Identifying local transit resources for evacuation

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IDENTIFYING LOCAL TRANSIT RESOURCES FOR EVACUATION

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The Department of Civil and Environmental Engineering

by

Alaa Shams
B.S., Damascus University, 1998
M.S., Southern University, 2004
May 2014
To my son Adam Alaa Shams the joy of my life
   To my parents, family and friends
   To the free Syrian people...

   I dedicate this thesis
ACKNOWLEDGMENTS

I would like to thank all my committee members for all the patience and the help that they offered during the time I spent in the graduate school at Louisiana State University. Also I would like to thank Dr. Wilmot specifically for offering me a graduate assistantship to work on this particular project to write this thesis. I also would like to extend my thanks to all my colleagues, family members and my friends for their love and support for the past couple of years. Special thanks to Navigation Electronics, Inc. in Lafayette, LA to make my dream come true.

It is been a tough journey, but I can assure you that I worked very hard to earn this master’s degree. Always remember not to give up because there is always a hope and a light at the end of the tunnel, never lose your faith in yourself and be strong. Always dream big and work hard toward your dreams no matter how big they are.
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ABSTRACT

The objective of this thesis is to establish a GIS that can be used to identify local human-services and special-needs transit resources in Louisiana’s 20 coastal parishes. The intention is that the system be used to identify and then call upon local transit services to assist in the evacuation of an area during an emergency. ArcGIS Online was selected as the platform on which to establish the GIS for this purpose. Socio-economic and transit vehicle data were collected from a variety of official sources and loaded on to the ArcGIS Online portal at LSU. The development of the system is described in this thesis. Its ability to provide graphical output of the underlying data is demonstrated, including the ability to easily and quickly determine transit resources residing at a point, within a buffer surrounding a point, or within a polygon drawn by the user.
INTRODUCTION

Although there are many different “on demand” transit systems managed by several state agencies with different federal funding that will provide transportation to various categories of riders such as the elderly, low-income, veterans, disables, and those needing access jobs; currently, there is no single means of identifying all these local resources (drivers and vehicles) and yet, with sufficient organization and collaboration, these resources could be leveraged to address localized transportation needs, particularly during an emergency. Louisiana legislature established a working group to create coordination and collaboration among these agencies and providers, but most were not sufficiently motivated to put their full weight behind the effort. However, if the call to collaboration is to provide life-saving support during an emergency, and they see sufficient benefit to themselves and those they serve, these agencies may be motivated to commit more earnestly. Inventorying and assessing the capabilities of the various human services transportation providers operation 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 saving to the state and local authorities.

This thesis addresses the incorporation of data of local transit resources and the users of these systems into a Geographic Information System (GIS). The purpose of the GIS is to provide a convenient platform from which emergency managers can identify local transit resources as well as local transit demand in times of an emergency. The local transit resources will be used, primarily, to evacuate human services and special needs patrons that they usually serve, but may, in a special crisis, be called upon to support the evacuation needs of the general public because their proximity and ubiquity may allow quicker service than other systems.
OBJECTIVES

The primary purpose of this study is to establish a GIS which officials of the Louisiana Department of Transportation and Development (LA DOTD) and Emergency Managers of the Governor’s Office of Homeland Security and Emergency Preparedness (GOHSEP) can use to identify local human services and special needs transit resources in Louisiana’s 20 coastal parishes. These then can be called upon to serve evacuation needs in an emergency. A secondary purpose is to identify the demand that is likely to need the resources identified.

The system must be capable of being accessed remotely from multiple sites, with minimum training of the users in the utilization of the system. The system must also be capable of providing information quickly so that the delay in providing emergency services is minimized. These requirements are motivated by the fact that in an emergency, users of the system likely to be located at more than one location, would be able to initiate independent and maybe near-simultaneous queries and are likely to be unskilled in the use of GIS systems.

The objectives of the study can be summarized as:

(a) Consolidate information on transportation assets in the public, private, and state sectors to facilitate the movement of and transportation support of special or human service transportation need citizens in Louisiana’s 20 coastal parishes during an emergency or disaster.

(b) Identify the number of passengers currently served by special or human service transportation services.

(c) Incorporate information from (a) and (b) above into a GIS capable of querying evacuation demand and transit supply by geographic area in the 20 coastal parishes of Louisiana.
REVIEW OF LITERATURE

The use of Geographical Information Systems (GIS) in transportation dates back to the early use of GIS in the 1980s. It has been used in a variety of ways in transportation where its ability to present spatial data graphically has made it a popular choice of data management among transportation professionals. In transit, its use has primarily been in characterizing the population that potentially could be served by transit, or in graphically presenting the service being provided. For example, Orange County Transportation Authority (OCTA) in southern California uses it to map the demographic characteristics of the population within walking distance of its routes such as the number of senior citizens, children under the age of 17, persons with disabilities, and households not owning a vehicle (US DOT, 2001). In their application of GIS, it is used in planning new routes, and then presenting the information to patrons in terms of maps and the opportunity to view schedules and initiate queries.

Following Hurricane Katrina in 2005, Congress commissioned a study by the Transportation Research Board on the role of transit in emergency evacuation (TRB, 2008). A committee of 11 people from industry, practice, and academia prepared a report on how best to provide mobility to persons in large urban areas in the United States using transit during an emergency. They concentrated not only evacuation but on the whole question of mobility including the ability provide entry of emergency staff, supplies, and equipment during the emergency as well as the re-entry of the population once the emergency has passed.

The question of human services and special needs transit has long received attention on the matter of coordination (Burkhardt et al., 2004). So many agencies provide transportation for human services and special needs passengers that coordinating these services would provide large improvements in efficiency (Enders and Seekers, 2011). However, while there have been
many appeals from federal government and state agencies to achieve coordination and collaboration, only isolated cases of joint activity have been achieved (Seekins et al., 2007). A current study being conducted by the Louisiana Transportation Research Center, which this thesis is part of, is aimed specifically at achieving collaboration among human-services and special-needs transit providers during an emergency because it is believed that collaboration is more likely to be achieved during an emergency than under normal circumstances. Having an inventory of transit vehicles owned by the human services and special needs agencies in the coastal parishes of Louisiana will allow a state agency such as the Governors Office of Homeland Security and Emergency Preparedness (GOHSEP) to call upon individual agencies to provide transit service once agreement on mutual assistance to participating agencies is obtained. The matter of the expected demand that will arise during an emergency is a topic of interest in this study. One of the issues pertaining to identifying demand for evacuation is the migrational movement of people. That is, at any time during the day or week people change their location as they go about their regular activities – going to work, school, shop, or social/recreational activities. Thus, depending on when an emergency occurs, people are likely to be at different locations depending on the time of day, day of week, or even the season. This concept of including the time element into cartographic information was introduced in the 1980s (Langran and Chrisman, 1988; Peuquet, 1994). Three methods of representing time in spatial analysis were used: time-slice snapshots, base map with overlays, and space-time composite (Langran and Chrisman, 1988). In space-time composite maps space is shown, as usual, in terms of a point or an area on the map while time is depicted thematically in terms of color or hue. Thus, for example, areas of different land use can be shown as polygons on a map while the variation in their population can be shown by change in color or variation in hue of a specific color.
Although some research has been conducted on the temporal population distribution during an emergency (Freire and Aubrecht, 2012) most studies have been conducted to estimate the temporal distribution under normal circumstances. Typically, this involved using official statistics such as the census for nighttime population distribution (McPherson and Brown 2004) and then estimates of workers, students, and shoppers per household to estimate daytime population in residential, commercial, industrial, and other neighborhoods. Work locations and number of workers were estimated from data in business directories. Numbers of workers at the home end were obtained from census county-to-county journey to work data.
METHODOLOGY

Choice of GIS platform

One of the first tasks was to identify a GIS that suited the needs of the project. Specifically, the system had to be accessible to LA DOTD and GOHSEP officials, had to be capable of handling multiple users simultaneously, and had to be user friendly. During the review process we came across multiple platforms used by different state departments in Louisiana and we studied them in detail to determine the pros and cons of each system. The two systems that promised to provide the best match to our requirements were the GIS system operated by LA DOTD and ArcGIS Online, a commercial program developed by ESRI (Environmental Systems Research Institute) the well-known developer of the GIS ArcINFO.

GIS at DOTD

The GIS at LA DOTD operates within the department’s Web Application Development System. The system was developed by LA DOTD’s IT Section and has implemented standards for all web applications. Any web application developed for DOTD must comply with their software standards. By meeting these standards, contractors and developers ensure that their work will be compatible with the existing DOTD IT infrastructure. Contract deliverables that do not comply with these standards cannot be assimilated into the DOTD IT system. In addition, applicable State of Louisiana Office of Information Technology standards also apply.

Some of the requirements for the Development Environment Standards for LA DOTD’s Web Applications include:
• Web Server OS: Microsoft Windows Server 2008 with IIS7. All web application must be compatible with this OS.

• Development IDE: Microsoft Visual Studio 2008 SP1. Applications must be delivered in the form of a Visual Studio, non-compiled solution including licensed copies of all dependent libraries and become the property of LA DOTD.

• Approval and Registration of 3rd Party Components: All third party libraries must be approved and registered in the name of LA DOTD.

• Software Standards for DOTD Web Applications: All web applications must be built with ASP.NET and the .NET 3.5 SP1 Framework (or newer) using the Visual Basic.NET Programming language. ASP.NET MVC is not an approved framework.

• The AJAX Control Toolkit Library may be included in any web application.

• All Intranet web applications must be viewable and fully functional in Internet Explorer 7 and above. All public web applications must be viewable and fully functional in all major web browsers.

• Database Standards for DOTD Applications: DOTD web applications must use DB2 as the standard database management system. Approval to use Microsoft SQL Server will be given on an individual basis.

• Documentation: Specific documents will be identified in the contract.

• User Guide must be available online from within the application

• All design documents, installation instructions, and implementation guides must be delivered with the application

• Development: DOTD will provide the Master Pages and Style Sheets for web applications.
• DOTD Standards must be followed in all web applications. The standards documents will be made available on a need to know basis.

• Applications developed on site must follow the DOTD software development life cycle and other DOTD processes.

• Applications developed offsite must follow these guidelines: The Contractor will provide a scope of work to IT at the beginning of the project. The Contractor will involve the applications clients in all requirements gathering sessions. The Contractor will adhere to LA DOTD’s Web Standards and Best Practices. The Contractor will deliver all source code at least once a month to LA DOTD. LA DOTD will then perform code reviews to validate web standards and best practices are being followed. The Contractor will perform adequate testing before the solution is transitioned to LA DOTD. This includes but is not limited to unit tests, functional tests, integration tests, performance tests, and user acceptance tests. LA DOTD IT personnel must be involved in all testing.

• For solutions that will be hosted by LA DOTD, the solution must be deployed to the LA DOTD staging environment where tests will be executed against LA DOTD test data. The Contractor must provide documentation of the steps required to deploy the solution. The LA DOTD project manager will be responsible for the deployment. The Contractor will be responsible for fixing all defects prior to transitioning the project to LA DOTD.

ArcGIS Online

In contrast to the LA 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 more quickly. The system allows the monitoring of events, activities, and assets through interactive dashboards and maps, images, and scenarios may be shared with others or combined with your own data to provide enriched information.

With spatial analytics, you can use geographic relationships to gain understanding and make better decisions. In the particular case being investigated in this project, namely the identification of human services and special needs transit resources that could be used for evacuation in emergencies and the demand that may arise to make use of these services, the system can be used to estimate which locations lack resources or which areas are likely to have more people that need to be evacuated.

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 our situation, the way we work, and the functionality we want people to be able to use. For example, we might have some members who need access to our maps and apps but do not need to create groups. Or we might have other member who needs to publish features but not files.

**Establishing an ArcGIS Account**

An ArcGIS Online account was established under the site license for the software at Louisiana State University. The author was assigned publisher privileges in the account meaning that he can add and analyze data. Users can be added to the account so that they can access the system and conduct queries but they are not allowed to add or manipulate data in the databases in ArcGIS Online. ArcGIS Online has a limit of 1000 features per layer, meaning that those files that contained more than 1000 features, had to be broken up into separate files.

**Choice of Spatial Unit**

Within the data, the smallest geospatial units at which most of the data needed in this study was available were Traffic Analysis Zones (TAZs). TAZs are established by Metropolitan Planning Organizations (MPOs) as part of their urban planning requirements. Data from the American Community Survey is used to populate the TAZs with aggregate demographic data. However, TAZs tend to be small (geographically) in urban areas and large in rural areas because the emphasis is on urban rather than regional planning. Since some human services transit is in rural areas a more uniform set of geographical units was sought in this project. To address this need, the TAZ layer was overlaid by the Census Block Group
(BG) layer and the overlay geospatial intersect tool used to create a new set of polygons consisting of all areas resulting from the intersection of the TAZ and the BG polygons. From approximately 1800 TAZs and a similar number of Census Block Groups (BGs), approximately 4,500 new areal units were established. They are referred to as TAZBGs hereafter. The distributional capabilities of GIS were used to apportion the demographic data associated with the TAZs and BGs to the TAZBGs based on relative area. The TAZBGs formed areal unit on which further GIS applications and queries were based.

**LA DOTD Parish Boundaries**

The current Louisiana parishes boundary layer was approved by Resolution of the GIS Council on January 19, 2000. This is a regional dataset depicting the polygon boundaries of the 64 parishes comprising the state of Louisiana. Parish boundaries extend 3 miles into the Gulf of Mexico from the coastline. The coastal parishes of Louisiana are defined as the 20 parishes listed in and shown in Table 1 and Figure 1 (Louisiana Department of Natural Resources, 2003).

![Figure 1 Coastal Parishes of Louisiana](image-url)
### Table 1 Coastal Parishes of Louisiana

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**Census Blocks**

The 2010 Census Block Map Series from the United States Census Bureau, also referred to as the Geographic Unit (GU) block maps, are produced to support the 2010 Decennial Census data release. These maps display tabulation geography down to the census block level. The 2010 Census Block Maps are produced for the following entities: counties (or parishes) and statistically equivalent entities, minor civil divisions (MCDs), census county divisions (CCDs) and statistically equivalent entities, incorporated places, census designated places (CDPs), consolidated cities, sub-MCDs, federal American Indian reservations, state American Indian reservations, Oklahoma tribal statistical areas (OTSAs), Alaska Native village statistical areas (ANVSAs), tribal designated statistical areas (TDSAs), state
designated tribal statistical areas (SDTSAs), tribal subdivisions, and Hawaiian home lands (HHLs).

These large-scale maps show the boundaries and numbers for all census blocks within an entity. These maps also show and label base features, such as roads, railroads and hydrography. The intent of this series is to show each entity on the fewest number of map sheets possible and at the maximum practical scale, depending on the size and shape of the entity and the density of the census blocks it contains. Census block density affects the display of the census blocks numbers and feature identifiers. Each entity is covered by one or more parent map sheets at a single scale. Inset map sheets at larger scales were created as required to show the map content described above.

Each map is accompanied by a Census Block to Map Sheet relationship file. These semicolon-delimited text files include a record for each census block within the entity, consisting of the corresponding state, county, census tract, and census block codes for the block and a list of all map sheet numbers that the block appears on for that map. When the map entity is a federal American Indian reservation or a tribal subdivision, the Census Block to Map Sheet relationship file also includes the related tribal census tract and tribal block group for each census block.

The 2010 Census Blocks in the coastal parishes of Louisiana were downloaded from the United States Census Bureau website. There are a total of 88,120 Census Blocks in the coastal parishes shown in

Figure 2. Unfortunately, very little data is released by the Census Bureau on data associated with Census Blocks due to the small area involved and the potential for violation of privacy and confidentiality rules.
Census Block Groups

These national level shapefiles join the geometry and selected attributes from the 2010 Census TIGER/Line shapefiles and the 2010 Census Summary File 1 Demographic Profile (DP1) for the United States and Puerto Rico. They contain data items such as total population, total housing units, median age, population of those 16 years and over, population 65 years and over, race, relationship, average household size, and many other data items. Note that there are 1,759 Block Groups in the coastal parishes as shown in Figure 3.
Traffic Analysis Zones (TAZs)

The cartographic boundary files are simplified representations of selected geographic areas from the Census Bureau’s MAF/TIGER geographic database. These boundary files are specifically designed for urban transportation planning and small scale thematic mapping. Generalized boundary files are clipped to a simplified version of the U.S. outline. As a result, some off-shore areas may be excluded from the generalized files. The 2,131 TAZs in the coastal parishes of Louisiana are shown in Figure 4.

Figure 4 Traffic Analysis Zones in Coastal Parishes of Louisiana

TAZ/Block Group Overlay Intersect

By performing geo-processing using the overlay tool to combine input from both the TAZ and Block Group layers, the intersection analysis tool was used to establish new areal units that result from the overlay of the two layers. The resulting 4,533 areal units are termed TAZBGs and are shown in Figure 5. As mentioned earlier, data associated with the TAZs and the Census Block Groups were assigned to the TAZBGs on the basis of the area each TAZBG made up of the TAZ(s) or BG(s) area. Comparing the TAZ and TAZBG polygons in Figure 4 and Figure 5 respectively, it can be seen that smaller polygons are established in rural areas using the TAZBG areal units.
Coastal Zone Boundary (2012)

The Coastal Zone Boundary in Louisiana was amended by the Louisiana legislature and signed into law as Act 588 by Governor Jindal in 2012 (Louisiana Department of Natural Resources, 2012). The Coastal Zone Boundary shown by the red line in Figure 6 envelopes the Louisiana Coastal Zone. The Coastal zone includes 20 coastal parishes.
DATA

Collection

An extensive study was made of public sources of information to identify the population that could potentially be served by human services and special needs transport in times of an emergency. This involved identifying the number and location of persons who were potential patrons. Typically, this would involve those normally served by these services; the poor, elderly, sick, disabled, and jobless. But in a no-notice emergency the human services and special needs transit may be required to serve the general public if it can be accessed quicker than other forms of transportation. Thus, information was gathered on the location and magnitude of the population in the coastal parishes of Louisiana with special attention given to identification of the poor, elderly, sick, disabled and jobless in the population.

Most of the data collected for the project (the data collection effort was conducted by another graduate student as a separate activity in the project) were in the form of Excel files. The data was checked and cleaned and converted to CSV (Comma Separated Values) format. The first process performed on the data was geocoding the location of facilities. This involved submitting the address given in the data to a database in ArcGIS Online that identifies the location of the address on the map and expresses it in terms of longitude and latitude. Where addresses were missing, an attempt was made to identify the location by using the internet and submitting the name of the facility to find the address.

Socio-Demographic Data

Family Independence Temporary Assistance Program (FITAP)

In an effort to identify where people were located that need public assistance and are most likely to need human services transportation to access essential services or get to work,
data were gathered from, among other sources, the Department of Children and Family Services Family Independence Temporary Assistance Program (FITAP). FITAP is a program that provides temporary cash assistance to households with children when income is insufficient to meet subsistence needs but where the recipient is encouraged to become self-sufficient as soon as possible. Data were acquired which provided the number of cases receiving FITAP assistance by census block in coastal parishes in Louisiana. As noted earlier, there are over 88,000 census blocks in the coastal zone of Louisiana, so census blocks are small geographic areas that appear almost like dots on a map. The results are shown in map form in Figure 7 where the darkness of the census blocks show the number of recipients in the FITAP program in each census block.

Figure 7 FITAP Recipients by Census Block in Coastal Parishes
Supplemental Nutrition Assistance Program (Food Stamp Program) (SNAP)

Similarly to FITAP data, SNAP or food stamp data were gathered from the Department of Children and Family Services by querying the original data from the main database and getting all the records that fall in our study area (20 parishes). These records were geocoded then by spatial join analysis to get the total number of households that fall in each census block. The incidence of households in the SNAP by census block is shown in Figure 8.

Figure 8 Food Stamp Recipients by Census Block in Coastal Parishes of Louisiana
ANALYSIS

Using ArcGIS Online

In this section a description is given of how ArcGIS Online shown in Figure 9 is used to store data and provide the capability to launch queries that an emergency official in LA DOTD or GOHSEP may need to identify transit resources and the demand that may be put upon them. To begin, 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 LA DOTD will be given authority to authorize legitimate users of the system. Before using the system users assigned user name and password so they can gain access to the ArcGIS online website shown in Figure 9.

Figure 9 ArcGIS Online Web Site
When users log in to ArcGIS online a welcome message will appear indicating that they are successfully logged in to their organization ArcGIS online portal Figure 11.

Each license for ArcGIS Online has an administrator tasked with managing the account. In this project, an application was made to the administrator of ArcGIS Online account at LSU by the author for permission to use the system. A username and password was granted to access the LSU organization data as shown in Figure 10. Figure 11 shows the Louisiana State University ArcGIS Online portal.

Each account can have multiple users, viewers, and publishers, but only one administrator. Publishers are permitted to add data files to the account. The account at LSU, has only one publisher (the author) but eight users as shown in Figure 12.

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.
Figure 11 ArcGIS Online Portal at LSU

Figure 12 LSU ArcGIS Online Users

Data files are added online as shown in Figure 13. All the files of interest are added in this manner by the system and remain available to users designated by the publisher. The data files remain stored in the system but may be withdrawn, amended, or replaced by the publisher.
Analysis of the socio-demographic and transit data listed earlier was conducted using ArcGIS Online. The results are shown in the sections which follow. In these diagrams, the entire state of Louisiana is shown with the coastal zone shown in red. The entire state is shown because it is sometimes interesting to observe the distribution of data between the coastal and non-coastal portions of the state as well as the distribution within the coastal zone.

Private Schools

To estimate the number and location of children at schools in the coastal zone of Louisiana, data were gathered on school location and student enrolment from the National Center for Education Statistics. The location and student enrolment of 224 private Pre, Elementary, Middle and High schools were identified and geocoded in the study area. The locations are shown in Figure 14.
Public Schools

Data were gathered from the Louisiana Board of Regents and the National Center for Education Statistics on the address and student enrollment in public schools in the coastal parishes of Louisiana. A total of 622 Pre, Elementary, Middle and High schools were identified in this manner. Their location was geocoded from the given addresses. The resulting location of public schools in the study area is shown in Figure 15.

Figure 14 Private Schools in Coastal Parishes of Louisiana

Figure 15 Public Schools in Coastal Parishes of Louisiana
Private Universities

Figure 16 Shows the location of private universities in the coastal parishes of Louisiana. A cluster of private universities are located in New Orleans. Clicking on an icon representing a university brings up the information in the database related to that university.

![Private Universities in Coastal Parishes of Louisiana](image)

Figure 16 Private Universities in Coastal Parishes of Louisiana

Public Universities

The public universities in the coastal parishes of Louisiana are shown in Figure 17. The location of universities and schools, along with their enrolment, provide an estimation of the number of people at a location depending on the time of the day and day of the week. Thus, if an emergency occurs at a time when students are expected to be present at school, their number and location can be useful information for an emergency official.
Human Services Transportation Stakeholder

Transportation Louisiana is a resource center promoting transportation for individuals with disabilities. Data from their website on stakeholders in Humans Services Transportation (HST) in Louisiana includes information on each region’s Coordinated Human Services Transportation Plan, regional contact information, regional events, and links to each regional transportation commission. The purpose of this information is to have access to the most current information regarding human services transportation in each region and to promote the development and revisions of the Coordinated Human Service Transportation Plans. The site is an effort of the Arc of Louisiana to promote advocacy, capacity building, and a systems change in the transportation in Louisiana for individuals with disabilities. The establishment and maintenance of this website is made possible through a grant from the Louisiana Developmental Disabilities Council.

Because of the file size limitations in ArcGIS Online and the size of the file on HST stakeholders, the file was broken into three data sets; one for the New Orleans area, another for
the Houma region, and the last for the area surrounding Lake Charles. The HST stakeholder locations for these three areas are shown in Figure 18, Figure 19, and Figure 20 for the New Orleans, Houma, and Lake Charles areas of Louisiana, respectively.

Figure 18 HST Stakeholders in New Orleans Area

In Louisiana the Human Service Transportation (HST) Office works to support and increase transportation options for consumers to access health care, jobs, social services and a full range of opportunities within the community. The coordinated HST plan is required by the Federal Transit Administration (FTA) under Federal Law and part of continuing, coordinated and comprehensive planning process. Coordination involves the mutual effort of human service agencies, transportation providers, workforce development agencies, the public, and others, to better serve the transportation disadvantaged population with the limited resources that are available.
Figure 19 HST Stakeholders in Houma Area

Figure 20 HST Stakeholders for Lake Charles Area
Retirement Homes

Active retirement facilities in Louisiana are shown in Figure 21. These include Retirement Living Communities and Homes, Golf Course Communities and Golf Course Homes, Upscale Retirement Community Living, Manufactured Homes and Mobile Home Communities, RV Communities and RV Homes, Rental Retirement Homes and Rental Communities, Care for the Elderly Communities and Homes, Continuing-Care Communities (CCRC), Assisted Living Facilities and Communities, Skilled Nursing Communities, Independent living, Alzheimer's Care Facilities, and Nursing Homes. The number of residents in each facility is recorded in the data which can be accessed by placing the cursor over the facility on the map. Queries can also be conducted to identify the number of residents within an area.
**Department of Health and Hospitals**

Within the Department of Health and Hospitals, the Health Standards Section (HSS) licenses health care facilities to operate in the state of Louisiana and certifies these facilities for participation in Medicare and Medicaid. HSS enforces regulatory compliance for health care facilities in the State of Louisiana. Data on health care facilities licensed by HSS can be accessed from the DHH website (http://dhh.louisiana.gov/index.cfm/directory/home#top). The data includes information on the type of facility and its address from which geocoding has been performed to locate the facilities on a map. The types of facilities included are hospitals, clinics, hospices, and nursing homes. The data been broken into 4 groups of 1000 feature per group due to ArcGIS online limitation on file size. The location of the facilities is shown in Figure 22.

![Figure 22 Health Care Facilities in Louisiana](image-url)
**HSS-NEMT Facilities**

The Health Standards Section (HSS) of the Department of Health and Hospitals has published a list of 140 transit providers providing non-emergency medical transportation (NEMT) to facilities licensed by HSS. The data includes the name of the transit company, its address, a contact person and their address. The geocoded locations of these transit companies is shown in Figure 23.

![Figure 23 Non-Emergency Medical Transportation Providers](image)

**HSS-HCBS List**

Home and Community Based Service licensed by the Health Standards Section of DHH provides health services to Medicaid patients in their home or community. It serves adults who are elderly, or physically or mentally disabled. Data on the name, address, and contact person of 663 organizations providing these services in Louisiana is shown in Figure 24.
Non-Emergency Shelters

The location of non-emergency shelters such as shelters for the homeless, battered women, and persons suffering with substance abuse is shown in Figure 25. Non-emergency shelters can also function as emergency shelters for the same clientele they serve on a regular basis during an emergency.

Veteran Homes

Only 5 veterans homes are registered in Louisiana but they do serve a total of approximately 750 veterans. They tend to be self-sufficient in terms of vehicles to serve the veterans in their care. The location of the veterans home is shown in Figure 26.
Figure 25 Non-Emergency Shelters

Figure 26 Veterans Homes
Transportation Resource Guide

Transportation Resource Guide data is data on the transit services supported under section 5310 and section 5311 by the Louisiana Department of Transportation and Development (LA DOTD). The purchase and operating costs of vehicles used for human services and special transit is subsidized through LA DOTD. The locations of the organizations providing transit service in this program are shown in Figure 27.

Figure 27 Transit Resources Guide Data

Nine new columns were added to the attribute table of the Transport Data Guide (TRG) to identify the different type of vehicles and to show how many vehicles are available at each location. When adding a new attribute field or naming a new column header in GIS, especially when using spread sheets before converting to GIS formats, users must pay attention not to use any special characters nor leave any blank spaces in the column names, this explain using underscore in the naming convention below. Users must not start a column name with a number.
either, also must not use more than 32 characters in the naming convention because most of the Geodatabase software are not compatible with this excessive naming conventions.

The new column headers are (Veh_tot, Veh_lif, Veh_fix, Veh_bus, Veh_bus_L, Veh_bus_H, Veh_van, Veh_streetcar, and Veh_wheel). The meaning of each header is explained below. Care was taken to not leave any blank cell’s (null values) but rather enter zero instead because ArcGIS online reads a blank field as undefined and this might cause problems later in the analysis. Also when entering and typing data in the attribute users must make sure it’s accurate and spell checked, the data is case sensitive and leading and trailing spaces can affect the query results.

TRG Attribute description:

Veh_tot: Total vehicles number, including all following kinds of vehicles
(If these cells value are equal to zero, then it means the original data did not show the attribute of any vehicle)

Veh_lif: vehicles which are lift-equipped (attribute)

Veh_fix: vehicles with fixed route (attribute)

Vehicle type:
(If these cells value are equal to zero, then it means this kind of vehicle does not exist in this location)

Veh_bus: total bus number, including following light duty bus and heavy duty bus

Veh_bus_L: light duty bus

Veh_bus_H: heavy duty bus

Veh_van: vans, including paratransit and taxis

Veh_streetcar: fixed route street car

Veh_wheel: wheel chair accessible vehicles
The Transportation Analysis Zones and Block Group merged file were added to ArcGIS online after dividing it up to twenty files for each parish. We had to go this route due to the limitation of 1000 feature per file that we can upload to the ArcGIS online and there are more than 4500 features in the TAZBG feature class.

The following columns are in the attribute table which can be used in the analysis to determine the number of people who live in specific areas of interest. The headers of these columns explained below:
TAZBG Attribute description:

HHPop: household population number

HHSch: household school enrollment number, which means how many students live in that area

HHEmp: household employment number, which means how many worker live in that area

WorkatH: people who worked at home

StayatH: people who stay at home, which equals to HHPop-HHSch-HHEmp+WorkatH

Worker: worker number in this area, which means how many worker works in this area.

![Figure 29 Query on Population in an Area](image)

In ArcGIS online we can manage the queries as popup windows and customize the appearance of each window per feature to show only 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.

All the information and attributes that will be on the query popup window are coming
from the attribute table associated with our feature layer. For example the user can view the
attribute table of any layer with the feature associated with it. And if close attention is paid to
Figure 30 you can see the attribute table of the TRG layer and the location of each feature on the
map as well.

Figure 30 Viewing the Attribute Table of a Layer

The user can clip data by clicking on the extract data tool from the analysis tools to get
the number of vehicles surrounded by a polygon in specific area for example. The example in
Figure 31 if the user would like to query the number of existed vehicles in a specific area, they
can draw a polygon around that area, and extract the attributes of the features inside the polygon.
Figure 31 Attributes of an Area

The data will be extracted to Comma Separated Value (CSV) format and can be displayed in a spreadsheet program such as Excel and run further analysis on it. The user can apply the summation function for example on each column as it shown in Table 2 to get the number of vehicles in that polygon.

Table 2 Number of vehicles query results

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<th>AC</th>
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<td>Veh_fix</td>
<td>Veh_bus</td>
<td>Veh_bus_L</td>
<td>Veh_bus_H</td>
<td>Veh_van</td>
<td>Veh_streetcar</td>
<td>Veh_wheel</td>
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SUMMARY AND CONCLUSIONS

This thesis focused on the supply and demand of the local transit systems that provide emergency transportation in south Louisiana. This applies to various categories of riders that are in need such as the elderly, low-income, veterans, disables, and those needing access jobs. This study will not only allow the decision makers at LA DOTD or GOHSEP to visualize the locations of the transportation resources on the online map, but it will also allow them to query and summarize the total number of vehicles and the different types of vehicles which are available in a specific area. They can query the data by simply clicking on the map or by defining the area by a surrounding polygon. The technology used in this study is very simple, user friendly, fast, and be accessed remotely. It could be utilized during emergency planning to make a better decision to address localized transportation need where time is a very important factor to save lives.

By creating one online portal between different agencies and providers to coordinate, collaborate and provide life-saving support system during an emergency, could provide considerable benefit to the participants and those they serve. Keeping this system up to date by inventorying and assessing the capabilities of the various human services transportation providers operation 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 saving to the state and local authorities.

Using an Online GIS provides a convenient platform from which emergency managers with minimal training can identify local transit resources as well as local transit demand in times of an emergency. The local transit resources would be used primarily to relocate human services and evacuate the special needs patrons that they usually serve, but may, in a special crisis, be
called upon to support the evacuation needs of the general public because their proximity and ubiquity may allow quicker service than other systems.
REFERENCES


VITA

Alaa Shams received a Bachelor’s degree in Civil Engineering in 1998 from Damascus University - Syria, a Master’s degree in Computer Science in 2004 from Southern University - Baton Rouge, LA. He will receive his master’s degree in Civil Engineering in May 2014. He joined Navigation Electronics, Inc. in 2014 as a Survey, Construction & Geomatics: Technical Support Sales representative. Prior to that he was the GIS Training Coordinator since 2008 at Louisiana State University (LSU) and a Desktop Associate, authorized, and certified instructor from Environmental Systems Research Institute (ESRI) at Louisiana Geographic Information Center (LAGIC) Special Programs with the School of the Coast and Environment. Alaa also an adjunct instructor at Baton Rouge Community College (BRCC) since 2010 teaching GIS, Surveying, and Intro to Computers also teaches AutoCAD and Surveying at Southern University in Baton Rouge, LA. He served as a GIS Analyst at Southern University and A & M College (SUBR) for more than five years at the Center for Coastal Zone Assessment and Remote Sensing (CCZARS). He was part of SUBR Bering Glacier, Alaska Team in 2007 and 2008 as a GIS/GPS/Remote Sensing specialist. Before that he held several positions as a Research Associate at the National Wetlands Research Center (NWRC) with the United States and Geological Survey (USGS) in Lafayette, LA and a GIS Analyst in New Orleans City Hall after Hurricane Katrina. He participated in several regional and national conferences, and has published and presented papers in international conferences as well.