRSGP): A component of TSGP, the FRSGP assists freight railroad carriers and owners of rail bridges and railroad cars financially to optimize the security of essential surface transportation infrastructure.
- Emergency Transportation Operations (ETO): This program works with local Departments of Motor Vehicles (DMV's), state/local patrols, and local DOTs to finance emergency training programs and accountability assessments.

These programs provide grants to help finance the strengthening of transportation infrastructure in natural disaster and/or terrorist attack emergencies. For such programs, vehicle owners and operators must follow protocol required by the Department of Homeland Security (DHS) to procure funding.

Prescription During Evacuation

Vehicle Operation. The powers of the Governor (RS 29:724) and parish president (RS 29:727) include prescription of the itinerary of the evacuation process and the modes of transportation to be used. According to the Administrative Procedure Act of 2006, these authorities must take measures to evacuate people in high-risk areas utilizing all available modes of transportation:

* school and municipal buses
* government-owned vehicles
* vehicles provided by volunteer agencies
* trains
* ships

All vehicles are directed to a common destination: public shelters. Some state and parish system-owned facilities are designated as default shelters: public school gymnasiums and the Pete Maravich Assembly Center at LSU are examples of such de facto shelters. GOHSEP workers receive training and are aware of the shelters' locations. Nevertheless, communication with non-GOHSEP workers and the manner in which this knowledge is disseminated to non-GOHSEP drivers must still be specified.

According to the Stafford Act (42 USC 5150 and 5152), the President of the United States may establish contracts or agreements with firms so that their vehicles, personnel (drivers), and facilities (shelters) can be used in an emergency.

Vehicle Insurance. Vehicles are insured according to the owning companies' policies and Louisiana DOTD laws. However, Section 311 of the Stafford Act indicates that a state may act as self-insurer for state property if necessary.

School buses are often requisitioned in emergency and disaster situations. Louisiana Revised Statutes R.S. 17:159, R.S. 32:601, R.S. 32:604, and R.S. 45:162 state that school bus insurance covers both the vehicle and its passengers. The owning education agency (whether public or private), however, remains responsible for paying premiums.

Location of Vehicle(s) When Not in Use. The location of an emergency vehicle when not in use is at the discretion of the owning company or organization (police station, ambulance stations, etc.). This is due to the fact that vehicles used in emergency evacuation are usually used for other general purposes outside of such instances.

Driver Licensing

RS 29:735 specifies that license ownership is required for any driver assisting disaster victims, including those who help gratuitously and voluntarily – although they have immunity in case of an evacuee's death or injury not attributed to "gross negligence and willful misconduct" as specified in Louisiana Act 295 mentioned above in the section on State Laws.

Drivers' and License Requirements. The type of license required depends on the type of vehicle being operated. Nevertheless, as per the previously mentioned RS 29: 726, the office of the Governor reserves the right to suspend any statutes, including license requirements, in an emergency.

Only U.S. citizens and permanent residents may operate HST and SNT vehicles for federal and state-funded programs. Data on privately funded HST and SNT operations has not yet been made consistently available. The Code of Federal Regulations of the United States of America §383.71, reproduced in Table 4, specify the documents required to verify a drivers' citizenship or residency status.

Table 4
List of acceptable proofs of citizenship or lawful permanent residency

Status	Proof of status
U.S. Citizen	Valid, unexpired U.S. Passport.
	Certified copy of a birth certificate filed with a State Office of Vital Statistics or equivalent agency in the individual's state of birth, Puerto Rico, the Virgin Islands, Guam, American Samoa, or the Commonwealth of the Northern Mariana Islands.
	Consular Report of Birth Abroad (CRBA) issued by the U.S. Department of State.
	Certificate of Naturalization issued by the U.S. Department of Homeland Security (DHS).
	Certificate of Citizenship issued by DHS.
Lawful Permanent Resident	Valid, unexpired Permanent Resident Card, issued by USCIS or INS.

Funding for HST Operation Drivers' Licensing and Credentialing. The Federal Highway Administration of the U.S. Department of Transportation has developed a Highway

Safety Improvement Program (HSIP) (23 USC § 148) that requires states to have a Strategic Highway Safety Plan (SHSP). SHSP's have funds available to enhance drivers' licenses in terms of security (identification management based on information technology systems). In addition, in states with Threat and Hazard Identification and Risk Assessment (THIRA) programs, funds are also made available to facilitate licensing. THIRA programs are funded by FEMA and their purpose is to allow a jurisdiction to understand the threats that it faces so as to better identify defensive action it may take in advance of the risk.

Federal Transit Administration (FTA) safety training programs are available under sections 5307, 5311, and 5327 of the Stafford Act, and the duration and renewal process of licenses varies based on license type. However, training programs are for auditors and overseers, not drivers. For FEMA programs, training for disaster workforce helps ensure driver mastery of protocol and national standards. Thus, FEMA training may provide certificates for emergency preparedness, but it does not provide additional driving licenses; local DMVs are responsible for providing driver credentials prior to an emergency situation.

Regulations on HST and SNT Service Areas

Residents Served. Emergency public transportation serves people who are least likely to be mobile in case of a disaster (RS 29:726; Administrative Procedure Act of 2006). Priority consideration is given to people with special needs (e.g., the elderly, the infirm), tourists, essential workers, those without personal transportation, and, to a lesser extent, those who refuse to leave. RS 29:729 also authorizes accompanying pets whose transportation does not endanger human life.

Discrimination. Regulations do not directly reflect any form of discrimination, as the areas served are not reported to follow any segregation pattern. The authors did not find any study that reported an inequality directly involving transportation services during a mandatory evacuation. Actually, section 308 of the Stafford Act (42 USC 5151) directly forbids any form of demographic discrimination. Some scholarly published studies, however, revealed that the implementation of regulations resulted in imbalance in demographic characteristics regarding other emergency services for shelters *[40] [41]*.

Evacuation Routes. The Louisiana Emergency Preparedness Guide identifies routes throughout southern Louisiana and contraflow crossover points for use in an evacuation of Southeast Louisiana *[42]*. The Guide provides insight as to strategic evacuation itineraries, that is, the route of pick-up points that transit drivers must follow in order to bring affected residents to shelters. However, this itinerary is not legally regulated, which makes the implementation of the strategy challenging to evaluate and assess if the degree of compliance

is not known. Another shortcoming of the manual is that it does not provide alternate routes to be followed if the original itinerary's roads and avenues are blocked.

Route and vehicle operation regulations are formulated in RS 29:724; RS 29:726-727. The Governor (§724) and parish president (§727) prescribe an itinerary and modes of transportation, and the Administrative Procedure Act of 2006 provides evacuation regulations for people in high-risk areas utilizing all available modes of transportation (see Prescription During Evacuation section, subsection Vehicle Operation in this chapter). All routes are chosen to lead to public shelters.

The Louisiana THIRA used GIS devices to design and develop strategic itineraries, whereby geospatial technology is utilized to map routes. GIS is used to facilitate calculations of shorter, safer routes that allow transit to serve a greater number of residential areas safely.

Schedule. For evacuation by private vehicle, the local Offices of Emergency Preparedness in Louisiana recommend phased evacuation procedures and have developed an Evacuation Map to illustrate it *[43]*. Under a hurricane-specific threat, phased evacuation will be based on geographic location and time in which tropical storm winds are forecast to reach the affected areas. Hurricane-related evacuation phases are summarized in Table 5.

Passenger Pick-up. The *Louisiana Emergency Operations Plan* explains that only a limited number of registered public bus companies are authorized to provide emergency evacuation services during natural and manmade disasters. Consequently, each parish is responsible for accounting for and reaching out to available buses and coordinating their service to the state *[43]*. For such companies, job descriptions for drivers document the procedure for passenger pick-up during emergency situations. However, it must be noted that private transportation companies or community service organizations will have their own pick-up procedures. Therefore, as the legislation authorizes the US President, the Governor, and the Parish Presidents to request private companies' collaboration, there is a need for a documented, uniform policy regarding passenger pick-up during an emergency.

Table 5

Schedule of evacuation phases in Louisiana

Phase	Time of implementation	Areas	Evacuation map color
I	50 Hours before onset of tropical storm winds	• South of the Intracoastal Waterway. • Outside any levee protection system • Vulnerable to Category 1 and 2 storms • No route restrictions	Red
II	40 Hours before onset of tropical storm winds	• South of the Mississippi River • Areas which are levee protected but remain vulnerable to Category 2 or higher storms • No route restrictions	Orange
III	30 Hours before onset of tropical storm winds	• East Bank of the Mississippi River in New Orleans Metro Area • Within levee protection system but vulnerable to a slow-moving Category 3 or any Category 4 or 5 storm. • Certain routes will be directed and the Contraflow Plan implemented	Yellow

Private HST. Other transportation services can be used at the discretion of individuals or communities. For instance, churches, small organizations and businesses can organize to evacuate their members. They do, however, have to follow the evacuation routes specified by the state and follow state and federal emergency preparedness guidelines. Those services that are not federally funded but those that incur expenses linked to the emergency transportation can claim their expenses in their taxes.

As per R.S. 29:721, GOHSEP is responsible for compiling a database of industries, resources, and facilities – public and private. Upon assessing the feasibility of contracts with these agencies, GOHSEP must evaluate the potential provision of disaster response services, including transportation for evacuation purposes. GOHSEP is thus in charge of planning for their use, including financial compensation under specified terms and agreements.

DISCUSSION OF RESULTS

Pilot Survey

The pilot survey was conducted from October 8, 2014 through November 14, 2014, on organizations randomly selected from the following five parishes: Acadia, East Baton Rouge, Iberville, Lafayette, and West Baton Rouge. These parishes are non-coastal parishes, but are still similar to those organizations in the coastal parishes and were, thus, considered suitable for the purpose of the pilot survey.

From a total of 123 survey packages sent out in the pilot survey, the following response was received:

- 19 replies
- Of the 19 replies, 6 did not have any transportation service
- 94 did not reply ("wait reply" plus "resent and wait reply")
- 21 had incorrect addresses and were returned
    - 15 of the 21 incorrect addresses were corrected and sent again. 4 replied. 4 failed to be delivered again after being resent. 7 failed to reply after being resent.
    - 2 of the 21 incorrect addresses are agencies that no longer exist.
    - 3 of the 21 incorrect addresses are agencies that are not applicable to be sent to again.
    - 1 of the 21 bad addresses is received recently, which the agency has multiple addresses.

Of the total sample of 123 organizations, some form of response was received from 29 (19 replies (which includes 6 who do not have transportation service), 2 who no longer exist, 3 who are not applicable agencies, 1 which has multiple addresses, and 4 who had the wrong address). So, the number with eligibility known is 29 and the number with eligibility unknown is 94. Among the 29 with eligibility known, 13 are eligible (19 replies minus the 6 that did not have any transportation service) and 16 are ineligible (6 with no transportation service, 2 who no longer exist, 3 of which are not applicable agencies, 1 which has multiple addresses, and 4 who had the wrong address). Thus, the eligibility rate among the organizations whose eligibility is known is:

$$Eligibility\ rate\ e_c = \frac{13}{29} = 0.45$$

The response rate is defined by the Council of American Survey Research Organizations (CASRO) as the number of completed surveys divided by the number of eligible sampling

units. Since the number of eligible sampling units among those who did not respond is not known, the assumption is made that the eligibility rate among the non-responding units is the same as among the responding units. Thus, response rate using the CASRO approach is:

$$Response\ rate = \frac{no.of\ completed\ surveys}{no.of\ known\ eligible\ units + e_c.no.of\ units\ of\ unknown\ eligibility}$$

$$= \frac{13}{13 + 0.45 \times 94}$$

$$= 23.5\%$$

Response to the survey by individual organizations is shown in Table 6.

Table 6

Pilot survey response by organization

Organization	Surveys issued	Replies	No response	Resent	Failed to deliver	Reply rate
DHH NEMT	17	1	15	0	1	6.25%
TRG	17	4	11	1	1	25.00%
DCFS	17	1	16	0	0	5.88%
DHH HSS HCBS	17	4	9	1	3	28.57%
DHH HSS	17	1	14	0	2	6.67%
Veterans	4	3	1	0	0	75.00%
RetireNet	17	3	13	1	0	17.65%
HST	17	2	8	4	3	14.29%
Total	**123**	**19**	**87**	**7**	**10**	**16.81%**

Based on the results of the pilot survey, changes were made to the survey design and to the survey instrument. First, the low response rate indicated there was a need to motivate a higher participation rate. One change in response to that was to alter the introductory text in the questionnaire to emphasize the fact that while an organization may be in the position to help a neighboring organization on one occasion, they may be the organization receiving help the next. Another change was to introduce the opportunity to win a prize (a Surface Pro 3 tablet) by completing the survey. Last, beside the cover letter from DOTD, a similar cover letter signed by the Secretary of DHH was obtained to use with all organizations registered with the Department of Health and Hospitals.

Some changes were also made to clarify issues surrounding survey. One was to set a date by which the completed questionnaire was to be returned. The deadline date was also repeated in each of the postcard reminders. Another change was to emphasize with bold font the need for organizations to reply even when they provided no transportation service to their clients. In addition, some other modifications were made to help respondents understand the questions better, such as the replacement of the word "ridership" with "passengers," and to alter the structure of a table to better regulate data inputs.

Changes were also made to the survey materials. For the mail-out envelope, changes were made to follow the standards stipulated for USPS bulk mail, such as the location of the non-profit postage and clearance in the bar code area. The mail-back envelope was designed by post office facility to follow its special format. For the questionnaire, an internal code, unique to each organization, was added to the front cover to simplify the manual work of inserting and matching the questionnaire to its mail-out envelope. For the advertisement page, an attractive description of the prize was made and different paper color was used to make it stand out. For the post card reminders, a different paper color was used for each batch to distinguish them from each other.

Main Survey

The main survey was conducted in January and February 2015. It was a mail-out, mail-back survey and from a total of 2,001 survey packages sent out, the following was received:

- 232 replies
- Of the 232 replies, 7 were duplicate responses
- Of the remaining 225 unique replies, 58 owned vehicles and 6 contracted with other organizations to provide transportation service
- 1756 did not reply
- 12 had incorrect addresses and were returned
- 1 was not applicable to this survey

Of the total sample of 2,001 organizations, some form of response was received from 245 (225 unique replies, 7 duplicate replies, 12 failed delivery, and 1 who was not an applicable agencies). So, the number with eligibility known was 245 and the number with eligibility unknown was 1756. Among the 245 with eligibility known, 58 were eligible (58 replies that have transportation service) and 187 were ineligible (167 with no transportation service of their own, 7 repeated survey, 12 failed delivery, 1 of which was not an applicable agency). Thus, the eligibility rate among the organizations whose eligibility was known was:

$$Eligibility\ rate\ e_c = \frac{58}{245} = 0.24$$

The response rate is defined by the Council of American Survey Research Organizations (CASRO) as the number of completed surveys divided by the number of eligible sampling units. Since the number of eligible sampling units among those who did not respond is not known, the assumption is made that the eligibility rate among the non-responding units is the same as among the responding units. Thus, response rate using the CASRO approach is:

$$Response\ rate = \frac{no.of\ completed\ surveys}{no.of\ known\ eligible\ units + e_c.no.of\ units\ of\ unknown\ eligibility}$$

$$= \frac{58}{58 + 0.24\ \times\ 1756}$$

$$= 12.10\%$$

Response to the survey by individual organizations is shown in Table 7.-

Table 7

Main survey response by organization

Organization	Surveys issued	Replies	Reply rate	Vehicle Owners	Owner rate
DHH NEMT	26	2	7.7%	2	100%
TRG	47	14	29.8%	13	93%
DCFS	729	103	14.1%	14	14%
DHH HSS HCBS	221	20	9.0%	6	30%
DHH HSS	851	68	8.0%	16	24%
Veterans	1	0	0.0%	0	-
RetireNet	80	3	3.8%	2	67%
HST	46	15	32.6%	5	33%
Total	**2001**	**225**		**58**	

Reply Date Analysis. The survey booklet was mailed out on January 15, 2015. Postcard reminders were mailed out on January 22, January 29, and February 5, 2015.

Of the 232 replies, 185 had postmarks indicating the date they were mailed but 47 were without postmarks. The number of replies received each day is shown in Figure 6. The red lines indicate the date that postcard reminders were issued.

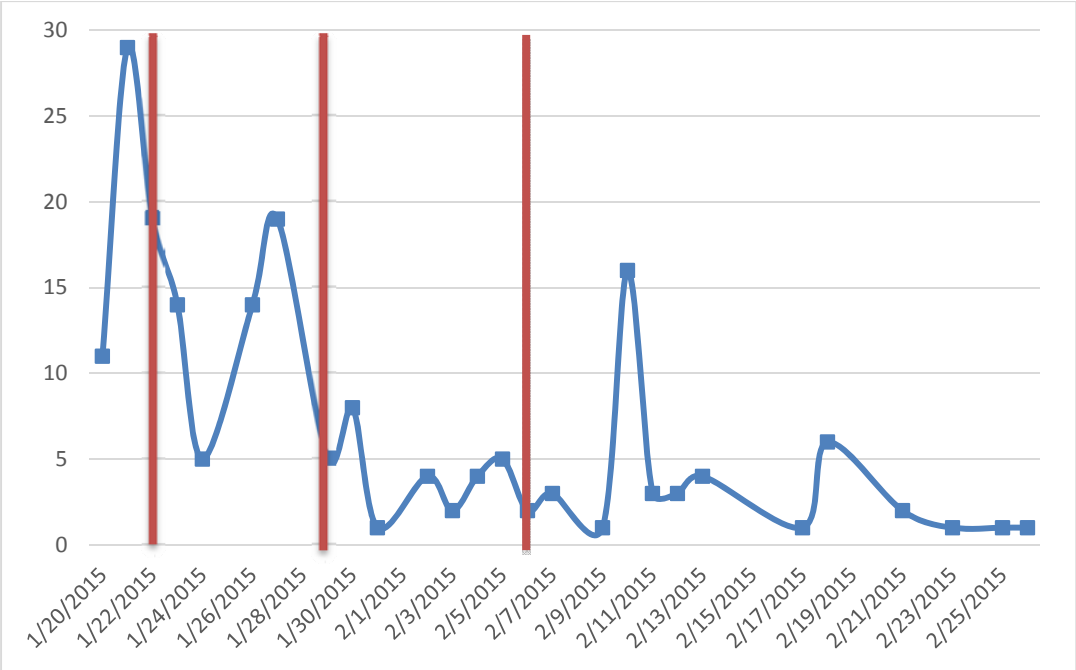


Figure 6

Reply date trend

Analysis

Vehicles

Vehicle questions in the questionnaire include the type of vehicles operated, the registered owner of the vehicle, the number of vehicles of each type, the passenger capacity of each vehicle, and special features. In addition, the address of the organization and where they kept vehicles were asked at the end of the questionnaire. While some organizations kept their vehicles at the drivers' home at night, the address of the organization, where the vehicle(s) would be located during the day, was geocoded as the location of the vehicles in the data.

Of the 225 organizations responding to the survey, 58 organizations stated they owned and operated their own vehicles. The total number of vehicles from all organizations was 384. The distribution of vehicles from each organization is shown in Figure 7. The maximum vehicle ownership from a single organization was 70 and the minimum value was 1. Most of the surveyed organizations own less than 10 vehicles.

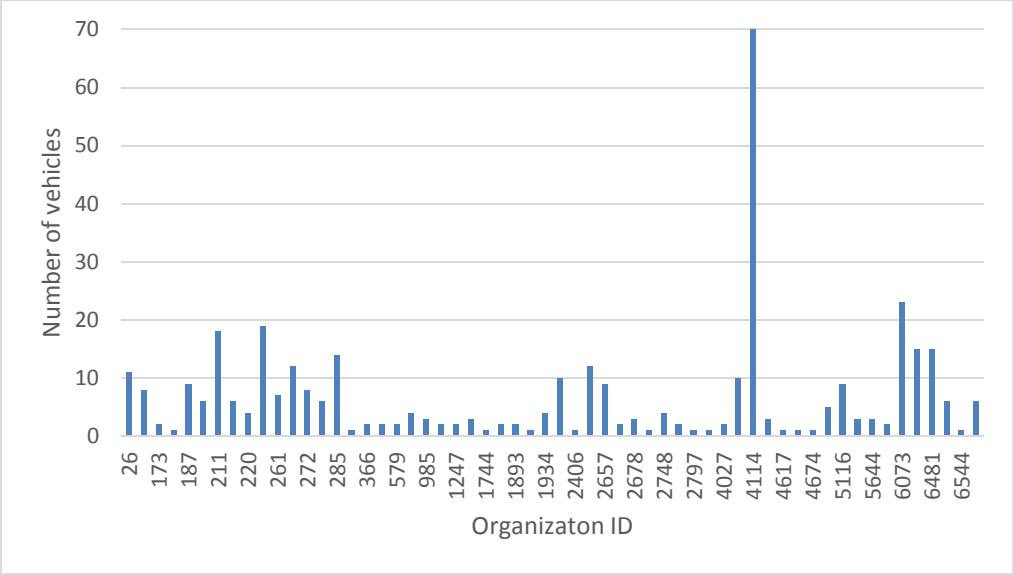


Figure 7

Number of vehicles of each organization

The total passenger capacity of all vehicles was 3,638. The distribution of vehicle capacity of each organization is shown in Figure 8. The maximum capacity of one organization is 385. The minimum capacity is 0 as some organizations did not provide this information.

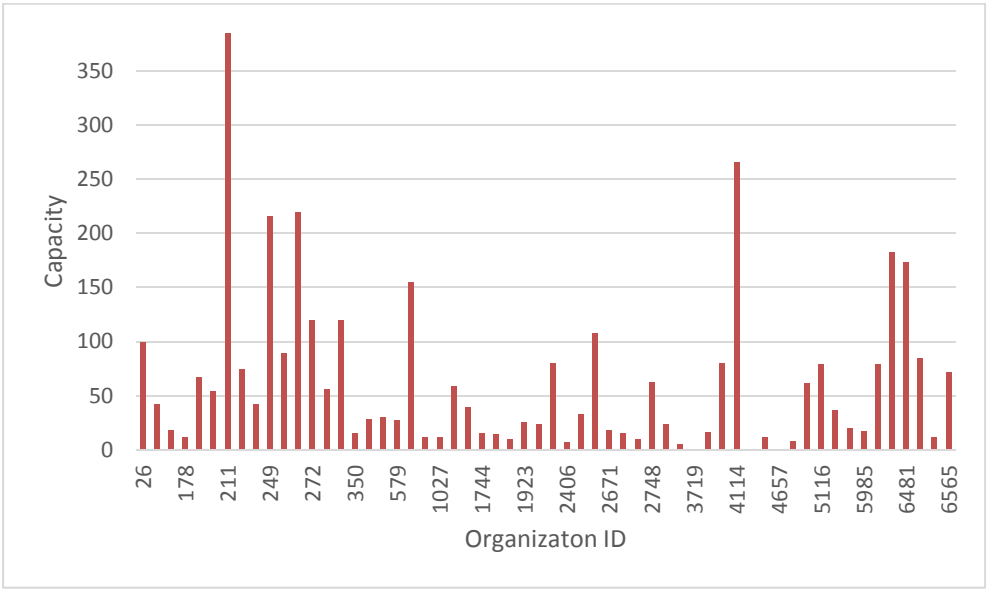


Figure 8

Capacity of vehicles of each organization

Six types of vehicles were coded in the survey: Bus, Van, Minivan, Truck, Ambulance, and other. In the "other" category, most were cars. The number of vehicles and the capacity of each type of vehicle is shown in Table 8.

Table 8

Vehicle by type

Vehicle Type	Vehicle number	Percent	Capacity	Percent
1=Bus	82	21%	1357	37%
2=Van	172	45%	1229	34%
3=Mini Van	28	7%	150	4%
4=Truck	3	1%	20	1%
5=Ambulance	10	3%	40	1%
6=Other	89	23%	842	23%
Total	**384**	**100%**	**3638**	**100%**

Regarding vehicle attributes, 244 of the total 384 vehicles have special features. Four attributes were coded in the survey: with wheelchair, with lift, with wheelchair and lift, and "Other." "Other" included features such as bed or oxygen. The number of vehicles by attribute and type are shown in Table 9.

Table 9

Vehicle by type and attribute

Vehicle Type	With wheelchair	With lift	With both	Other
Bus	10	8	42	0
Van	0	7	76	0
Mini Van	1	0	16	0
Truck	0	2	0	0
Ambulance	0	0	0	10
Other	0	10	62	0
Total	**11**	**27**	**196**	**10**

Driver Analysis

Driver-related questions in the questionnaire included the total number of drivers, number of drivers who are trained to provide additional services, expected number of drivers who would be willing to assist in emergency, and expected average time from notification to driver readiness of vehicles.

The total number of drivers is 699, of which 459 can operate a wheelchair lift (66%), 474 can secure a wheelchair in a vehicle (68%), 581 can administer first aid (83%), 636 can administer CPR (91%), 74 can administer oxygen (11%), and 69 can administer IV (10%). Organizations were also asked the expected number of drivers who would be willing to assist in an emergency. For an advance-notice emergency (6 hours or more forewarning), 279 of total 699 drivers were estimated to be available (40%). For a no-notice emergency, 134 drivers were estimated to be available, which is about 19% of the total number of drivers.

Regarding the expected time from notification to driver readiness, the range was from 5 minutes to 1 day. The average expected time to driver readiness of all organizations was approximately 90 minutes. The mode of expected time of all organizations was 60 minutes.

Rider Analysis

Respondents were asked to report the maximum and average number of passengers they transport on a regular day, and to estimate the number of passengers per day that would require transportation service from them during an emergency. Respondents were asked to use their judgment when answering this question. The collective response from all organizations who provided transportation service is shown in Table 10 and Table 11.

Table 10

Passenger demand on a typical day

	Weekday		Weekend	
	Assistance required	No assistance required	Assistance required	No assistance required
Max	152	385	50	75
Average	21	45	21	22

Table 11

Estimated passenger demand during an emergency

	No-notice emergency		Advance-notice emergency (6+ hrs)	
	Assistance required	No assistance required	Assistance required	No assistance required
Max	160	200	160	200
Average	50	47	46	51

Operating Restrictions

Organizations were asked whether their insurance company, or any other agency, restricted their area operation or the riders they served. Of the total of 58 replies, 20 organizations marked "Yes" for this question, which is about 35%. As there may be multiple restrictions for one organization, the above number only reflects the percentage of organizations that are subject to restrictions and not the number of restrictions. Table 12 shows the reported number of restrictions by type from the 20 organizations reporting restrictions.

Table 12

Restriction analysis

Restriction type	No. reporting restriction
Existing service area/routes	9
Home parish	7
Home state	3
Riders served by your organization on a regular basis	15
Time of day limitation	4
Day of week limitation	3
Other	4
Total	45

Funding Source Analysis

Organizations were asked what funding source they used to support their transit service. Fourteen different funding sources were provided in the questionnaire and the responses by organization are shown in Table 13.

Resident Analysis

Organizations were asked whether they have overnight or permanent residents. Of the 58 organizations which provide their own transportation, 25 stated they have overnight or permanent residents. The reported average and maximum number of residents per organization was 61 and 226, respectively. Very little variation was reported in permanent resident numbers between weekday/weekend and by season of the year. Only one organization reported there might be peaks during festival days.

Table 13

Funding source analysis

	DOTD	DHH	DCFS	RetireNetet	HST	Total
Self-support	0	11	5	1	0	17
Section 5311 Rural Transportation	2	1	0	0	3	6
Section 5310 Elderly and Disabled Transportation	9	5	0	0	3	17
Section 5316 JARC	1	1	0	0	0	2
Section 5317 New Freedom	0	0	0	0	0	0
Governor's Office of Elderly Affairs	3	0	0	0	2	5
Governor's Office of Rural Affairs	0	0	0	0	0	0
Department of Child and Family Services	1	1	5	0	0	7
Department of Health and Hospitals	2	4	1	0	1	8
Veterans Administration	0	0	0	0	0	0
Non-Emergency Medical Transportation	0	0	0	1	0	1
Local Dedicated Sales Tax	1	0	0	0	0	1
Local Government Funds	2	1	1	0	3	7
other	3	4	5	0	0	12
Not applicable	0	1	0	0	0	1
Missing Value	1	1	0	0	0	2

Arrangement Analysis

Organizations were asked whether they have an existing arrangement with another organization that comes into effect when an emergency arises. Of the total 58 organizations providing their own transportation, 25 stated "yes" to this question. In the questionnaire, 12 types of arrangements were stated by respondents. Table 14 shows the summary statistics of the arrangements quoted. Note that each organization could quote more than one arrangement.

Table 14

Summary statistics of arrangements

Arrangement	No.
1=Memorandum of Understanding (MOU)	5
2=Transport children in case of emergency	1
3=Evacuation	3
4=Transport during emergency	7
5=Transports patients in need of assistance	1
6=Notification	1
7=Ambulance	3
8=Contract	1
9=Replacement of home	1
10=Transit service	2
11=Shelter in emergency	1
12=Part of the local government	2
-99=Missing value	2

Coordination Analysis

Organizations were asked whether they coordinate their day-to-day transit operations with other agencies providing a similar service to their own. Of the total 58 organizations who provide their own transportation, only 3 marked "yes" to this question. They are organizations from the data from DOTD, DHH HSS, and RetireNet. The organization from the DOTD data source stated they coordinated with 5 other agencies about 1 to 11 times per year. No funding was exchanged among the agencies. The vehicle miles of travel of coordinated service that occurred per month was estimated at 2 miles. The organization from the DHH HSS data source stated they coordinated with 2 other agencies every day. No funding was exchanged among them. The vehicle miles of travel of coordinated service that occured per month was estimated at 200 miles. The organization from the RetireNet data source stated they coordinated with one other agency every day. Funding was exchanged among them. The vehicle miles of travel of coordinated service was estimated at 1,200 miles per month.

Geocoding

The geographic locations of the 58 organizations were geocoded with ArcGIS. Figure 9 shows the result of the geocoding. One organization outside the coastal boundary was erroneously included in the survey as can be seen in the one red dot outside the turquoise area in Figure 9. By clicking on a point on the map, ArcGIS will show the detailed information of that organization as shown in Figure 10. Conversely, going to the attribute

table and clicking on a particular organization will display the location of that organization as shown by the turquoise dot in Figure 11.

Figure 9

Geographic location of organizations provided transit service

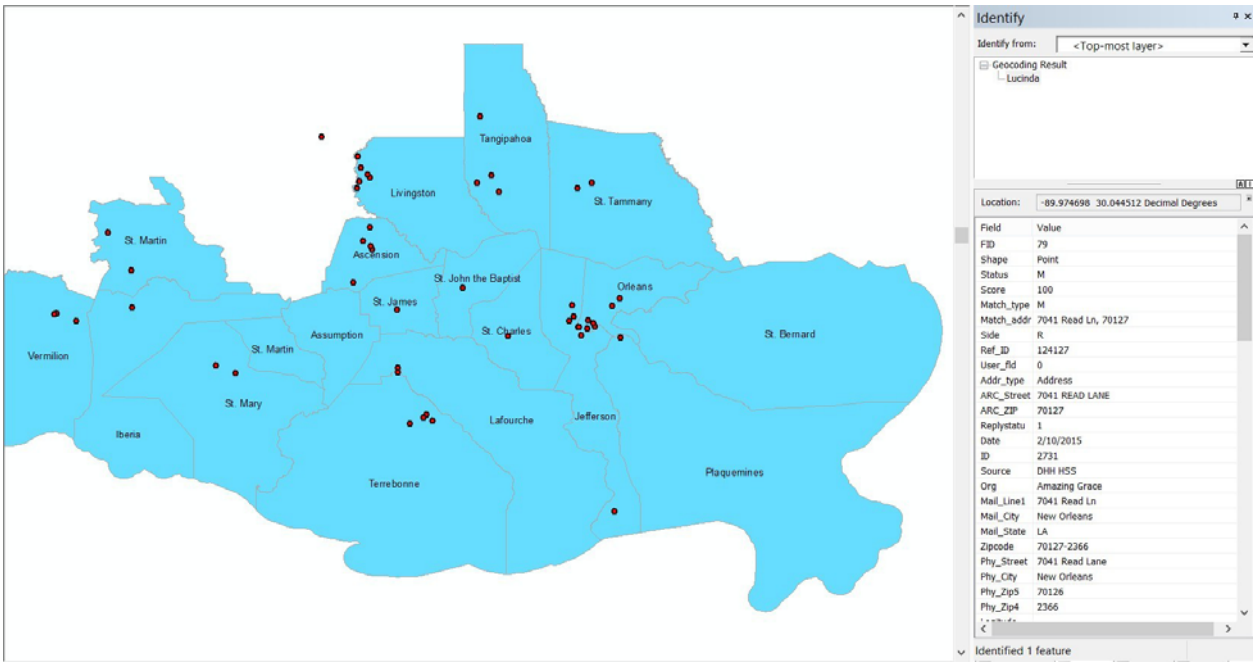


Figure 10

Attribute display of one organization

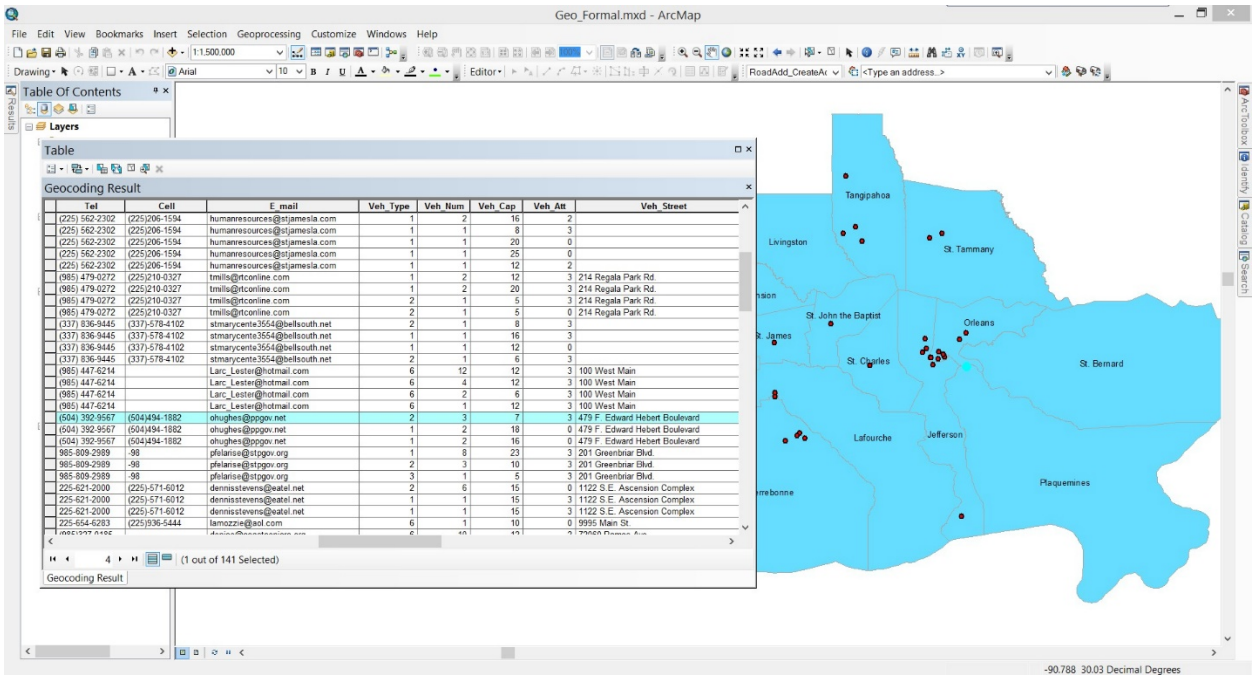


Figure 11

Identify location of organization

Demonstration of the Procedure

A hypothetical emergency situation in New Orleans was used to demonstrate how the procedure developed in this study could be used to identify the demand for transit that would arise in such a situation, and the supply of transit vehicles that could be called upon to satisfy the demand. A chemical spill in New Orleans was used to demonstrate the procedure.

Demand Estimation

The population of the New Orleans metropolitan area is approximately 1.2 million but it attracts a large number of tourists. The Louisiana Visitor Profile Report lists the number of tourists visiting Louisiana in 2012 at over 26 million and New Orleans is estimated to host approximately 38% (10 million) of that number. Although the duration of their visit is not known, if it were only for two to three days on average, that would result in between 50,000 and 80,000 tourists per day in the New Orleans metropolitan area with a higher number during festivals and a lower number during off-peak periods. Thus, tourists can make up a significant portion of the population in New Orleans during particular times of the year. Knowing how many people are in New Orleans and where they are at any time is an important issue for emergency preparedness and the evacuation process.

The Orleans Parish land cover map is shown in Figure 12. Note, Orleans Parish is just one

parish within the six-parish New Orleans metropolitan area but this portion of the metropolitan area is used here to more easily display the small intersection polygons used in our analysis. The map displays 15 types of land cover and as can be seen by the predominance of blue in the map, open water and wetlands occupy a large portion of the included area. In addition, within inhabited areas the intensity of development varies considerably as illustrated by the intensity of red hue in the diagram. If the population were to be distributed uniformly within the area, none of this variation would be captured. Thus, the dasymetric approach, which uses land cover information in estimating the distribution of the population, is more appropriate. However, the only land cover classification in the NLCD associated with inhabitants is "developed land" and it is only distinguished by intensity of human occupation (high, medium, and low intensity, and open space). This does not distinguish whether people are living, working, shopping, or visiting in these areas. As mentioned earlier, this is a problem in high density industrial areas since, if people are distributed by land use intensity, residents, tourists, and shoppers could be distributed to high intensity industrial areas such as the New Orleans port or an industrial park, and workers could be assigned to high-rise residential areas. This was addressed in this case study by observing the population density in TAZs that are known industrial areas and comparing the population density with those that were not industrial areas. In this study the cutoff distinguishing industrial from other land use was found to be 4,100 persons per square kilometer. This was used to distinguish industrial land use from other land uses in the high density category; no distinction was made in medium and low density cases. The land cover of the area shown in Figure 12, expressed as a percentage of each land cover category, is shown in the second column of Table 15.

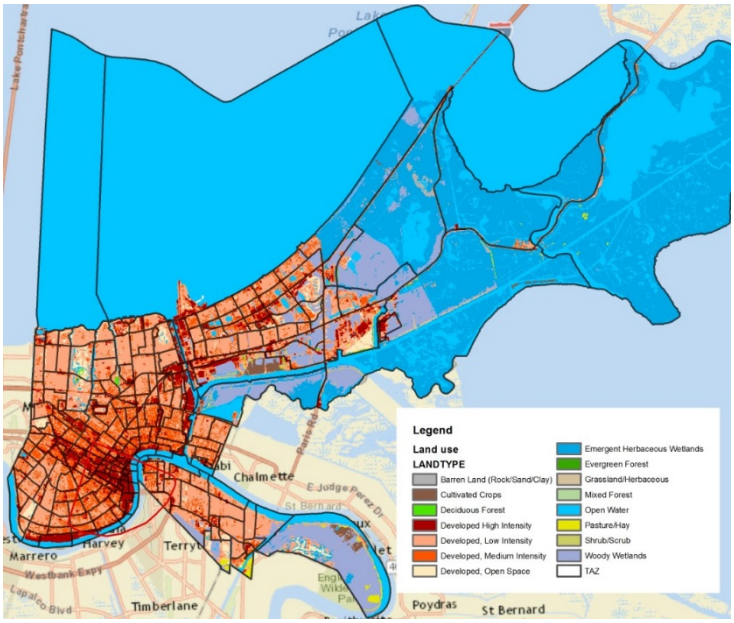


Figure 12

Land cover map of New Orleans

A regression analysis was conducted on the data of the variables listed in the first column of Table 15. The dependent variable is the number of persons in each population group in the geographic unit at which the population is known (e.g. TAZ, ZIP code, or parish area). The independent variables are the areas of different land cover types from the NLCD aggregated to TAZ level. Regression results are listed in the last five columns of Table 15. All coefficients have the expected sign and are significant at the 95% level of significance.

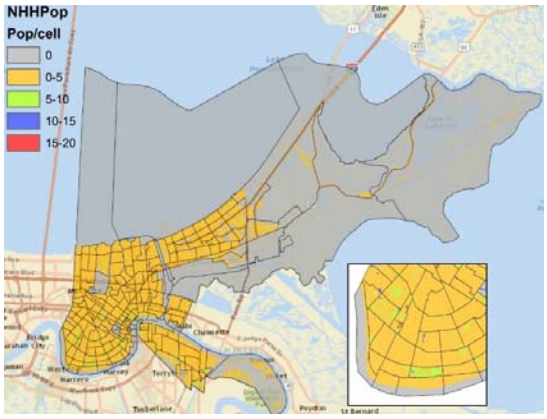
With the coefficients listed in Table 15, population can be distributed by land cover type. In order to keep the final data at the same geographic unit level, TAZ and land use intersection polygons (TAZLUs) are used as the basic geographic unit layer. Population data at TAZ level, such as resident and worker, can be disaggregated to intersection polygon level by using equation (1). However, for population data at other levels, such as nighttime tourist at zip code level, additional steps in the process are necessary. First, the TAZLU must be intersected with the Zip code layer. Second, equation (1) must be applied to the TAZLU_ZIP intersection layer. Third, the data must be aggregated to TAZLU level.

Table 15

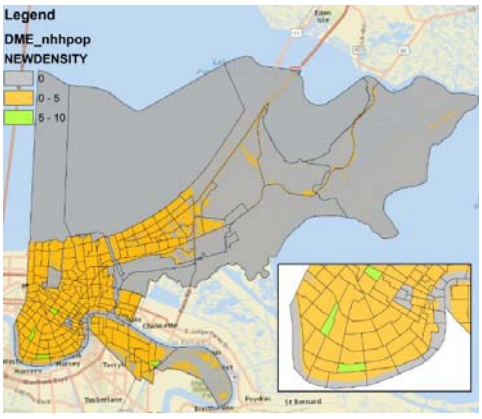
Land cover type regression results

Land Cover (ha)	Area (%)	Resident		Worker		Shopper		Nighttime Tourist		Daytime Tourist	
		Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Open Water	51.46	0				0		0		0	
Developed, Open Space	0.84	2.9942	10.48	7.084	4.51	0		0		3.5971	3.24
Developed, Low Intensity	12.24	4.2378	18.57	0		0.0922	2.77	0.9911	2.81	0	
Developed, Medium Intensity	5.7	18.3	14.23	0		0.5868	2.95	5.8165	2.77	0	
Developed, High Intensity, Industrial	2.05	0		10.5	15.41	0		0		0	
Developed, High Intensity, Others	0.89	51.2	15.95	55.9	36.4	2.8988	4.06	11.8	1.59	59.5	4.13
Barren Land	0.12	0				0		0		0	
Deciduous Forest	0.03	0				0		0		0	
Evergreen Forest	0	0				0		0		0	
Mixed Forest	0	0				0		0		0	
Shrub/Scrub	0.08	0				0		0		0	
Grassland/Herbaceous	0.07	0				0		0		0	
Hay/Pasture	0.25	0				0		0		0	
Cultivated Crops	0.29	0				0		0		0	
Woody Wetlands	5.75	0				0		0		0	
Emergent Herbaceous Wetlands	20.15	0				0		0		0	
No. of Observations		2124		2129		185		184		19	
R square		0.6486		0.4406		0.5854		0.4338		0.7195	

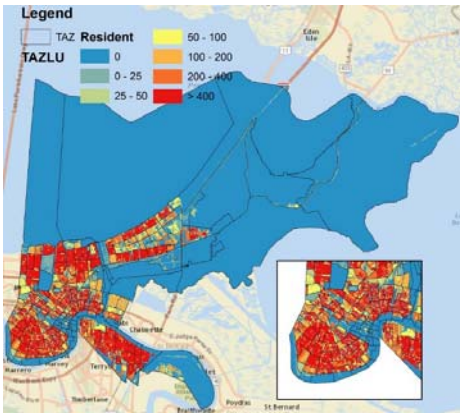
Three dasymetric mapping methods distributing nighttime residents are compared to illustrate the difference in results obtained with different methods. The results of distributing residents with the Holloway method (which uses a fixed proportion of the population for each land use based on subjective judgment) is shown in Figure 13 (a). The Dasymetric-Mapping Extension (DME) method, which uses a sampling method to establish population weights for each land use but assigns population at TAZ level, is shown in Figure 13(b). Among these two methods, the Holloway method clearly provides a more detailed estimate of population distribution but both methods fail to avoid distributing nighttime population to industrial areas such as the port area located on the western side of the crescent of the Mississippi river. Figure 13 (c) shows the results of the method used in this study. It shows the greatest detail of population distribution and residents are not distributed to the port. However, all methods solve the problem of distributing population to open water areas or marshlands.



(a) Resident distribution by Holloway et al. method [34]. Unit: Resident per cell.



(b) Resident distribution by DME [35]. Unit: Resident per cell



(c) Resident distribution by modified method of this study. Unit: Resident.

Figure 13
Resident distribution by a different method

Student data are collected at point level and therefore do not require spatial distribution. At the temporal level they are assumed to be at school during the daytime on weekdays and at home the rest of the time with the exception of the portion expected to participate in shopping over the weekend. Worker distribution is shown here to illustrate the precision of the method used in this study. As Figure 14 shows, workers are concentrated in the port and downtown commercial area of the city.

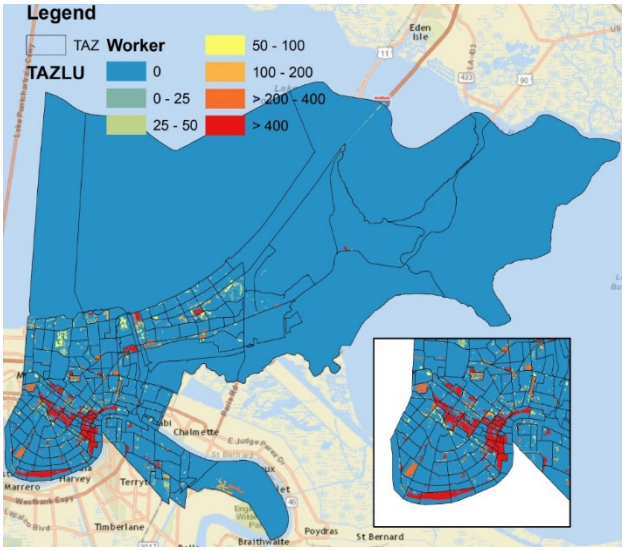
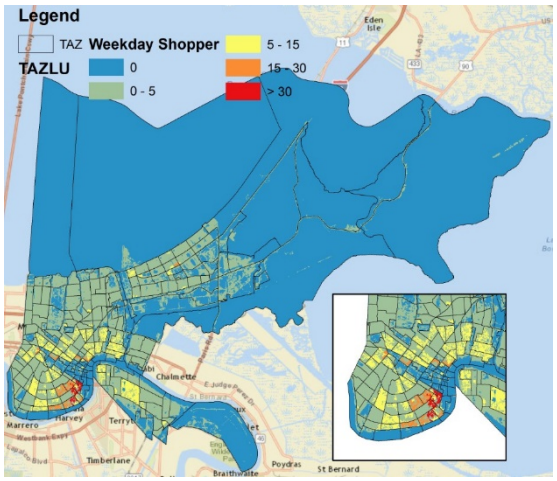


Figure 14

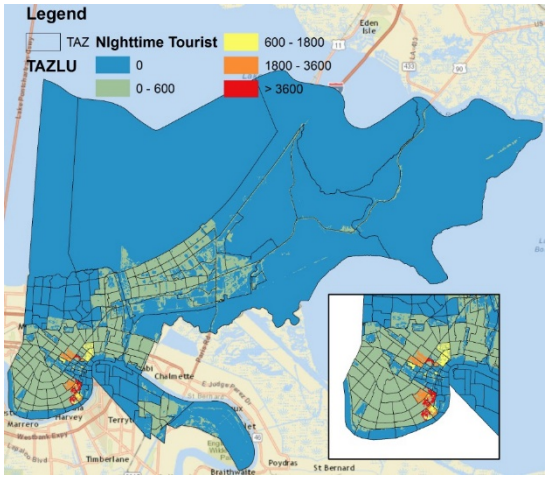
Worker distribution

In this study, "high intensity other" land cover includes high density residential, commercial, and mixed land use areas. To distribute nighttime tourists and shoppers directly to this land cover may cause a problem due to the diversity of the land uses it represents. Employee data are used as ancillary data in this study to improve the appropriateness of the distribution. Specifically, the retail employment is used to identify commercial areas, and hotel employee data is used to identify the spatial location of hotels. Figure 15 (a) shows shoppers distributed to retail-employee concentrated areas. Figure 15 (b) shows nighttime tourists distributed according to the distribution of hotel employee concentration in the area.

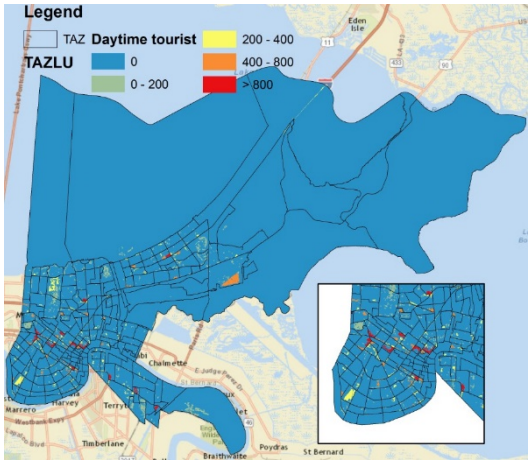
Daytime tourist distribution is based on analysis of local conditions. In New Orleans, festivals occur mainly in Open Space and High Intensity Other land use areas, such as parks and mixed commercial areas. Thus, daytime tourists are distributed in relation to these land uses as shown in Figure 15 (c).



(a) Weekday shopper distribution



(b) Nighttime tourist distribution



(c) Daytime tourist distribution

Figure 15
Shopper and nighttime tourist distribution

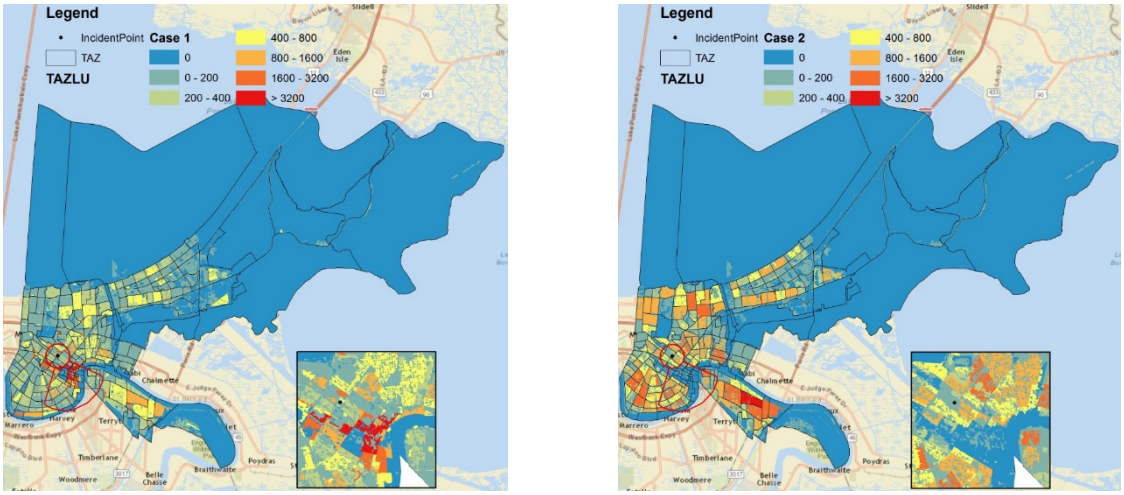
Hypothetical Chemical Spill. As mentioned earlier, the case of a hypothetical chemical spill in New Orleans is considered. The affected area is developed based on guidelines in the Emergency Response Guidebook 2012 *[44]*. The location of the spill and the toxic plume that is assumed to develop is shown in Figure 16. The location of the spill, chemical material type, wind bearing, and scale are the same in two cases but the time of occurrence is allowed to change to illustrate the impact of time of day on who is affected. Say in the first case (Case 1), the spill occurred on March 5, 2014, at 2 pm. This is daytime on a weekday in the first quarter of the year during a festival period. How many people will be exposed to the toxic gas? In Case 2, the same chemical spill is assumed to occur almost a

month earlier on a Saturday night in a non-festival period. Note that while this occurrence is still in the first quarter of the year, it is on a weekend and at night. How many people would be affected in this case?

Case 1: Daytime population is the sum of worker, student, weekday stay-at-homer, weekday shopper, and daytime tourist of the first quarter during a festival period. School/university data are specific to location, which present as points in ArcGIS. It is easier to judge how many students are affected by summing the point layer. And whether it is during a school season when the event happen must also be taken into account. In this case, schools were closed. So, population groups except students are summed. See Figure 16 (a).

Case 2: Nighttime population is the sum of residents and nighttime tourists of the first quarter non-festival days. See Figure 16 (b).

Applying the procedure developed in this study, for Case 1 the GIS system is able to sum the population within the plume area for the specified conditions. It was found that the affected number of population for Case 1 was 82,813. Looking at the distribution of the affected population in Figure 16 (a), it is clear they are concentrated in the downtown commercial and industrial areas. The number of workers was 58,335, stay-at-homers was 8,490, shoppers was 1,001, and tourists was 14,988. Thus, the majority of people affected are workers at their place of employment. For Case 2, the results are shown in Figure 16 (b). The total affected number of population is estimated at 39,147, and the population is much more dispersed than in Case 1. The estimated number of residents was 30,061 and tourists was 9,086. Note that the largest group affected is now residents. Clearly, the number and composition of those affected varies considerably with time and the method is able to estimate the changing conditions over time.



(a) Case 1 (b) Case 2

Figure 16
Population distribution in two cases

The population estimates above are for the total population, which would be useful in a no-notice emergency where emergency managers would want to estimate the total demand irrespective of how they would evacuate (car, conventional transit, walk, or SN/HS transit). However, in a situation where only special needs and human service transportation needs are being assessed, the expected demand is derived from the inventory for organizations within the affected area (see Table 11).

Supply Estimation

How many organizations are close to the incident point and can potentially provide transit resources? As Figure 17 shows, four organizations are within or quite near the affected area. Information on the number of vehicles, drivers, and other transit attributes at each location can be easily extracted by clicking on the points in the map representing the organizations close to the incident. When using ArcGIS Online to perform analysis, the following steps need to be conducted: click on the layer "Organizations"> click *Perform Analysis* > click *Manage Data* > click *Extract Data* > select *Clip Features* > draw a shape according to the needs > and click on *Run Analysis*. The result will be exported to a comma separated variable (CSV) file on which analysis can be conducted in Excel such as summing of vehicles in the affected area.

The ArcGIS Online window with the affected area drawn by the analyst, is shown in Figure 18. It is slightly larger than the affected area in Figure 17 to include all organizations in or close to the area affected by the chemical plume (the keyhole-shaped area drawn in red in

Figure 17). Output from the query (*Perform Analysis* > *Manage Data* > *Extract Data*) produced an Excel file with the information reproduced in Table 16. The four organizations within the affected area have IDs 2475, 2748, 2752, and 5566. Since vehicles must be reported separately by size, capacity, and attributes, multiple lines occur in the table for the same organization when they have different vehicles of different capacity or attributes. As can be seen in Table 16, the total number of vehicles close to the incident is 21, of which 13 are buses (code 1), 5 are vans (code 2), and 3 are other types of vehicle (code 6). The total number of drivers is at least 11 (organization 5566 did not report the number of drivers they have), of which 6 are available in an advance-notice emergency (Driver type 8) and 4 are available in a no-notice emergency (Driver type 9). The expected average time from notification to driver readiness is shown in column Driver 10 in minutes. Of all the drivers, 5 are trained to operate a wheelchair lift (Driver type 1), 5 are trained to secure a wheelchair in a vehicle (Driver type 2), 11 are trained to administer first aid (Driver type 3), 14 are trained to administer CPR (Driver type 4), and only 1 is trained to administer oxygen (Driver type 5).

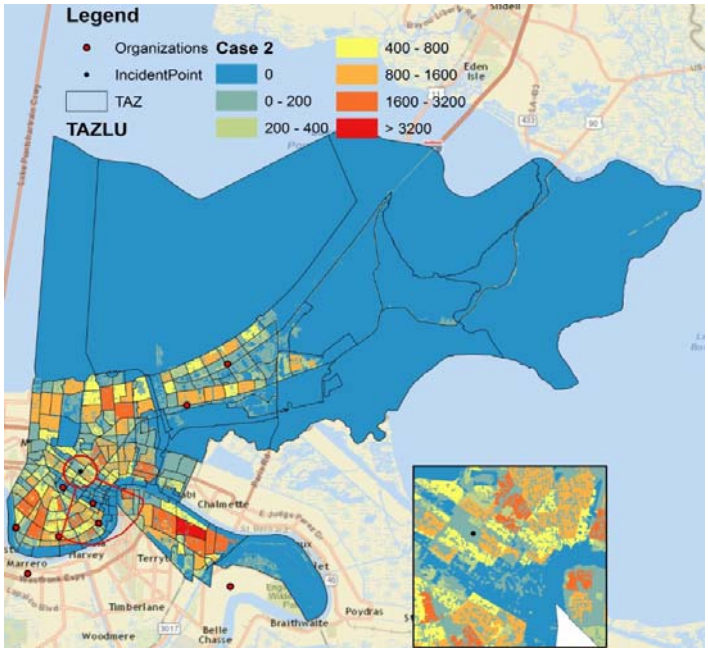


Figure 17

Organizations near the incident point

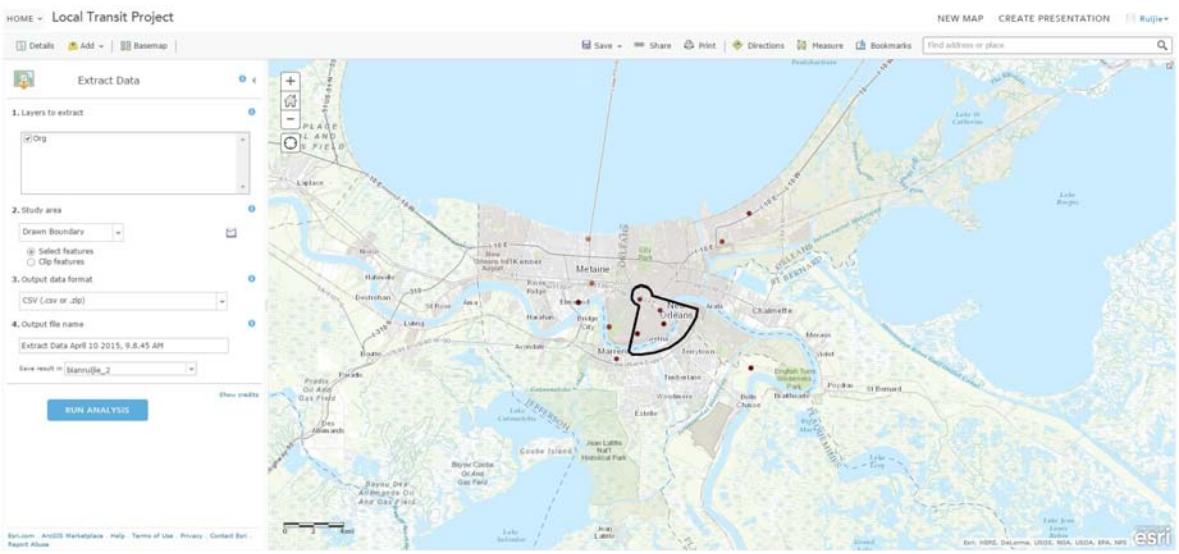


Figure 18

Selecting features in ArcGIS Online

Table 16

Result of feature selection

Organization ID	Veh Type	Veh Num	Veh Cap	Veh Attr	Veh Owner	Driver 0	Driver 1	Driver 2	Driver 3	Driver 4	Driver 5	Driver 6	Driver 7	Driver 8	Driver 9	Driver 10
2475	2	2	12	0	1	6	0	0	6	6	0	0	0	0	0	60
2475	6	3	3	3	8	0	0	0	0	0	0	0	0	0	0	60
2475	1	7	-99	3	8	0	0	0	0	0	0	0	0	0	0	60
2748	1	1	14	1	1	0	0	0	0	0	0	0	0	0	0	10
2748	1	3	16	1	2	2	2	2	2	2	0	0	0	2	2	10
2752	1	2	12	3	1	3	3	3	3	3	1	0	0	3	2	5
5566	2	3	12	0	1	-99	0	0	0	3	0	0	0	1	0	60
		Σ = 21	Σ = 69				Σ = 5	Σ = 5	Σ = 14	Σ = 14	Σ = 1	Σ = 0	Σ = 0	Σ = 6	Σ = 4	

Note: -99 = missing value.

CONCLUSIONS

The purpose of this study was to establish an inventory of special needs and human services transit resources in the coastal parishes of Louisiana and incorporate the inventory into a GIS system that would allow easy querying when emergency evacuation conditions arose. After completing the project, the main conclusion is agencies providing this transit are reluctant to participate in a cooperative venture such as the one outlined in this project. This is consistent with the findings of past studies that have generally found that transit providers of special needs and human services transit do not see a net benefit of participating in cooperative arrangements *[2], [4], [5], [7], [8]*. In this study, only 58 of an estimated 473 eligible organizations responded to the survey (12%) even though the survey was endorsed by the Secretaries of the Department of Transportation and Development and the Department of Health and Human Services, included a substantial prize, had three reminders, and was a survey that could be completed in 10 minutes. The conclusion is drawn that cooperation will only be achieved by forcing organizations to cooperate (either through legislation or as a condition of them receiving public funding), or by making it so attractive that they want to cooperate. Some improvement in the attractiveness of cooperation could be achieved by removing the liability, cost, and inconvenience of participation, and introducing attractive reimbursement for vehicle, labor, and facility expenses.

A significant finding of the survey is that only about one-quarter of the organizations contacted in this survey provide transit service to their clients. The most common form of transportation was a van (45%), bus (21%), and minivan (7%). The remaining types of vehicles used were car, truck, and ambulance. A total of 384 vehicles with a total passenger capacity of 3,638 were reported from 58 organizations. Two deductions are drawn from this situation. First, if 12% of the organizations field 384 vehicles, 100% participation rate of organizations would field approximately 3,200 vehicles with a total capacity of approximately 30,000 passengers. While this transit capacity is spread among the 20 coastal parishes, it does illustrate the extent of the resource that could be tapped if cooperation among organizations could be achieved. Second, the fact that three-quarters of the organizations provide no transportation service to their clients at all suggests that many organizations will be unable to evacuate their clients if they face an immediate threat. This is most likely to be the case for veterans' homes, retirement facilities, rehabilitation centers, special needs schools, hospices, nursing homes, and hospitals. Nursing homes and hospitals are supposed to make their own evacuation arrangements but those that have contracted with outside transportation companies to provide emergency service are not guaranteed that the contractor can accommodate the needs of all the organizations they have contracted with at

once. Thus, assistance from neighboring organizations with vehicles and expertise in transporting these types of people becomes very important. Establishing a cooperative system where organizations in close proximity to a threatened area serve their neighbors with the expectation that they will also be helped when they are in need, becomes a worthy goal to pursue because it promises to provide the most timely and effective form of evacuation. Obstacles to achieving this are the general resistance to cooperation that currently exists and the operating restrictions imposed on organizations by insurance companies and other agencies as reported in the section on "operating restrictions" on page 44 of this report.

Another interesting finding of the survey was the level of training of drivers and their willingness to help in an emergency. Of the drivers in the survey, 91% can administer CPR, 83% can administer first aid, 68% can secure a wheelchair in a vehicle, 66% can operate a wheelchair lift, 11% can administer oxygen, and 10% can administer an IV. This represents a high level of training needed in the transport of special needs people. The fact that 40% of drivers in the survey reported that they were prepared to drive their vehicles in the case of an advance notice emergency, and 19% in a no-notice emergency, represents a high level of cooperation on their part. This further reinforces the conclusion that while it may be difficult to establish cooperation among organizations, the potential benefit of doing so is substantial, and under the right circumstances, achievable.

The need to incorporate the inventory information in a system that permitted queries on available resources and likely demand was accomplished by loading the data into ArcGIS Online. Estimating demand and supply was demonstrated through a series of examples of each. The system operates through the internet and therefore can be accessed at any location where the internet is accessible. Access has to be authorized and use of the system consumes credits which have to be purchased at 10 cents per credit sold in packs of 1,000. A typical user has a subscription of 2,500 credits per year. Thus, the use of ArcGIS Online in this application with occasional use is expected to cost $250/year or less, depending on the level of use although it will not be less than $100/year since that is the lowest annual purchase of credits that can be made. The use of ArcGIS Online appears to provide the accessibility and performance required in this project.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. A study must be conducted to investigate the feasibility of providing state-sponsored insurance to organizations providing emergency evacuation transit service at the request of the state.
2. Develop an online accounting system that allows participating transit providers an easy and quick method of claiming reimbursement for expenses incurred in providing evacuation transit service when requested by the state.
3. Establish reimbursement rates that make it attractive for organizations to cooperate in providing evacuation transit service.
4. Investigate whether cooperation among organizations can be mandated as a condition of receiving funding from state and federal agencies.
5. When sufficient measures have been implemented to ensure that at least the majority of organizations will cooperate with each other in emergencies, conduct a survey similar to the one conducted in this study to establish an inventory of transit resources.
6. Incorporate the data gathered in the second inventory into ArcGIS Online.
7. Train users of the system in its use.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

CASRO	Council of American Survey Research Organization
CBP	County Business Pattern
CCAM	Coordinating Council on Access and Mobility
CPR	Cardiopulmonary resuscitation
CRPC	Capital Region Planning Commission
CSV	Comma Separated Value
CRBA	Consular Report of Birth Abroad
CTPP	Census Transportation Planning Package
CVB	Convention and Visitor Bureau
DCFS	Department of Children and Family Service
DHH	Department of Health and Hospitals
DHS	Department of Homeland Security
DMV	Departments of Motor Vehicles
DOTD	Department of Transportation and Development
DVA	Department of Veterans Affairs
ESRI	Environmental Systems Research Institute
ETO	Emergency Transportation Operations
FRSGP	Freight Rail Security Grant Program
FTA	Federal Transit Administration
GIS	Geographic Information System
GOHSEP	Governor's Office of Homeland Security and Emergency Preparedness
HCBS	Home and Community Based Service
HSIP	Highway Safety Improvement Program
HSS	Health Standards Section
HST	Human Service Transportation
IBSGP	Intercity Bus Security Grant Program
IPRSGP	Intercity Passenger Rail Security Grant Program
LA	Louisiana
LDE	Louisiana Department of Education
LTRC	Louisiana Transportation Research Center
MAP 21	Moving Ahead for Progress in the 21st century
MOU	Memoranda of Understanding
MPO	Metropolitan Planning Organization
NCES	National Center for Education Statistics
NEMT	Non-Emergency Medical Transportation

NHTS	National Household Travel Survey
NLCD	National Land Cover Database
NTD	National Transit Database
SHSP	Strategic Highway Safety Plan
SMP	State Management Plan
SNT	Special Needs Transportation
TAZ	Traffic Analysis Zone
TAZLU	TAZ and land use intersection polygons
THIRA	Threat and Hazard Identification and Risk Assessment
TSGP	Transit Security Grant Program
TSP	Trucking Security Program
USC	United States Code
USPS	United States Postal Service

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APPENDIX A

METADATA

1. *Sponsorship for the survey*— The Louisiana Transportation Research Center (LTRC) sponsored the survey.
2. *Survey purpose and objective*— The purpose of this survey was to establish an inventory of human services and special needs transit vehicles in Louisiana. The specific objectives of the survey were to collect the following information from each provider:
   1) fleet size
   2) characteristics of each vehicle in the fleet
   3) location where vehicles are kept when not in use
   4) drivers, type of license, and availability during an emergency
   5) number of passengers served during normal operation
   6) estimated proportion of passengers in 5) above who would rely on transit to evacuate in an emergency
   7) restriction on the area or riders that the organization can serve
   8) funding source
   9) overnight or permanent resident
   10) existing arrangement with another organization that comes into effect when an emergency arises
   11) whether there is day-to-day coordination on transit operation with other organizations
   12) contact person information
3. *Data collection methods*—Mail-out and mail-back questionnaires were used to collect data.
4. *Survey period*— The pilot survey was conducted from October 8, 2014 through November 14, 2014. The main survey was conducted between January 15, 2015 and February 15, 2015. In the main survey, the survey package was mailed out on January 15, 2015. Three batches of postcard reminders were mailed after that. Reminders were mailed out on January 22, January 29, and February 5 separately.
5. *Questionnaire and other survey documents*—The questionnaire is presented in Appendix B. Codes used to code the survey results are provided in a codebook attached as Appendix C.
6. *Incentive*— A Microsoft Surface Pro3 Tablet (value $800) was provided as an incentive. The chance to win this prize turned out to be 1 in 200.
7. *Organization list preparation*—Names of organizations were collected from data files listed on the internet of organizations licensed by the Louisiana Department of Health and Hospitals (DHH), Department of Children and Family Service (DCFS), Department

of Transportation and Development (DOTD), and Department of Veterans Affairs (DVA) to provide service to special needs and human services groups. Data were also collected from an organization listing human service transportation resources in Louisiana (tranportationla.org), and a website called RetireNet which listed retirement facilities.

8. *Organization list cleaning*— First, organizations within the 20 coastal parishes were picked out from the list. Second, duplicate records of the same organization were removed using name of organization, telephone number, or contact person as the means of identifying the duplicate cases. Third, organizations that clearly did not provide any transit services were deleted. The resulting data list contained 2001 organizations.
9. *Sample selection*—No sample selection was conducted in this survey because the objective of this survey was doing an inventory.
10. *Processing description*— The data were edited for accuracy and consistency by manually checking each and every questionnaire returned by organizations.
11. *Geocoding of organization location*—All organizations were asked to report their physical address. However, only organizations with vehicles answered this question. Most organizations were geocoded by using this address in ArcGIS. However, a few were geocoded by identifying their location using Google Earth since they could not be located using their street address in ArcGIS.

APPENDIX B

QUESTIONNAIRE

Survey of Human Services and Special Needs Transit Vehicles in Louisiana

Louisiana Department of Transportation and Development

and

Governors Office of Homeland Security and Emergency Preparedness

Baton Rouge, Louisiana
August 2014

Questions? Call 225 578 4697 or e-mail cecgw@lsu.edu

«FacilityName»
«Street»
«City», «State» «Zipcode»

Dear [salutation] [lastname],

The purpose of this survey is to establish an inventory of human services and special needs transit vehicles in Louisiana. The information will be used to identify the existence and location of transit resources that potentially could be solicited to help in an emergency. However, participating in the survey WILL NOT commit you or your organization to making vehicles available when a request for assistance in an emergency is issued – you will remain free to accept or decline any request at all times. It is also planned to compensate you fully for any expenses incurred during an emergency. Since an emergency can befall any of us, you could be the helper on one occasion and the one being helped in the other.

If your organization <u>does not operate any vehicles but contracts with a company</u> to provide transit service, please have that company complete parts 1-3 of this questionnaire while you complete the rest.
If your organization <u>does not provide any transportation service</u> to its clients at all, please

check the box below and return the questionnaire unanswered in the reply-paid envelope.

☐

Please complete the survey by **January 31st, 2015** in order to get your chance to win the **PRIZE of a Microsoft Surface Pro3 Tablet (value $999)!** Note we expect approximately 1,000 respondents to the survey – so you have a good chance of winning it!

Thank you!

If you have any additional comments after filling the survey, please provide them below:

……

……

……

……

No. «code»

1. Please complete the table below with information on all <u>transit vehicles</u> your organization operates:

Type (e.g. bus, van, other - specify)	Registered owner of vehicle	Number of vehicles	Passenger capacity of each vehicle	Special features? (e.g. lift-equipped)
Example: Van	Our organization	1	12	None
Example: Bus Type 1	DOTD	3	15	wheelchair lift
Example: Bus Type 2	DOTD	4	10	None
Example: Ambulance	HHS	2	2	2 beds oxygen

2. Please provide approximate information on the following aspects of the drivers of transit vehicles your organization operates:

Total number of drivers: ……..

Number of drivers who are trained to

(1) operate a wheelchair lift: ……..
(2) secure a wheelchair in a vehicle: …….
(3) administer first aid: ……...
(4) administer CPR: ……...
(5) administer oxygen: ……...
(6) administer IV: ……...
(7) other (specify): ……..

Expected number of drivers who would be willing to assist[1] in:

(1) an advance-notice[2] emergency: ……..
(2) a no-notice emergency: ……...

Expected average time from notification to driver to readiness of vehicle: ……. (min)

1 Please use your judgment in answering this question; an estimate is all we require.
2 6 hours or more advance notice of emergency.

3. Please provide an estimate of your typical daily passengers:

(1) average passenger on a typical (non-emergency) day:

Weekday		**Weekend**	
Assistance required	**No assistance required**	**Assistance required**	**No assistance required**

(2) estimated passenger requiring evacuation in an emergency[3]:

No-notice emergency		**Advance-notice emergency (6+ hrs)**	
Assistance required	**No assistance required**	**Assistance required**	**No assistance required**

3 Please use your judgment in answering this question. Knowing your riders better than anyone else, you will be able to make an educated guess which is all that is required of this item in this survey. You will not be held responsible for the estimate and your estimate will be combined with estimates from other respondents in the survey to provide an overall estimated%age of regular riders who are likely to require transportation during an emergency.

4. Does your insurance company, or any other agency, restrict the area or riders your transit service may serve?

Yes ☐ ☐ No

If "no", please skip to next page.

If "yes", please select as many of the listed restrictions below that are applicable and indicate what authority imposes each restriction:

	Restriction	Applicable?	Authority
(1)	Existing service area/routes		
(2)	Home parish		
(3)	Home state		
(4)	Riders served by your organization on a regular basis		
(5)	Time of day limitation		
(6)	Day of week limitation		
(7)	Other (please specify below)		

5. What funding source do you use to support your transit service?

Please check the box on the right-hand-side of the table for each funding source that applies to your transit service.

	Funding Source		
(1)	Section 5311 Rural Transportation		☐
(2)	Section 5310 Elderly and Disabled Transportation		☐
(3)	Section 5316 JARC		☐
(4)	Section 5317 New Freedom		☐
(5)	Governor's Office of Elderly Affairs		☐
(6)	Governor's Office of Rural Affairs		☐
(7)	Department of Child and Family Services		☐
(8)	Department of Health and Hospitals		☐
(9)	Veterans Administration		☐
(10)	Non-Emergency Medical Transportation		☐
(11)	Local Dedicated Sales Tax		☐
(12)	Local Government Funds		☐
(13)	Other (please specify below)		☐ ☐ ☐

6. Does your organization have <u>overnight or permanent residents</u> (e.g. homeless shelter, nursing home, retirement village)?

Yes ☐ ☐

If "no", please skip to next page.

If "yes", please give an approximate estimate of the number of people present in the facility by time of day and day of week:

	Weekday	Weekend
Daytime		
Nighttime		

Do the numbers above alter significantly during the year? If so, estimate the approximate seasonal fluctuations in terms of a%age of the annual average for each quarter:

Season	Percentage
Winter	
Spring	
Summer	
Fall	
Total	100%

7. Does your organization have an <u>existing arrangement</u> with another organization that comes into effect when an emergency arises?

Yes ☐ ☐

If "no", please skip to next page.

If "yes", please indicate the organization that is applicable in the table below and specify the arrangement that exists:

Organization	Applicable?	Arrangement
Example: GOHSEP	**Yes**	**Memorandum of Understanding to assist in evacuation**
Example: A1 Transit, LLC	**Yes**	**Contract to provide transit service in emergency**
GOHSEP		
DHH		
DCFS		
DOTD		
VA		
Private transit company		
Other (please specify below)		

8. Do you currently <u>coordinate your day-to-day transit operations</u> with other agencies providing a similar service to your own?

Yes ☐ ☐

If "no", please skip to next page.

No

If "yes", please provide the following information related to that coordination:

(1) How many agencies do you coordinate with? ……

(2) How often do you coordinate your services with these agencies collectively:
   1. Daily ☐
   2. Between once and 6 times/week ☐
   3. Between once and 4 times/month ☐
   4. Between once and 11 times/year ☐

(3) Is funding exchanged among coordinating agencies? Yes ☐ ☐ No

(4) Approximately how many vehicle miles of travel of coordinated service occurs per month? ……..

(1)

9. Please identify a <u>contact person</u> in your organization that can be contacted in the event of an emergency:

Name:……..

Position:……..

Telephone: landline:……..

cell:……

E-mail:……..

Address of your organization:

……

……

……

……

Are the vehicles identified previously kept at the address above?

Yes ☐ ☐

……

No

……

……

……

APPENDIX C

CODEBOOK

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	1	Replystatus	Reply status of participation	0=Did not reply 1=Replied 2=Failed to deliver 3=Not applicable 4=Repeated survey	-	0=1756 1=225 2=12 3=1 4=7	"Repeated survey" means the survey was mailed to several branches of the same organization and more than one response was received from the same organization. If more than one response was returned, the additional surveys are marked as "Repeated survey".
Numeric	8	Date	The date the reply envelope was received	Date in MM\DD\YY format -99=missing value	-	-	If no date was shown on the business reply envelope, then -99 was entered.
Character	4	ID	ID of the surveyed organization	5-135=DHH NEMT 144-297=TRG 324-1980=DCFS 2055-5712=DHH HSS 5714=Veterans 5719-6379=RetireNet 6435-6661=Human Service Transportation	-	DHH NEMT=26 TRG=47 DCFS=729 DHH HSS=1072 Veterans=1 RetireNet=80 Human Service Transportation=46	ID is a discontinuous number due to the "within coastal parish" requirement of the data.
Character	20	Source	Data source	Same as above	-	Same as above	
Text	20	Org	Name of the surveyed organization	Name	-	2001	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Text	20	Mail_Line1	The 1st line in the mailing address, it can be street or P.O. Box	Name	-	2001	For mail-out/mail-back survey
Text	20	Mail_City	Mail city	Name	-	2001	For mail-out/mail-back survey
Text	2	Mail_State	Mail State	LA=Louisiana	-	2001	For mail-out/mail-back survey
Character	10	Zipcode	Mail zip code	5-digit zip code, dash, and 4-digit extension	-	2001	e.g. 70403-8504
Text	20	Phy_Street	Physical street address	Name -98=Not applicable -99=Missing value	Q9_6	Name=58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Text	20	Phy_City	Physical city	Name -98=Not applicable -99=Missing value	Q9_6	Name=58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Character	5	Phy_Zip5	Physical zip code	5-digit zip code	-	2001	e.g. 70403
Numeric		Long	Longitude	Value -98=Not applicable -99=Missing value	-	Total locating=58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Numeric		Lat	Latitude	Value -98=Not applicable -99=Missing value	-	Total locating=58 -98=167 -99=1776	Same as above.
Text	20	Contact	Full name of the contact person	Name -98=Not applicable -99=Missing value	Q9_1	Name=58 -98=167 -99=1776	
Character	5	Salute	Salutation of the contact person	Mr., Ms., Mrs., and Sir / Madam	-		Based on judgment

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	10	Firstname	First name of contact person	Name -98=Not applicable -99=Missing value	Q9_1		
Character	10	Middle	Middle name of contact person	Name (Blank) -98=Not applicable -99=Missing value	Q9_1		
Character	10	Lastname	Last name of contact person	Name -98=Not applicable -99=Missing value	Q9_1		
Character	3	Suffix	Suffix of contact person	Name (Blank) -98=Not applicable -99=Missing value	Q9_1		
Character	20	Position	Position of the contact person	Name of position (Blank) -98=Not applicable -99=Missing value	Q9_2		
Character	10	Tel	Telephone number	10-digit telephone number; -98=Not applicable -99=Missing value	Q9_3	Total reporting=58 -98=167 -99=1776	Format example: 225-XXX-XXXX
Character	10	Cell	Cellphone number	10-digit telephone number; -98=Not applicable -99=Missing value	Q9_4	Total reporting=43 -98=167 -99=1791	Format example: 225-XXX-XXXX
Character	10	E_mail	Email address	Email address -98=Not applicable -99=Missing value	Q9_5	Total reporting=56 -98=167 -99=1778	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	1	Veh_Type	Type of vehicles	1=Bus 2=Van 3=Mini Van 4=Truck 5=Ambulance 6=Other -98=Not applicable -99=Missing value	Q1	1=22 2=47 3=7 4=1 5=1 6=15 -98=167 -99=1776	(1) If organization has no vehicles, then enter -98. (2) If there are multiple types of vehicle, then add a new row to specify each type of vehicle.
Numeric	3	Veh_Num	Number of vehicles in each type	Number -98=Not applicable -99=Missing Value	Q1		If organization has no vehicles, then enter -98.
Numeric	3	Veh_Cap	Capacity of single vehicle in each type	Number -98=Not applicable -99=Missing Value	Q1		If organization has no vehicles, then enter -98.
Character	3	Veh_Att	Attribute of vehicle	0=none 1=wheelchair 2=lift 3=wheelchair and lift 4=other -98=Not applicable -99=Missing Value	Q1	0=37 1=3 2=4 3=34 4=2 -98=167 -99=1776	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	3	Veh_Owner	Owner of vehicle	1=Our organization 2=DOTD 3=Local 4=Reliant Transportation 5=ETC, Inc. 6=Private 7=Church 8=RTA 9=Rehab Service 10=AMED Ambulance 11=TVCOA 12=VCOA -98=Not applicable -99=Missing Value	Q1	1=43 2=12 3=1 4=1 5=1 6=1 7=1 8=1 9=1 10=1 11=1 12=1 -98=167 -99=1776	Character
Text	20	Veh_Street	Street name where all vehicles are kept	Name 0=Kept at drivers residence -98=Not applicable -99=Missing Value	Q9_7	Total reporting =58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Text	20	Veh_City	City name where all vehicles are kept	Name -98=Not applicable -99=Missing Value	Q9_7	Total reporting =58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Numeric	3	Driver_0	Number of drivers of vehicles	Number -98=Not applicable -99=Missing Value	Q2	Total reporting=58 -98=167 -99=1776	If organization has no vehicles, then enter -98.
Numeric	3	Driver_1	Number of drivers who can operate a wheelchair lift	Number -98=Not applicable -99=Missing Value	Q2	Total reporting=41 -98=167 -99=1793	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	3	Driver_2	Number of drivers who can secure a wheelchair in a vehicle	Number -98=Not applicable -99=Missing Value	Q2	Total reporting=42 -98=167 -99=1792	
Numeric	3	Driver_3	Number of drivers who can administer first aid	Number -98=Not applicable -99=Missing Value	Q2	Total reporting=50 -98=167 -99=1784	
Numeric	3	Driver_ 4	Number of drivers who can administer CPR	Number -98=Not applicable -99=Missing Value	Q2	Total reporting=51 -98=167 -99=1783	
Numeric	3	Driver_5	Number of drivers who can administer oxygen	Number -98=Not applicable -99=Missing Value	Q2	Total reporting =9 -98=167 -99=1825	
Numeric	3	Driver_6	Number of drivers who can administer IV	Number -98=Not applicable -99=Missing Value	Q2	Total reporting =6 -98=167 -99=1828	
Numeric	3	Driver_7	Number of drivers who can do other	Number -98=Not applicable -99=Missing Value	Q2	Total reporting =1 -98=167 -99=1833	
Numeric	3	Driver_8	Expected number of drivers who would be willing to assist in an advance-notice emergency	Number -98=Not applicable -99=Missing Value	Q2	Total reporting =50 -98=167 -99=1784	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	3	Driver_9	Expected number of drivers who would be willing to assist in a no-notice emergency	Number -98=Not applicable -99=Missing Value	Q2	Total reporting =36 -98=167 -99=1798	
Numeric	3	Driver_10	Expected average time from notification to driver readiness (min)	Minutes -98=Not applicable -99=Missing Value	Q2	Total reporting =53 -98=167 -99=1781	
Numeric	3	Rider_1	Average ridership on a typical (non-emergency) weekday, assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=45 -98=167 -99=1789	If organization has no vehicles, then enter -98 for all Q3.
Numeric	3	Rider_2	Average ridership on a typical (non-emergency) weekday, no assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=53 -98=167 -99=1781	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	3	Rider_3	Average ridership on a typical (non-emergency) weekend, assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=11 -98=167 -99=1823	
Numeric	3	Rider_4	Average ridership on a typical (non-emergency) weekend, no assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=15 -98=167 -99=1819	
Numeric	3	Rider_5	Estimated ridership requiring evacuation in an emergency, no-notice emergency, assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=28 -98=167 -99=1806	
Numeric	3	Rider_6	Estimated ridership requiring evacuation in an emergency, no-notice emergency, no assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=33 -98=167 -99=1801	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	3	Rider_7	Estimated ridership requiring evacuation in an emergency, advance-notice emergency (6+ hrs), assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=23 -98=167 -99=1811	
Numeric	3	Rider_8	Estimated ridership requiring evacuation in an emergency, advance-notice emergency (6+ hrs), no assistance required	Number -98=Not applicable -99=Missing Value	Q3	Total reporting=29 -98=167 -99=1805	
Character	3	Serve_0	Does your insurance company, or any other agency, restrict the area or riders your transit service may serve?	0=No 1=Yes -98=Not applicable -99=Missing Value	Q4	0=38 1=20 -98=167 -99=1776	If organization has no vehicles, then enter -98 for all Q4.

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	3	Serve_1	Which restriction is applicable?	1= Existing service area/routes restriction 2= Home parish 3= Home state 4= Riders served by your organization on a regular basis 5= Time of day limitation 6= Day of week limitation 7=Other restrictions -98=Not applicable -99=Missing Value	Q4	1=9 2=7 3=3 4=15 5=4 6=3 7=4 -98=167 -99=1776	(1) -98 may mean no vehicle is available or no restriction exists; (2) "Other restrictions" are specified in the next variable.
Text	20	Serve_2	Name of authority imposing each restriction	Name -98=Not applicable -99=Missing Value	Q4	Total reporting =10 -98=167 -99=1824	Use comma to separate the name of each authority that imposes a restriction.

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	3	Fund	Funding source supporting the transit service	0=self-support 1= Section 5311 Rural Transportation; 2= Section 5310 Elderly and Disabled Transportation; 3= Section 5316 JARC; 4= Section 5317 New Freedom; 5= Governor's Office of Elderly Affairs; 6= Governor's Office of Rural Affairs; 7= Department of Child and Family Services; 8= Department of Health and Hospitals; 9= Veterans Administration; 10= Non-Emergency Medical Transportation; 11= Local Dedicated Sales Tax; 12= Local Government Funds; 13=other -98=Not applicable -99=Missing Value	Q5	0=17 1=6 2=17 3=2 4=0 5=5 6=0 7=7 8=8 9=0 10=1 11=1 12=7 13=12 -98=168 -99=1778	(1) If organization has no vehicles, then enter -98 for all Q5. (2) If replier put self-support in "Other", then use code 0. (3) "other" includes other specified funding sources

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Character	3	Res_0	Does your organization have overnight or permanent residents?	0=No 1=Yes -98=Not applicable -99=Missing Value	Q6	0=33 1=25 -98=167 -99=1776	If organization has no vehicles, then enter -98 for all Q6.
Numeric	3	Res_1	Overnight residents, weekday daytime	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Numeric	3	Res_2	Overnight residents, weekday nighttime	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Numeric	3	Res_3	Overnight residents, weekend daytime	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Numeric	3	Res_4	Overnight residents, weekend nighttime	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Percentage	3	Res_5	Resident seasonal variation, winter	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Percentage	3	Res_6	Resident seasonal variation, spring	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Percentage	3	Res_7	Resident seasonal variation, summer	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Percentage	3	Res_8	Resident seasonal variation, fall	Value -98=Not applicable -99=Missing Value	Q6	Total reporting=25 -98=200 -99=1776	
Character	3	Arrg_0	Whether the organization has an existing arrangement with another organization that comes into effect when an emergency arises.	0=No 1=Yes -98=Not applicable -99=Missing Value	Q7	0=33 1=25 -98=167 -99=1776	If organization has no vehicles, then enter -98 for all Q7.
Character	3	Arrg_1	The name of the other organization that has an arrangement with the surveyed organization	1= GOHSEP; 2=DHH; 3=DCFS; 4=DOTD; 5=VA; 6=Private transit company; 7=other; -98=Not applicable; -99=Missing Value	Q7	1=3 2=3 3=4 4=2 5=0 6=8 7=13 -98=200 -99=1776	

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Text	3	Arrg_2	Code with the name of the arrangement	1=MOU; 2=Transport children in case of emergency; 3=Evacuation; 4=Transport during emergency; 5=Transport patients in need of assistance; 6=Notification; 7=Ambulance; 8=Contract; 9=Replacement of home; 10=Transit service; 11=Shelter in emergency; 12=Part of the local government -98=Not applicable; -99=Missing Value	Q7	1=5 2=1 3=3 4=6 5=1 6=1 7=3 8=1 9=1 10=2 11=1 12=1 -98=200 -99=1776	
Character	3	Coor_0	Do you currently coordinate your day-to-day transit operations with other agencies providing a similar service to your own?	0=No 1=Yes -98=Not applicable -99=Missing Value	Q8	0=55 1=3 -98=167 -99=1776	If organization has no vehicles, then enter -98 for all Q8.

Variable type	Length	Variable name	Variable description	Code	Question number	Frequency	Comments
Numeric	3	Coor_1	How many agencies do you coordinate with?	Value; -98=Not applicable -99=Missing Value	Q8	Total reporting =3 -98=222 -99=1776	
Character	3	Coor_2	How often do you coordinate you services with these agencies collectively:	1=Daily; 2=Between once and 6 times/week; 3=Between once and 4 times/month; 4=Between once and 11 times/year -98=Not applicable -99=Missing Value	Q8	1=2 2=0 3=0 4=1 -98=222 -99=1776	
Character	3	Coor_3	Is funding exchanged among coordinating agencies?	0=No 1=Yes -98=Not applicable -99=Missing Value	Q8	0=1 1=2 -98=222 -99=1776	
Numeric	3	Coor_4	Approximately how many vehicle miles of travel of coordinated service occurs per month?	Value; -98=Not applicable -99=Missing Value	Q8	Total reporting =3 -98=222 -99=1776	

APPENDIX D

VARIABLES DESCRIPTION AND FEATURE SELECTION WITH ARCGIS

This appendix explains the meaning of the variables used in the ArcGIS shapefiles. This appendix also shows how to do feature selection in the Desktop version of ArcGIS, in case it is available to analysts and they prefer to use it in preference to ArcGIS Online.

The Supply Side

Geocoding_All is a merged file showing the geographic location of organizations in terms of their longitude and latitude. Initially, some data points were geocoded by address and some were geocoded by longitude and latitude and they were stored in separate files. They were then merged and in this merged file those that failed to geocode with an address show up twice, but only appear once on the maps as a longitude and latitude of an item is needed in order to show on the map. The meaning of the variables in the data file are as specified in the coding manual shown in Appendix C.

The Demand Side

The TAZLU layer shows the number of people within each TAZLU polygon formed by the intersection of the TAZ and Land Use/Land Cover layers. Each TAZLU polygon has a single land use/land cover attribute and always appears within a single TAZ. The variables used in estimating transit demand are described in Table 17.

Table 17

Variable descriptions

Variable name	Variable description	Comments
HHPop2	Household population in each TAZLU	
WorkatH2	Number of people who work at home in each TAZLU	
WDStay2	Number of people who stay at home during the weekday daytime in each TAZLU	
SatStay2	The number of people who stay at home during Saturday daytime in each TAZLU	
SunStay2	The number of people who stay at home during Sunday daytime in each TAZLU	
Worker2	The number of people who work in each	

Variable name	Variable description	Comments
	TAZLU	
DQ1H	The number of daytime tourists in each TAZLU during a festival period in the first quarter of the year	The same applies when 1 in the variable name changes to 2,3, and 4, which stands for different quarters of the year
DQ1L	The number of daytime tourists in each TAZLU during a non-festival period in the first quarter of the year	Same as above
NQ1H	The number of nighttime tourists in each TAZLU during a festival period in the first quarter of the year	Same as above
NQ1L	The number of nighttime tourists in each TAZLU during a non-festival period in the first quarter of the year	Same as above
WeShop	People who shop during the daytime on a weekday in each TAZLU	
SaShop	People who shop during the daytime on a Saturday in each TAZLU	
SuShop	People who shop during the daytime on a Sundday in each TAZLU	
Q1HWD	The daytime weekday population during a festival period in the first quarter of the year	Q1HWD = [DQ1H] + [WDstay2] + [Worker2] + [WeShop]
Q1LWD	The daytime weekday population during a non-festival period in the first quarter of the year	Q1LWD = [DQ1L] + [WDstay2] + [Worker2] + [WeShop]
Q1HSaD	The daytime Saturday population during a festival period in the first quarter of the year	Q1HSaD = [DQ1H] + [SatStay2] + [SaShop]
Q1LSaD	The daytime Saturday population during a non-festival period in the first quarter of the year	Q1LSaD = [DQ1L] + [SatStay2] + [SaShop]
Q1HSunD	The daytime Sunday population during a festival period in the first quarter of the year	Q1HSunD = [DQ1H] + [SunStay2] + [SuShop]
Q1LSunD	The daytime Sunday population during a non-festival period in the first quarter of the year	Q1LSunD = [DQ1L] + [SunStay2] + [SuShop]
Q1HN	The total nighttime population during a	Q1HN = [NQ1H] + [HHPop2]

Variable name	Variable description	Comments
	festival period in the first quarter of the year	
Q1LN	The total nighttime population during a non-festival period in the first quarter of the year	Q1LN = [NQ1L] + [HHPop2

Feature Selection

Features can be selected by attribute, location, and by graphic feature. There are two ways to select a feature by graphic means *[45]*. The first method involves executing the following three steps:

(1) If you do not already have graphics in your map, create them using the *Draw* toolbar.
(2) Select the graphic(s) to be used for feature selection by clicking each graphic.
(3) Click *Selection* > *Select By Graphics* to select features that intersect your graphics.

This will select features from the selectable layers using the graphics that you have highlighted. For example, if you use an ellipse to select features, the following steps will accomplish this:

Step 1: Draw an ellipse. Create an ellipse using the ***Draw*** tools on the toolbar.

property of the graphic can be adjusted by ***Right clicking*** on the graphic > click ***Properties***. See Figure 19.

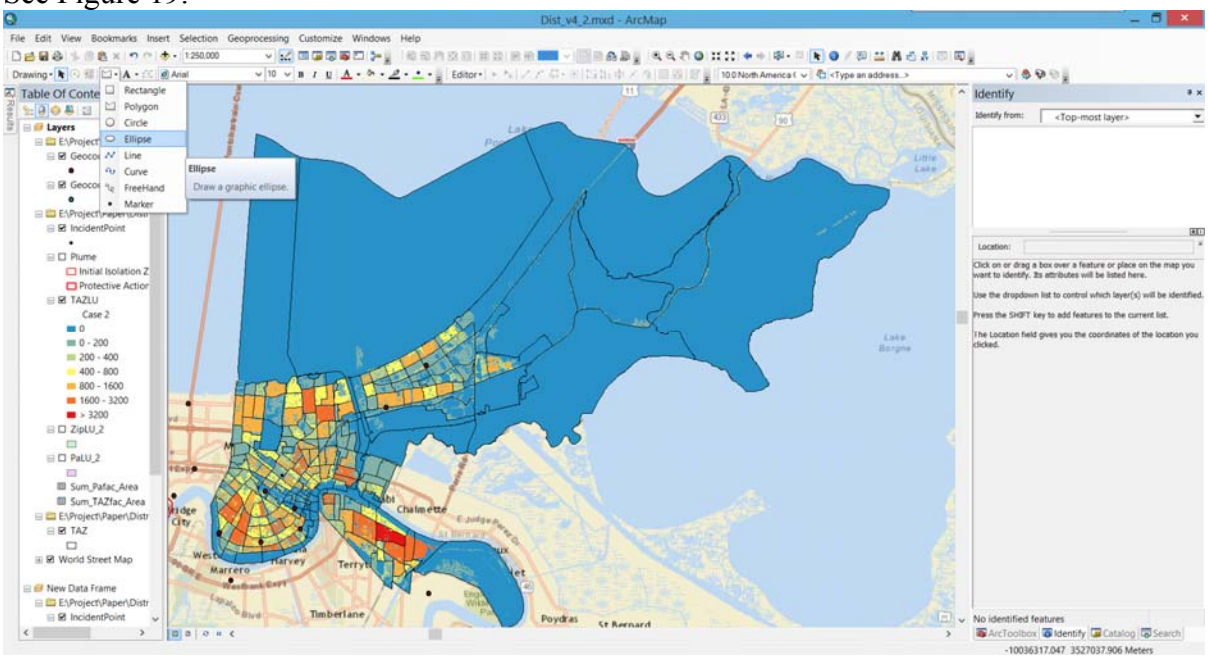

Figure 19

Step 1: Draw an ellipse

Step 2: Select features by the drawn graphics. First, make sure the graphic(s) you would like to use is selected. Then click ***Selection*** > ***Select By Graphics*** to select features that intersect your graphics. See Figure 20.

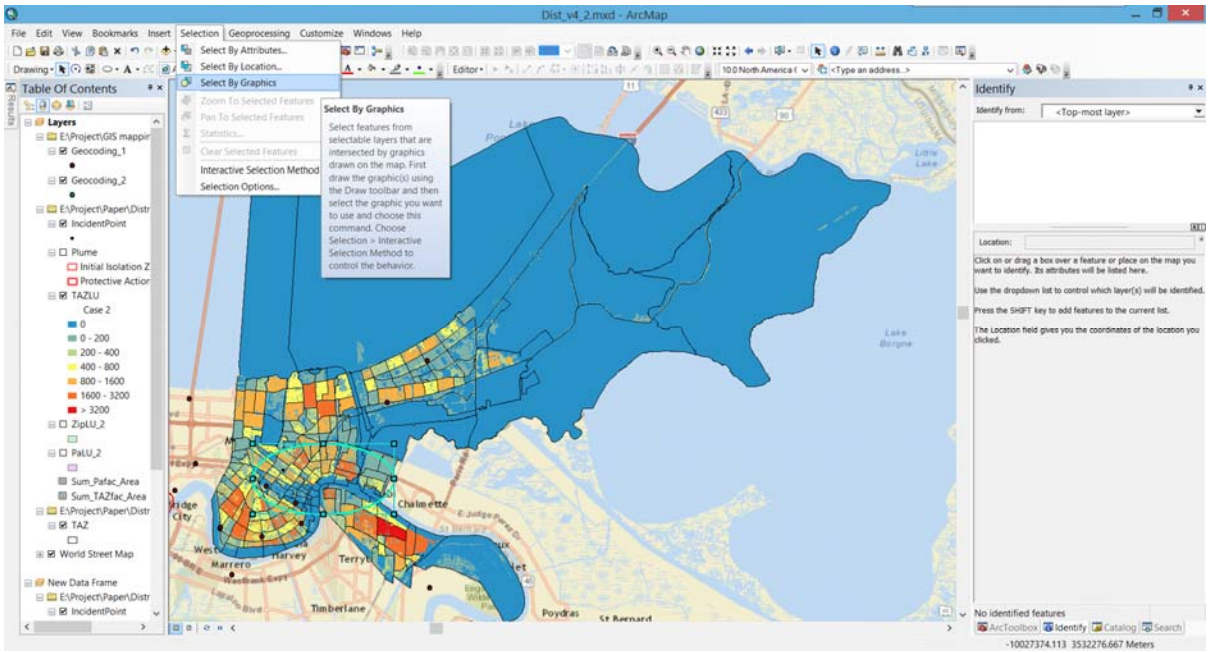

Figure 20

Step 2: Select features by the drawn graphics

Step 3: Adjust selection if the selected features do not fit the needs. Click ***Selection*** > ***Select Options*** to adjust your selection. For example, if examining carefully, you will find that the selected feature changes as you specify "Select features completely within the box or graphic(s)" (Figure 22) instead of "Select features partially or completely within the box or graphic(s)" (Figure 21). This step is totally based on what areas you would like to analyze.

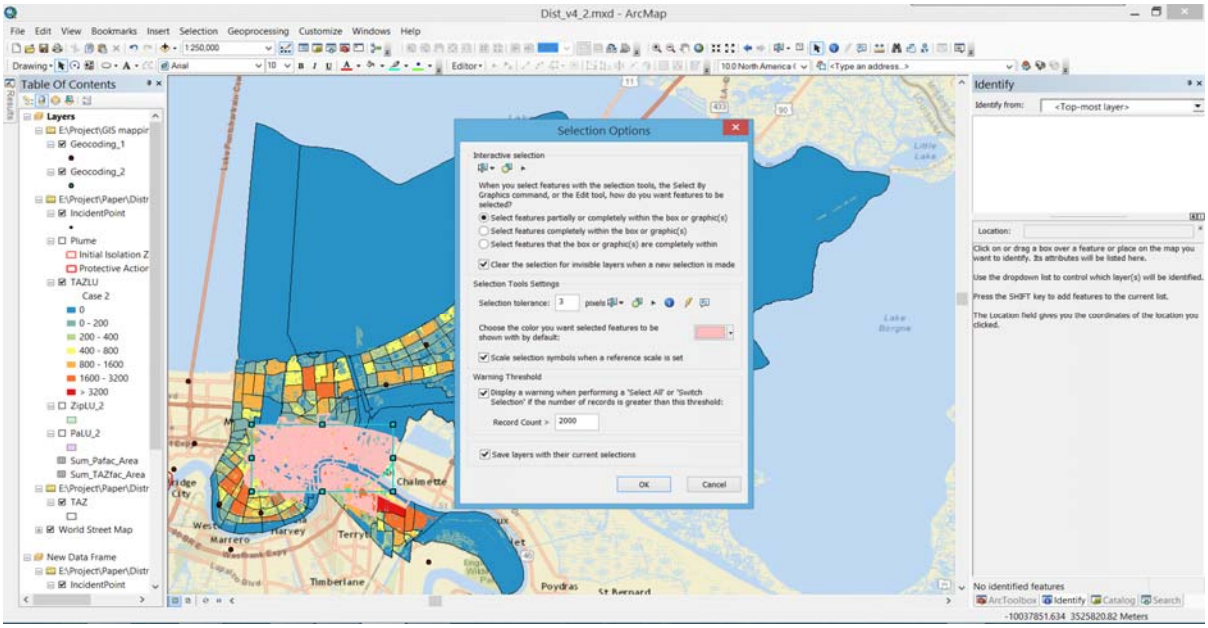

Figure 21

Before adjusting the selection

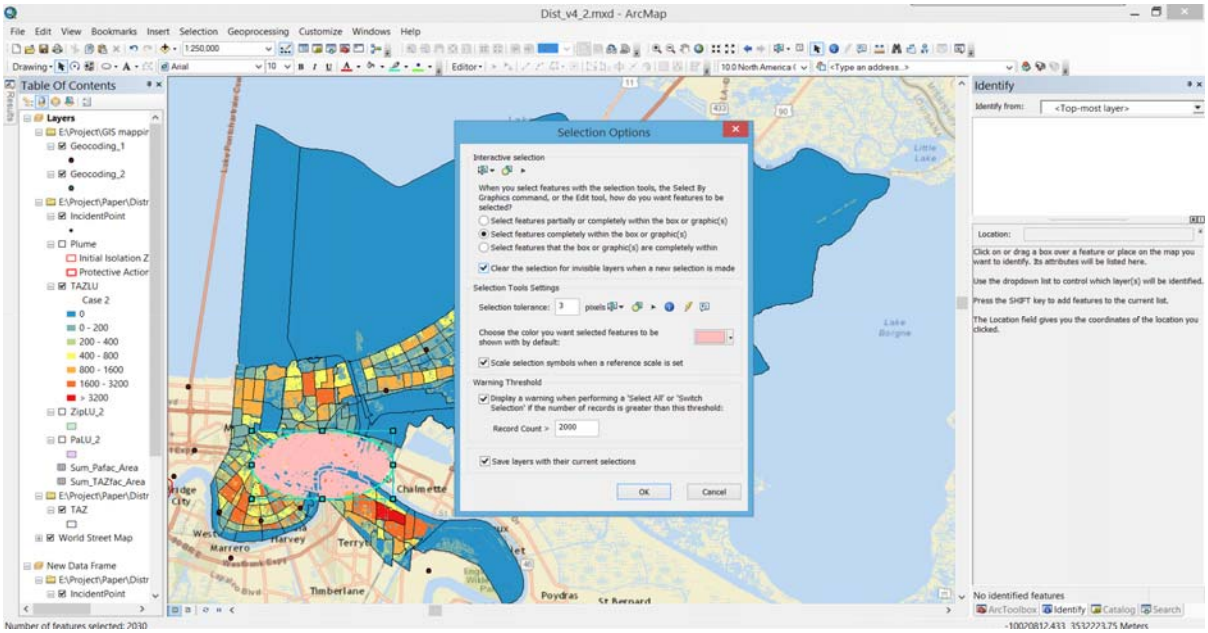

Figure 22

After adjusting the selection

Step 4: Check the statistics of selected features. Click ***Selection*** > ***Statistics*** to check the statistics. See Figure 23. A window will pop up to show the statistics of selected features. See Figure 24.

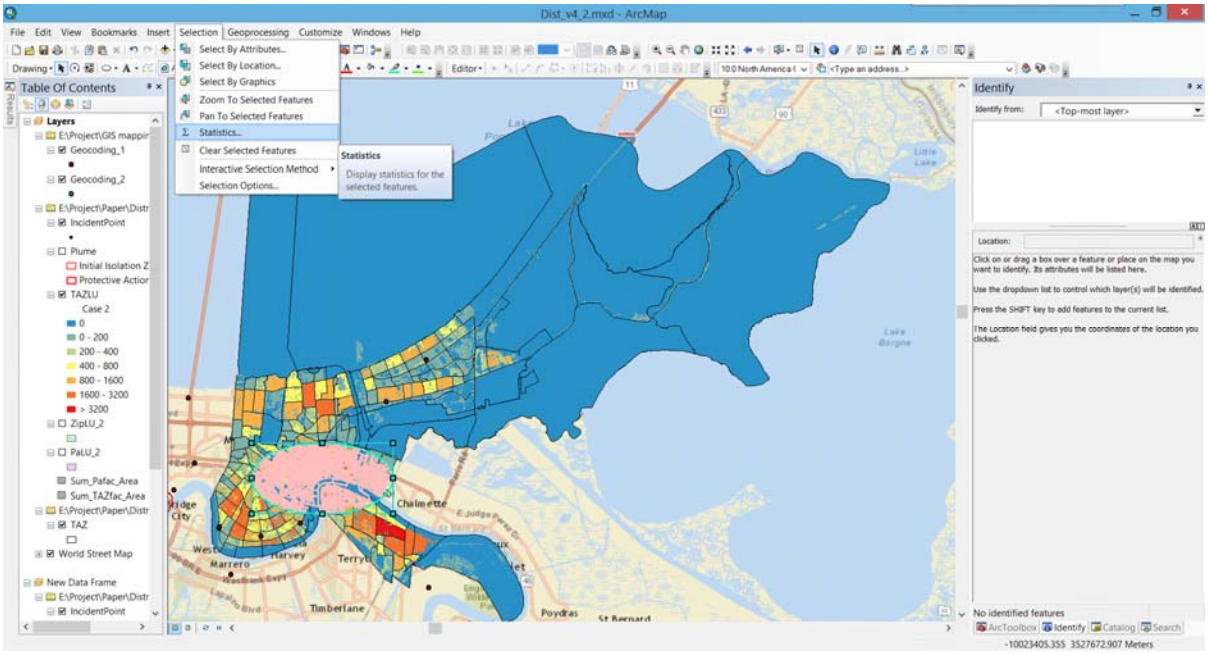

Figure 23

Check the statistics of selected features

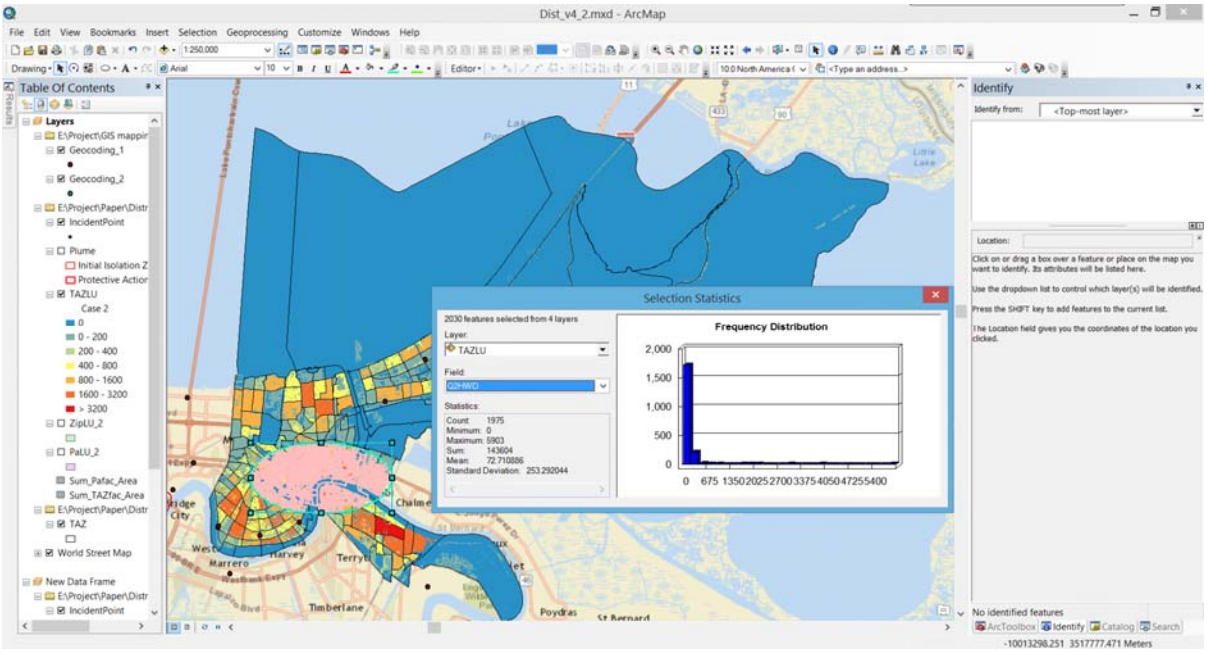

Figure 24

The window showing statistics

The second method to select a feature by graphic means involves using the *Tools toolbar* in ArcMap which contains an alternative tool for graphically selecting features. The *Select*

Features tool works on a single graphic that you interactively digitize as part of the selection process. Also, this tool does not add a graphic to your map display.

For example, if we would like to select features by a circle:

Step 1: Select features by graphic using tools on toolbar. Click the Tools toolbar  click ***Select by Circle***. See Figure 25. Which shape to use is based on the shape of area you would like to analyze. See the result of selection in Figure 26.

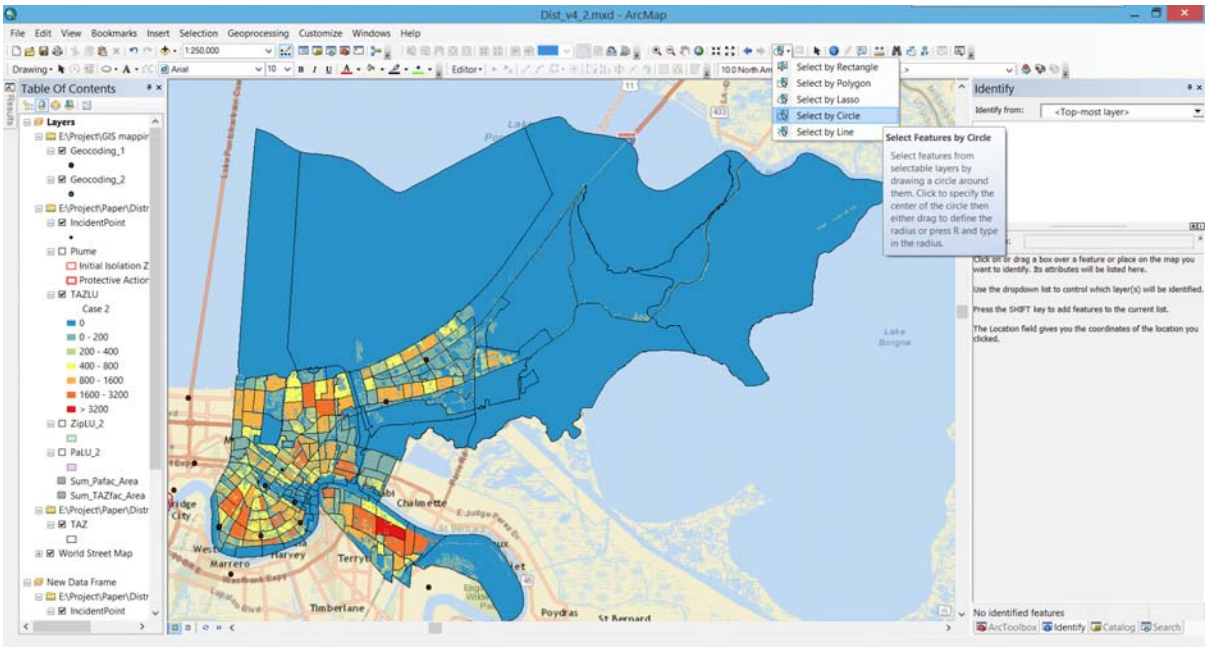

Figure 25

Select features by graphic using tools on the toolbar

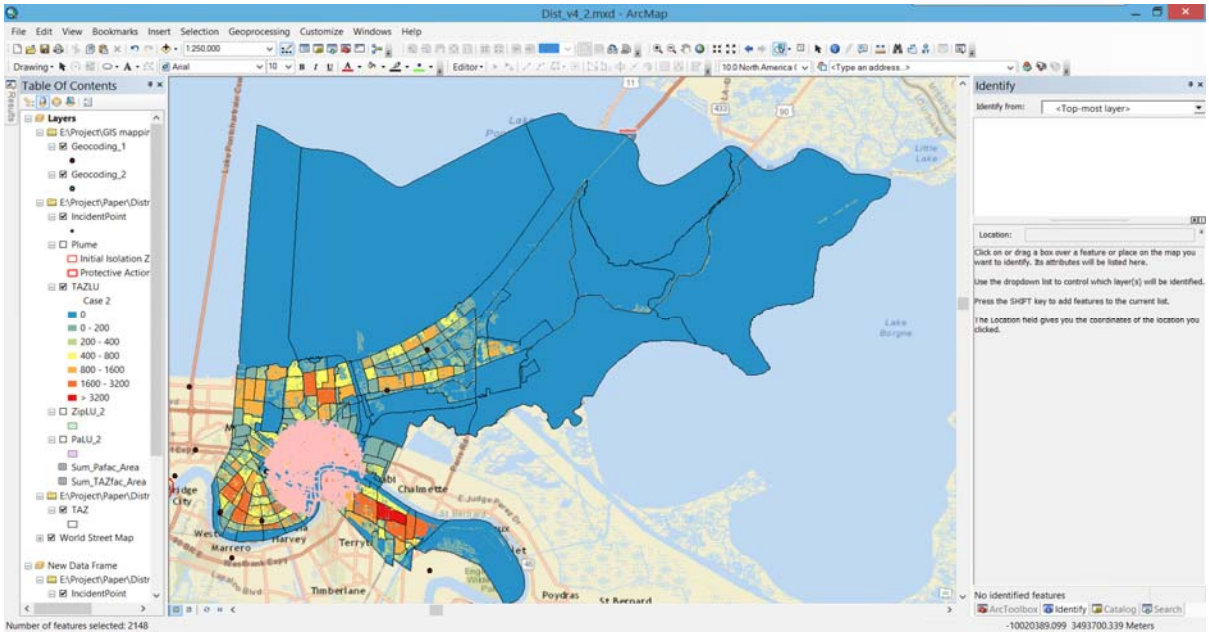

Figure 26

Results of selection

Step 2: If needed, do further adjustment to your selection. Click ***Selection*** > ***Interactive Selection Method*** to further adjust your selection. See Figure 27. Take ***Add to Current Selection*** as an example. The result is shown in Figure 28, Figure 29, and Figure 30. By drawing one more circle, new features within that circle are added into the current selection.

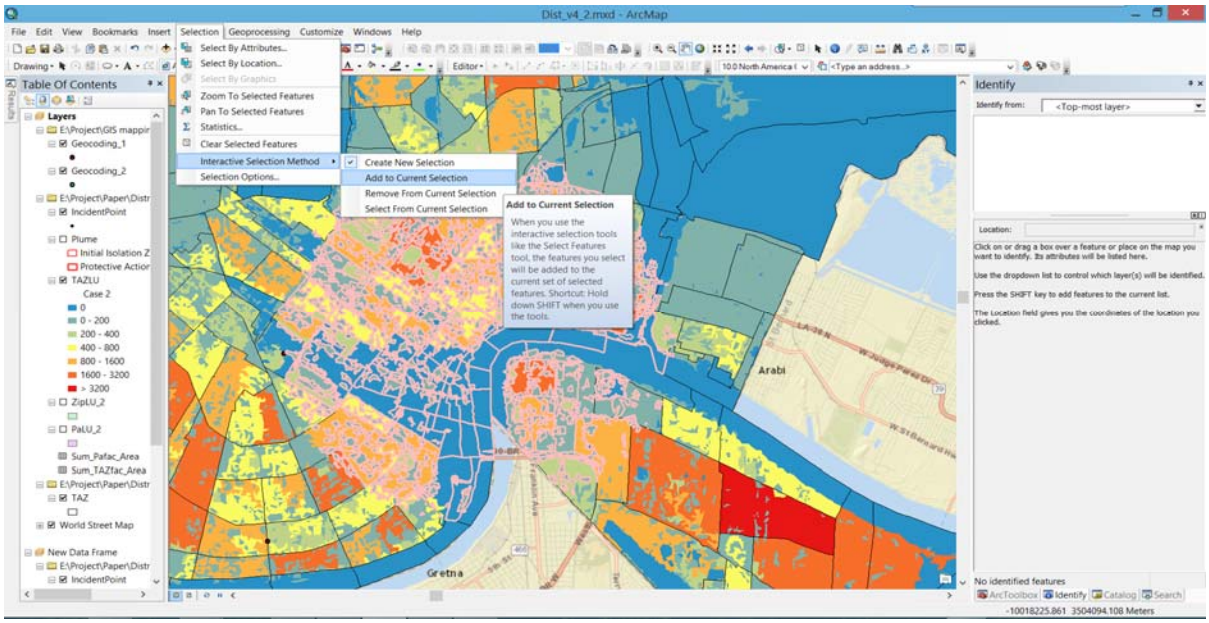

Figure 27

Interactive selection method

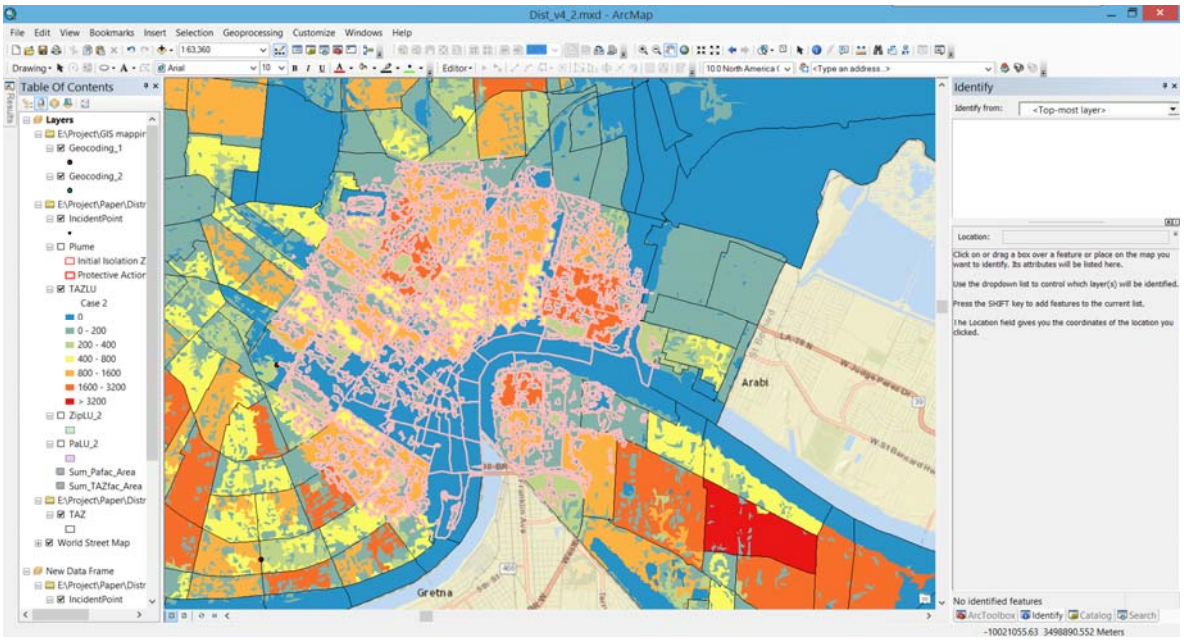

Figure 28

Before adjusting the selection

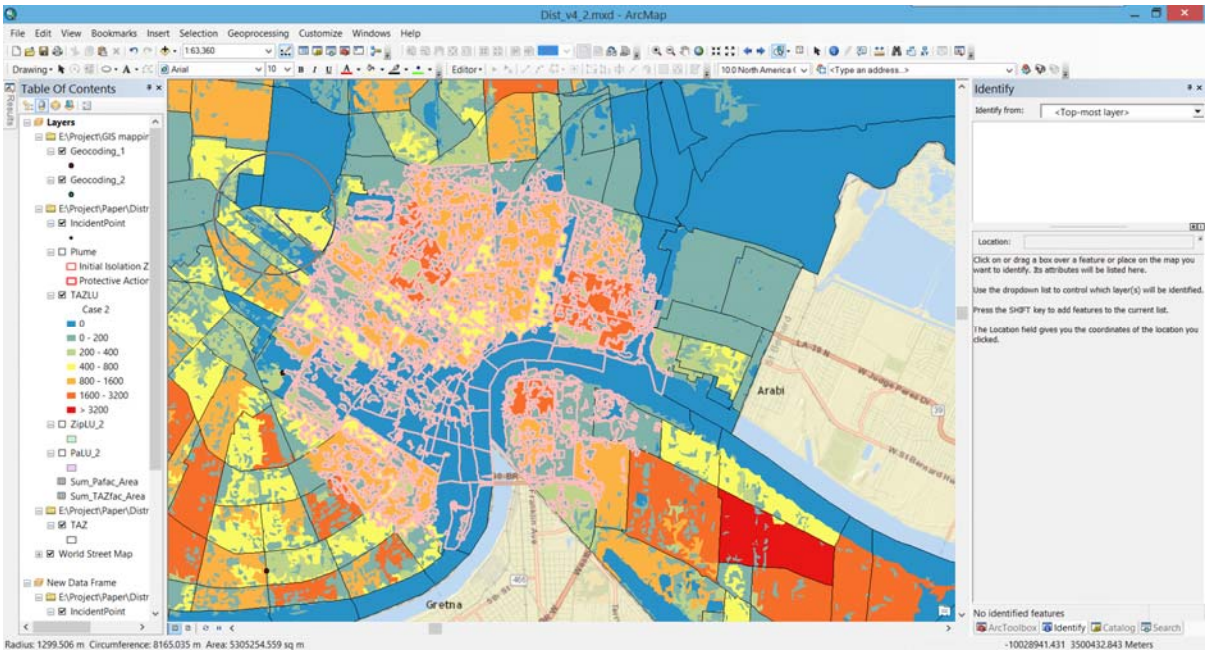

Figure 29

After adjusting selection 1

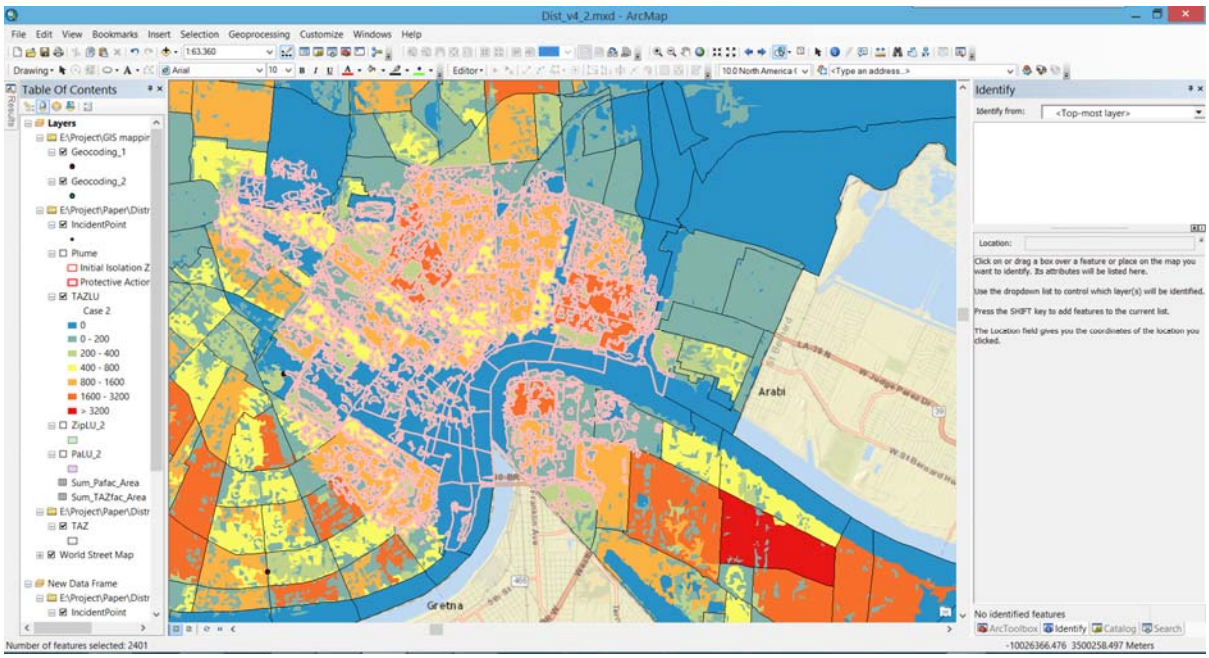

Figure 30

After adjusting selection 2

Step 3: Check the statistics of selected features Click ***Selection*** > ***Statistics*** to check the statistics. Figure 31 shows the results.

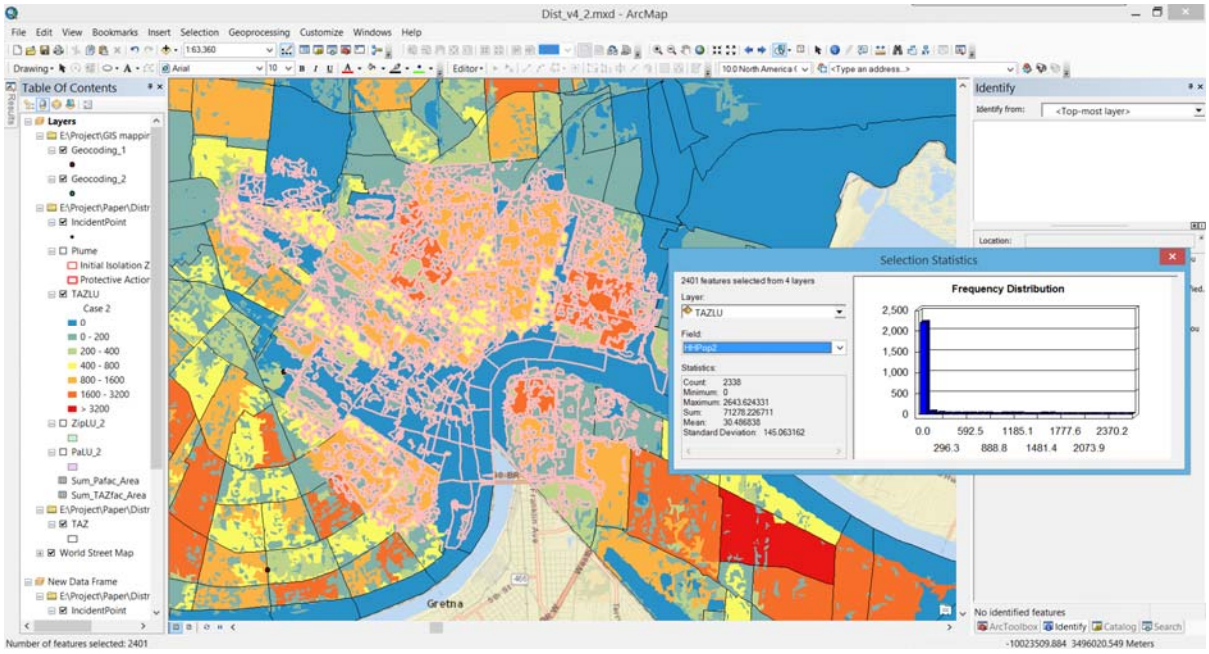

Figure 31

Check the statistics of selected features

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