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Project title: Developing a Business Case for the North Carolina Master Address Database Maintenance in North Carolina

Final Report

Organization: North Carolina Center for Geographic Information and Analysis, North Carolina Department of Information Technology, 20322 Mail Service Center, Raleigh, NC 27699-0322

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Executive Summary

The North Carolina Master Address Database (NC MADB) will provide multiple functions in the enterprise of North Carolina state government. It will provide a framework for supporting the maintenance of authoritative point addresses at the local government level, and aggregation of address data to ensure this value is leveraged across the North Carolina geospatial user community. The NC MADB serve as North Carolina's contribution to the development of a national address database initiative. The NC MADB will serve as a foundation for a number of address-oriented services including geocoding and reverse geocoding, address verification and validation, postage reduction services and non-deliverable mail avoidance.

Initial start-up costs for aggregation and quality control tool development is projected to be \$514,573 and on-going operation of the aggregation and services is estimated at \$162,395. The operational costs for a decade of operations is \$2,653,096. The primary benefit calculated for NC MADB is improved performance in decennial census enumeration in the form of avoiding undercounting on a statewide basis. Conservative estimates project enumeration of 3,000 North Carolina citizens will have an economic return of \$45,000,000 over the course of the 2020 decade

Project Narrative

Development and maintenance of address point geospatial data is among the most challenging datasets for statewide coverage. The assignment of authoritative addresses is a local government responsibility and local governments host this responsibility across a diverse set of local government units. Addresses may be created in the planning office in one jurisdiction, while another may assign addresses in the emergency management office, and a third in a dedicated address coordination unit. This variety ultimately results in a multitude of approaches of database schemas, point placement of the geometric representation, methods for storing the parsed addresses, and competing priorities within an office if address assignment is among many responsibilities. As time passes, it is common to have variation within a local government address dataset reflecting changes in staff, software used to maintain the address information and even consistency in address representations (for example, interchangeably using the fully spelled word "Road" versus the abbreviation "Rd") that introduce quality control issues when attempting to aggregate locally sourced data into a statewide dataset.

These challenges for local governments are relevant and directly impact the quality of individual address point records and collectively the quality and reliability of an aggregated (statewide) address point dataset. The development of a statewide address dataset must include outreach and support in the maintenance of local government address datasets. This will simultaneously improve local government applications reliant on these datasets, and benefit the aggregated dataset.

The development of the North Carolina Master Address Dataset (NC MADB) will have several benefits including:

- Developing a single effort to aggregate authoritative local government address point datasets to meet analytical and application requirements for multiple state agencies;
- Providing an interface point to national initiatives for address aggregation;
- Support improved enumeration in decennial census results; and
- Using the NC MADB to drive returns based on services such as geocoding, reverse geocoding, address verification and validation, postage reduction services, and non-deliverable mail avoidance.

The effort of develop an authoritative statewide resource for point addresses will focus efforts for improving quality in the source data and aggregated database. Once developed, it will also provide a supplement or alternative to database cleansing services. Numerous state agencies and local government subscribe to third-party databases for address scrubbing and improvement; at the least, there is no economy of scale benefit through individual transactions or procurements. More to the point, as each independent agency molds their business databases to whichever subscription service they choose, this hinders the opportunity for integrated analysis across business databases.

North Carolina has participated in federal initiatives beginning in 2011 to vision and develop a national address database resource. The opportunity to aggregate local government and tribal resources into a statewide dataset that can be standardized and shared to a national resource. This will provide material benefits to the local governments in the form streamlined services, and benefit the state and federal users with high quality, regularly maintained source data.

The decennial census is a foundation for a number of process that extend across all levels of public administration. Census results directly impact the composition of local voting districts and delineation of state and federal representation. Census geography drives numerous planning functions and plays an important role in funding allocation formulas. To achieve the best enumeration results, the Census Bureau works with each local jurisdiction to confirm address locations preceding each decennial census. The NC MADB will provide data to the Census's Geographic Support System (GSS). The GSS ingest guidelines provide a basis for providing locally sourced address data that will make the local updated of census addresses (LUCA) less burdensome for North Carolina local governments.

The state's obligation to support outreach to local governments, develop the workflows for quality control and aggregation mandate a thoughtful approach to demonstrating a return on

this required investment. In plain language, the initiative cannot end merely with the assembly of the statewide dataset. The complication of the NC MADB will provide services driven by the address point geospatial database. Some of these services such as geocoding (returning a coordinate location when provided a structured address string) and reverse geocoding (returning a structured address string when provided a coordinate) are oriented towards geospatial analysis and applications. NC MADB will extend these services into non-spatial contexts to improve business databases and opportunities for traditional business analytics. As an example, NC MADB will provide an address verification and validation function to support batch and transactional requests. A data entry application or web-based application will be able to confirm whether an address string is present in the NC MADB database, and return additional information such as coordinate location, whether the address is a situs address or mailing address, whether the address string is suitable for mailing materials, and other information. These services will drive the standardization of business databases in terms of included fields and field definitions. The improved standardization will enhance traditional data analytics tools and methods (improved match rates across databases linked by address information) and simultaneously prepared business databases to be analyzed in a geospatial context.

CGIA developed a survey as outreach to state agencies for evaluating engagement points and verify benefits expected from NC MADB. This survey was distributed to twenty-six state agencies. Eleven of the agencies responded, and follow-up conversations were held with a number of the responding agencies. A summary of the results is provided in Attachment A. Key highlights from the survey results include:

- There is not strong agreement or implementation of recognized standards in existing efforts: Only two agencies responded that they adopted the USPS standard. 40% percent mentioned that they did not enforce a particular one, 20% mentioned that they did not know and another;
- Responding agencies would be receptive to a centralized database management system: 70% of the participants recorded that they strongly agree or agree with the statement that their organizations would benefit from a centralized address database management system. 20% neither agreed or disagreed and 10% disagreed; and
- Coordination across stakeholders is important: 88.9% (8) of the respondents mentioned that communication is very important (66.7% strongly agreed and 22.2% agreed). Only one respondent neither agreed nor disagreed.

After analyzing the survey results, follow-up meetings were accepted by three of the respondents. The intent of the follow-up meetings was to engage respondents that were actively seeking engagement and to gain insight on how geospatial address information is currently used in their organization. The end results of these follow-ups supported the conclusion of a disconnect between modeling anticipated benefits from derived NC MADB services (geocoding, reverse geocoding, address verification and validation and others). In simple terms, potential consumers of NC MADB services want the benefits of aggregation, quality control, and expanded addressing services, but it needs to be free or next to free relative to on-line services from Google or Census.

The CGIA team reassessed this information and began the process developing a cost estimate for aggregation and quality control to develop the NC MADB and provide hosted services. The detailed estimate is provided in Attachment B. The cost estimate details steps required to build quality control, aggregation tools during the first year of operation and hosting of NC MADB services (\$514,573) and an operational costs for outreach and aggregation operations (\$162,395). For long term calculation purposes, the operational costs were held consistent for a ten year cycle, and the initial one-time costs were replicated in year six to anticipate hardware updates, migration to improved tools, etc. The operational costs were not modified for inflation to balance expectations of improved efficiency in operations. The ten year costs are demonstrated in Table 1 below totaling \$2,653,096:

Costs	Year 1	Year 2	Year 3	Year 4	Year 5
Non-Recurring	\$514,573				
Recurring	\$162,395	\$162,395	\$162,395	\$162,395	\$162,395
Total	\$676,698	\$162,395	\$162,395	\$162,395	\$162,395

Costs	Year 6	Year 7	Year 8	Year 9	Year 10
Non-Recurring	\$514,573				
Recurring	\$162,395	\$162,395	\$162,395	\$162,395	\$162,395
Total	\$676,698	\$162,395	\$162,395	\$162,395	\$162,395

Table 1: North Carolina Master Address ten-year cost figures.

CGIA developed a benefit model based on improved census enumeration. After the 2010 decennial census it is estimated each person enumerated is equivalent to \$1,500 per year in federal disbursements. Through interpretation, each person not enumerated results in \$15,000 of foregone allocation over the course of a decade. The Census LUCA program is a nationwide effort and represents a significant effort to find and account for each household address. The lag between LUCA operations and the census date is eighteen to twenty-four months. New construction created during this period represents the addresses most likely to be missed through enumeration operations. The CGIA benefit model assumes a conservative estimate of fifteen residential subdivisions that could be overlooked statewide. Each residential subdivision is composed of fifty households with an average of four members per household. The model estimates a total of 3,000 non-enumerated North Carolinians. Based on the 2015 updated population estimates of 10,040,000, this represents 0.0003 of the overall state population. The translation of these 3,000 citizens using the 2010 federal disbursement figure of \$1,500 works out to at least \$45,000,000 in unrealized apportioned federal funds from 2021-2031. In reality, the \$1,500/person/year figure will likely increase, and the parameters for missed neighborhoods represents extremely conservative estimates when compared to the state’s rate of population gain.

In preparation for the development of the 2016-2017 Governor's recommended budget, leadership of the NC Department of Information Technology (NC DIT) and NC Office of State Budget and Management (NC OSBM) were instructed to develop a budget request. The budget request provides a common content and format for documenting proposed modifications from the executive branch for the upcoming budget year. This request was evaluated and included in the Governor's recommended budget released ahead of the 2016 session of the North Carolina General Assembly.

Next Steps

The next steps in the project will be determined by the outcomes of the 2016 session and budget for the 2016-2017 budget year beginning July 1, 2016. The proposed NC Master Address initiative may receive full funding, partial funding, or no funding. CGIA has identified two areas for continued progress while the budget process continues:

- Preliminary implementation planning: CGIA is working on staff allocation, external requirements and incremental steps and milestones to complete the first year work.
- Outreach for calculating returns on NC MADB-driven services: CGIA will work with agencies and architecture / planning units in NC DIT to gain insight and data on the resources dedicated by state agencies for third-party addressing services. The opportunity to transition to authoritative state-hosted services plays into both the benefits calculations, as well as potential supplemental resources for agency- or application-specific services from the NC MADB database.

Feedback on Cooperative Agreements Program

What are the CAP Program strengths and weaknesses?

Where did it make a difference?

CGIA is divided into two programs; the Coordination Program supports work of the North Carolina Geographic Information Coordinating Council (GICC) and the NC OneMap geospatial portal, while the Services Program provides services on a cost-recovery basis. The CAP program resources was used to support the work Service staff in the development of these materials and lay the foundation for planning and eventual implementation of the NC Master Address Database.

Was the assistance you received sufficient or effective?

The survey, estimates, and ability to engage agencies is critical to the development of the NC Master Address program. CGIA has received resources in 2009 and 2012 to implement one-time aggregations of address point information. The resources from this project are a critical step in making the case to support NC MADB from a programmatic level.

What would you recommend that the FGDC do differently?

Are there factors that are missing or are there additional needs that should be considered?

The circumstance and timing of have led to a significant delay in delivering the final report. The efficacy of the work will have long term benefits, even if the NC MADB is not funded in the current state budget cycle.

Are there program management concerns that need to be addressed, such as the time frame?

If you were to do the project again, what would you do differently?

With respect to the timeframe of execution, it would be advisable to include strategic participation from architecture, planning, and budget management organizations in the role of project sponsors. The collection of thoughts and methods used in carrying out this work has significant potential beyond the geospatial community; inclusion of these groups would parlay these efforts and perhaps open doors to wider participation across the state government enterprise.

Appendix A: Agency Survey Summary

Introduction

The survey was addressed to managers and coordinators of State agency units that use, collect or manage address data and in particular spatial address data (address text with its corresponding geocode). The survey consisted in 35 questions in a combination of multiple choice format and a few open-ended questions. The questionnaire was designed to collect a general sentiment on the need across North Carolina State agencies about the efforts to maintain the many different address data silos and the need for designing and developing a Statewide Address Database Management System that could reduce redundancies on use of limited resources such as personnel, software and software licenses, hardware and ensure the sustainable management of a product that is consistent with different business needs and that finds value in core components such as text and geometry precision and compliance of nationwide standards.

The main expectation of collecting data through this survey is to provide an account of perceived costs and benefits incurred when collecting, managing or using address data. These data will be used to build a business case for a statewide address database management system.

Sample Size and Response Rate

The online survey was answered by 15 participants out of an initial list of 26 state agency contacts. Three of the participants asked to be removed from the survey since they decided early that the objective of the survey did not match their duties or tasks, so these surveys were taken out of the pool and the survey results. One respondent did not answer most questions so that response was removed as well. At the end of the data cleansing, the number of survey respondents was reduced to 11. With the previous considerations, the response rate was of 42.31%, which seems acceptable in term of online surveys although small in terms of number or responses.

The number of respondents does not provide enough statistical power for performing complex analyses, however, but given that the respondents hold a level of knowledge and use of address data use in their respective State Agencies or units, the data collected are still relevant to provide a general idea of different aspects of address management across the State Government.

Results

Section I: Introduction

Question 1: Names of participants

Which will not be shown in this analysis

Question 2: Name of Institutions

Each of the 11 responses collected was completed by a representative of each of the following State organizations:

North Carolina Department of Transportation

North Carolina Office of the State Auditor
North Carolina Department of Commerce
North Carolina Department of the Environment and Natural Resources
North Carolina Secretary of State
North Carolina Department of Administration / State Property Office
North Carolina State Parks
North Carolina Wildlife Resources Commission
North Carolina Department of Revenue Local Government Division
North Carolina Department of Insurance Office of State Fire Marshal
North Carolina Department of Public Safety

Question 3: Type of organization

All the respondents were from State Agencies

Question 4: Position of respondent

Three of them were GIS managers, three were GIS coordinators and the rest (7) had different roles within their units such as:

Spatial Data Manager
MIS, IT Help Desk, Purchasing
Land Records Manager
GIS Technician
GIS Specialist
Director (2)

Section II: Stewardship Role in Maintaining Address Database Systems

Question 5: Do you provide address production and/or maintenance services for your whole agency/local government?

Only 30% of the respondents selected "Yes" as their answer, whereas 70% selected "No".

Question 6. Which applications areas does your address database management system support?

This was a multiple choice question based on the applications determined during the 2012 survey to local governments. The most common selections were Land records and permitting (40%), together with 911 communications and EMS, together with Insurance, flood analysis, tax assessment and appraisal. City and county limits (30%).

Other important applications were planning, inspections, code enforcement; insurance and real estate, mortgage and home owners associations; Census Bureau applications (20%). Other applications also

mentioned were utilities, school districts, community organizations, mailing systems, and logistics and directions.

Other applications indicated by the respondents were: storm damage assessment teams. Risk assessment, flood, hurricane, landslide, fire damage and fire injury prevention activities. Licensing for home inspections and pyrotechnic display operators, pyrotechnic display permits for state property.

Question 7. How many users of address-based services does your organization support per year?

Only one agency (10%) reported supporting more than 1 million users per year. Similarly, 40% of the participants mentioned that they support less than 5 thousand users per year and the rest of participants declared that they did not know how many users they supported, although this percentage included agencies that did not have address management systems.

Question 8. Which address standard has your addressing database system adopted? Please select all the choices that apply.

Only two agencies responded that they adopted the USPS standard. 40% percent mentioned that they did not enforce a particular one, 20% mentioned that they did not know and another.

One agency mentioned that they only worked with the address data that they were provided without using any particular standard.

Question 9. In your municipality, county or agency would you say that your address database management system is:

For this question, of those who responded, 20% mentioned their address systems were silo-based and a similar percentage mentioned they were centralized (who?). 10% did not know if they had silo-based or centralized databases.

Question 10. Please indicate how much you agree with the following statement: "Address databases are stored across the state government in silos".

When it came to indicate if addressing systems across the State were stored in silos, 50% of the respondents strongly agreed and 10% agreed. Only 20% disagreed and another 20% neither agreed nor disagreed.

Question 11. Please indicate how much you agree with the following statement: "My organization would benefit from a centralized address database management system".

70% of the participants recorded that they strongly agree or agree with the statement that a their organizations would benefit from a centralized address database management system. 20% neither agreed or disagreed and 10% disagreed (who?)

Question 12. Has your organization changed from a silo to a centralized address database management system in the past years?

Only one organization mentioned they had changed from a siloed database to a centralized one.

Question 13: If you answered "yes" to the previous question, how long ago?

This question was removed from the analysis as the logic used forced respondents to answer it even though it did not apply to them.

Question 14. Which business needs are being solved through the use of an address database

management system in your organization? Please select all choices that apply.

From the list of business needs shown as alternatives to the respondents, the main choices were assisting others in need and increase efficiencies (50%), followed by decreasing costs and efforts (40%), delivering a set of products (30%), and providing certain core services and ensuring the enterprise's own operational effectiveness.

Question 15. What aspect(s) of address database management provide the most value to the services offered by your local government or agency?

Improve database accuracy, an additional resource to match against agency's in-house dataset. CRM. Consistent addresses across applications.

Section III: Maintenance Workflow

Question 16. How much would you agree with the following statement: "Developing a centralized and robust address database management system is important".

77.8% of respondents strongly agree (55.6%) or agree (22.2%) with the importance of developing a centralized and robust address database management system. 22.2% (2 participants) neither agreed nor disagreed but none disagreed or strongly disagreed.

Question 17. How much would you agree with the following statement: "Centralization of a statewide address management database system should be done under the leadership of one organizational entity".

77.7% strongly agreed (44.4%) or agreed (33.3%) that one entity should lead the centralization of the address database management system, with only one respondent disagreeing (11.1%, who?)

Question 18. If your organization relied on a centralized address database management system managed entirely by a third party which of the following statements would you relate to more (choose all that apply):

Could spend more time doing other tasks that are more important for the strategic plan of their organization (55.6% of the answers), they also chose that the benefits to their institution are linked to whether their business technical requirements are integrated (55.6% of the respondents showed that).

One respondent selected that a centralized database could not satisfy the requirements of their business needs.

Question 19. Standards or ordinances to ensure that addressing is consistent across all localities and departments should be applied at the _____ level.

88.9% of the respondents mentioned that standards or ordinances should be applied at all levels of data production.

Question 20. How much would you agree with the following statement: "Field capture and/or verification of address points using highly accurate GPS systems is needed".

Of the respondents, 44.4% strongly agreed or agreed with the statement. 22.2% of them neither agreed nor disagreed and 33.3% (3) disagreed.

Question 21. How much would you agree with the following statement: "The adoption of various

address databases and schema standards and recommendations, including the use of NENA standard and domain values, is necessary".

Most of the respondents (5, 55.6%) selected that they neither agreed or disagreed while 4 respondents (44.4%) strongly agreed. My interpretation in this case is that some of the respondents may not be familiar with addressing standards, including NENA.

Question 22. How much would you agree with the following statement: "Communication and coordination across all addressing stakeholders is important".

88.9% (8) of the respondents mentioned that communication is very important (66.7% strongly agreed and 22.2% agreed). Only one respondent neither agreed nor disagreed.

Question 23. How much would you agree with the following statement: "We need integration of address data with other critical local government datasets (buildings, parcels, roads, Ortho-imagery, e911, CAD)".

88.8% in favor of integration of address data with other dataset products, although the question did not mention any kind of mechanism and the depth of the respondents' idea of data integration should be explored further. Only one respondent neither agreed nor disagreed (11.1%).

Question 24. How much would you agree with the following statement: "Integration of a formalized data review and error reporting processes in a statewide address database management system is important".

In general 6 respondents (66.7%) strongly agreed (55.6%) or agreed (11.1%). Three respondents (33.3%) neither agreed nor disagreed.

Question 25. How much would you agree with the following statement: "Use of a standard approach for dealing with multi-unit address locations (apartments, etc.) is important".

88.9% of the respondents strongly agreed (77.8%) or agreed (11.1%) with this statement. Only one respondent neither agreed nor disagreed.

Section IV: Cost for Maintenance Operations

Question 26. In terms of staff, how many staff in Full-Time-Equivalents are dedicated throughout the year to maintain address database management system or address datasets?

For this question 100% of the respondents selected less than 1 FTE, which means that no agency has a position where the sole function is to collect or manage an address file or database.

Question 27. Which source(s) of funding does your address database management system(s) depend on? Please select all that apply:

44.4% selected State Government appropriations and 22.2% selected revenue. One respondent selected Federal Funding (11.1%). Grants and local government appropriations showed similar responses.

Question 28. In the past has your organization tried to contract out an address database management system solution for your business?

Only one (11.1%) of the respondents had tried in the past to contract out address database management system solution. 22.2% were not sure if their agencies had done so and 66.7% selected no as an answer.

Question 29. What was the reason for using the services of a third party?

In the case of the agency that contracted out address services it was mentioned that the price was affordable.

Question 30. What was the reason for not using the services of a third party? Please select all that apply:

In this case the two selected causes were:

- The agency unit could do this at a lower cost or
- The service offered did not meet the business requirement

Question 31. If address maintenance is contracted out, would you please indicate what the average cost per year is:

No one stated a cost

Section V: Benefits of an Address Maintenance Service

Question 32. Please enumerate the benefits to your organization of maintaining or having access to a well designed and maintained address database system (select all that apply):

Participants enumerated many benefits but could not assign a cost to any of them. We need to be able to estimate dollar figures for benefits, even if it is for only some of them.

Question 33. Please indicate an approximate range of the overall amount of current savings, increased revenue or productivity or any other benefits of your current address maintenance system:

See above

Question 34. Do the benefits generated from the address-based services you provide compensate for the cost of maintaining an address database management system for your organization?

One person stated that the benefits indeed exceeded the costs, however, nowhere in the survey can be found a dollar figure for either.

Attachment B: NC Master Address Database cost estimation

	Summary				
DIT Hourly rate	\$	84.00			
PC costs	\$	3,000.00			
Server Costs	\$	5,000.00			
SW license costs	\$	1,500.00			
Server Maintenance per unit per year	\$	2,500.00			
			Optimistic	Most Likely	Pessimistic
Total Recurring	\$	106,704.00	\$	160,056.00	227,440.00
Total Non-Recurring	\$	200,504.00	\$	304,648.00	410,640.00
Sub-Total	\$	307,208.00	\$	464,704.00	638,080.00
Project Management Overhead (15%)	\$	46,081.20	\$	69,705.60	95,712.00
PMO Overhead (\$82 per hour - 1 week per month x length of project)	\$	61,096.31	\$	92,521.23	125,270.77
Procurement Overhead (10%)	\$	30,720.80	\$	46,470.40	63,808.00
Grand Total	\$	445,106.31	\$	673,401.23	922,870.77
Staff Hours Total				3228.67	4889.33
Weeks				80.7	122.2
Lentgh of project in years				1.6	2.4

Goal: Point Address Database Management System under the AddressNC Program.
Main Product: a functional Point Address Database Management System

- Functional Services:**
- Bulk geocoding and reverse geocoding
 - Address validation
 - Mailing services
 - Census data submission

- This scenario includes rough estimates for
- Initial planning
 - Statewide Outreach (120 Local Govs.)
 - Design
 - Development
 - Testing
 - Production and 1 cycle operation
 - Functional services

The hardware and software are assumed to be provided by vendors

Type	Phase	Task	Description	Staff Hours Optimistic	Staff Hours Most Likely	Staff Hours Pessimistic	PERT Estimate Staff Hours	Amount Optimistic	Amount Most Likely	Amount Pessimistic	PERT Estimate
Non-recurring	Initiating/Planning	Coordination with Stakeholders	This task includes meetings with key project sponsors as well as key stakeholders to develop the scope of the project and participation in the next project phases	18	24	48	27	\$ 1,512.00	\$ 2,016.00	\$ 4,032.00	\$ 2,268.00

Non-Recurring	Planning	Workflow Design		80	100	120	100	\$ 6,720.00	\$ 8,400.00	\$ 10,080.00	\$ 8,400.00
Non-Recurring	Planning	Quality Control and Quality Assurance Design		80	100	120	100	\$ 6,720.00	\$ 8,400.00	\$ 10,080.00	\$ 8,400.00
Non-Recurring	Planning	Data Upload & Frontend Design	This section includes tasks for the design of an address ETL tools for the use of data providers and its QA/QC workflow								
Non-Recurring	Planning	Workflow Design		80	100	120	100	\$ 6,720.00	\$ 8,400.00	\$ 10,080.00	\$ 8,400.00
Non-Recurring	Planning	Quality Control and Quality Assurance Design		80	100	120	100	\$ 6,720.00	\$ 8,400.00	\$ 10,080.00	\$ 8,400.00
Non-Recurring	Execute/Monitoring	Development of Backend	Development phase of database backend according to design specifications.	160	320	480	320	\$ 13,440.00	\$ 26,880.00	\$ 40,320.00	\$ 26,880.00
Non-Recurring	Execute/Monitoring	Development of Data Matching System	Development phase of record and address matching system according to design specifications.	160	200	240	200	\$ 13,440.00	\$ 16,800.00	\$ 20,160.00	\$ 16,800.00
Non-Recurring	Execute/Monitoring	Development of Upload Frontend	Development phase of frontend interface for data upload/download according to design specifications.	160	200	240	200	\$ 13,440.00	\$ 16,800.00	\$ 20,160.00	\$ 16,800.00
Non-Recurring	Execute/Monitoring	Testing of Backend	Test of backend software functionality according to QA/QC design.	53.3	106.7	160.0	107	\$ 4,480.00	\$ 8,960.00	\$ 13,440.00	\$ 8,960.00
Non-Recurring	Execute/Monitoring	Testing Data Matching System	Test of record and address matching software functionality according to QA/QC design.	53.3	66.7	80.0	67	\$ 4,480.00	\$ 5,600.00	\$ 6,720.00	\$ 5,600.00
Non-Recurring	Execute/Monitoring	Testing of Upload Frontend	Test of ETL/Ux software functionality according to QA/QC design.	48	60	72	60	\$ 4,032.00	\$ 5,040.00	\$ 6,048.00	\$ 5,040.00
Non-Recurring	Execute/Monitoring	Production of Backend	Implementation of Backend Database and Final QA/QC.	53.3	106.7	160.0	107	\$ 4,480.00	\$ 8,960.00	\$ 13,440.00	\$ 8,960.00
Non-Recurring	Execute/Monitoring	Production Data Matching System	Implementation of Record Matching System and final QA/QC.	53.3	66.7	80.0	67	\$ 4,480.00	\$ 5,600.00	\$ 6,720.00	\$ 5,600.00
Non-Recurring	Execute/Monitoring	Production of Upload Frontend	Implementation of ETL/Ux frontend system and final QA/QC	53.3	66.7	80.0	67	\$ 4,480.00	\$ 5,600.00	\$ 6,720.00	\$ 5,600.00

Non-Recurring	Execute/Monitoring	Initial HW/SW procurement	This section includes time allocated to HW and Software procurement assuming it is needed from vendors.										
Non-Recurring	Execute/Monitoring	HW		4	6	8	6	\$ 12,000.00	\$ 18,000.00	\$ 24,000.00	\$	18,000.00	
Non-Recurring	Execute/Monitoring	SW		4	6	8	6	\$ 6,000.00	\$ 9,000.00	\$ 12,000.00	\$	9,000.00	
Recurring	Execute/Monitoring	DB Server HW cost		2	3	4	3	\$ 10,000.00	\$ 15,000.00	\$ 20,000.00	\$	15,000.00	
Recurring	Execute/Monitoring	DB Server SW licenses		2	3	4	3	\$ 3,000.00	\$ 4,500.00	\$ 6,000.00	\$	4,500.00	
Recurring	Execute/Monitoring	DB Server HW maintenance	Annual cost of maintenance	2	3	8	4	\$ 5,000.00	\$ 7,500.00	\$ 20,000.00	\$	9,166.67	
Recurring	Execute/Monitoring	DB Operational Improvement	Costs needed to improve database system on a year to year basis.	96	144	240	152	\$ 8,064.00	\$ 12,096.00	\$ 20,160.00	\$	12,768.00	
Recurring	Execute/Monitoring	DB Ongoing data updates	Costs needed to update data on a year to year basis: 120 loc govs x 8 hrs	960	1440	1920	1440	\$ 80,640.00	\$ 120,960.00	\$ 161,280.00	\$	120,960.00	

Services built on top of AddressNC DBMS

Long-term use cases												
Non-Recurring	All phases	Census	Considering that AddressNC is already built, the service of extracting a dataset for Census would take be estimated from a standard week task	40	48	60	49	\$ 3,360.00	\$ 4,032.00	\$ 5,040.00	\$	4,088.00
External use cases												
Non-Recurring	All phases	Bulk geocoding & reverse geocoding	Involves design, development and testing of frontend interface for bulk geocoding and reverse geocoding	160	240	320	240	\$ 13,440.00	\$ 20,160.00	\$ 26,880.00	\$	20,160.00
Non-Recurring	All phases	Address verification	Involves design, development and testing of frontend interface for address verification	160	240	320	240	\$ 13,440.00	\$ 20,160.00	\$ 26,880.00	\$	20,160.00
Non-Recurring	All phases	Mailing services verification	Involves design, development and testing of frontend interface for mailing services	160	240	320	240	\$ 13,440.00	\$ 20,160.00	\$ 26,880.00	\$	20,160.00

