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2010 CENSUS PLANNING MEMORANDA SERIES

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MEMORANDUM FOR The Distribution List

From: Arnold Jackson *[signed]*
Acting Chief, Decennial Management Division

Subject: 2010 Census Address Canvassing Operational Assessment Report

Attached is the 2010 Census Address Canvassing Operational Assessment Report. The Quality Process for the 2010 Census Test Evaluations, Experiments, and Assessments was applied to the methodology development and review process. The report is sound and appropriate for completeness and accuracy.

If you have questions about this report, please contact Glenn Schneider at (301) 763-9373.

Attachment

2010 Census Address Canvassing Operational Assessment

U.S. Census Bureau standards and quality process procedures were applied throughout the creation of this report.

Address List Operations Implementation Team

This document contains no Title 13 data or Personally Identifiable Information (PII).

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Executive Summary

The *2010 Census Address Canvassing Operational Assessment* documents planning assumptions, activities, results, statistics, and analysis. Qualitative information presented, such as lessons learned, was collected from the Address List Development Operations Implementation Team and subject matter experts. These teams and experts were involved in the development and implementation of the operation. Quantitative information comes from various decennial systems used for the operation.

The Address Canvassing operation was the earliest field operation of the 2010 Census. It was scheduled to be conducted from April 6 to July 17, 2009. The operation actually started in eight Early Opening Local Census Offices one week early on March 30, 2009 and finished one week ahead of schedule on July 10, 2009. It was the first time the Census Bureau deployed an automated field data collection operation of this size during a decennial census. The operation was managed out of 151 field offices – known as Early Opening Local Census Offices – located across the fifty states, the District of Columbia, and Puerto Rico.

The purpose of the Address Canvassing operation was to:

- Ensure that the Census Bureau's address list and maps were as exact as possible, which was vital to construct a sampling frame to use for an accurate enumeration of the population.

- Verify the existing Census Living Quarter's inventory and then the potential changes to it from the Local Update of Census Addresses program, allowing the Census Bureau to provide feedback to the local governments that participated in the program.

Operation Overview

To improve the Census Bureau's address list, production Listers canvassed assigned blocks and looked for every potential living quarter. Listers compared the addresses, map features, and types of Living quarters they observed on the ground to what was on the Census Bureau's address list and updated the list where appropriate using hand-held computers designed specifically for the operation. Listers also electronically collected structure coordinates locating the Living quarters on census maps. Quality Control Listers verified a sample of addresses from each Assignment Area and all deletes and duplicates identified by the production Lister. If a Quality Control Lister deleted a record not deleted by the production Lister or marked as a duplicate, a second Quality Control Lister verified the delete or the duplication during the Final Delete Verification phase of the operation.

The Large Block Address Canvassing operation was a successful mitigation strategy to canvass addresses in blocks containing too many addresses for the hand-held computer to process in an acceptable time. It was scheduled to be conducted from February 2 to June 17, 2009. The Large Block Address Canvassing operation was completed on schedule by working with existing software and processes originally designed for Census Bureau survey operations similar to Address Canvassing.

Notable statistics from the Address Canvassing operation included:

- 8,213 Crew Leaders managed 111,105 Listers during production
- 3,083 Crew Leaders managed 37,784 Listers during Quality Control
- 137,384,734 miles were driven by field staff
- 163,591,352 addresses in production and 44,323,317 addresses in Quality Control required field actions

Budget and Cost

The final cost of the Address Canvassing operation was $443,591,299, which was 19.4 percent more than the $371,383,683 budgeted for the operation. A large portion of this discrepancy can be attributed to an underestimated initial workload for both production and quality control. The quality control workload was underestimated by 247 percent as assumptions for recanvass work were not included in the initial budget estimate.

The final cost of the Large Block Address Canvassing operation was $10,275,874, which was 29.2 percent less than the $14,521,585 budgeted for the operation.

Successes

Production rates (number of addresses expected to be completed per hour) by field staff generally exceeded expectations. Management staff from the Regional Census Centers reported the performance of the hand-held computers exceeded their expectations. Losses of hand-held computers and Secure Digital cards were minimal and the majority of the Help Desk trouble tickets (79 percent) were resolved in the Early Opening Local Census Offices. The electronic payroll system allowed for the preparation, submission, review, and approval of all payroll data.

The following table provides summary data for the assessment questions in this report.

Summary Data for the Address Canvassing Assessment Questions

Assessment Questions	Summary Data
1. What was the initial Address Canvassing universe (Assignment Areas, blocks, and addresses)?	• 144,890,808 addresses in 5,961,492 collection blocks, grouped to form 712,938 Assignment Areas, including large blocks. These included: o 143,356,106 initial addresses stateside o 1,534,702 initial addresses in Puerto Rico • 141,822,612 addresses in 5,959,406 collection blocks were loaded onto hand-held computers as the initial workload, excluding pre-identified large blocks. • There were eventually 733,636 Assignment Areas, after the Assignment Areas were split-up in the field.
2. How many blocks were identified as large blocks to be worked in the Demographic Area Address Listing environment during the Large Block Address Canvassing operation (pre-identified versus field-identified blocks)?	• There were 2,526 total collection blocks worked in the Large Block Address Canvassing operation which translated to 12,988 total Census 2000 tabulation blocks. • 2,086 (82.6 percent) collection blocks were pre-identified and 440 (17.4 percent) were field-identified blocks. This translated to 12,597 pre-identified tabulation blocks and 391 field-identified tabulation blocks.
3. What were the final field outcomes for address records?	• 163,591,352 address records had field actions, including 159,494,710 addresses updated using the hand-held computer and 4,096,642 addresses updated during the Large Block Address Canvassing operation. (Record number is larger since it includes all addresses worked including adds.) • Final field outcome actions: o 117,038,023 address records changes, verified, and uninhabitable housing units o 829,522 address records changes, verified, and uninhabitable Other Living Quarters o 27,553,197 negative actions o 17,545,919 added housing unit or Other Living Quarters o 624,691 blank address records

Assessment Questions	Summary Data
4. What were the results of the Master Address File/Topologically Integrated Geographic Encoding and Referencing Database (MTdb) update process for address records?	• 155,167,805 address records had final address actions: o 97,635,517 verified addresses o 10,776,894 adds of which 6,624,155 were new adds, and 4,152,739 matched to an existing MTdb record o 19,608,785 address change actions o 5,450,563 move actions o 15,820,664 marked 'does not exist' (Double Delete) o 743 address records with a single Delete o 4,085,556 marked as Duplicates o 1,238,260 marked as Nonresidential o 551,566 marked as Uninhabitable • Geography Division processing rejected 2,205,702 records, of which 1,431,306 were rejected by operational design (Large Block Address Canvassing and Address Canvassing overlap) and 669,607 records which were duplicate deliveries from the FDCA contractor.
5a. What are the characteristics of Add records?	• 48 percent of the collection blocks added between two and nine address records. • 39 percent of the added addresses matched to an existing address on the MTdb but were not eligible to be included in the Address Canvassing universe. • Of the added records that matched existing records, 65 percent were not valid for Address Canvassing because they were ungeocoded, up from 61 percent in 2008.
5b. How many Adds matched records that were in the MTdb prior to Address Canvassing (geocoded versus ungeocoded)?	• Of the 10,776,894 Add actions, 4,152,739 matched an existing record in the MTdb. • 65 percent were not valid for Address Canvassing because they were ungeocoded.

Assessment Questions	Summary Data
6. What are the characteristics of Delete and Duplicate records?	• Negative actions, including Double Deletes, single Deletes, identification of Duplicates, and changes to Nonresidential status were 14 percent of all actions. • Less than 1 percent of actions identified units as uninhabitable. • Approximately 28 percent (825,012) of collection blocks with a Delete action had only one deleted unit. • Approximately 1 percent of all collection blocks with a Delete action had more than 500 deletes in the block.
7. What are the characteristics of Change records?	• 8,582,218 or about approximately 44 percent of addresses with a final change action had only a change to the location address. These changes included updates for the description (20 percent), street name (10 percent), unit designation (6 percent), and house number (1 percent) and a combination of changes (6 percent). • 5 percent of all addresses with a final change action had only a ZIP Code change. • 21 percent of change actions had a change to both the location address and the city-style mailing address.
8a. What were the field outcomes for map-spot coordinate collection?	• Listers attempted to collect map-spot coordinates for 105,298,999 out of 105,923,905 prompts by the hand-held computer (over 99 percent). • Map spotting on military installations was stopped mid-operation.
8b. How many map spot coordinate collection attempts resulted in capturing Global Positioning System coordinates?	• Listers collected 103,995,369 Global Positioning System structure points. • Over 98 percent of Global Positioning System collection attempts were successful (103,995,369 successful attempts out of 105,298,999 total attempts).

Assessment Questions	Summary Data
8c. How many times was the map-spot coordinate collection attempted or not attempted due to a dangerous situation or other problem?	• There were 105,298,999 Lister attempts for coordinate collection. • Listers did not attempt coordinate collection at 624,906 or 0.59 percent of the 105,923,905 total prompts for Listers to collect map spot structure points. • 603,902 were identified by Listers to be dangerous addresses. • 21,004 addresses were identified by Listers as having 'other problems'.
8d. What information was gathered from the Global Positioning System metadata?	• Three satellites were sufficient to record a valid coordinate, but over 98 percent of coordinates were collected while accessing six or more satellites. • Less than 2 percent of all Global Positioning System coordinates were collected using five or fewer satellites. The instances where there were fewer satellites might indicate some type of signal issue. • Approximately 45 percent of Global Positioning System coordinates were collected using the Global Positioning System Wide Area Augmentation System signal. This is the preferred type of signal because of its accuracy. Satellite positioning obstructions may have contributed to the low percentage of coordinates collected via Wide Area Augmentation System.
8d. How many Global Positioning System coordinates fell inside or outside of the collection block?	• Approximately 6 percent of the total Global Positioning System points, or 6,110,327 points, fell outside the active collection block.

Assessment Questions	Summary Data
9. What were the results of the MTdb update process for map-spot coordinates?	• Geography Division received 107,853,856 structure records and 104,292,813 records had coordinates. Geography successfully processed 96.7 percent. • There were 1,695,135 rejected Global Positioning System points: o 717,934 coordinate structure records were rejected by Geography Division due to rejected address records o Map spots that fell into military blocks were rejected to protect potentially sensitive information o A nominal number of structure records were rejected due to an Oracle database topology error
10. What were the final field outcomes for road feature updating?	• 2,756,444 feature updates were made, including feature adds, deletes, name changes, and splits. • Of these updates, 623,544 new features were added, of which 608,688 or 97.6 percent were collected with Global Positioning System. • There were 758,166 deleted features.
11. What were the results of the MTdb update process for road features?	• 2,691,667 updated features were reviewed and processed. (Please note there are small accounting discrepancies mostly due to the definitions of the updates. Recall that a split can be treated as a partial add and partial delete.) • 83.7 percent of the total updates passed review and were accepted.
12. What were the results of the Delete Verification phase of the operation?	• 25,443,124 Delete and Duplicate address records (99.99 percent) were checked during Delete Verification. Quality Control was performed on production field work actions. • 782,560 address records (100.00 percent) were sent to Final Delete Verification. • 845,025 address records (3.32 percent) were reinstated during Delete Verification and 61,654 (7.87 percent) were reinstated during Final Delete Verification. • Only 1,324 address records received a single delete and were not sent or did not complete Delete Verification.

Assessment Questions	Summary Data
13. What were the results of the Dependent Quality Control phase of the operation?	• Of the total 733,636 Assignment Areas (after splits), 8.42 percent failed the Dependent Quality Check. • 40,889 Listers (39.94 percent) worked at least one Assignment Area that failed Dependent Quality Check.
14. What were the major findings from the Asset Management System data regarding hand-held computers and Secure Digital cards?	• Planners estimated the loss rate at 1 percent for hand-held computers and Secure Digital cards. • Only 110 hand-held computers out of 154,802 (0.07 percent) and 190 Secure Digital cards out of 322,782 (0.06 percent) were reported as Lost/Missing/Stolen.
15. What were the major findings from the Help Desk operation?	• Out of the 177,297 resolved hand-held computer trouble tickets, 79 percent were resolved in the Early Opening Local Census Offices, 12 percent were resolved at the National Processing Center, and 5 percent resolved in the Regional Census Center. The remaining 4 percent required resolution through Decennial Operations Technical support and Level 3 Help Desk assistance. • Tallies of the hand-held computer tickets show: o 52 percent involved software records o 16 percent involved wireless transmission o 11 percent involved hardware o 8 percent involved enrollment
16. What were the major findings from the Time and Motion study?	• Time and Motion staff observed Listers completing an average productivity of 19 cases per hour. • The hand-held computer improved production rates for the 2010 Address Canvassing operation, with hourly Lister production rates almost double the 2006 Census Test, and more than triple the production rate of the 2008 Census Dress Rehearsal. • These increases in productivity did not account for procedural changes from the 2008 Dress Rehearsal to the 2010 Census.

Assessment Questions	Summary Data
17. What were the production rates (cases completed per hour) for both the regular Address Canvassing operation and the Large Block Address Canvassing operation?	• Address Canvassing Production: The average production rate was 15.37 cases per hour. Expectations were met in all but Production Rate Areas 1, where the rate was 18.28 but the goal was 19.20. • Address Canvassing Quality Control: The average production rate was 12.18 cases per hour. Production rates for Quality Control exceeded the expected production rate in all Production Rate Areas. • Large Block Address Canvassing: The average production rate was 25 addresses per hour. This met the national average expected production rate for Urban Fringe areas (suburban, low density, large land) but did not meet the national average expected production rate of 60 units per hour in Urban areas (high density, large multi-structure, compact land).
18. What data were collected for the addresses/areas identified through the Information Communication project?	• The addresses collected through the Information Communication (INFO-COM) project were provided to the Geography Division to match against the MTdb. • Of the 94,078 addresses returned on Information Communication forms from the Regional Census Centers, 26,561 of these addresses could not be matched and were sent to the Vacant/Delete operation to be checked in the field.

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1. Introduction

The Address Canvassing (AC) operation was the primary address list validation and update activity for the 2010 Census. In order to conduct the 2010 Census, the Census Bureau needed the address of every Living Quarter (LQ) in the United States and Puerto Rico. Conducted in the vast majority of the United States and all of Puerto Rico from March 30 to July 10, 2009, the AC operation improved and refined the Census Bureau's file of LQs before enumeration operations began in 2010. The AC operation served to verify the address and map updates provided from participating local, state, and tribal governments as part of the Local Update of Census Addresses (LUCA) program and provided information for delivering questionnaires and conducting subsequent census operations.

The AC operation consisted of field staff (Listers) canvassing the United States and Puerto Rico, updating the census address list and census maps, and collecting manual and Global Positioning System (GPS) coordinates (when available) for each valid address. Production listing was followed by a multi-stage Quality Control (QC) phase, designed to ensure high-quality data.

The Large Block Address Canvassing (LBAC) operation was conducted using laptop computers in blocks determined to have too many addresses to be worked using the hand-held computer (HHC). Generally, when the assessment document references the AC operation, it does not include the LBAC operation unless noted in the text or table. Section 5 covers the LBAC operation in detail.

For the 2010 Census, the Census Bureau opened 12 Regional Census Centers (RCCs) across the nation. The RCCs managed decennial operations in specific geographic areas. Each RCC managed between nine and 17 Early Opening Local Census Offices (ELCOs) for a total of 151 ELCOs across the United States and Puerto Rico. The AC operation was managed out of the ELCOs.

The 2010 Census AC operation marked the first time in Census Bureau history that a decennial field operation deployed an automated, paperless data collection and transmission process of this scope using an HHC. It was also the first decennial census where GPS was utilized to collect structure locations in the field. This data collection methodology allowed the Census Bureau to more quickly deliver updates to the address list and feature database for subsequent census operations.

The design and implementation of the HHCs and related hardware and software were provided through the Field Data Collection Automation (FDCA) program contract. FDCA provided laptop computers to Field Operations Supervisors (FOSs) in order to manage the operation for their area. The Census Bureau's Decennial Applicant, Personnel, and Payroll System (DAPPS) was used for administrative and payroll matters.

1.1 Scope and Purpose of this Assessment

The purpose of this assessment is to document planning assumptions and activities and provide results, statistics, and analysis from the 2010 AC operation. This assessment answers the assessment research questions developed by the Address List Development Operations Implementation Team (ALDOIT) and approved by the Census Integration Group (CIG).

The assessment provides an overview of the 2010 AC operation and a background of how the operation has developed since Census 2000. This assessment covers the details of each aspect of the 2010 AC operation:

- Workloads and workflow
- Schedule and cost
- Automation implementation results
- Staffing and training
- Findings from debriefings and observations
- Lessons learned

This assessment does not provide detailed operational information and previously documented decisions, but provides references to the appropriate documents for such information. The References section in this report contains a list of reference documents, including edition dates and authors.

1.2 Intended Audience

This document is intended for the following users:

- ALDOIT
- CIG/Executive Steering Committee
- Decennial Leadership Group (DLG)
- Additional internal stakeholders, such as program managers and subject matter experts involved in the planning and implementation of the 2010 AC operation and the 2020 Census
- External stakeholders

2. Background

This section provides information on previous address compilation operations that influenced and directly contributed to the development of the 2010 AC operation, including Census 2000 Block Canvassing and Census 2000 Address Listing, 2004 Census Test AC, 2006 Census Test AC, and 2008 Census Dress Rehearsal AC. Note the 2010 AC overview is provided in Section 2.3.1.1.

2.1 Census 2000

The following section describes similar Census 2000 operations.

2.1.1 Address Listing

The Census 2000 Address Listing operation differed from Block Canvassing in that Listers created the address list from scratch instead of updating an existing list. The operation was conducted in areas that mostly contained non city-style addresses. This operation was paper-based, with Listers attempting contact at every address. The Geography Division (GEO) used Address Listing to create the initial Master Address File (MAF) for the Update/Leave (U/L) areas for both the 1998 Dress Rehearsal and Census 2000. In U/L areas, the Census Bureau hand delivered questionnaires.

From July 1998 to May 1999, Listers canvassed each block in a prescribed path of travel to build a paper list of addresses or physical location descriptions of the housing units (HUs) they found on the ground. They annotated paper maps with map spots for each HU and updated map features to make the maps reflect what was found on the ground. GEO captured the address and map changes to update the MAF and Topologically Integrated Geographic Encoding and Referencing (TIGER) databases.

GEO added a total of 21,918,257 addresses to the MAF as a result of the Address Listing operation (Ruhnke, 2002). GEO added at least one residential address in over 57 percent of the approximately 3.5 million blocks that were part of the operation stateside and in Puerto Rico (Ruhnke, 2002). The production rate was four cases per hour (Schneider, 2001b).

2.1.2 Block Canvassing

In Census 2000, the Census Bureau conducted the Block Canvassing operation to update and improve the content and accuracy of the existing MAF and TIGER databases. This was a paper-based operation.

In 1999, Listers canvassed collection blocks within areas that contained predominantly city-style (house number and street name) addresses. Listers canvassed the blocks within their Assignment Areas (AAs) and used paper maps. The maps were used for finding the correct block they were to be working in and the Listers also updated the maps with feature updates. There were no map spots on the map. Block Canvassing was a canvassing operation. Listers compared each address found on the ground with those on the listing pages in the listing book and annotated all corrections, additions, duplicates, and deletions on the listing pages. Listers updated census maps to show additions, corrections, and deletions to map features. Listers stopped at approximately every third

HU, every multi-unit, and every added HU to inquire about the addresses on either side of that address as well as to identify any 'hidden' units such as basement apartments (Burcham, 2002).

Block Canvassing verified a total of 91,612,770 addresses (Burcham, 2002). The operation occurred in 3,801,560 blocks throughout the country, which represented 51 percent of the total blocks in the nation (Burcham, 2002). The production rate was 24.11 cases per hour (Schneider, 2001a).

2.2 Intercensal Testing

The following section describes the decadal census testing leading up to the 2010 Census.

2.2.1 2004 Census Test Address Canvassing

The Census Bureau conducted a full scale paper-based AC operation in the Queens, New York and southern Georgia test sites during the 2004 Census Test. The major change arising from lessons learned from the Census 2000 methodology was that Listers contacted an occupant or other knowledgeable person at every structure instead of every third structure. As with the Census 2000 Block Canvassing operation, Listers compared an address found on the ground to what was on the listing pages in the listing book and made the necessary additions or changes to the paper list. They added addresses missing from the address list, deleted addresses on the address list that duplicated other addresses, did not exist on the ground, or were nonresidential, and ensured that all addresses were assigned to the correct geographic location.

Listers classified each LQ in their assigned areas as either an HU or an Other Living Quarters (OLQ). Any addresses identified as OLQs were later validated during the Group Quarters Validation (GQV) operation to make sure that they contained LQs eligible for the Group Quarters (GQ) operations. One of the goals of the 2004 test was to evaluate the potential of a handoff of OLQ addresses from AC to GQV as this was a planned component of the 2010 Census.

Listers also updated paper maps with information about the locations and names of features (roads and streets). GEO captured the address and map changes and used them to update the MAF and TIGER databases.

In the 2004 Census Test, Nonresponse Followup Enumerators used HHCs. One of the reasons for using HHCs was to evaluate their effectiveness for obtaining GPS coordinates. The success of the 2004 test allowed the Census Bureau to move ahead with plans for using HHCs in the 2006 Census Test AC operation (Barrett et al, 2005).

2.2.2 2006 Census Test Address Canvassing

In 2006, the Census Bureau conducted a test in Travis County, Texas and the Cheyenne River Indian Reservation in South Dakota. The AC operation in 2005 used an automated instrument instead of paper listings for the first time. The Census Bureau developed the Listing and Mapping Instrument (LAMI, a prototype of the HHC used in 2010) that allowed Listers to verify, update, add, and delete address records in each census block, while also updating map spots and capturing

GPS structure coordinate data when available. The software also allowed Listers to identify duplicates and nonresidential addresses. GEO applied the updates to the MAF and TIGER databases for use in subsequent operations.

In the 2006 Census Test, there were no evaluation studies of the AC operation or the LAMI, but there was a *2006 Census Test Address Canvassing Operational Assessment* that documented what took place during the operation, as well as a Time and Motion (T&M) study. During the T&M study, observers recorded the amount of time it took a sample of Listers to perform each element of the AC procedures, such as driving, getting out of the car, walking to the front door, knocking on the door, and waiting for an answer. Data from the T&M study provided estimates of the Listers' productivity through every step of the operation. The study provided information about problems Listers encountered in the field, such as the time spent troubleshooting the HHC or receiving technical support for the HHC. The Census Bureau continued to move ahead with planning and development of an automated AC operation for the 2008 Dress Rehearsal.

2.2.3 2008 Census Dress Rehearsal Address Canvassing

The AC operation in the 2008 Census Dress Rehearsal was a test of the software developed as part of the FDCA contract. The dress rehearsal was conducted in three locations using the HHCs in San Joaquin County, California, Fayetteville, North Carolina, and portions of Eastern North Carolina. The results of this test allowed the Census Bureau to refine and improve AC processes and procedures for the 2010 Census. The 2008 AC operation required Listers to canvass assigned census blocks in a prescribed path of travel looking for all potential LQs. The AC software resident on the HHC displayed an address list from the MAF/TIGER database (MTdb) for each known LQ and Listers compared what was on the ground to this list. More specifically, the software on the HHC allowed Crew Leaders, production Listers, and QC Listers to:

- Verify or correct location and mailing address information
- Add and delete addresses
- Code an LQ as an HU or an OLQ
- Link duplicate addresses
- Collect structure type data
- Capture manual and GPS coordinates, when available, for all structures and link the address records to the captured map spot
- Update street features
- Identified a starting point, and used an algorithm to determine the number of addresses in the sample
- Conduct a Dependent Quality Control check (DQC) of a sample of addresses for each AA
- Verify all addresses coded as deletes and duplicate by the production Lister
- Prepare, submit, review, and approve electronic payroll data

The Decennial Statistical Studies Division (DSSD) assessed some of the feature adds, deletes, splits, and name changes. The *2008 Dress Rehearsal Address Canvassing Assessment Report* (Dixon et al, 2008) documents the findings from this test.

2.2.4 Summary of Interrelated Programs

This section describes several other census operations closely associated with AC. Some of these operations, like LUCA, were inputs to AC while others, such as GQV and Mailout/Mailback (MO/MB) were operations that followed AC and were dependent on the results from AC.

The Local Update of Census Addresses Program

The local review portion of the LUCA program preceded the AC operation. During this program, local, state, and tribal governments opting to participate in LUCA selected one of three participation options:

- Option 1: Title 13 Full Address List Review
- Option 2: Title 13 Local Address List Submissions
- Option 3: Non-Title 13 Local Address List Submission

All governments participating in the 2010 Census LUCA program could submit block-geocoded, city-style addresses to the Census Bureau. Other changes were allowed, depending on the option selected. The 2010 AC operation was used to field-verify the LUCA address submissions. After GEO received these addresses from participating governments, they compared them to the addresses in the MTdb. Addresses that did not match existing records were added to the AC operation for field verification. Listers did not know which addresses on the HHC came from the LUCA program. For further details refer to Section 5.4, or the *Study Plan for the Local Update of Census Addresses (LUCA) Program Assessment* (Rebecca Swartz, Stuart Irby, 2011).

Group Quarters Validation

The GQV operation refined the classification of OLQs identified during the AC operation. During the GQV operation, specially trained field staff verified that an OLQ contained LQs. If it did, field staff classified it as either an HU, transitory location (TL), or a GQ. For example, college residence halls were listed in AC as OLQs and then sent to GQV for final classification as GQs.

Specifically, GQV Listers completed the following actions using the GQV Questionnaire and Census maps:

- Verified the address had the correct census geography
- Determined the status of the OLQ address as either a GQ, HU, TL, Non-residential, Vacant, or Nonexistent
- If validated as a GQ, classified the type of GQ and collected the maximum number of residents who could live or stay at the address
- Added GQs, HUs, or TLs not already included on the address list

The 2010 Census GQV universe included the following addresses:

- OLQs and OLQ Adds identified during the AC operation and LBAC
- Census 2000 GQs and updates to the MTdb before the 2010 Census (pre-2010)

- GQs from administrative records provided by the Federal-State Cooperative Program for Population Estimates
- GQs from the LUCA program that contain certain character strings frequently associated with GQs in the GQ name
- GQs identified by the National Processing Center (NPC) Service-Based Enumeration Internet Research
- GQs identified during the American Community Survey (ACS) Time of Interview (TOI) operation

Questionnaire Delivery

The results of the AC operation were used to update the MTdb. HUs identified as a result of AC made it on to an initial mailing extract to create mailing labels for the questionnaires. All subsequent census operations used the updated MTdb.

In addition to providing information for questionnaire mailout, AC information was used to update the MTdb in areas where census Enumerators would later hand deliver questionnaires for mailback, rather than United States Postal Service (USPS). These were areas with a high percentage of non-city style addresses. This methodology was called U/L. The AC operation also covered areas where enumerators updated addresses and conducted interviews in an operation titles Update Enumerate (UE).

2.3 2010 Address Canvassing and Large Block Address Canvassing Planning Implementation and Monitoring

The following sections describe the planning, development, implementation, and program monitoring for the AC and LBAC operations.

2.3.1 Address Canvassing Planning and Development

The development cycle for the automated 2010 AC operation began with the planning and development for the 2008 Census Dress Rehearsal. Representatives from many stakeholder divisions participated in working groups to provide and clarify requirements for the Office Computing Environment (OCE), Mobile Computing Environment (MCE), data and file ingest and transmission processes, and management reports. Staff also planned strategies for the Help Desk processes and procedures.

The following section provides a high level overview of the AC operation. It covers the major phases of AC, the development of a systems plan, cost model and budget assumptions, workload and staffing assumptions, schedule development, the OCE and MCE, and features of the HHC. The section describes risk management planning and how the revised approach or replan (see Section 2.3.1.4) affected AC, as well as a summary of the supporting systems.

2.3.1.1 Address Canvassing Operation Overview

The following is an overview of the major phases of the AC operation including the *Detailed Operation and Systems Plan* (Schneider, November 25, 2008), the address universe, training, production, and QC. This sub-section also provides summary information about the HHC features.

Address Canvassing Detailed Operations and Systems Plan

The ALDOIT developed the *Address Canvassing Detailed Operations and Systems Plan* as part of the operational planning and documentation. The plan was developed prior to the start of the AC operation and continuously updated as changes impacted the program. The plan covered the following aspects of the program:

- Planning assumptions and key milestones
- Staffing needs and strategies
- An overview of training strategies
- An overview of operations and flows that informed system design including workflow diagrams and narratives
- Business rules and an overview of the capabilities needed
- A roadmap for determining acceptability of systems providing necessary capabilities

The plan identified the methodology to be used, the phases of the operation, and the various inputs and outputs required. In addition, the plan identified related systems and required resources and provided workload and staffing estimates and a detailed workflow chart.

Address Universe

GEO delivered the address universe and geographic reference files to the FDCA contractor for loading into the control system. AAs and their associated assignments for field staff were downloaded from this database. See Section 5.1 for information about what addresses were included in the AC operation.

Training

All AC field staff received formal training after being hired. The ELCO managers received Just-in-Time training shortly before the training of the field staff began. The production and QC staff including FOSs, Crew Leaders, Crew Leader Assistants (CLAs), and Listers received several days of classroom instruction which included hands-on use of the HHC and training on AC procedures. Afterwards, a Crew Leader or assistant observed Listers in the field during their first assignment and conducted on-the-job training, if necessary to ensure full compliance with AC procedures. The office clerical staff received both on the job training and computer based training (CBT), which prepared them to perform general office functions and to use the AC office control software.

Production Address Canvassing

The AC operation, conducted in 2009 for the 2010 Census, provided an updated address and physical location for every LQ. To improve the address list, AC field staff canvassed each assigned block in their AA and looked for every place where people live or stay, or could live or stay.

While working on their AC assignments, Listers used the HHC to make updates to the address list and electronic maps. The HHC had two-way communications that could transfer information:

- Information was transferred from the HHC to the office or Crew Leader. This is how Listers sent completed work, payroll, and text messages.
- Information was transferred to the HHC from the office or Crew Leader. This is how Listers received new assignments and messages.

Listers compared what they saw on the ground to what was shown on the Census Bureau's address list. Based on their findings, Listers verified, updated, or deleted addresses already on their list, and added addresses that were missing from the list. During this time, Listers updated electronic maps so that they accurately reflected what was on the ground. Listers collected map spots manually and via GPS, if a signal was available, for addresses to show their locations in the block. Listers did not collect map spots in areas they thought were dangerous, or for delete, duplicate or nonresidential address records, or for all units in multiunit structures. Later in the operation, Listers did not collect map spots on military installations. Listers transmitted an electronic payroll record for their time worked and miles traveled.

Address Canvassing Quality Control (Dependent Quality Control, Delete Verification, and Final Delete Verification)

After a Lister completed and transmitted work in an AA, a QC Lister was assigned to visit the AA and verify a sample of the addresses. This was called the DQC. Every AA received QC to ensure high-quality work. The HHC software selected a random start point from a randomly selected block in the AA unless there were map feature changes as described below.

To review the quality of the map updates, DQC included a quality evaluation of street features added or deleted by Listers. Only one feature was checked in each AA. The QC Listers did not verify spatial accuracy, but only that the feature update was correct. To accomplish this, the HHC software looked for any added or deleted map features in the AA. If there were any map changes, the HHC randomly selected one of those features for verification by the QC Lister and selected a starting point for DQC in the same block as the selected feature. If there were no added or deleted map features in the AA, the HHC skipped the map feature quality check and selected the DQC start point from a randomly selected block in the AA.

The DQC sample size for AAs varied based on the number of address records in the AA, but was approximately 3 percent of the address records. QC Listers corrected any errors identified in their sample. An AA failed the DQC if the number of errors, critical and noncritical, identified by the QC Lister exceeded the threshold for the size of the AA. If an AA failed the DQC, the QC Lister

immediately recanvassed the remainder of the AA, correcting errors as necessary. Quality evaluation of street features did not factor in the decision to pass or fail DQC.

If an AA passed the DQC, the QC Lister conducted Delete Verification (DV) to verify any deletes or duplicates identified by the production Lister. The DV ensured that any address record identified as a delete or duplicate by a production Lister received confirmation from an independent QC Lister. If the QC Lister disagreed with the production Lister, the QC Lister followed prompts in the automated HHC instrument to record his or her findings.

If a QC Lister flagged an address record as a delete or duplicate that the production Lister considered valid, a second verification of the new delete or duplicate was required. This was referred to as Final Delete Verification (FDV), during which a second QC Lister captured the final status of these records. These checks ensured that two people confirmed each Delete and Duplicate and allowed the Census Bureau to exclude the addresses from any subsequent operations.

All fieldwork for an AA was considered complete after DQC, and any necessary DV and FDV. GEO received the data for each completed AA and used it to update the MTdb in preparation for the GQV operation and the delivery of census questionnaires.

For further details on the QC Program for AC refer to the *Quality Control Plan for the 2010 Census Address Canvassing Operation (*RJ Marquette, Heather Haas, August 2008).

Hand-Held Computer Features

The HHCs were the backbone of the AC operation and represented a major step forward in the use of technology for the decennial census.

Automation provided opportunities for more complete, accurate, and efficient data collection by:

- Improved data collection (more consistent) through use of drop downs
- Prompts to Listers for specific actions, including required entries
- Keyboard entries for legible data
- Improved field communications
- Provided QC starting point and sample size with clerical intervention
- Close to real-time reports, not relying on clerical scanning for check in and out from the control system
- Improved backend processing

During the AC operation, HHCs were used by Crew Leaders, CLAs, and Listers to conduct the production and QC phases of the operation. As Listers canvassed their assigned blocks, they compared each LQ on the ground to what was displayed on the HHC. The AC software, resident on the HHC, displayed an address record from the MTdb for each address in the AC universe. Listers added any addresses missing from the HHC address list.

HHCs were equipped with:

- AC software which contained census map and address data and allowed the user to identify duplicate addresses, update, add, and delete information required to make the maps and address data accurate.

- Crew Leader HHCs contained assignment management system software to control the workload assigned to Listers. These HHCs also included software to display reports and an employee roster.

- A GPS receiver to assist in the collection of accurate GPS information and display a 'You Are Here' (YAH) indicator on the census-generated maps which helped the Lister to locate and travel within their assigned area.

- Functionality that allowed Listers and Crew Leaders to file payroll (E-308) electronically.

- Both wireless and dial-up options for Listers to transmit completed work and payroll and to receive new work assignments.

- Training software, so each user could practice the technical skills required for their job without compromising real census data.

- Several forms of help for the user, including screen-level help, How To Guides, and Computer Based Trainings (CBTs).

- Fingerprint reader that secured census data by only allowing the person whose fingerprint was registered to the HHC to unlock the device.

- Progress and performance reports.

- Capability for wireless connectivity.

The software on the HHCs allowed Listers to conduct the functions listed below in each census block within their AAs, and allowed QC Listers to conduct QC related functions:

- Update address information
- Verify or correct address record information
- Identify duplicate addresses
- Add LQs missing from the address list and delete the addresses for LQs that do not exist in the block being worked
- Assign an address status to each address on the address list
- Add, delete, and update map features
- Collect structure type data for each LQs

- Obtain one manually-identified coordinate and one GPS coordinate for every address[1]
- Identify a map feature (added or deleted street), if applicable, to be checked in each AA as part of the DQC
- Identify a randomly selected starting point for the DQC sample for each AA
- Identify any DV and FDV addresses for the QC Listers to check for each AA
- Conduct the DQC of the production Lister's work
- Determine the pass/fail status of the DQC

Electronic Maps

Electronic maps on the HHCs assisted Listers in locating their AAs and specific blocks, enabled recording and capturing structure points (locations) manually and via GPS, when available, and allowed updating maps associated with specific address records. Listers collected map spots for every structure containing an address. The HHC did not provide driving directions; however, the YAH indicator provided general guidance to locate the work assignment.

The HHCs contained electronic map files showing the entire RCC area at the census block level. The software allowed Listers to zoom in to their specific AAs to determine where to begin canvassing. During AC, Listers updated map features on the electronic maps to reflect what existed on the ground. The maps highlighted the boundaries of the AA the Lister was assigned. The block the Lister was working in, or the active block, was highlighted in a different color than the other blocks within the AA.

GPS Structure Coordinate Collection

The primary reasons for the GPS were to provide the YAH indicator on the electronic maps on the HHC and to collect GPS coordinates for all LQs. The indicator allowed Listers to view their locations within an AA. Map software allowed Listers to zoom in and out to achieve an accurate view from the block level out to a wider view of their AAs.

The GPS was used to capture spatially accurate structure coordinates. When a Lister completed an address record, the software prompted the Lister to capture the location of the address and presented a map on the HHC. When the Lister touched their stylus to the screen to place the manual map spot, the software automatically attempted to capture GPS coordinates based on where the Lister was standing. However, in some cases, the GPS collection failed due to a weak or nonexistent signal. When the GPS collection was successful, the software then associated both sets of coordinates with the listed address; if no GPS collection, only the manual coordinates were associated with the listed address.

For multi-unit structures, the software allowed the Lister to capture one address for all the units in the structure – the basic street address. After the address collection for a unit in a multi-unit, the Lister was prompted to indicate if this was the "first unit at a multi-unit." If it was the first unit, the instrument allowed the Lister to collect a map spot. The Lister was prompted to capture one map

[1] Listers did not collect map spots in areas they thought were dangerous or for delete, duplicate or nonresidential address records, or for all units in multi-unit structures. Later in the operation, Listers did not collect map spots on military installations.

spot representing all of the individual units within that structure. After the multi-unit structure type was selected, the Lister was prompted to indicate if this was the first unit at a multi-unit structure. If it was the first, the software prompted the Lister to collect a map spot using the step mentioned above. Listers were not prompted to collect a map spot for subsequent units in a multi-unit structure.

Collection of Structure Types

AC Listers determined a structure type that best represented each address record in their AA. The four choices were:

- Single unit structure (there is only one LQ at the physical structure)
- Multi-unit structure **(**there is more than one LQ at the physical structure)
- Mobile home
- Boat, tent, or other

2.3.1.2 Budget and Cost Model Assumptions

This section describes the Field Division Headquarters (FLD HQ) and the Decennial Management Division (DMD) cost models and details the DMD cost model assumptions, workloads, Production Rate Areas (PRAs), and estimated production rates.

Field and Decennial Management Division Budget Models

FLD HQ and DMD used independent cost models working with similar assumptions to determine baseline cost and staffing estimates. These models often varied as the FLD model took individual ELCO factors such as housing density, difficulty of enumeration, geography, and staffing and training ratios based on their data and experience, where the DMD model used high-level national assumptions to produce an overall operational cost estimate.

The estimated total workload used for the cost model purposes was 155,663,198 addresses. This total included an estimated 137,755,042 addresses for the production phase and 17,908,156 addresses for the QC phase of AC.

The FLD HQ cost model:

- Examined each Local Census Office (LCO) area based on HU density, difficulty of enumeration, workload, production rates, and estimates for training and staffing ratios to produce a baseline budget and staffing estimate.

- Developed a ‘bottom-up’ approach that provided detailed data for each ELCO.

- The staffing numbers and weekly targets helped support the ELCO level cost data that was reflected in cost and progress.

The DMD cost model:

- Used the same assumptions as the FLD HQ model, but calculated information from the overall national workload down to the ELCO level using production rates and estimates of days and hours worked.

- Developed a "top-down" approach that provided an operational view of the budget and staffing.

- Produced an overall operational budget estimate.

FLD HQ and DMD established various operational parameters for the cost models. Specific metrics for the AC operation were derived from the 2006 Census Test, the 2008 Census Dress Rehearsal, and previous census experiences. Developing reasonable parameters was difficult due to the lack of historical data with which to create baseline metrics for an automated AC operation.

Initial Address Canvassing Workload

There were 144,890,808 total addresses included in the initial AC workload. There were pre-identified collection blocks containing more than 1,000 addresses, which were removed from the AC universe and canvassed in the LBAC operation discussed in Section 2.3.3. As a result, the actual number of addresses loaded onto the HHCs for AC was 141,822,612 addresses in 5,959,406 collection blocks.

There were over 11 million addresses in the workload that were added as a result of the Delivery Sequence File (DSF) updates and the LUCA program. This workload was larger than expected and contributed to increase staffing and training as well as movement of HHCs between regions where the work had increased the most.

Assignment Areas

AAs were made up of census blocks and represented approximately three days of fieldwork for a Lister. There were 711,695 initial AAs created from the AC address universe. After the AAs were loaded into the Operations Control System (OCS), the RCCs split some of the initial AAs to create more efficient work assignments, resulting in a total of 733,636 AAs worked over the course of AC the operation.

Production Rates and Production Rate Areas

Production rates were an estimate of how many addresses a Listers could complete in one hour. These rates took into account travel to and from the AA as well as time expended conducting AC in the AA.

After Census 2000, the Census Bureau realized that one production rate for the entire country for the 2010 AC operation was not realistic. The rates needed to reflect different geographic areas. The country was subdivided into three geographic areas called Production Rate Areas (PRAs): (PRA 1)

Urban/Suburban, (PRA 2) Rural, and (PRA 3) Very Rural. The AC work assignments were then classified into one of the three PRAs.

Varied production rates per hour were established for Listers for each PRA category. This allowed Field Division (FLD) to better estimate the amount of production that could be expected based on the HU density of an area. These production rates were also applied in the DMD cost model.

Table 2.1 shows the planned production rates for the three different PRAs or the number of addresses (cases) per hour a Lister was expected to complete.

Table 2.1: Planned Production Rate per Hour for the Various Production Rate Areas

Production Rate Area	Production Number of Addresses/Hour	Quality Control Number of Addresses/Hour
Production Rate Area 1 (Urban/Suburban)	19.2	9.0
Production Rate Area 2 (Rural)	7.8	7.0
Production Rate Area 3 (Very Rural)	2.9	2.0

Source: Field Division.

Production and Training Budget Assumptions

Table 2.2 summarizes the budget assumptions for various operational variables in the DMD cost model. Some of these were designated by position and included production hours per day, production days, production and training mileage per day, and the estimated total training time by position. Training mileage covered trainees driving mileage from their home to the training site and returning to home. *Frontloading* is a staffing strategy of over-selecting Enumerators/Listers for specific field operations to compensate for the risk of attrition and to limit the risk that some staff may not be able to work the assumed hours per day or days per week. In addition, replacement training was additional training sessions anticipated to replace staff that did not show up for training or were released or quit.

Table 2.2: DMD Cost Model Data for Production and Training Budget Assumptions

Address Canvassing Production							
Position	**Production Hours/Day**	**Production Days**	**Production Miles/Day**	**Frontloading Rate**	**Replacement Training Rate**	**Training Miles /Day†**	**Training Days**
Lister	5.2	38.8	30.5	100%	25%	28.8	3.15
Crew Leader	5.9	63.3	34.4	0%	25%	28.3	4.15
Crew Leader Assistant*	5.7	48.3	35.3	0%	0%	10.0	0
Field Operations Supervisor	6.6	80.4	55.4	0%	25%	41.6	4.15
Address Canvassing Quality Control							
Position	**Production Hours/Day**	**Production Days**	**Production Miles/Day**	**Frontloading Rate**	**Replacement Training Rate**	**Training Miles /Day†**	**Training Days**
Lister	5.3	38.8	17.2	100%	25%	34.7	3.15
Crew Leader	5.9	63.3	34.4	0%	25%	28.3	4.15
Crew Leader Assistant*	5.7	48.3	35.3	0%	0%	10.0	0
Field Operations Supervisor	6.6	80.4	55.4	0%	25%	41.6	4.15

Source: Decennial Management Division Cost Model.
* Crew Leader Assistants were trained and paid at Lister rates.
†Training mileage varied by type of office.

Staffing Estimates

DMD's cost model categorized ELCOs as Urban/Suburban, Rural, or Very Rural. Each of these three ELCO designations had various assumptions associated with the type of office. For example, more daily mileage was allocated for rural offices as Listers needed to travel longer distances to and around their AAs than they would in an urban setting.

One challenge with these office classifications, and accuracy of the cost model, was that an ELCO sometimes covered large geographic areas. Since the overall geographical area represented by an ELCO was so varied, the type of classification was more accurate based on LCOs than ELCOs.

Table 2.3 shows the DMD cost model breakdown for number of staff by operational phase, by field position, and by type of office.

Production staff represents the number of staff required to complete the operation on time based on the assumptions in the model (production rate, hours per day, etc.).

As mentioned, *frontloading* is a staffing strategy of over-selecting Enumerators/Listers for specific field operations to compensate for the risk of attrition and to account for the fact that some staff will not be able to work the number of hours or days needed per week. This helped ensure the ELCO would meet established operational deadlines by ensuring that there was enough trained field staff.

Training staff represents the number of field staff invited to attend training. This number is higher than the frontloaded number of staff to compensate for the risk of no-shows and drop-outs. AC had fewer drop outs than similar operations did in past censuses, presumably due to the economy and high unemployment.

Table 2.3: Decennial Management Division Cost Model Staffing Estimates for Production and Quality Control

Address Canvassing Production Cost Model Staffing Estimate										
	Urban Suburban ELCOs			Rural ELCOs			Very Rural ELCOs			
Position	Production Staff	Production Staff with 100% Front-loading†	Training Staff	Production Staff	Production Staff with 100% Front-loading†	Training Staff	Production Staff	Production Staff with 100% Front-loading†	Training Staff	**Total**
Lister	28,249	56,496	63,559	15,242	30,481	34,290	2,292	5,983	6,732	**92,957**
Crew Leader	3,532	3,532	4,416	1,907	1,907	2,383	375	375	468	**5,814**
CLA*	3,532	3,532	0	1,907	1,907	0	375	375	0	**5,814**
FOS	443	443	554	239	239	300	48	48	59	**730**
Address Canvassing Quality Control Cost Model Staffing Estimate										
	Urban Suburban ELCOs			Rural ELCOs			Very Rural ELCOs			
Position	Production Staff	Production Staff with 100% Front-loading†	Training Staff	Production Staff	Production Staff with 100% Front-loading†	Training Staff	Production Staff	Production Staff with 100% Front-loading†	Training Staff	**Total**
QC Lister	7,836	15,670	17,628	2,274	4,402	4,970	564	1,128	1,270	**21,200**
QC Crew Leader	982	982	1,225	279	279	347	71	71	90	**1,332**
CLA*	982	982	0	279	279	0	71	71	0	**1,332**
FOS	125	125	155	37	37	45	10	10	12	**172**

Source: Decennial Management Division Cost Model dated 2/19/2009. *CLAs were trained and accounted for as Listers in the model from a pay rate standpoint. Numbers of CLAs were based on number of Crew Leaders in model. † Only Lister positions were front loaded.

Decennial Management Division Cost Model Budget Estimates

In building the cost model for the AC operation in fiscal year 2009, DMD used a production workload of 137,755,042 addresses with a QC workload estimate of 13 percent of the production workload or 17,908,156 addresses. Using these parameters, DMD initially allocated $371,383,638 to FLD for the data collection. These funds were allocated for both production and QC and sub-divided for training hours, production hours, and mileage across the 12 regions and the 151 ELCOs based on workload.

Table 2.4 shows the breakdown of the initial allocation in dollars and hours for training and production and QC fieldwork by position based on the DMD cost model.

Table 2.4: Budget Allocation – Dollars and Hours for Training and Fieldwork by Position

Address Canvassing Production						
Position	**Training Budget**	**Training Hours Budget**	**Fieldwork Hours Cost Budget**	**Fieldwork Hours Budget**	**Miles Cost Budget**	**Miles**
Lister	$40,413,014	2,635,442	$146,561,306	9,557,666	$27,947,748	50,814,107
Crew Leader	$4,089,225	241,267	$36,775,484	2,169,741	$7,427,325	13,504,228
Crew Leader Assistant*	$0	0	$24,526,965	1,599,462	$5,448,026	9,905,494
Field Operations Supervisor	$562,835	30,302	$7,153,764	385,352	$1,865,770	3,392,300
Subtotal	$45,065,074	2,907,011	$215,017,519	13,712,221	$42,688,869	77,616,129
Address Canvassing Quality Control						
Lister	$9,368,797	601,457	$33,969,675	2,180,871	$4,980,704	9,055,819
Crew Leader	$948,404	55,173	$8,511,145	495,077	$1,695,011	3,081,818
Crew Leader Assistant*	$0	0	$5,684,806	364,969	$1,243,123	2,260,233
Field Operations Supervisor	$132,317	7,031	$1,652,407	87,879	$425,832	774,244
Subtotal	$10,449,518	663,661	$49,818,033	3,128,796	$8,344,670	15,172,114
Total Production and Quality Control	**$55,514,592**	**3,570,672**	**$264,835,552**	**16,841,017**	**$51,033,539**	**92,788,243**

Source: Cost and Progress System.
*Crew Leader Assistants were trained and paid as Listers. After training these positions were allocated budget, hours, and miles for fieldwork.

Of the $371,383,638 allocated to FLD, $302,771,426 was for production work and $68,612,212 was for QC.

For budget and staffing purposes, FLD HQ modeling staff distributed the 137,755,042 estimated initial addresses to the 151 ELCOs. Then, using information available in the RCCs, FLD HQ applied the production rate and other parameters used in the DMD model to the planned number of addresses for each ELCO and used the approved pay rates for each ELCO to determine staffing costs at the ELCO level.

Once this was done, the RCCs delineated FOS districts and Crew Leader districts that were exclusively within one of the three PRAs and this information was provided to GEO to delineate AAs containing about three days of work for one Lister.

2.3.1.3 Schedule Development

This section describes the schedule system and procedures for baselining the initial schedule and some of the challenges associated with that process. This section provides the high level AC wave schedule. The final schedule is in the 2010 Census Schedule System.

2010 Census Schedule System

The purpose of the 2010 Census Schedule System was to provide project management and decision support functionality, including program schedule integration and analysis. The 2010 Census Schedule System was owned by CIG. Changes to the schedule were approved by CIG (except in situations where CIG delegated the authority to others) and managed using the processes in the *2010 Census Change Control Management Plan*.

Developing and Baselining the Schedule

The development of the 2010 AC schedule followed the finalization of the 2008 Census Dress Rehearsal schedule. The initial 2010 Census schedule was created by replicating the baselined 2008 Dress Rehearsal schedule and advancing the dates by two years. The AC Subteam met over a period of several months to further develop and refine details of the 2010 AC schedule. This involved a coordinated group effort with members from DMD, FLD, GEO, and DSSD, who were responsible for specific subject matter covering the scope of the census to ensure an integrated development. The DMD AC Subteam leader coordinated team members' reviews, feedback, and modifications of these schedule documents to ensure completeness and accuracy of the:

- Activity list
- Activity linkages (predecessors/successors) to include logic/relationships (Start to Start, Finish to Finish, Finish to Start) and lag times
- Actual dates for started and/or completed activities
- Activity durations
- Planned start and finish dates

Prior to May 22, 2008, the schedule baselining process provided for the formal approval of a schedule that included changes to start and finish dates, updates to remaining duration and percent complete without having to go through the formal change process. The initial baseline of the 2010

Census schedule occurred on May 22, 2008. After the schedule was baselined, changes to activities start and finish dates required review and approval as detailed in the change request process.

Schedule Successes

Overall, the 2010 decennial schedule process helped track key activity and deliverable deadlines for the AC operation. The schedule was primarily constrained by the requirement to meet the April 6, 2009 (original date) start of AC fieldwork. All of the critical components and phases of the AC operation were successfully managed with the use of scheduling software (Primavera), Management Information System (MIS) staff to assist the AC Subteam in schedule creation, and the weekly monitoring meetings managed by an Assistant Division Chief. All fieldwork was completed and results were delivered on time for the processing flow to the next decennial operation.

Schedule Challenges

While developing and monitoring the schedule, many challenges arose. Two major challenges of special note were: 1) the change from an initial six-week data collection period to a two-wave, to a three-wave, then finally, to a five-wave schedule for fieldwork and, 2) the integration of the LBAC operation into the schedule. Both presented challenges because of late introduction into a baselined 2010 schedule.

Reviewing and updating the weekly *2010 Activities to Review/Status* report became more difficult because the master schedule listed three waves. Increasing the waves to five (see Address Canvassing High Level Schedule in Table 2.5) would have added numerous lines to the report. DMD devised workarounds to allow activities to schedule properly without erroneously appearing to be late. Late activities triggered an 'Alert Report' that was automatically sent to top Census and Commerce Department officials, CIG, and the Office of the Inspector General.

Address Canvassing High Level Schedule — Waves

The schedule for conducting AC went through several iterations, from a single 6-week period to the final plan involving five waves of work.

The wave plan was modified due to an increased workload and the desire to roll out the operation in just a few offices. The modified plan would determine that all systems functioned well and it would mitigate the risk to the operation if there were significant software or transmission issues. The resulting decision was to conduct AC over five waves. The solution relied on extending the length of the regular AC operation in various ELCOs without extending the end date of the operation. Each ELCO was included in a wave based on determinations made by FLD and the RCCs.

All waves started and ended within the prescribed time period, with the exception of the eight ELCOs that started one-week early in order to test the system. The end date of July 17, 2009 for AC was constrained because of post-operational processing and the need to meet a critical date for getting the addresses to the print vendor to prepare over 100 million questionnaires.

Table 2.5 shows the scheduled start and end dates for each wave. End dates for conducting the operation are 'No Later Than' dates. A number of ELCOs were expected to finish earlier.

Table 2.5: Scheduled Start and End Dates for Each Wave

Wave	ELCOs in Each Wave	Production		Quality Control	
		Start	End	Start	End
Pre-Wave 1	8	3/30/2009	7/3/2009	4/6/2009	7/10/2009
Wave 1	92	4/6/2009	7/10/2009	4/13/2009	7/17/2009
Late Wave 1	8	4/13/2009	7/10/2009	4/20/2009	7/17/2009
Early Wave 2	37	4/20/2009	7/10/2009	4/27/2009	7/17/2009
Wave 2	6	5/4/2009	7/10/2009	5/11/2009	7/17/2009

Source: Field Division.

2.3.1.4 Risk Mitigation Planning

DMD conducted numerous meetings to identify and manage risk to the AC operation and the entire 2010 Census. Stakeholders at all levels participated in the risk identification and mitigation process. The operational teams conducted meetings to identify and mitigate risk at the program or operational level.

The AC Subteam performed all project-level risk management tasks and used a Risk Register to assess and manage the risks for AC. The Risk Register contained nine risks identified by the team on April 8, 2008. As the team assessed the risks, they formalized mitigation strategies and contingency plans.

Once each month, the Risk Register was reviewed and approved by the ALDOIT co-chairs, posted to the 2010 Operations Center site, and monitored by the DMD Program Management Branch. At any time, the AC Subteam could propose raising the probability and impact scores for a given risk and elevate the risk to the attention of the ALDOIT chairs, who could inform CIG, the DLG, or other groups as appropriate if the risk was deemed to have risen to program level. The final risk was closed out by June 2009.

Summary of Risk Assessments for Address Canvassing

Table E-2 (Appendix E) summarizes the nine project risks identified and managed by the AC Subteam and posted on the teams Risk Register. Each risk includes a brief description of how each risk was mitigated, what contingencies were planned, and the outcome.

The Census Bureau had to accept some of the risks as part of the replan and risks associated with the Puerto Rico addresses not being updated during the decade. Planning teams were required to review and post their revised risk plans to the Census Operations Center (an internet repository for specific census operational data) once every month.

The Replan

As part of the dress rehearsal planning, the Census Bureau identified potential risks and attempted to mitigate them in preparation for the 2010 Census. Among these were risks related to the FDCA system, which was a key component of the 2010 Census architecture. Based on results of targeted assessments of the dress rehearsal, technical monitoring, and other oversight activities, these mitigation efforts did not sufficiently reduce the risks related to the FDCA implementation required for the Census field operations, resulting in a replan of the 2010 AC operation.

Dress Rehearsal Challenges

- The Census Bureau had difficulty documenting clear and complete requirements. (For example, prior to Dress Rehearsal HHC performance requirements were incomplete.)

- The lack of understanding between the Census Bureau and the FDCA contractor resulted in numerous change requests.

- The HHC and OCE experienced some software and performance setbacks in dress rehearsal, including slow system performance on the HHC when linking duplicate addresses and linking multi-units to the same map spot.

- The HHC did not have sufficient memory capacity to efficiently handle large blocks. For further information see Section 2.3.3.

- Additional issues were identified during the dress rehearsal, including inconsistent and/or inaccurate OCS reports, slow performance of the HHC, and inconsistent and/or inaccurate address update data received as output from the HHC and transmitted to GEO.

- Throughout the dress rehearsal, technical monitoring highlighted the FDCA contractor and Census Bureau's difficulty in conveying and understanding the requirements.

Address Canvassing Impacts

The following changes were based on results from the dress rehearsal and replan efforts. Some of these changes were initiated to control costs (for example, revised contact procedures), while others, such as not linking duplicate addresses and not linking multi-unit addresses to a single map spot, were done to improve the overall HHC performance. Other contributing factors included limited time and development resources and capabilities.

Revising Contact Procedures

During the 2008 Dress Rehearsal, Listers conducted an interview at every structure with an occupant at least 15 years old, even if the structure appeared to be commercial or nonresidential. Once the Lister determined that the structure contained LQs, they verified the address, obtained a mailing address, and asked if there were additional LQs on the property. If there was an additional LQ, and if the LQ was not on the address list, they

attempted to conduct an interview with the occupants. Listers were able to obtain information from knowledgeable people for LQs where occupants were not home or that were vacant.

In 2010, Listers did not conduct interviews at every structure. Instead, they had to determine by observation if the structure possibly contained LQs. If not, they moved on. If so, they knocked on the door. The type of interview depended on whether or not a house number was posted. If a number was posted, the Lister made a 'courtesy contact' which was simply to let the occupant know the purpose of the visit and ask if there were any additional LQs. If the house number was not posted, the Lister conducted a brief interview in which he or she verified the location address, collected the mailing address if they were unable to obtain a house number for the location address, and inquired if there were any additional LQs. If so, the Lister collected the required information. The HHC tracked whether contact was made or not for every address worked in AC.

Duplicate Addresses Were No Longer Linked in Completing a Duplicate Address

During dress rehearsal Listers linked duplicate addresses they identified. In 2010, Listers did not link duplicate addresses on the HHC. The change saved time in the field by eliminating a step in the listing process. The time saved was significant since the HHC performed so slowly for that step in dress rehearsal. This change reduced the functions that needed to be included in training. The downside of this decision was that an address identified as a duplicate could not be linked to its matching address, which meant it may persist as a duplicate in subsequent MTdb updates.

Living Quarters in a Multi-Unit Structure Were Not Linked to a Single Map Spot

In the 2008 Dress Rehearsal, each LQ in a multi-unit structure was linked to a single map spot. For 2010, a single map spot was recorded for the first unit in a multi-unit structure. When the unit type for a multi-unit structure was selected, the user verified/updated the address information and then the HHC displayed a question to ask if this was the first unit in the multi-unit structure. If the user selected 'Yes', the HHC would take them to the map to collect the map spot. If the user selected 'No', they were returned to the address list. This revised procedure was developed as a workaround for a performance issue with the HHC. Dress rehearsal experience showed the HHC performance for linking all LQs in a multi-unit structure to a single map spot was extremely slow and jeopardized timely completion of the operation.

Mobile Computing Equipment Software Performance Requirements

Specific requirements for the HHC software were refined during the replan. Census required that 90 percent of all the HHC screens would display in two seconds or less, but no screen would take longer than ten seconds to display.

Creation of the Large Block Address Canvassing Operation

The LBAC operation was created in an effort to reduce the risk of negatively impacting the HHC performance during production in blocks with a large number of addresses - originally more than 1,000 and then was revised to blocks with more than 2,000 addresses.

Not related to the replan but to assist with cost control, the DQC sample size was dropped from 5 percent to 3 percent, increasing the QC design's weighted average outgoing quality limit from 5.9 to 8.1 percent. Most of the QC plan was unchanged.

2.3.1.5 Field Manuals and Training Development

The FLD HQ Address Coverage Operations Branch (ACOB) produced AC manuals, training guides, and workbooks for both the production and QC operations by position (Lister, Crew Leader, CLA, and FOS). Both production and QC FOSs used the same manual, but training guides and workbooks were separate publications. The Office Manual was also used for both operations. For Puerto Rico, ACOB adapted procedures for the Lister, QC Lister, Crew Leader, QC Crew Leader, CLA and QC CLA manuals, Guides for Training, and workbooks and sent these to the Puerto Rico Area Office (PRAO) for translation to Spanish. FOS materials were adapted for Puerto Rico and published in English.

As the need arose, Listers were promoted to Crew Leader in both Production and QC. ACOB developed 'gap' training materials to support these promotions. ACOB also prepared 'gap' training materials for converting production Listers to QC Listers, which occurred toward the end of the AC operation, in order to finish QC on schedule. Gap materials provided the trainee with just the new material necessary when changing positions rather than repeating everything they had already been trained on.

Additionally, ACOB produced supplements covering procedures for canvassing on military installations for Listers, Crew Leaders, and FOSs. Both production and QC used the same materials.

ACOB prepared three Lister job-aids and Guides for Training for special canvassing situations:

- Hard-to-find units in small multi-unit buildings
- Hard-to-locate HUs
- AC procedures in natural disaster areas

Writing began in 2004 as initial training materials were developed for the 2006 field tests, which used the census prototype version of HHCs, called the LAMI.

ACOB wrote procedures for the HHC in 2006 for the 2007 AC Dress Rehearsal implemented in the field. ACOB started writing in November 2007 for 2010 AC and finished in the fall of 2008. Throughout 2007, the writing paralleled the evolution of the HHCs based on the schematic and operational instructions the FDCA contractor provided. Learning and describing how the HHCs

worked was a major undertaking that understandably had a substantial impact on the procedures and training.

The FOSs used laptop computers requiring an entirely different set of operational instructions. For the 2008 Dress Rehearsal, Census Bureau contractors completed these materials because ACOB staff was needed to meet the deadlines for completing the Lister and Crew Leader series. ACOB hired additional staff to complete the FOS materials for 2010.

The software development schedule and the ACOB writing schedule did not mesh well and created a critical situation with regard to finalizing the procedures and training and getting them to print on time. ACOB received updated versions of the software as soon as possible after they were released but prior to FDCA contractor testing. Because the writing could not wait for the software to be released, ACOB staff wrote procedures and training based on requirements. When ACOB received each version of the software, staff had to compare what they had written from requirements to the way the software actually functioned and the way the screens looked. ACOB provided feedback on the functionality that was not working properly so that it could be fixed in the next release. Given the complex nature of the HHC, changing one part of the software at times produced unintended effects on other parts of the software. When these situations were discovered, the software was restored in some cases. In other cases, the functionality change remained, requiring writing revisions.

ACOB received the final screenshots from August 4-8, 2008, to prepare for the dry run, scheduled for the first week of September 2008. Inserting the screenshots into the manual required a lot of effort.

Several other situations complicated the writing schedule:

- The FDCA contractor provided screenshots to their training team so they could prepare the How To Guides. Each How To Guide addressed a function on the HHC and consisted of a three-column table listing the steps in numerical order, the action featuring the screenshots with explanations, and the results. When Census received the How To Guides, generally in quantities of hundreds of pages, ACOB staff tested the procedures on the HHC. Errors were often found and were sent to the FDCA training team for correction. This significantly delayed completion of the manuals.

- ACOB staff did not have HHCs with functioning GPS, requiring instructions for important procedures to be written based on requirements and PowerPoint presentations instead of actual user experience.

- The first time the FLD staff saw a functioning GPS on the HHC was during the Operational Field Test (OFT) in Fayetteville, North Carolina in December 2008, three months prior to launching the AC operation. All AC training materials had to be sent for printing prior to the start of the OFT so they could be kitted and shipped to LCOs prior to training the field staff. The tight schedule between the receipt of screenshots, writing HHC How To Guides, and critical publication deadlines precluded incorporating more information and practice training on using the GPS, YAH indicator, and map functions in the training materials. The

GPS and the YAH indicator were critical not only in helping Listers locate their AAs but in collecting and verifying map spots, and adding or redrawing streets to update the HHC maps.

- The HHC training database presented another significant challenge. Budgetary constraints precluded developing a new and more appropriate list of practice addresses and associated maps to use in training exercises. ACOB staff created scenarios to match the available addresses. For QC, ACOB staff worked with a FDCA programmer to select addresses and actions that would cause practice AAs to pass or fail the DQC. There was no AA in the QC training database that the QC Lister could follow through all the stages of QC, from DQC through recanvassing, and FDV.

- The decision of whether or not to have the QC Listers begin work by verifying a street feature in the AA that the HHC selected randomly changed multiple times. When the procedure was reinstated, the instructions had to be reinserted.

- Procedural changes after dress rehearsal further compounded difficulties in completing the training materials. Two examples of these changes are:

    - Listers were required to decide whether or not a house number was posted and to either make a 'courtesy contact' or conduct a 'brief interview.'
    - Listers were no longer required to stop at obvious nonresidential properties or obtain mailing addresses, except when prompted by the HHC.

Computer Based Training (CBT)

CBT was developed for both the HHC and the OCS.

The HHC CBT provided instruction on how to complete different HHC tasks. The training was not interactive. CBT was created for both the production and QC operations of AC. Due to the different kinds of addresses, an additional CBT was created for the Puerto Rico instrument and translated by staff in the PRAO.

The OCS CBT explained the basic OCS functions and walked the user through how to complete each function. This CBT included text that described the task, a demonstration of the task, and a 'Try Me' segment where the user attempted to complete the task. The OCS CBT was used in both stateside and Puerto Rico offices. Neither translation nor adaptation was done since it was assumed that the Puerto Rico office staff would be bilingual.

Adaptation and Translation for Puerto Rico

All training materials and the HHC software had to be adapted for Puerto Rico because of the unique differences in their addressing structure. In addition to adapting procedures in the training materials, all of the How To Guides, screenshots, CBTs, screen level help, and HHC training software had to be adapted to the PR software flow that matched the PR addressing structure. This required a significant effort on the part of ACOB, GEO, and the FDCA contractors. Once adapted,

printed materials were then translated by the PRAO. GEO provided most of the translation for the HHC screens. This was a departure from previous practice when the translation was completed at HQ by current staff or contractors.

There were several challenges with the translation of material:

- Prior to sending the documents for translations, ACOB staff adapted the procedures to accommodate differences in the address structure in Puerto Rico that corresponded to the HHC screens.

- The translated Spanish text appearing on the Puerto Rico version of the HHC needed to fit within the same screen space as the English version. The Spanish text for the HHC increased the number of characters by 25 percent from English. The functionality of a toggle switch on the HHC (user could toggle between a small and larger font) was eliminated. This issue required workarounds such as using symbols for words so that the translated instruction would fit within the HHC screen.

- The PRAO was understaffed to complete the volume of translation work on the required schedule.

- Once adapted and translated, there was very limited time in which to conduct a dry run of the materials with the Puerto Rico HHC software before sending documents to print.

2.3.1.6 Systems Supporting Address Canvassing

This section briefly covers the major systems supporting AC and a high level testing summary. Further system descriptions and testing details can be found in the *Decennial Testing Overview* (Colosi, 2010) and the *2010 Address Canvassing Testing Plan* (Schneider, 2008).

Office and Mobile Computing Environments

For the 2010 Census, the FDCA contractor provided the AC hardware and developed the AC software used in the office and on the HHCs and FOS laptops. The FDCA program provided automation resources, applications, and infrastructure necessary to support field data collection operations in the 2010 Census.

The FDCA contract included development of the OCE and the MCE.

- The OCE portion of the contract covered the OCS and the other hardware and software in the ELCOs, RCCs, PRAO, and HQ, such as routers, data storage, desktop computers, printers, and fax machines.

- The MCE portion of the contract included the laptop computers as well as the HHCs and the associated hardware and software to allow the mobile systems to function.

- The MCE system provided a secure mobile computing environment for field workers using the HHCs. FDCA included wired and wireless access for data movement in the field linking

field workers, office staff, and Census HQ, as well as interfaces to other census systems and a variety of support services.

Testing the OCE and MCE Systems

Testing was conducted by FDCA software developers, HQ staff, regional staff, and temporary field staff hired to complete the AC OFT in Fayetteville, NC.

FDCA Software Testing

The major areas of testing within FDCA included unit, assembly, product integration, validated systems, regression, security, continuity of operations, infrastructure, and performance.

Unit and Assembly Testing

The FDCA contractor software developers wrote code for the software functionality and testing of that code (unit testing). Structured testing protocols were followed, which tested all possible inputs and outputs to the piece of software, including exception cases and boundary values.

Assembly testing began as the individual pieces of code completed the peer review. Assembly testing was the first integration of related pieces of software. Assembly testers were a separate team from the developers. This was the first independent stage of testing. In assembly testing, all interactions between the pieces of code were tested. This testing included transmissions of data from the HHC to the backend database. This testing also included testing of data flowing through the system components, such as how the OCS reports reflect the data transmitted from the HHCs.

Product Integration Testing

Product Integration Testing (PIT), was the first of the two formal rounds of testing (Validated Systems is the second). The FDCA contractor's testing team, under the Systems Integration and Test Integrated Project Team (IPT), conducted this testing. The PIT integrated all the software functionality across all systems, which included HHCs, the OCS, the backend database, and external interfaces. This testing verified the FDCA software requirements.

Census Bureau stakeholders and the FDCA Project Management Office (PMO) reviewed test scripts, test data, and test results before PIT began. Census Bureau stakeholders participated in PIT either by running the FDCA contractor's test scripts, observing the FDCA contractor's testing, or by running their own scripts on the HHCs and the OCS training machines.

The first round of PIT for AC and GQV began on September 23, 2008. The final rounds of PIT were completed by October 8, 2008. The FDCA contractor ran 2,534 scripts with a 91.55 percent pass rate.

Validated Systems Testing

Validated Systems Testing (VST) was the second and last round of testing before the system was deployed. This testing verified the FDCA software and system requirements. VST occurred at the accredited, secure Data Processing Centers and included live connectivity to the interfaces for the other production systems. This testing consisted of two passes where FDCA's Quality Assurance team formally witnessed the last pass with Census Bureau participation. VST included the following types of testing: Functional, Security, Performance, User, External Interface, Infrastructure, and Regression. VST was completed on December 12, 2008 with 2,295 scripts run with a 90.82 percent pass rate.

Regression Testing

Regression Testing occurred during the PIT and VST and for any changes to the system baseline during production. Regression testing is any type of software testing that seeks to uncover new errors, regressions, in existing functionality after changes have been made to the software, such as functional enhancements, patches, or configuration changes.

User Testing

In conjunction with PIT and VST testing, Census Bureau staff conducted user testing by accessing the FDCA contractor's Training Lab and HHCs in training mode.

Operational Field Test

The primary goal of the OFT was to ensure operational requirements were met and the functionality, usability, workability, and performance of the AC applications and systems were sufficient to conduct the 2010 AC operation. Temporary field staff were hired in the Fayetteville ELCO to work with actual data from the Census Bureau's HU inventory and spatial information from the Master Address File/Topologically Integrated Geographic Encoding and Referencing Database (MTdb). From December 4 -12, 2008, staff from the ELCO in Fayetteville, North Carolina, HQ, and the Charlotte RCC participated in the OFT. The Charlotte RCC conducted the OFT and all 12 Regional Offices (ROs), the IG and GAO observed for one or more days during the OFT.

Table E-3 (see Appendix E) provides a brief description of some of the other support systems and summarizes testing of these systems.

2.3.2. Implementation

The following section discusses AC implementation by reviewing operational challenges and successes, materials and logistics, staff recruiting and training, procedures to conduct fieldwork, and closeout.

2.3.2.1 Overview

Overall, the operation proceeded as planned and was completed one week prior to the scheduled end date of July 17, 2009. The AC operation started as scheduled and many of the ELCOs exceeded progress goals. Operational challenges and successes are noted in the following sections.

Listers were given AAs to canvass and update. Using the HHCs, Listers transmitted AAs when they completed production work and downloaded new work. The completed AA was then assigned to a QC Lister who conducted the DQC. If the AA passed DQC, it was considered complete, the same QC Lister continued to check any deletes and duplicates in the rest of the AA in a process referred to as DV. If the AA failed DQC, the same QC Lister recanvassed the remainder of the AA, which also included checking any remaining deletes and duplicates. If the original QC Lister created new deletes or duplicates during their work, the AA was sent to another QC Lister to check only those newly created deletes and duplicates in a process called FDV. Once the AA completed any DQC, DV, and any required FDV, then the AA was complete and was transmitted to the FDCA contractor who transmitted it to GEO. Refer to the *Quality Control Plan for the 2010 Census Address Canvassing Operation (*RJ Marquette, Heather Haas, August 2008).

Ingest of the Geography Division Address Canvassing Data Files by FDCA

GEO delivered the AC address and spatial files (extracts) to the FDCA contractor by November 7, 2008. FDCA staff updated the FDCA database with AC addresses by December 4, 2008, which was ahead of the February 9, 2009 scheduled deadline. GEO delivered the pre-identified AC large block files to the FDCA contractor for removal from the universe on December 10, 2008. The FDCA database was updated with spatial data from GEO by December 12, 2008.

Census stakeholders reviewed the ingested production data for AC to validate that the data had been ingested as expected. Stakeholders evaluated samples that GEO selected from the delivered production data. The reviewer concluded the data were acceptable after examining such variables as the total number of addresses, removal of the large blocks, GQ flags, and location addresses.

GEO discovered in November 2008, while at the FDCA contractor's facility in Largo, Maryland, that the FDCA contractor had not ingested the mailing address house numbers for the Puerto Rico addresses. The FDCA contractor explained the Puerto Rico mailing house number (MAILHNPR) field was listed as optional and never mapped to the HHC since the MAILHNPR field was not included in the Address Update (ADDUP) output file. The FDCA contractor therefore was not expecting data in the MAILHNPR field.

Instead of FDCA changing their ingest code, they requested that GEO move the data from the MAILHNPR field to the mailing house number one field (MAILHN1) and redeliver the Puerto Rico extracts. GEO agreed and the Puerto Rico house numbers were ingested successfully.

In addition, the following situations also required investigation and resolution. These issues pertained to the LUCA program data included in the AC universe and not with the FDCA ingest process.

- Per Census Bureau instructions, LUCA participants added *xxx (with 'xxx' being the number of units) when the participant did not know the correct unit designation for multi-unit LUCA adds. GEO's MAF update process for LUCA submissions converted these units into *1, *2, *3, etc. However, the ingested FDCA data showed just the * without the unique sequence number. This was due to the way FDCA ingested the data. The software forced the user to make an entry in the unit (designation) field. This happened because of the edit that checked to see if each address was unique. If the '*' was left untouched and there was more than one similar unit identifier associated with the basic street address, then software would require the Lister to change it.

- Only the location description of LUCA adds where the participant submitted both a mailing address and a location description was sent to the FDCA contractor. GEO investigated this issue and redelivered the AC data for 14 ELCOs. The FDCA contractor successfully re-ingested the data.

- One LUCA participant moved over half of the addresses in Baltimore, Maryland; a similar problem was discovered with Jacksonville, Florida, where about one third of the participant's addresses were moved to other blocks. GEO implemented a fix to revert the blocks to their pre-LUCA state. In February 2009, GEO redelivered the AC extracts for two ELCOs. The FDCA contractor successfully reloaded these revised extracts. GEO also created new input files for the LBAC work in Jacksonville and Baltimore and sent out new assignments.

Operational Challenges

AC had its share of operational challenges during implementation. This sub-section details the following AC challenges:

- Issues that required software patches
- Access to military installations to conduct AC as planned
- Natural disasters
- AAs that needed rework
- Interactive Voice Response/Automated Call Distribution (IVR/ACD) performance issues

Section 2.3.3 details the LBAC operational challenges.

Software Patches for the Hand-Held Computer

Patch 64 (February 2009 - before the operation started):

- Provided a fix for when splitting a street and performing multiple edits caused the street name to be displayed incorrectly.

Patch 65 (April 10, 2009):

- Changed Enrollment Process Screen: The first page of the enrollment screen was changed and a new "Wrench" utility icon now appeared in the top right corner of the page for both "State-Side" and "Puerto-Rico" modes.

- Changed Wrench Utility Page (tools): Wrench Page was modified to add a "Dial up" option to the Synchronize button.
    - If the Dial up Option was selected, the HHC initiated a Dial up Transmission using the Prefix the user had last setup when the Synchronize button was pressed.

- Changed Dialup prefix: The update prevents automatic dialing of the eight, nine and *70 prefixes in dialup mode. If the user has specified a prefix previously it will be used. When no prefix has been specified previously, the HHC will not add any prefixes. In the above two cases the HHC will attempt to dial for two times to connect the HHC.

- Incorporated 5848 (send/receive) transmission error fix in the HHC update.

- Prevented the user from entering duplicate and overlapping time and expense details on the HHC. Time and expense details include E-308 points of travel, hours worked, or expenses.

- Prevented the user from creating an E-308 with a zero Coordinated Universal Time offset.

- Prevented the scenario where the user enters a comment or mileage entry but does not proceed to the next page and hence he is required to re-enter the information.

- Prevented the rare scenario where the user attempts to review the review E-308 application but was being entered into the Edit E-308 application.

Patch 66 (April 28, 2009):

- Prevented duplicate E308 submissions.

- Fixed the QC "spinning beach ball" issue when completing threshold address. At the start of the QC phase, processing the DQC on the HHCs resulted in the sustained spinning of the beach ball icon that indicated the HHC was having problems processing information. A software solution was identified and a patch was distributed to a select group of users in order to test the solution. Shortly after the FDCA contractor deployed this patch there was

a noticeable drop in the DQC failure rate. A code walkthrough conducted by the FDCA contractor and HQ personnel concluded that the software patch contained no code change that would account for a difference in the failure rate of AAs. DSSD independently programmed the calculation of QC errors and the pass/fail decision and reached the same results as those determined by the HHCs. The experts concluded that the failure rate dropped because the patch resolved a problem that was preventing AAs that passed DQC from being marked as completed, so the DQC failure rate was artificially high prior to the patch. Users who received the patch reported improved performance. See the memo *Analysis of the Sudden Drop in Dependent Quality Control Check Failure Rates During the 2010 Census Address Canvassing Operation*, Marquette; DSSD 2010 Decennial Census Memorandum Series F-13 for more information.

- Developed fix to resolve Error Code 5064 which was a send/receive error received during an attempt to transmit.

- Removed logs that were not needed on the HHC but were impacting performance.

- Spread the Soft Reset from 2am spike throughout the 2am - 3am window.

- Disabled setting that accepts a Picture Mail notification.

Patch 67 (May 15, 2009):

- Fixed the defect where QC completed AAs were reopened after transmission. This occurred due to incorrect tagging of the collection phase to DQC instead of DV when an address that was deleted in AC production was rejected and worked in DQC.

- Fixed the defect where AAs in DQC were entering FDV but there were no addresses to work. This happened when a delete was introduced in DQC for the first time but it was later rejected and worked as a valid address.

- Fixed the defect where a QC or FDV Lister could be assigned to an AA that they worked previously. This defect fix prevented the 5809 errors from showing up.

- Fixed the over-sampling defect where addresses were worked beyond the DQC threshold required. This occurred when an address was reset in DQC after being deleted in production and reworked as part of the DQC phase.

There was an incident of a Crew Leader receiving a spam text on the HHC. This was the result of an incorrect service configuration which the wireless provider eventually corrected. Although this did not involve a software patch, it was included here as a configuration issue worth noting.

Military Installations and Map Spots

The Census Bureau had many meetings and laid the plan out fully to the Joint Services Working Group long before AC started and was given approval in writing to conduct AC and capture map spots on all military bases. Only once the actual work began did the individual bases object and the

plan required revision**.** Access to military installations to conduct AC was denied in some instances. The primary concern was the collection of GPS coordinates for LQs on base. Census Bureau staff met with Department of Defense staff on May 15, 2009 to discuss the concerns and present options. After the meeting the military allowed AC to proceed on military installations without the collection of map spots. The Census Bureau agreed to remove map spots already collected from their files for all military installations. The GPS and manual map spots were removed from the MTdb and a process was developed to prevent map spots from being added to the MTdb in the future for military bases. This impacted the overall map spot collection data discussed in Section 5.3. Listers were instructed to cease the collection of map spots on military installations for the remainder of the 2010 Census on May 20, 2009.

Natural Disasters

The flooding of the Red River in North Dakota and Minnesota in 2009 raised concerns about the ability to conduct and complete the AC operation in the impacted areas. The Census Bureau discussed various contingency plans, one of which was a change in Type of Enumeration Area (TEA) from MO/MB to U/L. No contingency plan was implemented as the AC operation was completed in these areas.

The operation experienced several additional weather-related disruptions in addition to the flooding along the Red River. These included tornadoes in Kentucky, mudslides in Puerto Rico, and flooding along the Mississippi. While access to the impacted areas took some time, FLD was able to gain access to these areas and complete the fieldwork for AC on July 10, 2009. In some instances, special efforts (such as using a helicopter) were necessary to complete the work.

FLD developed additional training materials that were used in areas impacted by Hurricanes Katrina, Rita, and Ike.

Initial Transmissions in Non-Sprint Coverage Areas

Sprint was the national wireless carrier selected by the FDCA contractor for AC. On March 18, 2009, it was discovered that some HHCs deployed to areas without Sprint cellular coverage could not transmit in dial-up mode due to incompatible data sequencing on the Secure Digital (SD) card and HHCs.

All HHCs shipped from the provisioning center were hard reset prior to being shipped to the ELCOs. This hard reset set a null value in the signal strength registry key value. The HHC software did not handle the null value when the users were outside a Sprint coverage area. If a null value was present when the transmission was initiated, a blank yellow screen banner was displayed on the HHC and the HHC froze. The result meant users outside of a Sprint area were not able to do any type of transmission (dial-up or wireless).

Two solutions were implemented for this problem.

- Listers traveled to a Sprint coverage area to perform a wireless transmission. The HHC initiated a connection with Sprint and the cell tower sent down a valid value into the signal

strength registry key field. The user was able to perform dial-up or wireless transmissions once the valid value was populated in the HHC.

- In non-Sprint coverage areas, a new SD card needed to be burned, shipped, and installed. The new SD card contained the software fix. Because the software change involved the transmission program, a software patch could not be sent remotely to the HHCs. A total of 54,079 SD cards were re-burned and distributed for this effort. Special instructions were developed at HQ, transmitted to the RCCs, and implemented within the ELCOs to replace problematic cards. Additional instructions were prepared for the Help Desk to assist Listers when needed. These additional instructions were instituted systematically resulting in a successful replacement of the "bad" SD cards.

Help Desk Call Distribution Issues

Callfinity, a small software firm, was selected by the FDCA contractor to develop the IVR/ACD system for the Help Desk. The system was designed to handle approximately 1,400 concurrent calls.

In mid-March 2009, the IVR/ACD Help Desk began having significant performance issues. The system could not support the number of users from the field. The primary cause was reported as a database bottleneck due to unexpectedly high load as a result of reporting and other query functions against the production database which exceeded the original design assumptions. The reporting capability had to be turned off until the problem was fixed, which affected the management capabilities for the Help Desk. On March 23, 2009, the reporting functionality was permanently turned off as Callfinity was unable to fix the problem.

Due to the full set of risks associated with the Callfinity system, the Census Bureau began implementing a contingency plan on March 27, 2009. The contingency plan addressed the problems by moving inquires off of the IVR and routing them directly to the ELCOs or to the National Overflow Desk at NPC.

Identified Field Assignment Area Requiring Rework

In the processing of the AC updates from the FDCA contractor, GEO uncovered situations in which AAs were failing the initial edits. GEO identified Master Address File Identification Numbers (MAFIDs) for addresses for which no record was received in the MAF extract. In these situations, the cause was determined and FDCA contractor developed software fixes. GEO isolated the AAs where these problems occurred. To correct the problem for these AAs, GEO rolled back the data to the AAs production state and FDCA sent them back to the field for rework.

Rework for this issue did not involve a recanvass of the entire AA and not all rejected AAs required rework. The two situations under which AAs were reworked were:

- Missing MAFIDs: Overall, 257 AAs were identified as having a missing MAFID. When the rework was complete, the AA was subject to the full QC operation.

- Listers performed the QC on their own work. This situation was discovered and reported by the FDCA contractor. This situation occurred when multiple Listers worked in an AA for production or in DQC. The check to ensure that a person did not perform QC on their own work included only the Lister who completed the AA and did not consider all Listers who worked in that AA. There were 335 AAs in which a Lister performed QC on their own work, either in DQC for the same AA that the Lister worked in production or in FDV where the Lister also worked the AA in DQC and DV. These AAs were reworked.

The 335 AAs that were reworked due to a Lister who quality checked (QC'd) their own work, were reverted back to an appropriate state depending on the situation:

- When a person worked DQC for the same AA they worked in production, the AAs were reverted to the end of production, prior to the start of DQC.

- When a person worked FDV for the same AA they worked in DQC/DV, the AAs where reverted to the end of the DQC/DV, prior to the start of FDV.

For the rework, AAs were assigned to a Lister who had not worked in that AA in an earlier phase of the operation and the appropriate phase of QC was completed. Of the 335 AAs that were identified, 11 could not be reworked because the MTdb had already been updated or was in the process of being updated. For these 11 AAs, the original updates, with the original Listers doing QC work, were applied to the MAF.

2010 Cost and Progress Report Challenges

This section details some of the challenges discovered in regards to the Cost and Progress (C&P) system during the AC operation. These challenges resulted from data differences between the C&P and the OCS, inconsistent data updates, and C&P report design.

Differences Between the Cost and Progress and Operations Control Systems Hours Data

Early in the AC operation, the DMD, FLD HQ, the FDCA contractor, and DMD Decennial Business Intelligence and Analysis area met to discuss discrepancies that Census management noticed in hours worked data between the OCS and the C&P reports. HQ staff compared the OCS D-220D(AC) and (AC QC) reports alongside the C&P *Current Employee Cost – Fieldwork* report drilled down to a similar ELCO level. They also compared the OCS D-220E(AC) and (AC QC) reports with the C&P *Current Employee Cost – Fieldwork* report drilled down to similar RCC and national levels.

The OCS and C&P were similar in that both provided a 'read only' view of the DAPPS database. Both took the DAPPS 'view' data and each system separately performed multiple layers of data aggregation before the data were produced on the reports. The algorithms used by C&P were developed in coordination with DAPPS staff to make sure that the C&P was calculating costs correctly.

The major difference between the two systems was the OCS displayed data from submitted unedited 308s (payroll forms) and then revised the displayed data for approved 308s. C&P only obtained data for approved 308s.

Understanding this difference allowed users to understand the variance. As the operation progressed, the final approved 308s provided the more accurate costs.

Inconsistency in Receiving Daily Cost and Progress Updates from the FDCA Database

There were inconsistencies in the daily data delivery from the OCS to the C&P. Sometimes there were no daily updates displaying on the C&P reports and at other times, the delivery was too late to be included for the HQ staff morning reviews.

The inconsistencies were due to multiple reasons:

- The file from FDCA was not present in the Product Services Messaging Queuing (PSMQ).
- The notification message from FDCA to PSMQ was not delivered quickly enough by the FDCA system to meet the C&P ingest for that day.
- The PSMQ did not deliver a notification to C&P.
- The C&P did not pick up the notification from PSMQ.

Various staffs met and stressed the importance of consistent and timely data deliveries. The deliveries became more consistent and timely.

Drill-Down Path was Cumbersome

The C&P drill-down hierarchy was: National→ RCC→ LCO Type→ ELCO. Users could not get to ELCO data directly from the RCC level, which was contrary to how most users preferred to access the data. DMD created a work-around by assembling custom reports by RCC that were pre-drilled down to the ELCO level. LCO Type still displayed but appeared as an extra column in the reports. LCO Type was based on budget categories and overall did not provide any value in analyzing reports.

Crew Leader Assistant Rows Displayed with No Data

Since the DMD cost model integrated the CLA training budget with the Lister training budget, the CLA training rows on C&P reports displayed with zeros. The DMD cost model was developed with the assumption, based on past practice, that CLAs would be selected from the pool of Listers at the end of Lister training. Instead, CLAs were selected prior to Lister training and assisted their Crew Leaders in the classes. This lack of CLA data in the C&P was annotated by a footnote at the bottom of cost reports that stated, “The Training Hours Cost Budget and the Training Hours Budget for CLAs are included in the Enumerator/Lister Budget.”

Operational Successes

The AC operation had numerous successes. It was the first national listing operation in census history to utilize technology for the following aspects:

Successful Automation

- Automated transmission of AC results to GEO for updating of the MTdb
- The confirmation that we got everything from the field and the timely updating of the MTdb ensured for the first time, that all of the updates from AC (map and address) made it in to the subsequent operations
- Acceptance Criteria and QC done to ensure we got the best quality data out of the mission data-base and transmitted to GEO
- The quality of the fieldwork and processing that allowed the vast majority of all updates from AC to be accepted and applied to the MTdb
- Automated CBT for office clerks
- Use of training mode software for field training
- Use of an HHC to record address information
- Electronic maps and the ability to collect GPS coordinates for structures
- Automated assignment management and control
- Help screens and pop-up messages to remind Listers of important tasks
- Text messaging from supervisors to Listers (relied on transmissions of both the sender and receiver)
- An automated QC instrument including the creation of a list of deleted address records for verification
- Progress reports showing data that were close to real time
- Electronic submission and approval of payroll forms

Efficient Movement of Staff

The flexibility provided by the HHC and the SD card with an RCC based map allowed the efficient movement of staff from areas where work was complete to other ELCOs within the same region to assist in the completion of AC, as necessary.

Successful Hand-Held Computer Performance

With a disappointing performance of the HHC in the 2008 Census Dress Rehearsal, the Census stakeholders and the FDCA contractor worked tirelessly to improve performance. The HHC worked during the 2010 AC operation and the improvement can be attributed to the diligence of the stakeholders and the FDCA contractor. For further information see Section 5.6.5.

Majority of the Help Desk Tickets Solved at the Early Opening Local Census Office Level

Out of the 177,297 resolved HHC trouble tickets, 79 percent were resolved in the ELCOs, 12 percent were resolved in NPC, 5 percent were resolved in the RCC, and the remaining 4 percent were solved by the Decennial Operation Technical Support Office. For further information see Section 5.6.4.

Productivity Rates Higher Than Expected

Productivity rates exceeded goals in all PRAs except PRA 1 for production, which barely missed the desired production rate. For further information see Section 5.6.6.

Early Opening Local Census Office Workload Progress Higher Than Expected

By May 21, 2009, more than eight weeks prior to the scheduled end of the operation, 92 percent of the AAs were complete through QC. This is attributed to the fact that the majority of the ELCOs were in one of the first four waves, but the majority of the ELCOs finished prior to the end date of their respective waves. The operation officially ended on July 10, 2009, a week ahead of schedule.

Lower Than Expected Hardware Loss

Planners expected to lose approximately 1 percent of the equipment during AC. The final percentage loss was .07 percent for HHCs, a total of 110 units, and .06 percent loss for the SD cards, a total of 190 cards. Processes for reporting possible loss of Title 13 data were followed for lost and missing HHCs and SD cards. For further information see Section 5.6.4.

Quality Goals Achieved

Overall, the DQC was designed to achieve an 8.1 percent average outgoing quality limit for critical errors and 22.6 percent for noncritical errors across AAs, and this goal was achieved. The average outgoing quality limit is a measure of the worst quality of address data the Census Bureau would expect over all AAs after the completion of all production and QC listing and any necessary recanvassing. Based on the results from the AC Quality Profile, the average outgoing quality was 7.21 percent for critical errors and 21.85 percent for noncritical errors. These results indicate that our objective of collecting a sample with higher quality than the worst quality of address data we would expect over all AAs was met.

In the LBAC Quality Assurance program, every block that was sent for listing was checked (12,829). Of those, 3,152 (24.6 percent) were recanvassed, which implies they failed DQC, but we had some indications that checkers were going "above and beyond" and would entirely check very small blocks, or check extra units in other blocks (and, if they found an error in those extra units, they may have failed the block). In addition, due to problems discovered after the listing was complete, some blocks were intentionally entirely re-listed during listing check. All three of these situations would inflate the apparent rate of failure;

unlike the HHC, the pass/fail decision for LBAC was entirely procedural. A total of 9,677 (75.4 percent) of blocks were either partially listed or zero blocks (no units at all), which implies they passed listing check.

2.3.2.2 Materials and Logistics

To prepare for fieldwork the FDCA contractor had to install hardware and software in each office. Field training kits, field supply kits, office supplies and FOS laptops, as well as the HHCs and SD cards were shipped to each of the 151 ELCOs as they opened. An SD Card (***S**ecure **D**igital Card*) is an ultra small card designed to provide high-capacity memory in a small size. SD cards are used in many small portable devices such as digital video camcorders, digital cameras, hand held computers, audio players, and mobile phones.

The OCE was installed while staff was recruited, tested, and then selected and trained. This section covers some information about the deployment of OCS, HHCs, and SD cards.

Operations Control System Deployment

Overall, the OCS was deployed successfully. The FDCA contractor successfully installed the OCS in each ELCO. FLD HQ staff released the OCS for all Waves scheduled (see Table 2.6). The releases contained the production Title 13 data and the CBT modules.

Secure Digital Card Deployment

The SD card and HHC deployment was scheduled to be completed by February 3, 2009, but did not finish until March 19, 2009, due to the later than expected opening of a few ELCOs and late changes in the level of geographic data to be included on the initial SD cards. GEO suppressed unnamed and intermittent hydrography from the spatial files to decrease the file size to allow use of the 2-gigabyte cards.

In early September 2008, the Census Bureau gave the FDCA contractor permission to order the 2 gigabyte SD cards. The Census Bureau moved forward with the planned 13 images (one for each RCC and the PRAO). The final images were completed by January 28, 2009.

To provide memory for the HHCs, the FDCA contractor shipped 140,000 production SD cards and kept an additional 158,000 SD cards as production spares. Some of these spares were reimaged and others were kept in reserve in case the planned software patch updates were not correctly downloaded by the HHCs. The FDCA contractor estimated the number of SD cards needed by determining the number of cards required for operations plus field spares and doubling the number to provide a contingency to allow a re-burn and distribution of an update to the field. Without the spares, the cards would have to be returned to the FDCA contractor to be re-burned which would have complicated the operation. The final number of total SD cards was 322,782.

Hand-Held Computer Deployment

The FDCA contractor shipped HHCs to the 151 ELCOs in the 12 regions and Puerto Rico. Some of the 11,056 HHCs available for production spares were employed in various ELCOs with larger

workloads. HHCs were transferred from some regions (such as Chicago and New York) to other regions (such as Dallas and Atlanta) where the workload increased more than originally estimated. Due to cost and logistical issues, purchasing additional HHCs was not an option. The final number of HHCs in the field was 154,802.

2.3.2.3 Recruiting and Staffing

This section describes recruiting and staffing and compares actual staffing with the staffing estimates in the cost model. This section provides a comparison of the actual number of staff trained by position to the cost model estimates and an overview schedule of training session by position.

Recruiting

The early operations recruitment goal was to test 710,770 applicants by April 26, 2009, for staffing approximately 140,000 temporary census jobs. Of that goal, it was anticipated that 72 percent or 511,754, would become qualified for census jobs. As of February 8, 2009, more than 12 weeks earlier than anticipated, FLD recruited and tested 812,071 applicants. The overall recruiting goal was surpassed by more than 400,000 as 1.189 million applicants were tested. In response to the large number of applicants, the Census Bureau adjusted estimates for the name check clearance process and fingerprinting, increased administrative staff, and established a toll-free telephone line to respond to inquiries generated by the name check backlog.

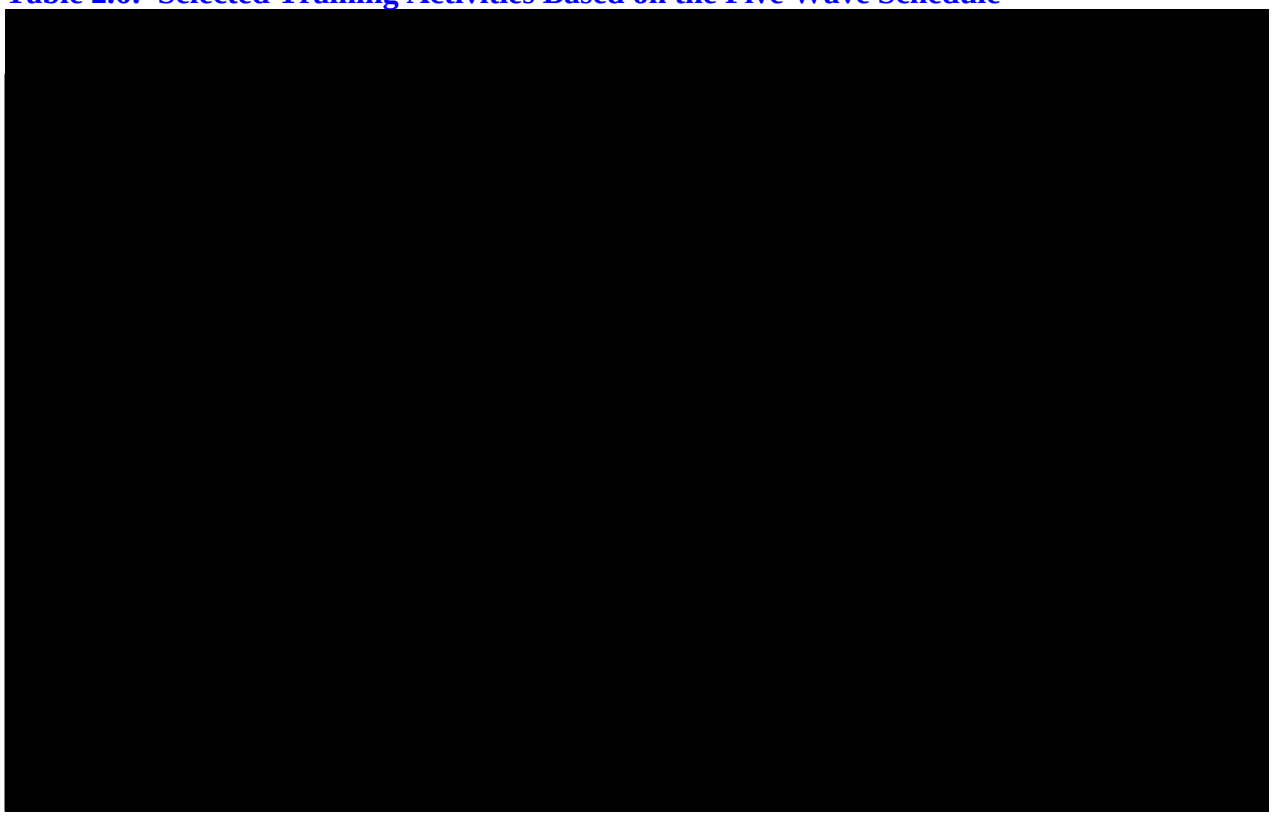
FLD HQ provided a staffing authorization to each RCC who relayed staffing authorization data to their ELCOs. Based on feedback from the debriefing sessions, the majority of the RCCs stated that the authorizations did not adequately reflect staffing needs in terms of numbers, particularly for office staff. Staffing numbers were also limited by the number of HHCs available to each ELCO.

Training

Clerks and other OCS users were trained on the OCS by way of a CBT on the FDCA portal. During the RCC debriefing, participants stated that overall the CBT was useful and helped the staff learn the system.

FLD followed the cascaded approach for training field staff where FOSs trained their Crew Leaders and then the Crew Leaders trained their Listers. Table 2.6 shows the various training dates based on the five wave schedule.

Table 2.6: Selected Training Activities Based on the Five Wave Schedule



Source: Field Division.
* End dates were provided as 'No-later-than' dates. Many ELCOS were given earlier expected completion dates.
Note: Production (Prod) and Operation (OP) are used in the table above.

Field staff received four to five days of classroom training depending on their position. Overall, RCC debriefing participants said that the guides for training and the procedural manuals were adequate for the positions. Some suggestions for improvement included:

- Provide an overview of the entire decennial census
- Supplement the verbatim training with multimedia and practice exercises
- Include training on how to deal with the public
- Give more training on the importance of conducting team meetings
- Provide instructions for the GPS on the HHC including what to do if it did not work as expected
- Require staff to spend a day in the field during training to learn the job
- Ensure the QC manual is developed to be more QC focused instead of copying production materials
- Provide additional Equal Employment Opportunity training
- Reduce or eliminate errata sheets which included procedural changes after the work started.

The exact number of training sessions cannot be determined because the data were not captured. However, an initial training session estimate can be determined using the following assumptions:

- Each ELCO had two FOS training sessions - one for production and one for QC.
- Each FOS or QC FOS held one training session for their staff of Crew Leaders.
- Each Crew Leader or QC Crew Leader held one training session for their staff of Listers.

Table 2.7 gives an approximate number of initial training sessions held during AC based on the assumptions above.

Table 2.7: Approximate Number of Initial Training Sessions Held for Address Canvassing

Employee Level	Production	Quality Control	Total
Field Operations Supervisor	151	151	**302**
Crew Leader	790	181	**971**
Lister	5,778	1,375	**7,153**

Source: Field Division Headquarters. Based on review and tally of staffing authorizations, the numbers above do not include replacement training sessions.

Table 2.8 and Table 2.9 summarize the total number of staff budgeted for training and the total number actually trained by position for production and QC. Please note that the tables do not include staff that went through 'gap' training which was abbreviated training to provide just the specific information needed for their promotion. Most of the differences between budgeted and actual are due to higher than expected workloads. Refer to Section 5.6 for further analysis of these differences.

Table 2.8: Total Staff Budgeted for Training and the Estimated Total Number Trained – Production

Production			
Position	**Number of Staff Budgeted for Training**	**Estimated Number of Staff Trained**	**Variance**
Lister	104,581	111,105	+6,524 (6%)
Crew Leader Assistant	5,814	6,320	+506 (8%)
Crew Leader	7,267	8,213	+946 (11%)
Field Operations Supervisor	913	1,160	+147 (14%)
Production Total	**118,575**	**126,798**	**+8,123 (6%)**

Source: Staff trained numbers equals actual staffing numbers from FLD division, budgeted staff training number from the Decennial Management Division cost model. Crew Leader Assistants were trained as Listers, so the number shown for training reflects the budgeted production number.

Table 2.9: Total Staff Budgeted for Training and the Estimated Total Number Trained – Quality Control

Quality Control			
Position	**Number of Staff Budgeted for Training**	**Estimated Number of Staff Trained**	**Variance**
Lister	23,868	37,784	+13,916 (37%)
Crew Leader Assistant	1,332	2,484	+1,152 (46%)
Crew Leader	1,662	3,083	+1,421 (46%)
Field Operations Supervisor	212	461	+249 (54%)
QC Total	**27,074**	**43,812**	**+16,738 (38%)**

Source: Staff trained numbers equals actual staffing numbers from Field Division DAPPS, budgeted staff training number from the Decennial Management Division cost model. Crew Leader Assistants were trained as Listers, so the number shown for training reflects the budgeted production number.

Staffing – Planned versus Actual

The cost model staffing figures in Table 2.10 show the budgeted staffing levels by position, including frontloading for the Lister position. These staffing numbers are shown along with the number of staff hired during the entire AC operation. These numbers come from tallies requested from DAPPS. The unique employee identification numbers represents the number for actual staff tallied throughout the entire duration of the AC operation. If staff submitted one payroll and then were released, they would be counted in these staffing totals. Staffing numbers were higher than budgeted for each position in both the production and QC phases of the AC operation. These higher numbers can be attributed to large workloads.

Table 2.10: Comparing Cost Model Staffing with Actual Hiring Totals

Position	**Cost Model Production Fieldwork Staff Totals with Frontloading for Listers**	**Number of Staff in Production with Unique Employee IDs**	**Position**	**Cost Model Quality Control Fieldwork Staff Totals with Frontloading for Listers**	**Number of Staff in Quality Control with Unique Employee IDs**
Lister	92,957	111,105	QC Lister	21,200	37,784
Crew Leader Assistant*	5,814	6,320	QC*Crew Leader Assistant	1,332	2,484
Crew Leader	5,814	8,213	QC Crew Leader	1,332	3,083
Field Operations Supervisor	730	1,160	QC Field Operations Supervisor	172	461
Production Staff Total	**105,315**	**126,798**	**QC Staff Total**	**24,036**	**43,812**

Source: Source of budgeted staffing with frontloading is the Decennial Management Division cost model. Source of production staffing numbers is from Field Division.
* One CLA was budgeted for each Crew Leader.

2.3.2.4 Conducting Fieldwork

Fieldwork progress in the 151 ELCOs consistently met FLD's national progress goals for percent AAs assigned and completed for both production and QC. Production progress goals provided by the FLD budget office were used to determine expected percentages of workload and cost to be completed by the RCCs and ELCOs by the end of each week of the operation. The progress goals are shown in Table 2.11. Please note that the QC phase of the operation was scheduled to last one week longer than the production phase and the entire operation was completed on July 10, 2009. Since the operation ended one-week early, goals published for July 15 and July 17 are not relevant.

Table 2.11: Address Canvassing National Progress Goals

	Address Canvassing Operation Dates																	
TASK	4/1	4/8	4/15	4/22	4/29	5/6	5/13	5/20	5/27	6/3	6/10	6/17	6/24	7/1	7/8	7/10	7/15	7/17
Percent Production Assigned	1%	7%	16%	28%	40%	51%	62%	72%	80%	87%	92%	96%	98%	99%	100%	-	-	-
Percent Production Complete	0%	4%	12%	22%	34%	46%	58%	68%	77%	85%	90%	94%	97%	99%	99.8%	100%*	-	-
Percent QC Assigned	-	-	4%	12%	22%	34%	46%	57%	68%	77%	85%	90%	95%	97%	98%	-	100%	-
Percent QC Completed	-	-	3%	10%	19%	31%	43%	55%	66%	75%	84%	90%	94%	98%	99%**	100%*	99.8%	100%

Source: Prepared by Field Division and distributed to the regions on 2/13/09.
* Indicates that the operation was completed on July 10, 2009.
**This % complete is in error due to rounding.

Overall, fieldwork progress accomplished during AC was better than projected. While this may seem an artifact of placing the majority of the ELCOs in one of the first four waves, it is important to note that the majority of the ELCOs finished prior to the end date of their respective waves.

By June 17, 2009, 145 ELCOs had completed all of their production work and 136 ELCOs had completed their QC work. By June 24, 2009 there were only 100 AAs not completed. On July 10, 2009 the final ELCO closed out, ending the fieldwork one week ahead of schedule. The following factors can be attributed to the one week early completion date: there was higher than expected productivity in two of the three PRAs for the production phase as well as all the PRAs for the QC phase, lower than expected attrition rates, and more hours worked by Listers than expected.

Determining Target Productivity Rates

The introduction of automation and the use of HHCs created uncertainty regarding the actual production rates that would be achieved. Automation decreases the need for paper products and can increase data quality. However, it potentially decreases the flexibility that may be achieved in a paper environment, as automation can limit staffing based on the availability of HHCs.

The production rate is defined as the number of cases expected to be completed per hour. The rate included time for actions other than actually updating addresses, such as time spent meeting with the Crew Leader and travel time.

AC was conducted nationwide and in Puerto Rico. For this reason, one production rate for the entire operation was not realistic. The rates needed to reflect different geographic areas. The country was subdivided into three PRAs: PRA 1 (Urban/Suburban), PRA 2 (Rural), and PRA 3 (Very Rural).

Budget assumptions were modified to support production rates of 25.6, 14.0, and 6.0 HUs per hour for the three PRAs for both production and QC operations for the 2008 Dress Rehearsal.

Small-scale field tests conducting AC on a hand-held device yielded productivity rates lower than those outlined above. None of the tests were conducted using the software and systems developed under the FDCA contract. (The first experiences with the FDCA system and software were during the 2008 Census Dress Rehearsal of AC.) Thus, based on the field tests, the production rates for dress rehearsal were set at 15.0 HUs per hour in PRA 1; 8.0 HUs in PRA 2, and 2.0 HUs in PRA 3 for the production operation and 5.0, 2.0, and 1.0 HUs per hour for PRAs 1, 2, and 3, respectively, for the QC component of the operation. The lower QC productivity rates took into account the increased travel time required during QC. The experiences from the dress rehearsal informed the final assumptions for the 2010 Census AC operation.

The 2008 Dress Rehearsal provided insight into how the 2010 AC operation might occur. It identified situations that were likely to turn into significant problems when the operation was conducted on a national scale. Some software problems experienced early in the deployment of the system were overcome with wireless software upgrades and the operation continued to make progress. However, there were several areas of concern with the software that had significant impacts on productivity. There were no PRA 3 areas in Dress Rehearsal

Primarily due to software problems the actual production rates during the 2008 Dress Rehearsal were lower than expected in most categories, as shown in Table 2.12.

Table 2.12: 2008 Census Dress Rehearsal Address Canvassing Productivity Rates

	Production Rate Area 1			Production Rate Area 2		
	Expected	Actual	Actual (minus downtime)	Expected	Actual	Actual (minus downtime)
Fayetteville						
• Production	15.0	9.1	11.8	8.0	7.2	9.3
• Quality Control	5.0	7.1	9.3	2.0	7.0	9.1
Stockton						
• Production	15.0	12.0	16.6	8.0	9.6	13.2
• Quality Control	5.0	6.8	9.4	2.0	6.4	8.8

Notes:
1. The actual rates are based only on employees that were able to be associated to a PRA.
2. Source of the hours and cases used for the production rate calculation was DAPPS (as reported by FDCA).
3. Source of the PRAs was the Employee Roster from the FDCA system.
4. Source of the omitted downtime was the T&M study conducted by the Administrative and Management Systems Division (AMSD).
5. Downtime can include breaks and non-production stops.

The 2008 Dress Rehearsal experience pointed to a significant disconnect between the actual productivity compared to the budgeted productivity rates supported by the fiscal year 2009 budget for the AC operation. With no guarantee the software performance would be increased to a level supported by the funding available, the Census Bureau reviewed the plans for the 2010 AC. The goal was to increase productivity without negatively impacting coverage and quality. In effect, dress rehearsal results led to a replan of the 2010 AC operation.

Table 2.13 shows the final production rates established after extensive testing prior to the start of 2010 AC operation.

Table 2.13: Final Address Canvassing Production Rates by Production Rate Area

Production Rate Area (PRAs)	Production Number of Addresses/Hour	Quality Control Number of Addresses/Hour
Production Rate Area 1 (Urban/Suburban)	19.2	9.0
Production Rate Area 2 (Rural)	7.8	7.0
Production Rate Area 3 (Very Rural)	2.9	2.0

Source: Field Division Lister Manuals.

Actual Production Rates by PRA can be found in Section 5.5.6.

Production Rates by Regional Census Center

Table 2.14 provides the overall production rates for the production phase of the AC operation for each RCC. The table also includes the average miles per case and average hours worked per day. The average national production rate was 15.37 cases per hour.

Table 2.14: Estimated Production Rates for the Production Phase of the Address Canvassing Operation by Region

RCC	Cases	Hours	Cases/Hour	Miles/Case	Hours/Day
Boston	12,846,478	919,169	13.98	0.27	6.27
New York	7,206,278	390,067	18.47	0.10	6.45
Philadelphia	10,898,042	680,378	16.02	0.26	6.35
Detroit	11,698,150	709,774	16.48	0.33	6.56
Chicago	11,773,684	649,512	18.13	0.29	6.17
Kansas City	11,623,529	806,829	14.41	0.50	6.43
Seattle	10,972,657	768,474	14.28	0.35	6.31
Charlotte	17,235,452	1,173,860	14.68	0.42	6.58
Atlanta	17,465,980	1,123,675	15.54	0.37	6.97
Dallas	14,924,912	1,014,636	14.71	0.40	6.57
Denver	11,487,786	881,463	13.03	0.62	6.68
Los Angeles	10,138,889	527,409	19.22	0.19	6.56
Production Total	**148,271,837**	**9,645,245**	**15.37**	**0.35**	**6.51**

Source: Field Division.
Note: Data were taken from the D-220E level reports. The D-220 reports series only reflects work done by the Listers and not the CLAs or Crew Leaders. The total Production cases represent approximately 93.3 percent of the workload and therefore, should be representative.

Table 2.15 provides the overall production rates for the QC phase of the AC operation for each region. The table also includes the average miles per case and average hours worked per day. The national average production rate for QC activities was 12.18 cases per hour which may indicate our QC production rates were set too low.

Table 2.15: Estimated Production Rates for the Quality Control Phase of the Address Canvassing Operation by Region

RCC	Cases	Hours	Cases/Hour	Miles/Case	Hours/Day
Boston	3,753,415	292,883	12.82	0.53	6.32
New York	1,642,721	118,178	13.90	0.29	6.43
Philadelphia	2,929,728	244,544	11.98	0.62	6.53
Detroit	2,941,350	229,468	12.82	0.75	6.46
Chicago	2,807,719	212,770	13.20	0.71	5.94
Kansas City	2,800,589	262,150	10.68	1.16	6.47
Seattle	2,631,492	249,729	10.54	0.76	6.09
Charlotte	5,140,385	418,707	12.28	0.93	6.78
Atlanta	6,086,647	443,334	13.73	0.70	7.06
Dallas	4,193,707	332,119	12.63	0.84	6.35
Denver	3,415,992	363,809	9.39	1.41	6.45
Los Angeles	2,625,834	195,893	13.40	0.43	5.69
QC Total	**40,969,579**	**3,363,581**	**12.18**	**0.76**	**6.44**

Source: Field Division.
Note: Data were taken from the D-220E level reports. The D-220 reports series only reflects work done by the Listers and not the CLAs or Crew Leaders. The total production cases represent approximately 93.3 percent of the workload and therefore, should be representative.

2.3.2.5 Closeout

The major focus during the closeout of the AC operation was the collection and return of equipment used in the field and the post processing of the results.

Collection and Disposition of Hand-Held Computers and Secure Digital Cards from Field Staff

As the ELCOs completed 100 percent of their AAs through the QC phase, the staff in the ELCO began to close out the AC operation. The field staff returned their HHCs and SD cards and the office staff logged the equipment into the AMS system as it was received. The HHCs were returned to HQ and the SD cards were sent to the FDCA contractor for destruction, following Title 13 guidelines.

Updating the MTdb

The MTdb updates from the AC operation occurred for almost all stateside counties and Puerto Rico. Stateside areas designated as Remote Update/Enumerate or Remote Alaska TEAs did not receive AC updates, as the operation was not conducted in these areas. Section 5.2 details the results of the MTdb updates.

AC updates were sent to GEO to update the MTdb on a flow basis from two sources.

- The FDCA contractor delivered ADDUP files when updates were received from HHCs.
- DSSD delivered update files from the LBAC operation. GEO reformatted these to the ADDUP format. DSSD provided adjudication instructions to GEO to reconcile production and QC results. See Section 2.3.3.

Updates from the AAs completed through QC were transmitted on a nightly basis.

Automation afforded a more expeditious updating of the MTdb compared to previous census that involved the keying of paper listing prior to updating. For the first time, GEO was able to update the MTdb much more quickly than when paper was used because the listing pages no longer needed to be keyed and the results transmitted prior to updating.

GEO accepted the final AA update on July 10, 2009. GEO completed the update of the MTdb with AC address updates by August 7, 2009 and completed updating the spatial updates from AC by the scheduled end date of August 18, 2009.

2.3.3 Large Block Address Canvassing Operation

The following section describes the LBAC operation purpose, background, strategy, budget and costs, and implementation in the field. See Appendix B for a workflow diagram.

2.3.3.1 Overview

The purpose of the LBAC operation was to reduce the risk associated with the performance of the HHCs used in the 2010 AC operation while listing census blocks containing a large number of addresses.

Large Blocks were single collection blocks that potentially contained more than 1,000 LQs. Large blocks were problematic because the HHC could not process a large quantity of address records in a single block in an efficient manner. Given the uncertainty of the software performance, the Census Bureau investigated other means for listing large blocks, resulting in the development of the LBAC operation. The LBAC operation was not conducted in Puerto Rico because the support systems for the LBAC were not designed for deployment there for the existing Census Bureau survey operations.

The planning, development, testing, and implementation of the LBAC operation were completed under severe time and resource constraints and with no dress rehearsal experience to reduce risks.

However, the LBAC operation was completed by working with existing deployed software, systems, and processes originally designed for the Census Bureau's Demographic Survey operations.

Large Block Threshold

Based on the dress rehearsal experience with the HHC performance, the threshold for defining a large block for the 2010 AC operation was initially set at 700 addresses or greater. The Census Bureau continued to try to raise the threshold of addresses per block in order to keep as many collection blocks as possible within the regular AC operation and not move them to the LBAC operation. Noting improved performance of the HHC and wanting to limit the number of addresses in the LBAC operation, the large block threshold was set at 1,000 addresses prior to the delivery of the AC address universe.

The two categories of large blocks were defined as follows:

- Potentially contained more than 1,000 LQs and were identified and removed prior to the start of AC. These were called pre-identified large blocks as GEO identified these blocks and moved these from AC to the LBAC workload in advance of the AC address universe.

- Contained 2,000 LQs and were discovered during the course of AC fieldwork. These were called field-identified large blocks.

As a result of testing and HHC software improvements by the contractor, the performance improved through February 2009. Through the combined efforts of the FDCA contractor and Census Bureau staff, by the scheduled start of AC fieldwork in March 2009, the performance of the HHC improved sufficiently so that Census management increased the large block threshold from 1,000 addresses to 2,000 addresses for field-identified large blocks. Consequently, 2,086 large pre-identified large collection blocks and only 440 large collection blocks were identified during the field-identified large block process (see Table 2.20).

2.3.3.2 Planning the Large Block Address Canvassing Operation

In March 2008, DMD formed a working group comprised of representatives from DMD, GEO, FLD HQ, Technologies Management Office (TMO), and DSSD to analyze the large blocks issue. A number of efforts were taken to "break up" the large collection blocks into manageable pieces. Due to resource constraints and the limited time remaining before the start of the 2010 AC operation, using the Demographic Area Address Listing (DAAL) field operation and systems along with the Automated Listing and Mapping Instrument (ALMI) software was the only viable option for listing large blocks. The ALMI was developed to support the Demographic Surveys and the ACS and was already in use in the field. The ALMI updates from the DAAL field operation provided updates to the Census Bureau's address list and map features for specific geographic areas, a task similar to AC. DSSD provided requirements for GEO to develop software to adjudicate address updates where there was overlapping coverage from the AC and LBAC operations and translate the files into the format used by the existing software that processed the HHC AC results.

The DAAL system uses the Census Bureau's current survey (not decennial) infrastructure, and thus was managed from the Census Bureau's 12 ROs, although some regions chose to have the RCC run the LBAC operation. Trained current survey field staff as well as new hires used laptop computers to complete these assignments. A benefit to using the DAAL/ALMI for LBAC was being able to use data from the same source as the HHC and also use existing processes to create files and update the MTdb. The working group developed a two-pronged strategy for using the platform and systems in DAAL and the ALMI software in pre-identified and field-identified large blocks.

Pre-Identified Large Blocks Strategy

Prior to the start of the 2010 AC operation, known large blocks were removed from the AC operation and put into the LBAC operation. GEO identified and flagged large blocks in Geographic Reference File-Codes (GRF-C) delivered to the FDCA contractor who then removed them from the HHC universe. Once a block was removed from the HHC universe, it could not be put back into that universe.

The pre-identified blocks removed from the regular AC operation were listed with the DAAL/ALMI in the LBAC operation.

Field-Identified Large Blocks Strategy

It was difficult to estimate the number of field-identified large blocks before AC fieldwork started. This increased the difficulty in estimating the budget and staffing needs. If field staff identified a large block during the course of the AC operation, the OCS had functionality to remove the block from the AC workload. The field-identified blocks were then listed with the DAAL/ALMI in the LBAC operation.

Field-identified large blocks were processed at HQ and turned into assignments for completion in the LBAC operation. HQ staff sent the new assignments to the ROs, which then assigned them to staff trained on the DAAL/ALMI. RO staff transmitted completed listings back to HQ. Upon receipt of the completed listings, HQ staff generated MTdb update files for the blocks listed.

Estimated Production Rates

The LBAC planning team estimated a national average production rate of 25 units per hour in Urban Fringe areas (suburban, low density, large land).

Hand-Held Computer and the Automated Listing and Mapping Instrument Software Comparison

The LBAC working group compared the HHC and the ALMI approaches to determine which existing DAAL procedures could be used for the LBAC operation. While the data collected and the procedures used to list a geographic area for AC and DAAL were similar, there were some important differences, as shown in Table 2.16. Some of the rules enforced by the software differed also. Handling of LUCA addresses with special characters in the within structure unit identifier, required information for complete addresses and collection of mailing address.

Table 2.16: Comparison of Address Canvassing Software and the Automated Listing and Mapping Instrument

Hand-Held Computer Address Canvassing Software	Automated Listing and Mapping Instrument
Collects GPS coordinates	The laptops had the capability to collect GPS coordinates, however the software interface with laptop did not exist
Collects structure type	Did not collect all structure type values collected in AC, but did collect "trailer."
Collects OLQ information	Collects GQ information
Uses 2010 Collection geography	Uses 2000 Tabulation geography
Cannot accommodate ungeocoded addresses	Could handle both ungeocoded and geocoded addresses; GEO and DSSD created datasets that excluded ungeocoded addresses to match AC
Puerto Rico version is available to handle unique address schema	Puerto Rico address schema was not supported
Used on a hand-held computer	Used a laptop

Due to time and resource limitations, the group worked around the differences and modified existing DAAL procedures for the LBAC operation to be as similar as possible to the AC operation.

2.3.3.3 Collection Blocks for the HCC versus Tabulation Blocks for the ALMI

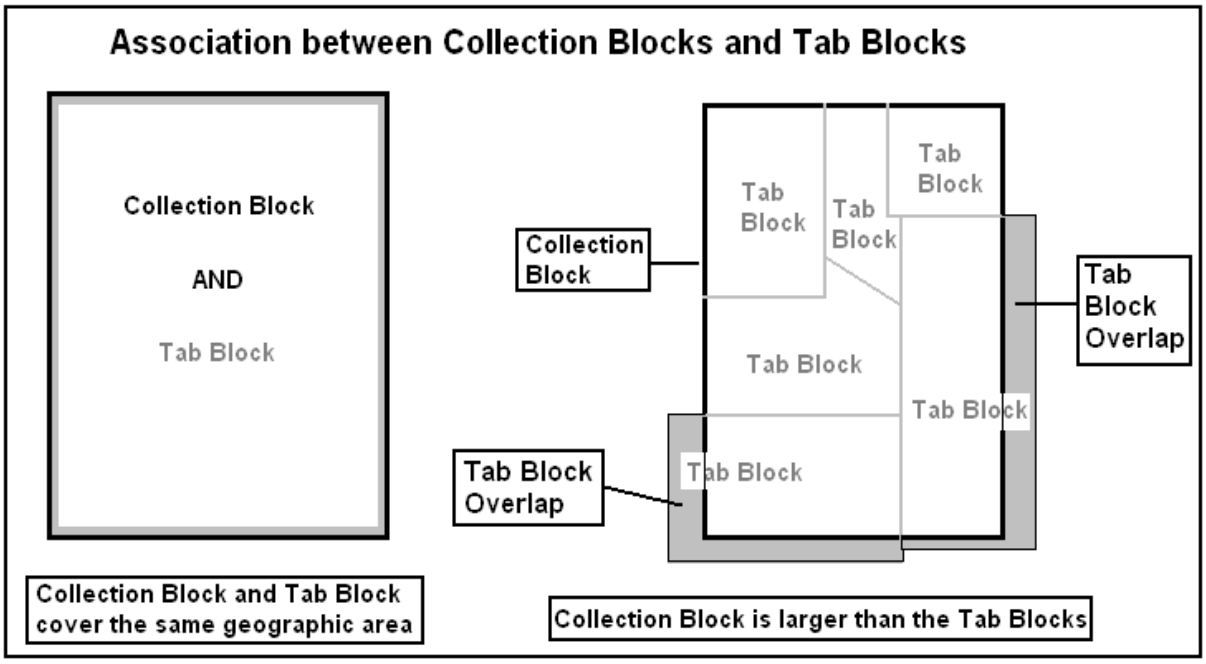
The Census Bureau maintains two types of block level geography: collection blocks and tabulation blocks. It is important to understand the difference between the two block types in order to understand the unique challenges in the LBAC operation.

- *Collection geography* is used for collecting data for a census and is generally bounded by visible physical features observable by the Lister, such as roads and streams.

- *Tabulation geography* is used to report census data to the public and can be bounded by non-visible boundaries that cannot be physically observed on the ground, such as legal or statistical boundaries.

All 2010 Census field operations used geography based on 2010 Census collection geography. The ALMI software is based on current 2000 tabulation geography. Since the LBAC operation used software designed for current surveys and not the decennial census, listing large blocks was limited to the geography used by the ALMI software. Therefore, the LBAC operation required a translation between the 2010 Census collection blocks and 2000 tabulation blocks because there is not a one-to-one correspondence between 2010 Census collection blocks and 2000 tabulation blocks. Generally, there are multiple 2000 tabulation blocks within a 2010 Census collection block. Figure 2.1 shows the conceptual difference between collection block and tabulation block geography.

Figure 2.1: Diagram of Collection Block and Tabulation (Tab) Block Geography



As suggested by Figure 2.1, some addresses were listed twice, once using the HHC with collection blocks and once using the DAAL with tabulation blocks because collection and tabulation boundaries often overlap. The overlap was 667,014 addresses. GEO and DSSD developed an adjudication process to handle the overlap areas during GEO processing. In most cases when an equivalent DAAL and HHC update was received for the same address, the HHC update took precedence. This preserved the GPS coordinate data collected by the HHC. DSSD prepared specifications that outlined the adjudication process for GEO processing.

2.3.3.4 Schedule

The Labor and Crime Surveys Branch in FLD served as the coordinator for the ROs and RCCs during the planning and execution of the LBAC operation. The fieldwork was conducted in two waves to allow an early start on the pre-identified work while allowing time for FLD to identify work. Table 2.17 shows the lines that DMD added to the 2010 Census Schedule associated with the LBAC.

Table 2.17: Large Block Address Canvassing Activities in the 2010 Decennial Census Schedule

Activity	Start	Finish	Conduct Address Canvassing Operation Dates	
Write/deliver LBAC test plan	7/1/08	9/3/08		
Conduct DAAL/ALMI OFT for LBAC	10/29/08	1/5/09		
Mail LBAC input file (IFALMI) CDs to the ROs	12/8/08	12/19/08		
DSSD receives files of pre-identified large blocks from GEO	12/30/08	12/30/08		
Train field representatives on LBAC	1/5/09	3/31/09		
Conduct Wave 1 LBAC Listing and QC	2/2/09	5/11/09	**Start**	**Finish**
Conduct Wave 2 LBAC Listing and QC	2/2/09	6/17/09	3/30/09	7/10/09

Source: 2010 Census Schedule.

2.3.3.5 Estimated and Actual Workloads

This section examines the LBAC workload estimates used for planning assumptions and the actual LBAC workload.

Pre-Identified Large Block Estimated Workload

FLD provided the *expected* workload of pre-identified blocks as listed in Table 2.18. For pre-operational planning purposes, the *Housing Units* columns at the right are based on GEO's *estimated* number of addresses per Census 2000 Tabulation Block prior to any LBAC fieldwork. The regions used these data to determine the number of field staff necessary to complete the pre-identified block workload from the pre-identified block counts and their corresponding estimated HU counts. FLD HQ also used these estimates to determine the necessary resources needed to train and support the LBAC operation.

Table 2.18: Estimated Pre-Identified Large Block Address Canvassing Workloads by Regional Office and Wave

Pre-Identified Large Block Workloads by Regional Office and Wave as of 2/2/2009						
	Tabulation Blocks			Estimated Housing Units*		
Region	Total	Wave 1	Wave 2	Total	Wave 1	Wave 2
Boston	152	55	97	44,049	22,068	21,981
New York	332	290	42	247,945	232,813	15,132
Philadelphia	631	496	135	195,865	167,746	28,119
Detroit	300	182	118	95,770	58,590	37,180
Chicago	218	98	120	44,771	28,026	16,745
Kansas City	469	325	144	79,285	52,944	26,341
Seattle	599	250	349	149,434	94,960	54,474
Charlotte	1,735	1,127	588	329,799	193,717	136,082
Atlanta	3,401	2,306	1,095	1,062,038	737,021	325,017
Dallas	1,747	944	823	669,999	348,043	321,956
Denver	1,757	1,321	436	495,274	441,409	52,865
Los Angeles	1,236	638	598	318,660	128,617	190,043
Total	**12,597**	**8,052**	**4,545**	**3,732,889**	**2,505,954**	**1,226,935**

Source: Excerpt from, "Demographic Area Address Listing Large Block Address Canvassing Assessment." Field Division, Labor and Crime Surveys Branch, J. Godenick and N. Hillila. November 5, 2009, p.16.
*Housing unit columns are *estimated* counts per tabulation block (GEO database).

Actual Workload – Pre-Identified and Field-Identified Workloads

- The actual initial pre-identified large block workload was 3,068,196 addresses in 2,086 collection blocks. The pre-identified large block workload consisted of 12,597 tabulation blocks (translated from 2,086 collection blocks - see Table 2.21) split between two operational waves.

- The field-identified large block workload consisted of 391 tabulation blocks (translated from 440 collection blocks - see Table 2.20). Of the 391 total field-identified tabulation blocks, 116 of these were water blocks and 275 blocks were a combination of valid large blocks and blocks field staff transferred from AC in error.

  Water Blocks

  GEO excluded these blocks in the 2010 AC universe delivered in the GRF-C to the FDCA contractor since they assumed the blocks contained no LQs. Once the FDCA contractor loaded the list of 2010 AC blocks into the OCS, no additional blocks could be included in AC.

  The purpose of adding some of these water blocks into the LBAC workload was to re-include areas with suspected HUs after it was too late to add these to the listing via the AC HHC. The LBAC operation (designed to allow added blocks – i.e., field-identified) became the solution to include these areas that otherwise would have been missed by the 2010 Census.

2.3.3.6 Staffing and Budget

This section examines staffing assumptions, actual staffing, and costs associated with the LBAC.

Staffing Assumptions

The ROs prepared staffing plans after receiving the pre-identified tabulation block and estimated address workloads from GEO. Table 2.19 contains a summary of the RO staffing plans that include Listers, QC Listers, Crew Leaders, and FOSs. Each RO also had at least one Program Supervisor and clerical support person for the program.

Table 2.19: Large Block Address Canvassing Staffing Plan by Regional Office and Position

	New Hires					Current Survey Staff					
RO/RCC	Listers	QC Listers	Crew Leaders	Field Operation Supervisor	Total	Listers	QC Listers	Crew Leaders	Field Operation Supervisor	Total	Grand Total
Boston	29	0	0	0	29	14	23	7	0	44	**73**
New York	112	13	20	4	149	0	22	0	0	22	**171**
Philadelphia	201	15	15	4	235	0	0	0	0	0	**235**
Detroit	36	0	4	0	40	39	17	8	0	64	**104**
Chicago	40	17	17	0	74	0	0	0	0	0	**74**
Kansas City	0	0	0	0	0	72	12	11	0	95	**95**
Seattle	183	30	30	3	246	0	0	0	0	0	**246**
Charlotte	82	0	0	0	82	156	25	25	10	216	**298**
Atlanta	506	33	33	0	572	0	21	21	7	49	**621**
Dallas	229	21	25	0	275	0	8	4	4	16	**291**
Denver	197	27	26	5	255	0	0	0	0	0	**255**
Los Angeles	108	12	26	0	146	50	15	15	13	93	**239**
Total	**1,723**	**168**	**196**	**16**	**2,103**	**331**	**143**	**91**	**34**	**599**	**2,702**

Source: U.S. Census Bureau, "Demographic Area Address Listing Large Block Address Canvassing Assessment." Field Division, Labor and Crime Surveys Branch, J. Godenick and N. Hillila. November 5, 2009, p.16.

The LBAC operation was managed either from the RO or the RCC. Positions in the ROs or RCCs included an RO coordinator, an RO supervisor, various office support positions, an RO computer specialist, and RO computer specialist assistants. Large blocks were listed by a combination of staff already trained on the DAAL/ALMI and new hires who needed DAAL/ALMI training. Field staff positions included FOSs, Crew Leaders, production Listers, and QC Listers. *Listing check* is the ALMI equivalent of QC in the AC operation.

Field initial planning assumptions estimated that the LBAC operation needed 2,613 total field staff and each staff member needed a laptop to complete LBAC assignments. Of these, 605 were current survey staff and 2,008 were new hires. As seen in Table 2.19 these staffing numbers were revised reflecting a modest increase. Appendix D contains more detailed information on LBAC assumptions.

The cost estimate for the LBAC operation, based on assumptions as shown in this section and in Appendix D, was $14,628,704. It is important to note that this cost estimate *did not* include the

field-identified large block workloads. After discussions about the cost estimate assumptions, the budget allocated to the LBAC field operation was $14,521,585.

Staffing Numbers – Actual

Determining staffing for the pre-identified workload posed fewer challenges than the field-identified workload because the pre-identified workload was a known quantity. Determining staffing for the field-identified workload was only an estimate because there was no way to know how many blocks would be identified during the AC operation.

- For the pre-identified workload, HQ instructed the RCCs to complete the 12,597 tabulation blocks in February and March 2009 so that the field staff would be available for the field-identified workload in April, May, and June 2009.

- Staffing for the field-identified workload was reduced when the threshold number of units to classify a field-identified large block increased from 1,000 addresses to 2,000 addresses on February 5, 2009. This resulted in a smaller field-identified workload than the RCCs had anticipated. Since there were only 391 field-identified tabulation blocks, much of the staff that worked in February and March 2009 on the pre-identified workload were not needed in April, May, and June 2009.

Costs – Actual

The LBAC operation was completed on time and under budget.

The spending breakdown for the major activities was:

- $3,126,823 on training
- $962,583 on office work in the RCC
- $619,173 on Crew Leaders and FOSs
- $3,591,662 on listing addresses
- $1,169,392 on performing QC Listing

Actual total expenditures for the LBAC field operation were $10,275,874, or 70.7 percent of the budget allocation.

2.3.3.7 Results

Table 2.20 summarizes the completed workload of LBAC results.

Table 2.20: Summary of Large Block Address Canvassing Results

	Count	Percent of Total Workload
Addresses Listed in LBAC 2000 Tabulation Blocks		
Total addresses listed in LBAC	4,096,642	100.0%
LBAC 2000 Tabulation Block Counts		
Total 2000 Tabulation Block workload in LBAC	12,988	100.0%
Pre-identified tabulation blocks	12,597	97.0%
Field-identified tabulation blocks	391	3.0%
Corresponding 2010 Collection Block Counts		
Total 2010 Collection Blocks	2,526	100.0%
Pre-identified collection blocks	2,086	82.6%
Field-identified collection blocks	440	17.4%
LBAC Productivity Rate		
Production listing hours (C&P)	162,457	
Average hours worked per tabulation block	12.5	
Average number of addresses listed per hour	25.2	

The national average production rate (cases per hour) for the LBAC operation was just over 25 units per hour, which was slightly higher than the expected rate of 25 units per hour. The average time spent canvassing each tabulation block was 12.5 hours.

There were a total of 2,526 collection blocks worked in the LBAC operation (which translated to 12,988 tabulation blocks). Of these, 2,086 collection blocks (82.6 percent) were pre-identified large blocks and removed from the AC workload prior to the start of the operation. Only 440 collection blocks (17.4 percent) were field-identified large blocks.

Table 2.21 provides the distribution of 2010 Census collection and Census 2000 tabulation blocks by HU count range.

Table 2.21: Block Counts by Address Count Range for Pre-Identified and Field-Identified Large Blocks

Pre-Identified Large Blocks					Field-Identified Large Blocks				
Housing Unit Count Range	2010 Collection Blocks		2000 Tabulation Blocks		Housing Unit Count Range	2010 Collection Blocks		2000 Tabulation Blocks	
	Count	Percent	Count	Percent		Count	Percent	Count	Percent
0-1,200	876	42.0%	11,529	91.5%	0	350	79.5%	182	46.5%
1,201-1,400	414	19.9%	314	2.5%	1- 50	64	14.5%	139	35.5%
1,401-1,600	260	12.5%	197	1.6%	51-100	7	1.6%	15	3.8%
1,601-1,800	164	7.9%	142	1.1%	101-200	5	1.1%	20	5.1%
1,801-2,000	105	5.0%	103	0.8%	201-500	6	1.4%	22	5.6%
2,001+	267	12.8%	312	2.5%	501+	8	1.8%	13	3.3%
Total	**2,086**	**100.0%**	**12,597**	**100.0%**	**Total**	**440**	**100.0%**	**391**	**100.0%**

Source: U.S. Census Bureau, Geography Division, "Large Block Summary - DMD," September 29, 2009, based on MTdb query. 2000 Tabulation Block Count Source: SAS data run by Decennial Statistical Studies Division 10/19/10. Percentages may not sum to 100 due to rounding.

Large Block Address Canvassing Quality Control

The LBAC operation included QC listing (also called Listing check by the DAAL operation) for every listed block. The QC process was to be completed the week following completion of the initial listing assignment. There was a bug in the software on the laptops that delayed Listing check for several weeks starting the second week. Listing check was delayed, so as not to create a backlog for FLD with assignments they could not do until the bug was corrected. After the bug was fixed, sampling restarted. QC for Wave 1 and Wave 2 was completed on time at the end of May 2009 and June 2009, respectively.

2.3.3.8 Operation Monitoring with Cost and Progress System Reports

In May 2008, DMD gathered requirements for monitoring LBAC costs and progress in the C&P system. Developing LBAC reports was not as straight-forward as developing C&P reports for the AC operation and differed as follows:

- There was no prior development and testing of reports during previous decennial test cycles and no dress rehearsal on which to base 2010 reports.

- There was no prior experience working with non-decennial source systems to provide data for C&P reports. Because LBAC was managed by the current survey side of the Census Bureau, the LBAC control system was the Regional Office Survey Control Operation (ROSCO) rather than the OCS. While decennial C&P staff had extensive experience in working with DAPPS, the task codes and positions used by current surveys were entirely different than those used by decennial project managers.

- There was an extremely short timeframe to gather report requirements while the working group determined the LBAC operational details. However, current survey and decennial staff succeeded in planning the reports within the timeframe provided.

2.3.3.9 Large Block Address Canvassing Operational Challenges and Successes

LBAC had operational challenges and successes. The highlights are detailed under the following categories:

- Staffing
- Training
- Fieldwork
- Quality Control
- Data
- Updating the MTdb

Staffing Challenges

- The recruiting, hiring, and training process occurred close to the holiday season. As a result, it was sometimes difficult to train staff in time for the February 2, 2009 start date for listing.

- A number of Listers and QC Listers assumed the LBAC project would provide more hours of work and last for a longer period of time than it did. Because that did not prove to be true, many Listers eagerly transferred back to the AC operation with the belief that it would provide more work.

Staffing Successes

- FLD reported the staffing authorization levels were adequate to complete the LBAC operation on schedule and within budget.

- For several regions, the most effective staffing method was to ask their experienced DAAL staff to take on the LBAC assignment, while also hiring new employees. The regions had access to the DAPPS applicant pool as well. Hiring a large number of staff was simplified by dividing the selection activities between supervisors and administrative staff and, in some cases, between the RCCs and the ELCOs.

Training Challenges

- In the RO/RCC debriefings, several regions indicated they would have benefited from additional training for the office staff. Some RO/RCCs believed that there were enough differences between DAAL and LBAC to warrant the creation of new training materials.

- It was a challenge for HQ to prepare training materials and for the ROs to conduct training sessions in the short time allotted. Ideally, the training would have focused more specifically on LBAC rather than regular DAAL.

Fieldwork Challenges

- Some regions were surprised by blocks with a larger number of units than the initial unit count.

- A number of LUCA program adds were apartment buildings with no apartment numbers. The LBAC Lister was instructed to add unit designations for the apartments where there were unspecified unit designations on the address list. There were occurrences when the Lister did not do this, as the ALMI software did not prompt the Lister to update the unit designation as did the HHC.

- Blocks containing more than10,000 units became difficult to work with using the DAAL/ALMI software. These blocks could not be split between several Listers or reassigned if a particular Lister was unable to complete the listing in time. The laptop's memory and speed made it difficult to process the extremely large and complex blocks.

Fieldwork Successes

- The field-identified large block process operated smoothly overall, particularly for an operational contingency plan developed late in the decennial process.

- The LBAC operation started fieldwork in some ROs ahead of schedule with the listing of the blocks beginning on January 12, 2009. This early start allowed these ROs an opportunity to complete the pre-identified work sooner than expected.

- Listing check was used to complete some tasks erroneously excluded by the original Lister, such as adding unit designations to LUCA units with unspecified unit designations.

Quality Control Challenges

- Regions commented that the schedule was challenging because of a delay between the time production work was completed and the time the block was available for QC. A few regions had difficulty retaining staff during the interim period, since there often was not additional work available.

- QC Listers were unable to see Listers' work in two situations:

    - Initially there was a problem with Case Management (CM) that prevented the QC Listers from seeing the Listers' work. Incorrect logic in the CM software caused the problem, which HQ fixed in February 2009. After discovering the problem, no cases were sent to the field until the issue was resolved.

    - Starting in early February 2009, some QC Listers could not see the Listers' work, since no error codes appeared in the ALMI. The solution was to resend the work assignments in separate QC assignment periods. Additional checks searched for and resolved the problem before sending the completed work assignments to TMO.

- There were errors while loading QC datasets: in early February 2009, the ALMI would not load some datasets. HQ wrote a program to detect the problem and then manually fixed the work assignments.

Data Challenges

- LBAC input files for the ALMI (IFALMI) datasets were incorrect for 11 counties in the Baltimore, Maryland and Jacksonville, Florida areas because the LUCA program adds in these locations were put into the wrong blocks. To fix this, GEO reproduced the county datasets for those 11 counties with the correct LUCA geocodes. The incorrect files were returned to DSSD. DSSD gave the new data disc to local LBAC Listers. The ROs loaded the new corrected assignments into ROSCO and CM.

- The ALMI was originally designed for listing mostly rural areas. It was never envisioned that there would be thousands of units added in a block. Due to limitation in the ALMI, when more than 5,000 units were added, all subsequent map spot numbers were given the value 1001. These map spot numbers had to be reassigned at HQ by DSSD before passing them to GEO to update the MTDB.

Data Successes

- The creation and delivery of the Large Block Assignment File by GEO to DSSD worked well. The Assignment File was the file GEO produced for DSSD to send assignments to the DAAL/ALMI users for LBAC. This file converted the collection block(s) to tabulation block(s). GEO identified the work by collection block, and created an Assignment File for DSSD by tabulation block.

MTdb Updating Challenges

- The Progress File and Control File provided by DSSD created some difficulty for GEO. GEO could not always determine which Master Address File Update File (MAFUF) and Automated TIGER Update File (ATUF) were being delivered and which tabulation blocks were included in the delivery. Some deliveries were incomplete or had incorrect data. This resulted in redeliveries or supplemental deliveries from DSSD. At the end of the operation, GEO conducted an inventory of all blocks expected (provided in the Large Block Assignment File from GEO to DSSD) to make sure DSSD delivered all updates. This ensured all large block updates were received by GEO.

- Converting the LBAC output from the ALMI (MAFUF and ATUF) to 2010 AC format (ADDUP and STRUCT) was a difficult and complex process. An *ADDUP* is the address update file and the *STRUCT* is the MAF structure point (or map spot) update file. The differences between the DAAL/ALMI and HHC functionality and procedures added to the complexity of the task. The ATUF file, which contains coordinates for the map spots, was not unduplicated before they were given to GEO and GEO received no instructions for the unduplication or processing of these files.

MTdb Updating Successes

- The purpose of the large block adjudication was to combine the LBAC Listing and QC address updates and assign a final AC outcome code to the LBAC fieldwork. Once a final AC outcome code was obtained, the LBAC updates were applied to the MTdb using the 2010 AC software. The adjudication documentation stated that the HHC updates should take precedence over the DAAL/ALMI updates. GEO met this requirement by using different MAF source codes for the two updates. The *Adjudication of DAAL Updates for 2010 LBAC* (DSSD Memo 2010-D-04R1, U.S. Census Bureau, March 30, 2009) provided GEO with instructions for the adjudication of the 2010 LBAC address updates for Listing and QC. The adjudication process was successfully implemented

- The differences between the collection blocks used in the HHC and the tabulation blocks used in the DAAL/ALMI resulted in a spillover or overlap in some of the addresses listed. During address updating, GEO used a spatial look-up process to determine if the update was in a large block. GEO used the coordinates from the map spot to determine collection block. If the map spot was not available in a large collection block, GEO rejected the update as a spillover unit. For deleted units without map spots, GEO used the tabulation block to determine if the deleted unit was a spillover unit.

2.3.4 Program Monitoring

This section covers the various methods of communication and reports employed during the AC operation.

2.3.4.1 Schedule Monitoring

This topic describes the process of statusing and maintaining the Master Activity Schedule.

Statusing Process

Statusing is the process for updating a schedule in the Primavera software by adding actual start and finish dates, percent complete information, remaining duration information for in-progress activities, and adding any notes relevant to activity status. Once developed and baselined, the AC operational schedule was statused on a regular basis. The updates involved deliverables from each stakeholder division, such as software requirements, software development and testing, and preparation and delivery of field procedures and training materials.

Each stakeholder division had to ensure that its scheduled activities were managed and statused on a weekly basis. Each division had a primary and secondary schedule statusing point-of-contact, who was formally trained on statusing responsibilities and the use of Primavera. Monitoring by the integration teams, census managers, and other staff was the last step in the process. Monitoring was defined as checking or keeping a close watch on the schedule activity start and end dates, ensuring the census was progressing and work was being completed as planned. Each planning team had a designated monitor in DMD, who was responsible for identifying and communicating potential problems and/or late activities to either divisions or teams in a timely fashion to ensure proper action was taken. The monitor also had the responsibility to report on the impacts to any critical milestone activities that ran late.

Schedule Reports

The DMD Management Information Systems (MIS) staff, who managed the scheduling system, provided multiple reports to program managers, team leaders, and division monitors and statusers to help staff manage their individual projects. The DMD MIS staff generated reports using filters that identified specific activities, operations, and schedule reports that showed which activities should have started or finished. Reports could be sorted based on filter, column, name, etc. The most useful reports to the AC program managers were the In-Progress, Finished, and Not Started activity reports which were archived by DMD. Weekly Alert reports were designed for CIG review and contained colored symbols signifying whether key milestone activities were on track (green), were about to become a problem (yellow), or were behind schedule (red). Schedule statusers and monitors quickly took pre-emptive action, where possible, to resolve problem activities showing on the Alert report each week at the multi-divisional Schedule Workshop. Problems that could not be resolved at this lower level were escalated to the CIG for action.

2.3.4.2 Census Operational Status Meetings

The following section discusses the daily meetings, management briefings, and external reporting that occurred during the AC operation.

Stakeholders Daily Meetings

Divisional stakeholders met daily leading up to the start of the operation and throughout the implementation of AC to discuss operational issues and make decisions on how to proceed. Stakeholder divisions which made up the Integrated Project Team (IPT) included the AMSD, FDCA PMO, GEO, FLD, TMO, DMD, and DSSD. This IPT provided daily communication and oversight to all of the development and testing activities leading up to the start of the AC operation. The team had daily contact with the FDCA program contract representatives working on the AC operation that allowed quick identification and resolution of issues.

Census Management Briefings

Management was updated daily through their IPT representatives, but more formal group sessions were held three times a week during the AC operation. These meetings were an opportunity to provide operational data and open discussion about any potential issues. The attendees included managers from the stakeholder divisions and decennial management staff.

Stakeholders presented various reports and graphics containing performance metrics that highlighted progress, costs, or any developing challenges that arose during the operation. System outages, HHC and SD card disposition, access to military installations, and rework were some of the critical issues discussed during these meetings. The typical agenda included, but was not limited to, the following:

- A general review of the meeting agenda
- A review of current progress and cost for the AC and LBAC operations
- A review of current field issues or progress towards closeout by ELCO and RCC
- A review of current staffing levels
- A summary of the Help Desk trouble tickets and their resolution status and progress
- Updates from GEO on the receipt of completed files and processing status
- A final summary of the action items from the meeting

External Reporting

Management reported to Congressional Committees, the Government Accountability Office, and the Commerce Department's Office of the Inspector General. These oversight groups sent observation summaries, preliminary draft reports, and specific questions for which the Census Bureau provided written and oral responses.

3. Methodology

This report answers the assessment questions by gathering and analyzing information from the AC production and tally files. The sources of information were collected from the Time and Motion (T&M) study, debriefings, observation reports, lessons learned, and recommendations from stakeholders involved in the planning and implementation of the AC operation. This section describes the files and methods used to tabulate the assessment data.

3.1 Information Used for the Operational Aspects of the Assessment

- DMD Cost and Progress reports – contain the comparison of budgeted and actual hours, miles, and costs associated with AC training and field work
- Financial Management Reports – provide summary budget allocations and expenditure by month and category
- DMD Cost Models – contain planned staffing and budget allocations, for Production and Quality Control phase of the AC operation
- FLD DAPPS data – contain actual staffing numbers for field positions
- Debriefing, observation, and lessons learned reports – contain qualitative information used for the assessment

3.2 Budget Data Analysis Caveat

The cost results presented in this assessment were generated by program office staff using methods predating the U.S. Census Bureau's commitment to comply with the Government Accounting Office's cost estimating guidelines and the Society of Cost Estimating and Analysis best practices. Hence, while the Census Bureau believes these cost results are accurate and meet the needs for which they will be used, the methods used for estimating costs of 2010 Census operations may not meet all of these guidelines and best practices. The Census Bureau will adhere to these guidelines in producing 2020 Census cost estimates.

3.3 Address Canvassing Address Filter

The Address Filter provided a set of criteria to identify MTdb addresses eligible for AC. There was one set of general criteria that excluded certain addresses immediately and other sets of criteria to identify particular groups of addresses to include in either the AC operation or the LBAC operation. The universe for AC started with the inventory of addresses from Census 2000. The inventory grew as the 2010 LUCA operation, the USPS DSF, and any other field operations (ACS, DAAL, and current demographic surveys) added more addresses (Owens, 2009).

Address Filter General Criteria for All Addresses

The MTdb contains a complete inventory of address records added from many sources including Census Bureau address list development operations. Records classified at the time of creation of the AC universe as a Duplicate, Nonresidential, or others identified as ineligible are never removed from the MTdb. The address records eligible for AC include HUs[2], TLs[3], and GQs[4]. The general criteria for addresses included in the universe for the AC operation are:

- The address must be located in a 2010 Census Collection Block. Census field operations require a block code in order to construct Lister assignments.
- The address must not be in the Rural Update/Enumerate or Remote Alaska TEAs.
- The address must not be considered a sensitive GQ, such as a domestic violence shelter.
- The address must not be a mobile food location or targeted non-sheltered outdoor location.
- The address must not be located on a military ship or maritime/merchant vessel.

Additional criteria, with the exception of LUCA addresses[5], are:

- The address must be classified as residential in the MTdb.
- The address must not be designated as a duplicate in the MTdb. Duplicates in the MTdb were identified through previous census field operations or GEO matching procedures.
- The address must not have been deleted by a legitimate source (e.g., the ACS TOI operation).
- The address must meet the minimum address requirements for location, except in Puerto Rico. The address must at least have a:
    - House number and street name
    - Physical location description and map spot
    - Complete Rural Route address, street name, and map spot
    - Building name and within-unit designation
- The address must not be identified as a duplicate by the ACS GQ Frame Research.
- The address must not have been deleted in the 2008 Census Dress Rehearsal, unless the address has residential status on the spring 2008 DSF or the address was added in the 2008 Census Dress Rehearsal operations following AC (GQV) or Non-ID Telephone Questionnaire Assistance Fulfillment operations.

[2] A housing unit (HU) is any unit (single-family home, trailer, apartment, etc.) that is intended for use as a separate LQ and has direct access from the outside or through a common hallway.
[3] A transitory location (TL) is an LQ where people may stay that do not have a usual home elsewhere. Examples of TLs include campgrounds, carnivals, marinas, and recreational vehicle parks.
[4] A Group Quarters (GQ) is a place where people live or stay that is normally owned or managed by an entity or organization providing housing and/or services for the residents.
[5] LUCA addresses were not required to meet all the additional criteria since LUCA actions needed to be verified in AC.

Address Filter Inclusion Criteria/Groups

The following criteria are hierarchical building blocks for the records eligible for the AC operation. The criteria started with valid Census 2000 address records and then included address records from other legitimate sources, as presented in Table 5.9.

- **Census 2000 addresses:**
  Any address record that was recognized as a good address in the final Census 2000 inventory of HUs was included. If the valid Census 2000 address was identified as a duplicate (retired from the MTdb), then the address it was linked to (the surviving address) was included.

- **Addresses added or reinstated by Count Question Resolution (CQR) operation:**
  CQR is a post-census operation in which local and tribal governments verify the accuracy of legal boundaries and the allocation of LQs in relationship to those boundaries. The operation for Census 2000 resulted in added addresses and the reinstatement of previously deleted Census 2000 addresses, as well as deletions of addresses. Any address record 'validated' through CQR was included.

- **Post-Census DSF adds:**
  Since Census 2000, GEO has updated the MTdb with a DSF twice per year, March and September. Any residential address record that was added to the MTdb through a post-census DSF update was included. The address record was only included if it first appeared as a residential address in the November 1999 DSF or later and it appeared on the most recent DSF (which at the time of the creation of the 2010 Census AC extract files was the spring 2008 DSF). The AC operation included DSF addresses in mixed (city-style and non-city style) address areas. The potential for duplication was high in these types of areas since non-city style addresses were difficult to match to city-style addresses. However, the AC operation was a complete canvas of all collection blocks and the Census Bureau relied on Listers to identify duplicates as they canvassed a block.

  The DSF had addresses with an unknown residential status, known as Excluded from Delivery Statistics (EDS) records. With the aid of other DSF information, GEO identified categories of records as truly invalid (e.g., multi-unit placeholders or commercial units). A subset of the EDS records still had an unknown status. Since they could be legitimate records such as new construction, the records were included in the AC eligible universe as a DSF add for the first time in the 2006 Census Test AC operation. The process was repeated for the 2008 Census Dress Rehearsal and for the 2010 AC operation. All categories of EDS records shown to have a relatively high rate of validity based on results from the 2006 Census Test were included in the 2010 AC workload. Residential Delivery Point Type codes associated with EDS records are assigned according to the designations assigned by the USPS. See Section 5.2.13 for definitions.

- **Census Deletes that persist in the DSF:**
  Any address that was deleted in the process of creation of the final Census 2000 universe but appeared on the most recent DSF as residential was included.

- **DAAL adds:**
  The DAAL program carries out address listing and updating activities for the Census Bureau's demographic surveys and the ACS. The program is the largest source of MTdb updates, aside from the DSF, between the decennial censuses. In general, these updates occur in areas where DSF coverage is incomplete. Any addresses added to the MTdb through the DAAL program were included in AC.

- **Special Census updates:**
  A Special Census is a basic enumeration of population, HUs, and GQs conducted by the Census Bureau at the request of a local governmental unit. Address updates from Special Census operations were included in the MTdb, and any residential address that was verified, added, or changed was included in the AC workload.

- **ACS Time of Interview updates:**
  The ACS is a nationwide survey that replaced the decennial long form after Census 2000. Any address records changed or verified during ACS interviews were included.

- **2010 Census LUCA updates:**
  The 2010 Census LUCA program was designed to utilize the expertise of tribal, state, and local governments to improve the accuracy and completeness of the U.S. Census Bureau's address records. Participants provided updates to GEO that were included in the MTdb prior to AC. Those updated address records were sent to the field for verification by AC Listers.

3.4 Methods

The supporting information to the assessment questions were obtained by gathering and tallying information from the Address Canvassing production files.

Identifying the Initial Address Canvassing Universe/Workload

The initial universe of addresses was available on the GEO extract of the MTdb called the Address Canvassing Product Database (PDB). The AC universe flag (ADCANUNV), the Delivery Specific Address Flag, and the Large Block flag (Collection Block Suffix 2 field contains "LB") on the PDB were used to identify the full universe of address records for both the AC and LBAC operations.

The Geographic Reference File (GRF) was used to identify the universe of 2010 collection blocks and AAs for the AC operation. The GRF was used to report on the number of pre-identified large collection blocks. However, the full universe of collection blocks (pre-identified and field-identified) and tabulation blocks for the LBAC operation were identified on the File of Large Block Assignments provided by GEO.

Reporting on Field Actions

As the Address Canvassing Listers canvassed blocks and updated the address list, their data were recorded and classified through a unique set of codes on the HHC. The HHC actions for each address record were available on the FDCA Census Evaluation and Experiments (CEE) address

files. A FDCA transaction code was assigned to the address record for the production Lister, the QC Lister, and the Final Delete Verification Lister separately.

The FDCA transaction code values are presented below.

FDCA Transaction Code	HHC Transaction Description
A	Added Housing Unit
B	Housing Unit (without changes to the address components)
C	Housing Unit (with changes to the address components)
X	Added Other Living Quarters
Y	Other Living Quarters (without changes to the address components)
Z	Other Living Quarters (with changes to the address components)
D	Does Not Exist (Delete)
T	Duplicate
N	Nonresidential
U	Uninhabitable
V	Added Uninhabitable

Once the Address Canvassing fieldwork was complete, FDCA delivered the ADDUP files to the GEO for the MTdb update. FDCA assigned each record a GEO action code to facilitate the MTdb update. For the report, the field results are presented in terms of the GEO action code, also available on the CEE Address File:

GEO Action Code	ADDUP Action Code Description
A	Add
C	Change to address
D	Delete
K	No change to address, or change to non-address component(s), or duplicate address
N	Nonresidential

The Uninhabitable actions are coded as "C" actions and the Duplicate actions are coded as "K" actions. The GEO Unit Status variable on the CEE Address File was used in conjunction with the GEO Action Code to break out Uninhabitable (Unit Status 31) and Duplicate (Unit Status 7) actions.

The DAAL field results for large blocks were sent to the GEO in the form of Master Address File Update Files (MAFUFs). The MAFUFs were created for the initial listings and the Listing check (LC) operation. The GEO adjudicated the listing MAFUFs with the LC MAFUFs to ultimately create AC ADDUP files. The DAAL field results are presented in terms of GEO AC action codes made available on the ADDUP files.

Reporting on the MTdb Update of Addresses

During the AC operation, the GEO updated the MTdb on a flow basis, with the field results reflected on the ADDUP files. During the update process, records on the ADDUP may not have met requirements for update and were subsequently rejected. In order to assess the MTdb update process, the GEO created tallies during processing that reflect:

- The number of address records received for each of the GEO actions
- The number of address records rejected by reason for rejection

The GEO made the rejected records available in a reject file so that they could be assessed to identify any consistent problems.

The final inventory of updates that were applied to the MTdb was tallied from the GQV/ Initial Universe Control & Management (UC&M) PDB. The action codes from the AC operation are reflected on the PDB with the following codes:

PDB Action Code	PDB Action Code Description
A	Add
C	Change to address
D	Double Delete (Delete record that was verified by a second Lister)
K	No change to address, or change to non-address component(s), or duplicate address
M	Address block move identified during the update process when an Add record matched a Delete record
N	Nonresidential
S	Single Delete (Delete record that was not verified by a second Lister)

Uninhabitable and Duplicate actions may be separated out from the actions above by using the Unit Status code on the PDB in conjunction with the action code.

The results from the AC FDCA solution and the DAAL solution were available on the PDB with the same set of action codes. However, each solution had its own source code so that results may be separated.

Reporting on the Pre-Address Canvassing Status of Adds

Ungeocoded records from the MTdb were not included in the initial AC universe, but they were available on Address Canvassing PDB. After the AC updates were applied to the MTdb, the universe of AC Add records were identified on the GQV/ Initial UC&M PDB. The universe of Add records were matched back to the Address Canvassing PDB using the MAFID. After the match, the following were identified:

- The number of Add records that matched to the Address Canvassing PDB (indicating the address was on the MTdb prior to the operation), and
- Of the matched Adds, how many did not have a 2010 collection block code assigned to them in the Address Canvassing PDB (indicating the record was ungeocoded prior to the operation).

Quality Control Data

The AC QC information was available on the Census Experiments and Evaluations (CEE) Address File, the CEE AA File, and the CEE DQC Results File.

3.5 Data File Descriptions

Several data files were needed to answer the assessment questions. For each table presented in these analysis sections, a data source is given as a footnote to the table. A description of each of the data sources used to create these tables is given below.

- AC Extract Files: ELCO-level extract delivered by GEO to DSSD prior to the AC operation, with the most recent DSF update from spring 2008. An extract is a subset of the MTdb records and variables that a user of the MTdb requests. The record count was 180,703,840 addresses.
- AC GRF-C: A block-level file delivered by GEO to DSSD prior to the AC operation, detailing the collection block universe for AC. The record count was 6,710,413 collection blocks.
- AC Eligible Records: A subset of records in the AC extract that were eligible for the operation. The record count was 144,890,808 address records.
- FDCA Assessment File: File of AC results delivered from FDCA to DSSD for Assessment and Quality Profile purposes. The record count was 159,494,710 address records.
- Large Collection Block MAFUF: Address Update file delivered from DAAL large collection block listing to DSSD for Assessment and Quality Profile purposes. The record count was 4,096,642 address records.
- GEO Reject File: Address records that were rejected during GEO processing. The record count was 1,536,095 address records.
- GEO AC Listed Records Tally File: A list of ELCO-level tallies of AC listed records received and processed by GEO from HHC and large block data collection.
- GEO Map Spot Tally File: A list of ELCO-level tallies of map-spot records processed by GEO from HHC data collection.
- GQV Extract Files: Federal Information Processing Standard-level extract delivered by GEO to DSSD prior to the GQV operation. This file includes updates from AC up to the spring 2009 DSF. The record count was 189,374,944 address records. Of these,

155,167,805 have final actions from the AC operation. This file is also known as the Initial UC&M for the 2010 Census.

4. Limitations

The primary content of this report is similar to that of the assessment report produced for the 2008 Census Dress Rehearsal. There are limitations inherent in comparing results due to procedural and software differences between operations. Table E-1 (see Appendix E) shows the main differences between address compilation operations in Census 2000, the 2008 Census Dress Rehearsal, and the 2010 Census. The 2004 Census Test and the 2006 Census Test were not used in this comparison. Caution should be taken when comparing results across censuses.

4.1 Listing Limitations

HHC limitations led to the LBAC operation, which could better handle blocks with over 1,000 addresses. While AC continued to use the HHC and collection geography, LBAC used the existing ALMI and Census 2000 tabulation geography. This resulted in some overlap because of the differences in collection and tabulation geography. Despite a rigorous adjudication process to match the ALMI listing with the AC listing, 17 ALMI listing case outcomes were not defined by the specification requirements.

4.2 Limitations of the Assessment Data Files

The following limitations impacted the analysis of AC address data. In some cases workarounds were employed and others simply limited the analysis of the AC address data.

Some variable values were not populated in the MAF extracts from GEO, such as the ADCANUNV (AC Universe) variable in the GQV extract files. This limited the ability to trace AC address records through the subsequent GQV operation.

DSSD did not receive an ADDUP file from GEO for the AC listings, thus DSSD was not able to track record changes applied to the MTdb. However, the file FDCA provided to DSSD did match the file FDCA provided to GEO.

LBAC assignments were selected based on 2010 Collection Block size, but the ALMI used Census 2000 Tabulation Blocks to list in the field. The Census 2000 Tabulation Blocks could include more area than just the large 2010 Census Collection Block. As a result, 175,318 records were double-listed by the HHC and the ALMI and both MTdb source records were retained on the MTdb operation files. Refer to Section 2.3.3 for a discussion on the differences.

The category Housing Type in Tables 5.3 and 5.17 and the category Housing Unit Type in Appendix Table C-1.2 were derived from simple records matching of the specified address fields to determine the number of units at a single address location. The variable HUTYPE or a location description was used to determine if an address was a Mobile Home/Trailer. The variable ISOLQ was used to determine if an address was an OLQ.

The category Original Source in Appendix Table C-1.5 was derived from the operational history of the MTdb extract record and the date the record appears on the USPS DSF.

It is important to note that some addresses in the extract files were changed or added by the fall 2008 or spring 2009 DSF update. This is discussed in Section 5.2.16.

The GEO Reject File includes one more record than the number of records rejected denoted in the GEO AC Listed Records Tally File.

Readers need to be careful when comparing data between tables in Section 5.1. For example, the collection blocks counted in Table 5.5 are sourced from the workload canvassed from the FDCA and LBAC collection data. Tables 5.14 and 5.24 were tabulated from changes in the MAF attributed to AC and LBAC as sourced from the GQV extract.

The GQV extract included only HU data, processed by GEO. The FDCA and LBAC collection data contained any collection information: HUs, blocks with no HUs, AC and LBAC duplications (overlap), and other updates that GEO did not accept, etc. Also note that there were blocks canvassed that had no address information, thus no data for either above.

4.3 Data Limitations of GPS Collection Data

The source for the majority of the analysis in this section is the FDCA Assessment File. The universe of records includes those records verified as valid residential addresses by the end of the production and QC phases. In order to maintain consistency with the GEO information, records for analysis were limited to those with a valid status.

Living quarters located in a multi-unit structure could not all be linked to the same map spot. Listers were instructed to collect only one map spot for the building after they listed the first unit. The map spot became part of the HHC address record for the first unit. This map spot was collected at the main entrance, or if the building had no main entrance, at the entrance closest to the first unit. Unlike dress rehearsal, the HHC did not link the building map spot from the first unit with all other units. This situation affects the number of structures (105,923,905 structures) and number of GPS coordinates (103,995,369 coordinates) presented in Table 5.28.

Duplication of records between AC and the LBAC operations affected the count of valid residential address records (132,911,346 address records). See Section 5.2.4 for an explanation of rejected Duplicate listing records.

There is no variable to indicate whether a GPS coordinate was accepted or rejected by GEO on the FDCA Assessment File. The final count for the number of rejected records was taken from the GEO Map Spot Tally File. GEO rejected a total of 1,695,813 GPS coordinates. All other questions are answered using the FDCA Assessment File. See Section 5.3.9 for an explanation of GEO-rejected coordinates.

The FDCA Assessment File has 103,995,369 address records with populated GPS latitudinal and longitudinal coordinates. The GEO Map Spot Tally File has a total of 104,292,813 GPS coordinates. This discrepancy of 297,444 records was due to duplication of address records across deliveries and was resolved by map spot reject reasons.

4.4 Other Limitations

Accuracy of Reported Address Corrections

The final number of address corrections made in the field may be overstated in the final assessment report. Situations where the production Lister corrects the address and then the QC Lister determines that the original address was correct (and therefore changes the record back) are represented as an address correction on the CEE and the GEO files.

Excluding the GPS Coordinates for Military Base Housing Units

Listers were permitted access to military installations, however map spots were not allowed to be collected and the Census Bureau had to delete any previously collected coordinates. The Census Bureau agreed to remove any collected GPS coordinate from their databases for any LQs located on military bases. This process impacted the reporting of the overall success rate for GPS coordinates that were collected.

5. Results

Sections 5.1 through 5.5 provide data to answer the assessment questions and Section 5.6 compares the expected operational planning assumptions to the actual results. Section 5.6 also provides a summary of the observation reports.

5.1 Address Canvassing Workload Input and Output

The primary goal of the AC operation was to update the MTdb for subsequent 2010 Census operations. Sections 5.1 through 5.4 focus on the inputs and outputs of the AC operation and how the results affected the MTdb address information. The workload for AC and LBAC originated from the Census 2000 Block Canvassing operation and other 2000 address listing operations and was supplemented with addresses from the LUCA program and the USPS DSFs.

The initial workload for AC is covered in this section and provides information about the address filter used for AC and operational data limitations. Data are provided to answer Assessment Question 1. The location of additional assessment data to answer this question is shown in the table below.

Assessment Question Answered in Section 5.1	Additional Information
1. What was the initial Address Canvassing universe (Assignment Areas, blocks, and addresses)?	Section: 5.1.1 Tables: 5,1, 5.2, 5.3 Figure: 5.1

5.1.1 Initial Workloads

Assessment Question 1: *What was the initial Address Canvassing universe (Assignment Areas, blocks, and addresses)?*

In Table 5.1, the initial workload for listing was 144,890,808 addresses in 5,961,492 collection blocks comprising 712,938 AAs. AC was conducted in 89 percent of the blocks in the nation and occurred in 3,216 out of 3,221 counties. Because the HHCs could not efficiently handle blocks with a very large number of LQs, most of the collection blocks containing more than 1,000 addresses were removed from the AC universe and canvassed in a special Large Block Address Canvassing (LBAC) operation. As a result, the actual number of addresses loaded onto the HHCs for AC was 141,822,612 addresses in 5,959,406 collection blocks and 711,695 AAs. These addresses comprise the initial workload.

LBAC was conducted using the ALMI. The LBAC operation used Census 2000 tabulation geography to determine assignments due to the data requirements of the ALMI. The pre-identified LBAC listing workload was 3,068,196 addresses in 2,086 collection blocks, which translated to 9,300 Census 2000 Tabulation Blocks containing these addresses. Some of these addresses were in spillover areas so they were listed by both LBAC and AC. LBAC was not conducted in Puerto

Rico, so blocks containing 1,000 or more addresses in Puerto Rico were not removed from the AC universe.

Table 5.1 shows the workload by addresses, collection geography, and field assignments.

Table 5.1: Initial Workload by Addresses, Collection Geography, and Field Assignments

Table 5.1
The 2010 Census Address Canvassing Operation:
Initial Workload by Addresses, Collection Geography, and Field Assignments

Initial Workload	Addresses	Collection Blocks	Assignment Areas+
Total	144,890,808	5,961,492	712,938
United States	143,356,106	5,925,043	702,089
Puerto Rico	1,534,702	36,449	10,849
Total Initial AC Workload	141,822,612	5,959,406	711,695
United States	140,287,910	5,922,957	700,846
Puerto Rico	1,534,702	36,449	10,849
Total Pre-Identified LBAC Workload	3,068,196	2,086	9,300
United States	3,068,196	2,086	9,300
Puerto Rico	0	0	0

+The LBAC Listing used Census 2000 tabulation blocks to locate assignments on the ALMI. Each tab block became the equivalent of an AA to assign work in the ALMI, represented here as blocks with at least one address. The total is all Assignment Areas for all AC Eligible universe geography.

Sources: AC Eligible Records, defined by ADCANUNV, COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, TABBLKST, TABBLKCOU, TABBLKTRACT, and TABBLK variables and AC GRFC file, defined by the AACE, COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, ELCOCE, FLDOPCODE, HOUSING, and LWBLKTYP variables.

Table 5.2 categorizes 2010 Collection Blocks by the number of addresses for blocks eligible for 2010 AC. This table shows that 24 blocks with 1,000 or more addresses were assigned to the initial AC workload. These were located in Puerto Rico. These numbers also show that 37 percent of all the blocks with at least one address contained from one to nine residential addresses, which was consistent with expectations carried from dress rehearsal.

Table 5.2: Collection Blocks Size Based on the Universe of Eligible Addresses

Table 5.2
The 2010 Census Address Canvassing Operation:
Collection Blocks Size Based on the Universe of Eligible Addresses

Block Size Based on Number of Addresses	Count	Percent of total
Total	5,961,492	100.00
0	1,312,235	22.01
1	300,064	5.03
2-9	1,422,670	23.86
10-19	1,097,414	18.41
20-49	1,193,286	20.02
50-99	368,003	6.17
100-499	250,906	4.21
500-999	14,833	0.25
1000+	2,081	0.03
AC Listing Total	5,959,406	100.00
0	1,312,234	22.02
1	300,064	5.04
2-9	1,422,670	23.87
10-19	1,097,411	18.41
20-49	1,193,283	20.02
50-99	368,002	6.18
100-499	250,900	4.21
500-999	14,818	0.25
1000+	24	0.00
LBAC Listing Total	2,086	100.00
0	1	0.05
1	0	0.00
2-9	0	0.00
10-19	3	0.14
20-49	3	0.14
50-99	1	0.05
100-499	6	0.29
500-999	15	0.72
1000+	2,057	98.61

Source: AC GRFC file, defined by the COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, FLDOPCODE, HOUSING, and LWBLKTYP variables.

The initial stateside workload for the HHC listing was 140,287,910 addresses in 5,922,957 collection blocks. These blocks were in 700,846 AAs. In Puerto Rico, the initial workload was 1,534,702 addresses in 36,449 collection blocks, with the blocks comprising 10,849 AAs.

Figure 5.1 displays the initial workload for AC by the number of addresses in each county. Densely populated metropolitan counties are shaded darker than the less populated areas of the nation. However, since the size of counties can differ widely, relative densities between areas are not proportional. For example, compare the representation of Los Angeles County with the five boroughs of New York City. The initial workload in Figure 5.1 includes large blocks. Source data for this figure were the AC extract files.

Figure 5.1: Address Canvassing Initial Workload

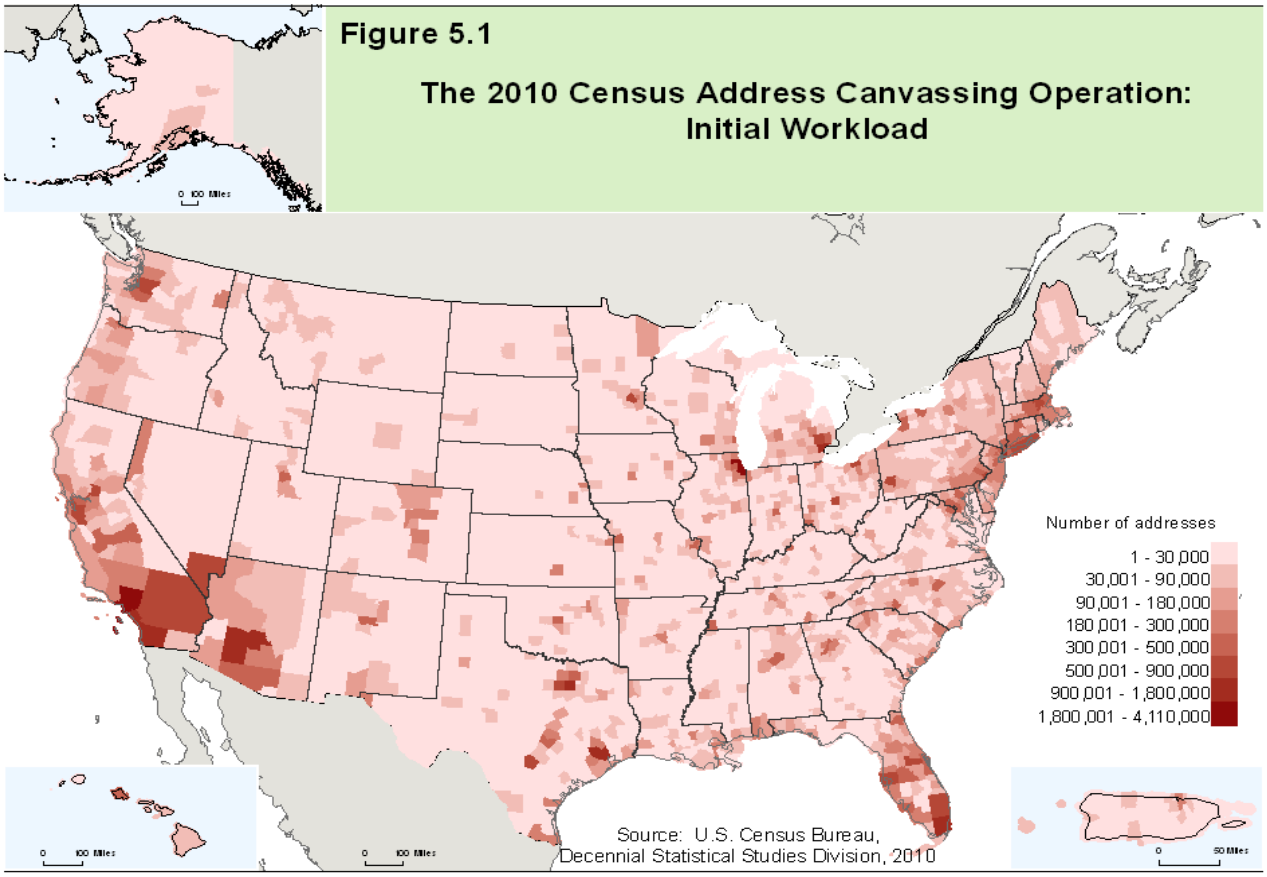


Table 5.3 presents housing type from AC eligible records sorted by the number of units at the basic street address level. The basic street address consists of the location house number, street name, ZIP Code, and collection block identification. It is important to know the number of single versus multi-unit structures included in the AC operation because map spot collection procedures differ between the two structure types. See Section 5.3 for more information. Additionally, this table displays mobile home and trailer counts.

Table 5.3: Address Eligibility by Housing Type

Table 5.3
The 2010 Census Address Canvassing Operation:
Address Eligibility by Housing Type

Housing Type	Count	Percent of total
Total	144,890,808	100.00
Single Unit	101,890,415	70.32
Multi-Unit	42,106,766	29.06
2 - 4 Units	12,087,114	8.34
5 - 9 Units	6,699,626	4.62
10 - 19 Units	4,978,779	3.44
20 - 49 Units	5,482,055	3.78
50+ Units	12,859,192	8.88
Mobile Home/Trailer	893,627	0.62
AC Listing Total	141,822,612	100.00
Single Unit	100,550,406	70.90
Multi-Unit	40,390,609	28.48
2 - 4 Units	12,005,580	8.47
5 - 9 Units	6,620,771	4.67
10 - 19 Units	4,854,528	3.42
20 - 49 Units	5,309,766	3.74
50+ Units	11,599,964	8.18
Mobile Home/Trailer	881,597	0.62
LBAC Listing Total	3,068,196	100.00
Single Unit	1,340,009	43.67
Multi-Unit	1,716,157	55.93
2 - 4 Units	81,534	2.66
5 - 9 Units	78,855	2.57
10 - 19 Units	124,251	4.05
20 - 49 Units	172,289	5.62
50+ Units	1,259,228	41.04
Mobile Home/Trailer	12,030	0.39

Source: AC Eligible Records, as defined by the ADCANUNV, COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, HUTYP, LOCDESC, LOCWDESC1, LOCHNPRE, LOCHN1, LOCHNSEP, LOCHN2, LOCHNPR, LOCNAME, LOCPREDIR, LOCPREQUAL, LOCPRETYP, LOCSUFDIR, LOCSUFQUAL, LOCSUFTYP, LOCZIP, and MAILWSDESC1 extract variables.

Table 5.3 shows that 70.32 percent of the AC listing addresses contained only one LQ. The addresses pre-identified for LBAC listing contained more than one LQ at the same address 56 percent of the time. The other 44 percent of addresses pre-identified for LBAC listing contained only one LQ at the address.

Comparison of Address Canvassing to 2000 Block Canvassing

Table 5.4 compares the 2010 AC initial workload to the Census 2000 Block Canvassing workload and the geographic coverage for each operation. In Census 2000, the Block Canvassing operation used a similar methodology to 2010 Census AC, although it was paper-based. The Block Canvassing initial workload was 91,612,770 stateside addresses inside areas with mail delivery to predominantly city-style addresses, or 'inside the blue-line,' which was the terminology used during Census 2000 to define areas of city and non-city-style addresses. The initial stateside AC workload contained 58 percent more addresses than Block Canvassing. In order to compare the geography, both operations are represented in Table 5.4 by using Census 2000 tabulation geography. Block Canvassing covered 3,801,560 Census 2000 Tabulation Blocks with at least one address, which was 51 percent of all blocks nationally (Burcham, 2002). AC covered 5,667,554 tabulation blocks with at least one address, which was 76 percent of all blocks nationally.

Table 5.4: Initial Workload Comparison to the Census 2000 Block Canvassing Operation

Table 5.4

The 2010 Census Address Canvassing Operation:
Initial Workload Comparison to the Census 2000 Block Canvassing Operation

Initial Workload	Percent increase+	2010 Census Address Canvassing	Census 2000 Block Canvassing
		Count	Count
Addresses	58.16	144,890,808	91,612,770
Census 2000 Tabulation Blocks	49.08	5,667,554	3,801,560
Counties	51.77	3,216	2,119

+Percentages use Census 2000 numbers as the base.
Source: AC Eligible Records, as defined by TABBLK and TABBLKCOU variables and Burcham, 2002.

As shown in Table 5.4, AC canvassed 58 percent more addresses, 49 percent more non-empty tabulation blocks, and 52 percent more counties than Census 2000 Block Canvassing.

5.1.2 Listing Results

During AC, 159,494,710 addresses were compared against the information in the HHC. Similarly, LBAC Listers canvassed 4,096,642 addresses using the ALMI. There were 440 collection blocks defined as large collection blocks by the regions and reassigned to LBAC, according to the data provided by GEO. These collection blocks were converted to the equivalent Census 2000 Tabulations Blocks in order to be canvassed in LBAC. There were 42,002 addresses canvassed in those field-identified blocks.

Table 5.5 shows the combined total AC and LBAC workload, including QC, DV, FDV, and listing check, for stateside and Puerto Rico. For LBAC work, the tabulation geography does not necessarily align with collection geography. LBAC Listers canvassed 2010 Census Collection

Blocks adjacent to and overlapping identified large blocks, which were also canvassed by the AC Listers. Duplicate work from this overlap was resolved in GEO processing (Riley, et. al. 2009). See Section 2.3.3 for a discussion of the difference between collection and tabulation geography.

Table 5.5: Workload Canvassed by Address, Collection Geography, and Field Assignments

Table 5.5
The 2010 Census Address Canvassing Operation:
Workload Canvassed by Addresses, Collection Geography, and Field Assignments

Workload Canvassed	Addresses*	Collection Blocks*	Assignment Areas*+
Total	163,591,352	4,834,665	708,336
United States	161,542,682	4,802,703	697,605
Puerto Rico	2,048,670	31,962	10,731
Total AC Listed	159,494,710	4,812,035	698,654
United States	157,446,040	4,780,073	687,923
Puerto Rico	2,048,670	31,962	10,731
Total LBAC Listed	4,096,642	22,630	9,682
United States	4,096,642	22,630	9,682
Puerto Rico	0	0	0

*The LBAC Collection Blocks counts are the converted collection block equivalents to the Census 2000 Tabluation Blocks listed using the ALMI.
+The LBAC Listing used Census 2000 tabulation blocks to locate assignments on the ALMI. The number denoted for LBAC Assignment Areas is Census 2000 tabulation blocks. The total adds the AC Listed AAs with the LBAC Listed Census 2000 tabulation blocks.
Sources: FDCA Assessment File, Large Blocks MAFUF, as defined by STATE, COUNTY, BLOCK, AA, UBCTRLNUM_MLS, and UBCTRLNUM_MLC variables.

Table 5.6 tracks records sent to AC in the initial workload that were canvassed in AC and LBAC combined with the records added by Listers. *New Addresses Listed* could be an address new to the MTdb, an address that was ineligible for AC, or part of a move action. A *move action* is when an address found in a different block was deleted from the present block and added to the new block. Please refer to Table E-6 in the appendices which trace the initial workload through processing.

- There were 249,247 records from AC Listing with no final Lister action, 10,931 of which were in the initial workload for AC, field-identified within large blocks, and matched to LBAC Listing records.
- The Census 2000 Tabulation Blocks field-identified within large blocks contained 42,002 addresses when canvassed during LBAC Listing.
- There were 667,014 LBAC Listing records that were in the initial workload for AC and were not field-identified within a large block, so they were duplicate listings, due to the conversion overlap between tabulation and collection geography.
- Of the 20,093 LBAC other listing actions, which had no final Lister actions, 39 were matched to MTdb records that were not pre-identified for AC.
- A total of 118,309 records in the initial LBAC workload were not matched to listing records (FDCA Assessment file or large collection block MAFUF). Final GEO processing resulted in:
    - 64,537 records had Delete final AC actions

- 38,117 were Adds matched to existing records
- 15,655 were unmatched records in the initial LBAC workload with no AC final action

Table 5.6: Workload Canvassed by Initial Workload, New Records, or Other Canvassing Actions

Table 5.6
The 2010 Census Address Canvassing Operation:
Workload Canvassed by Initial Workload, New Records, or other Canvassing Actions

Workload Canvassed	Total Addresses Canvassed	Initial/Pre-Identified Workload Addresses Canvassed	Field-Identified Addresses Canvassed	Duplicated AC and LBAC Canvassing	New Addresses Listed	Other Canvassing Actions
Total	163,591,352	144,761,568	42,002	667,014	17,851,428	269,340
United States	161,542,682	143,226,866	42,002	667,014	17,344,902	261,898
Puerto Rico	2,048,670	1,534,702	0	0	506,526	7,442
AC Canvassed	159,494,710	141,811,681	0	0	17,433,782	249,247
United States	157,446,040	140,276,979	0	0	16,927,256	241,805
Puerto Rico	2,048,670	1,534,702	0	0	506,526	7,442
LBAC Canvassed	4,096,642	2,949,887	42,002	667,014	417,646	20,093
United States	4,096,642	2,949,887	42,002	667,014	417,646	20,093
Puerto Rico	0	0	0	0	0	0

Sources: AC Eligible Records, FDCA Assessment File, and Large Blocks MAFUF, as defined by ADCANUNV, DSAF, COLBLK, COLBLKST, COLBLKCOU, COLBLKSUFX2, MAFID, LEGACYMAFID, TABBLK, TABBLKST, TABBLKCOU, TABBLKTRACT, F_ACTION, STATE, COUNTY, BLOCK, BLOCKSUF2, MAFID 2, ACTION CD MLS, UNIT STATUS MLS, ACTION CD MLC, UNIT STATUS MLC, UBCTRLNUM MLS, and UBCTRLNUM MLC

5.1.3 MTdb Action Code Results

Table 5.7 compares the final address actions, after GEO processing, for the 2010 AC and the Census 2000 Block Canvassing operations. Adds and moves were virtually identical, yet changes and negative actions (Deletes, Duplicates, or Nonresidential) increased several times compared to the 2000 operation. The action code Verified dropped from 83 percent in the 2000 operation to 63 percent in 2010, most likely as a result of the LUCA addresses being included in AC which may have impacted the overall quality of address records for each operation. For Census 2000, not all LUCA updates were incorporated into the address universe before Block Canvassing. Single Deletes are not included in Table 5.7, since the Delete action required agreement by two field Listers before that address was made ineligible for further census operations. *Final Address Add Actions* resulted from taking *New Addresses Listed* (from Table 5.6) and comparing them to the MTdb.

Details on the comparison of the canvassed records to the MTdb are found in Table 5.8. See Section 5.2.5 for a further discussion of final actions in the AC operation as it related to updating the MTdb, including single deletes and other comparisons to the Census 2000 Block Canvassing operation.

Table 5.7: Results Compared to the 2000 Block Canvassing Operation

Table 5.7
The 2010 Census Address Canvassing Operation:
Results compared to the Census 2000 Block Canvassing operation

Final Address Actions	2010 Census Address Canvassing		Census 2000 Block Canvassing	
	Count	Percent of total	Count	Percent of total
Total	156,703,156	100.00	97,894,639	100.00
Add	10,776,894	6.88	6,389,271	6.53
New	6,624,155	4.23	4,536,234	4.63
Matches to Existing Record	4,152,739	2.65	1,853,037	1.89
Change	19,608,785	12.51	2,295,168	2.34
Move	5,450,563	3.48	2,948,414	3.01
Verify	97,635,517	62.31	81,115,466	82.86
Negative Actions	21,143,737	13.49	4,972,041	5.08
Does Not Exist (Double Delete only)	15,819,921	10.10	4,452,888	4.55
Duplicate	4,085,556	2.61	154,869	0.16
Nonresidential	1,238,260	0.79	364,284	0.37
Uninhabitable	551,566	0.35	174,279	0.18
Unduplicated Rejected Records	1,536,094	0.98		

The Census 2000 Address Listing operation, an independent listing not depicted above, added 23,271,819 new Stateside and Puerto Rico records to the MTdb. Adds from Address Listing combined with Block Canvassing represent 25 percent of the total actions to update records on the MTdb.
Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Negative Actions and Uninhabitable in this table is the same as "Delete" category in Burcham, 2002.
Sources: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables, GEO AC Listed Records Tally File, Ruhnke, 2002, and Burcham, 2002.

Table 5.8 tracks the records canvassed in AC, combined with the rejected records processed by GEO, to the records with final AC actions on the initial UC&M, or GQV MTdb extract. This shows the listing results in the MTdb.

Table 5.8: Workload Canvassed by Address Canvassing Outcomes

Table 5.8
The 2010 Census Address Canvassing Operation:
Workload Canvassed by AC Outcomes

Workload Canvassed	Addresses Canvassed	Addresses with AC Final Actions		Unknown Records
		Actions Applied to MTdb	Unduplicated Rejected Records	
Total	163,591,352	160,618,175	1,536,094	1,437,083
United States	161,542,682	158,617,758	1,510,240	1,414,684
Puerto Rico	2,048,670	2,000,417	25,855	22,398
Total HHC Canvassed	159,494,710	157,682,056	269,239	1,543,415
United States	157,446,040	155,681,639	243,384	1,521,017
Puerto Rico	2,048,670	2,000,417	25,855	22,398
Total LB Canvassed	4,096,642	2,936,119	1,266,856	106,333
United States	4,096,642	2,936,119	1,266,856	106,333
Puerto Rico	0	0	0	0

Sources: GQV Extract Files, FDCA Assessment File, and Large Blocks MAFUF, as defined by ADCANUNV, DSAF, COLBLKSUFX2, STATE, COUNTY, BLOCK, AA, UBCTRLNUM_MLS, and UBCTRLNUM_MLC variables.

Several inconsistencies appeared between the FDCA Assessment File, the large block MAFUF, the GEO Reject File, and the GQV MTdb extract delivered to DSSD. The FDCA Assessment File and the large block MAFUF contained a combined 163,591,352 records while the GQV MTdb extract and GEO Reject File only accounted for 162,154,269 records. This was because the count from the GQV MTdb extract only included records that had an AC final action. The final action code was populated by the action code from either the 2010 AC source or the LBAC source. The 160,618,175 actions applied to the MTdb differ from the 155,167,805 final address actions applied to the MTdb (shown in Table 5.13) due to the way GEO processed Move actions. If a record with an Add action matched to a record with a Delete action, GEO merged these two records and assigned it a Move action[6].

The majority of the differences occurred between the FDCA Assessment File and the GQV MTdb extract. The FDCA Assessment File contained 159,494,710 records while only 157,951,295 records appeared in the GQV MTdb extract or GEO Reject File, with an action code from AC producing a difference of 1,543,415. These records did not match to a record in the GQV MTdb extract that had an AC action code or a record in the GEO Reject File.

The number of records with final action codes found in the GQV MTdb extract and GEO Reject File exceeded the number of records received in the large block MAFUF. GEO processed 4,395,586 records, which is 298,944 more than the number received in the large block MAFUF. The negative difference of 106,333 comes from these additional processed records. The large

[6] GEO did not assign the record a Move action in the MTdb; it had both an Add and a Delete action assigned to it in the MTdb. This caused two records from the FDCA Assessment File to be applied to one record in the MTdb.

number of rejected records in LBAC can be attributed to the overlap with AC, where the majority of time, the duplicate AC record with coordinates was accepted and the LBAC record was rejected.

Table 5.9 categorizes the AC eligible records in the MTdb according to the filter type. See Section 3 of this document for a description of the filter and criteria. The category *Not Eligible for AC Listing* in the case of *Valid for Address Canvassing* denotes the number of address records eligible for LBAC listing.

Table 5.9: Address Filter Eligibility by Listing Device Eligibility

Table 5.9
The 2010 Census Address Canvassing Operation:
Address Filter Eligibility by Listing Device Eligibility

Address Filter Inclusion Criteria	Count	Percent of total	Eligible for AC Listing		Not Eligible for AC Listing	
			Count	Percent	Count	Percent
Total	180,703,840	100.00	141,822,612	100.00	38,881,228	100.00
Not valid for Address Canvassing	35,813,032	19.82	0	0.00	35,813,032	92.11
Valid for Address Canvassing	144,890,808	80.18	141,822,612	100.00	3,068,196	7.89
Census 2000 address	116,694,815	64.58	115,261,656	81.27	1,433,159	3.69
CQR add or CQR reinstatement	4,672	0.00	4,382	0.00	290	0.00
Post-Census 2000 DSF add	15,709,373	8.69	14,776,862	10.42	932,511	2.40
Census 2000 delete that persists on the DSF	1,554,293	0.86	1,526,707	1.08	27,586	0.07
DAAL or ACS validated address	225,387	0.12	210,604	0.15	14,783	0.04
Census Test or other special update address	419,958	0.23	404,781	0.29	15,177	0.04
LUCA Address	10,282,310	5.69	9,637,620	6.80	644,690	1.66

Source: Address Canvassing Extract Files, as defined by ADCANUNV and ADCANAF variables.

Eligible Addresses

Once the address filter criteria were applied to all the address records in the MAF, GEO produced extract files to use for the AC production operation and for analysis. The addresses that met the filter criteria were flagged as 'eligible' on the extracts.

- There were a total of 144,890,808 eligible MTdb address records, representing 80 percent of all records in the MTdb. For Puerto Rico, in the MTdb, 95 percent were eligible. These two rates are not comparable because some TEAs were excluded from the stateside AC operation.
- Of the eligible addresses, 141,822,612 were delivered for AC listing and 3,068,196 were delivered for LBAC listing.
- Approximately 70 percent of the total AC eligible addresses were designated as addresses containing only one LQ (single unit). Sixteen percent were small multi-units (2 to 19 units).
- Approximately 95 percent were designated as complete city-style addresses.
- The AC and LBAC operations did not include 35,998 address records from TEA 3-Remote Update Enumerate and TEA 4-Remote Alaska.

- Approximately 84 percent of blocks with at least one eligible address had fewer than 50 addresses.
- The 1990 Address Control File is still the major original source at 44 percent of all MAF records and 52 percent of the AC eligible records. In the Census 2000 final address count, the Address Control File was the original source for 62 percent of the 115 million address records (Vitrano, et al. 2004).

5.2 Updating the MAF/TIGER Database

These topics detail final field action codes, final action codes applied to the MTdb, update data for the MTdb, as well as characteristics of certain types of address records. These sections also answer Assessment Questions 3, 4, 5, 6, and 7. The following table lists the location of any additional information for review.

Assessment Questions Answered in Section 5.2[1]	Additional Information
3. What were the final field outcomes for address records? Note: Section 5.1 also provides data for this question.	Sections: 5.2.1, 5.2.2, 5.2.5 – 5.2.10, 5.2.12 Tables: 5.10 – 5.12 Appendix C
4. What were the results of the Master Address File/Topologically Integrated Geographic Encoding and Referencing Database (MTdb) update process for address records?	Sections: 5.2.5 – 5.2.8, 5.2.10, 5.2.12 Tables: 5.13, 5.15 – 5.18, 5.20, 5.21 Figures: 5.2, 5.3 Appendix C
5a. What are the characteristics of Add records?	Section: 5.2.15 Tables: 5.24 – 5.26 Figure: 5.4 Appendix C
5b. How many Adds matched records that were in the MTdb prior to Address Canvassing (geocoded versus ungeocoded)?	Section: 5.2.15 Table: 5.13
6. What are the characteristics of Delete and Duplicate records?	Sections: 5.2.5 – 5.2.9 Tables: 5.14 – 5.18 Appendix C
7. What are the characteristics of Change records?	Section: 5.2.11 Table: 5.15 Appendix C

[1] Each assessment question is answered by specific references in multiple tables and sub-sections, spread throughout the section. The individual assessment questions and references are only noted in the table above and do not appear again throughout Section 5.2.

5.2.1 Lister Action Codes

AC Listers took the first action on an address during the production phase. Listers compared the LQs on the ground to the list of addresses in the HHC and assigned a status to each address on the HHC. Assigning a status to an address is referred to as an *action*. The Listers made corrections to the information in the HHC to match what they found on the ground, including adding addresses. Similarly, the LBAC Listers, using the ALMI software, canvassed their assigned tabulation blocks.

Table 5.10 presents the Lister actions taken for LQs by action type: Adds, Change, Verify, Negative Actions, and Uninhabitable. Sixty-two percent (97,807,744 actions) of AC Lister actions were HU verifies and 65 percent (2,639,575 actions) of LBAC Lister actions were HU address changes. Adds were 11 percent of Lister actions for both AC and LBAC, while negative actions were 23 percent of LBAC Lister actions and 17 percent of AC Lister actions.

The final action code was populated by the action code from either the 2010 AC source or the LBAC source. This was primarily caused by the differences in tabulation and collection blocks as explained in Section 2.3.3. Note that some address records were updated in both AC and the LBAC operations.

Table 5.10: Lister Actions Prior to Quality Control and Delete Verification or Listing Check by Action Type

Table 5.10
The 2010 Census Address Canvassing Operation:
Lister Actions Prior to QC and DV or Listing Check by Action Type

Lister Action	Total Lister Actions		AC Canvassed		LBAC Canvassed	
	Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	162,966,661	100.00	158,934,984	100.00	4,031,677	100.00
Adds	17,545,919	10.77	17,121,253	10.77	424,666	10.53
HU	17,084,244	10.48	16,661,865	10.48	422,379	10.48
OLQ	296,766	0.18	295,039	0.19	1,727	0.04
Uninhabitable	164,909	0.10	164,349	0.10	560	0.01
Change	18,883,888	11.59	16,233,962	10.21	2,649,926	65.73
HU	18,633,568	11.43	15,993,993	10.06	2,639,575	65.47
OLQ	250,320	0.15	239,969	0.15	10,351	0.26
Verfiy	98,415,733	60.39	98,386,906	61.90	28,827	0.72
HU	97,836,540	60.03	97,807,744	61.54	28,796	0.71
OLQ	579,193	0.36	579,162	0.36	31	0.00
Negative Actions	27,586,507	16.93	26,667,805	16.78	918,702	22.79
Does Not Exist (Delete)	21,829,369	13.39	20,954,593	13.18	874,776	21.70
Nonresidential	1,233,914	0.76	1,223,357	0.77	10,557	0.26
Duplicate	4,523,224	2.78	4,489,855	2.82	33,369	0.83
Uninhabitable	534,614	0.33	525,058	0.33	9,556	0.24

*Does not include non-production listing (cases first listed in QC).
Sources: FDCA Assessment File, Large Blocks MAFUF, as defined by TRANSCODE_LIS, ACTION_CD_MLS, UNIT_STATUS_MLS variables.

5.2.2 Quality Control Action Codes

As part of the QC phase of the AC operation, a sample of addresses was randomly selected for the DQC. The sample was selected by AA (for AC assignments) or tabulation block (for LBAC assignments) to ensure that the production fieldwork of every Lister was checked and there were enough addresses in the sample to satisfy quality requirements. If the QC Lister and production Lister disagreed on the status of addresses more than QC thresholds allowed, the QC Lister recanvassed the entire AA or tabulation block.

Another component of QC was the DV check, which ensured that all Delete or Duplicate actions on the address records were confirmed by a second Lister prior to those addresses being removed from the Census universe. If an address was marked as a Delete or Duplicate for the first time in the QC phase of the operation, then a separate QC Lister conducted a FDV for the address record. DV was necessary to ensure that all addresses that received a final Delete or Duplicate action code had been declared a Delete or a Duplicate by two independent individuals to satisfy the Census Bureau's double delete rule. See Section 5.5.3 for more information about the workloads and outcomes of the DV.

The QC Lister confirmed or rejected the actions taken by the production Lister and added new units the Lister missed. Table 5.11 compares the production Lister and QC Lister actions. The following categories group the possible QC Lister actions:

- Blank (A Blank QC action implies no QC action was recorded on the specific address because it was not selected for QC, whereas a Blank Lister action implies the record was added during QC or there were processing issues with the address)
- Added HUs, OLQs, or Uninhabitable
- Change, Verify, Move, or Uninhabitable actions for HUs, which were positive actions indicating valid HUs
- Delete, Nonresidential, or Duplicate actions, which were negative actions indicating invalid HUs
- Change, Verify, or Uninhabitable actions for OLQs

Table 5.11: Lister Actions by Quality Control Actions by Action Type

Table 5.11
The 2010 Census Address Canvassing Operation:
Lister Actions by Quality Control Action Type

Lister Action	Total Lister and QC Lister Actions	Production or QC		QC Action Type			
		Lister Actions with no QC	Total QC Lister Actions	Added HU, OLQ, Un-inhabitable	Change, Verify, Uninhabitable HU	Negative Actions	Change, Verify, Uninhabitable OLQ
Total	163,591,352	117,355,798	46,235,554	597,041	19,060,734	26,389,683	188,096
Blank	624,691	8,881	615,810	591,795	9,408	14,603	4
Added HU or OLQ	17,545,919	14,840,408	2,705,511	5,246	2,402,697	248,777	48,791
Change, Verify, Uninhabitable HU	117,038,023	100,696,431	16,341,592	0	15,805,241	515,822	20,529
Negative Actions	27,553,197	1,107,132	26,446,065	0	827,234	25,591,987	26,844
Change, Verify, Uninhabitable OLQ	829,522	702,946	126,576	0	16,154	18,494	91,928
Total AC Listed	159,494,710	115,171,393	44,323,317	550,845	18,048,418	25,539,414	184,640
Blank	559,726	8,881	550,845	550,845	0	0	0
Added HU or OLQ	17,121,253	14,559,292	2,561,961	0	2,279,419	233,942	48,600
Change, Verify, Uninhabitable HU	114,326,795	98,880,018	15,446,777	0	14,951,756	475,180	19,841
Negative Actions	26,667,805	1,028,857	25,638,948	0	801,367	24,811,890	25,691
Change, Verify, Uninhabitable OLQ	819,131	694,345	124,786	0	15,876	18,402	90,508
Total LBAC Listed	4,096,642	2,184,405	1,912,237	46,196	1,012,316	850,269	3,456
Blank	64,965	0	64,965	40,950	9,408	14,603	4
Added HU or OLQ	424,666	281,116	143,550	5,246	123,278	14,835	191
Change, Verify, Uninhabitable HU	2,711,228	1,816,413	894,815	0	853,485	40,642	688
Negative Actions	885,392	78,275	807,117	0	25,867	780,097	1,153
Change, Verify, Uninhabitable OLQ	10,391	8,601	1,790	0	278	92	1,420

Sources: FDCA Assessment File, Large Blocks MAFUF, as defined by TRANSCODE_LIS, TRANSCODE_QC, TRANSCODE_FDV, ACTION_CD_MLS, UNIT_STATUS_MLS, ACTION_CD_MLC, and UNIT_STATUS_MLC variables.

Table 5.11 provides the following information:

- Lister Actions with no QC: There were 117,355,798 or 72 percent of all records, on the FDCA Assessment File and large block MAFUF without a QC action because they were not selected for the QC sample or visited as part of DV. There was not a 100 percent QC for AC.

- Lister actions with QC: There were QC actions for 28 percent of all the address records on the FDCA Assessment File and the Large Block MAFUF. These records were checked as part of the DQC or the recanvass of AAs that failed DQC.

- Address records added during QC: There were 591,795 records in either the AC or LBAC listing operations added only as part of the QC operation. This number is represented in Table 5.11 as records with a Blank Lister action and an added HU or OLQ in QC. Of these records, 512,275 were added as part of recanvassing of AAs that failed DQC.

- Lister Adds Included in QC: There were 2,705,511 (the sum of non-blank QC actions on added HUs or OLQs) production Lister added addresses included in QC. Approximately 9 percent of those addresses received a negative action during QC (9 percent for AC listing and 10 percent for LBAC listing). The corresponding rate from the 2008 Census Dress Rehearsal was approximately one of out six.

Some addresses were not canvassed in production: 559,726 AC listing records and 64,965 LBAC listing records. Of the addresses not canvassed in production, all addresses except 8,881 were canvassed in QC. These 8,881 addresses were field-identified as large blocks and were assigned to the LBAC operation.

5.2.3 Action Codes from the Field to Update the MTdb

The ADDUP file for the AC listing was not provided to DSSD, so analysis cannot be provided for this listing. The FDCA Assessment File provided to DSSD had 249,364 more records compared to the number of records received by GEO according to the GEO AC Listed Records Tally File for HHC sources.

According to the LBAC MAFUF, a total of 4,096,642 addresses were listed in the LBAC listing. Of those addresses, 16,255 records were excluded by processing specification definition: Adds in listing (production) that had different actions for the same address record in listing check (QC), such as Change, Delete, or Nonresidential (Owens, 2009). The large block MAFUF shows that 5,246 records had action and unit status updates which were defined as not possible, such as Adds in both listing and listing check. There were 17 records with an Undefined action and unit status update combination, the majority of which were Deletes or Duplicates in listing and defined as Moves in listing check. According to the GEO AC Listed Records Tally File for LBAC sources, GEO received 4,395,586 address records, which is a difference of 298,944 additional records.

5.2.4 Rejected Records by the Geography Division

To update the MTdb for subsequent Census operations, GEO processed the files delivered by FDCA and DAAL. This processing can contribute to discrepancies between counts of addresses from the update files because GEO can reject certain records or actions made on MTdb records. According to GEO counts provided to DSSD for the assessment report, GEO received 163,640,932 records and processed 162,104,838 records.

Table 5.12 shows GEO rejected 2,205,702 records from AC, or approximately 1 percent of all processed records. With the exception of the last reject category, 1,536,095 reject actions had either a unique MAFID or no MAFID for Add actions.

Table 5.12: Rejected Records by Reject Reason

Table 5.12
The 2010 Census Address Canvassing Operation:
Rejected Records by Reject Reason

Reject Reason	Count*	Percent of total
Total	2,205,702	100.00
Operational Design	1,431,306	64.89
(Code=23) LBAC action on a record that is not in a Large Block	1,207,648	54.75
(Code=L) Matching duplicate positive actions	223,302	10.12
(Code=19) HHC listing in a LB area	356	0.02
Unacceptable Lister Actions	81,374	3.69
(Code=E) Illegal Action Code/Residential Status Code combination	18,612	0.84
(Code=O) Attempting updates utilizing a house number change and record retirement	19,777	0.90
(Code=P) Multiple transactions targeting the same MAFID	57	0.00
(Code=Q) House number trade in same block (stateside only)	12,862	0.58
(Code=1) Incomplete Location Address or there is a physical location description	19,150	0.87
(Code=2) Incomplete Location Address without a physical location description	9,018	0.41
(Code=3) Incomplete Mailing Address	1,847	0.08
(Code=13) Stateside OLQ Add or Changes must have a location building ID	34	0.00
(Code=15) Added an incomplete mailing address	14	0.00
(Code=21) Invalid characters from Change actions in HHC listing of LUCA source record	3	0.00
Other Processing Requirements	23,415	1.06
(Code=K)Target MAFID could not be found in the MTdb	1,880	0.09
(Code=10) Address components changed since 2010 AC. Several exceptions apply	253	0.01
(Code=20) Not eligible for Address Canvassing record or not found in the MTdb	21	0.00
(Code=30) Positive LBAC actions with no matching structure information*	21,261	0.96
Duplicated deliveries	669,607	30.36
(Code=31) Duplicated MAFID in Harris HHC delivery	669,607	30.36

*The GEO Reject File excludes 1 record that is included from the ADDUP files here. All reject records (except Code=31) have unique or missing IDs.
Source: GEO Reject File as defined by REJECT variable. Reject code 31 count is from the Geo AC Listed Records Tally File.

Three categories account for over 95 percent of rejected AC records. The large block rejected actions where the structures were not located in a large block was the single largest reject category accounting for 1,207,648 records, or 55 percent of all the rejects. The second largest category, consisting of 669,607 records, or 30 percent, was multiple actions targeting the same MAFID by HHC and LBAC operations. When the AC listing action disagreed with the LBAC listing action, the positive action was taken over the negative action. When they agreed, the AC listing action was applied, in order to retain the GPS map spot. Duplicate positive action updates to the same record by the same operation account for 10 percent of AC rejects. All other categories are each less than 1 percent of rejected records.

5.2.5 Final Action Codes to Update the MTdb

This topic examines the action codes and final status of the AC records on the GQV extracts of the MTdb. The GQV operation followed AC in the field. MTdb action codes did not always reflect the action taken on the record by the AC or LBAC Listers due to possible changes during GEO processing.

The final actions are listed below with the description of each action.

- **New Add:**
  A record was new to the MTdb and had a MAF source indicating it came from the AC or LBAC operation.

- **Add that matches to existing record:**
  A record matched to an existing record whose original source was not the 2010 AC operation.

- **Change:**
  The record had a change to some address component of the record.

- **Move:**
  The record was deleted by a Lister in one block and the same address was added in a different block This was accomplished during processing and was not a valid field action.

- **Verify:**
  The record was verified in the field without changes to address or unit status and is not a duplicate of another record, but may have changes such as assigning the HU type, or adding other structure information. A record where the only update was to the map spot coordinates or unit status was considered to be a Verify, rather than a Change.

- **Double Delete:**
  The address did not exist in the block as confirmed by at least two Delete actions. The record was not eligible for subsequent Census operations.

- **Single Delete:**
  Address did not exist in the block but had been confirmed with only a single Delete action. These were accepted as Double Deletes in most situations through contingency programming.

- **Duplicate:**
  Record was a duplicate of another in the AC universe. The record was not eligible for subsequent Census operations.

- **Nonresidential:**
  Address used entirely for commercial purposes. The record was not eligible for subsequent Census operations.

- **Uninhabitable:**
  The record had a change in unit status to uninhabitable.

The records included in the following tables are all records on the GQV extract of the MTdb with an AC or LBAC action code from the 2010 AC operation, and/or were in the original set of addresses provided to AC. Note that the first category included units added in AC, whereas the

second category ensured that units in the AC universe were included in the census if AC did not act on them. Table 5.13 presents the GEO updates to the MTdb for the combined AC and LBAC final address actions. Additional tables relating to the MTdb updates are located in Appendix C.

Table 5.13: Final Address Actions Applied to the MTdb

Table 5.13
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb

Final Address Actions Applied to MTdb	Count*	Percent of total
Total	155,167,805	100.00
Add	10,776,894	6.95
New	6,624,155	4.27
Matches to Existing Record	4,152,739	2.68
Change	19,608,785	12.64
Move	5,450,563	3.51
Verify	97,635,517	62.92
Negative Actions	21,144,480	13.63
Does Not Exist (Delete)	15,820,664	10.20
Double Delete	15,819,921	10.20
Single Delete	743	0.00
Duplicate	4,085,556	2.63
Nonresidential	1,238,260	0.80
Uninhabitable	551,566	0.36

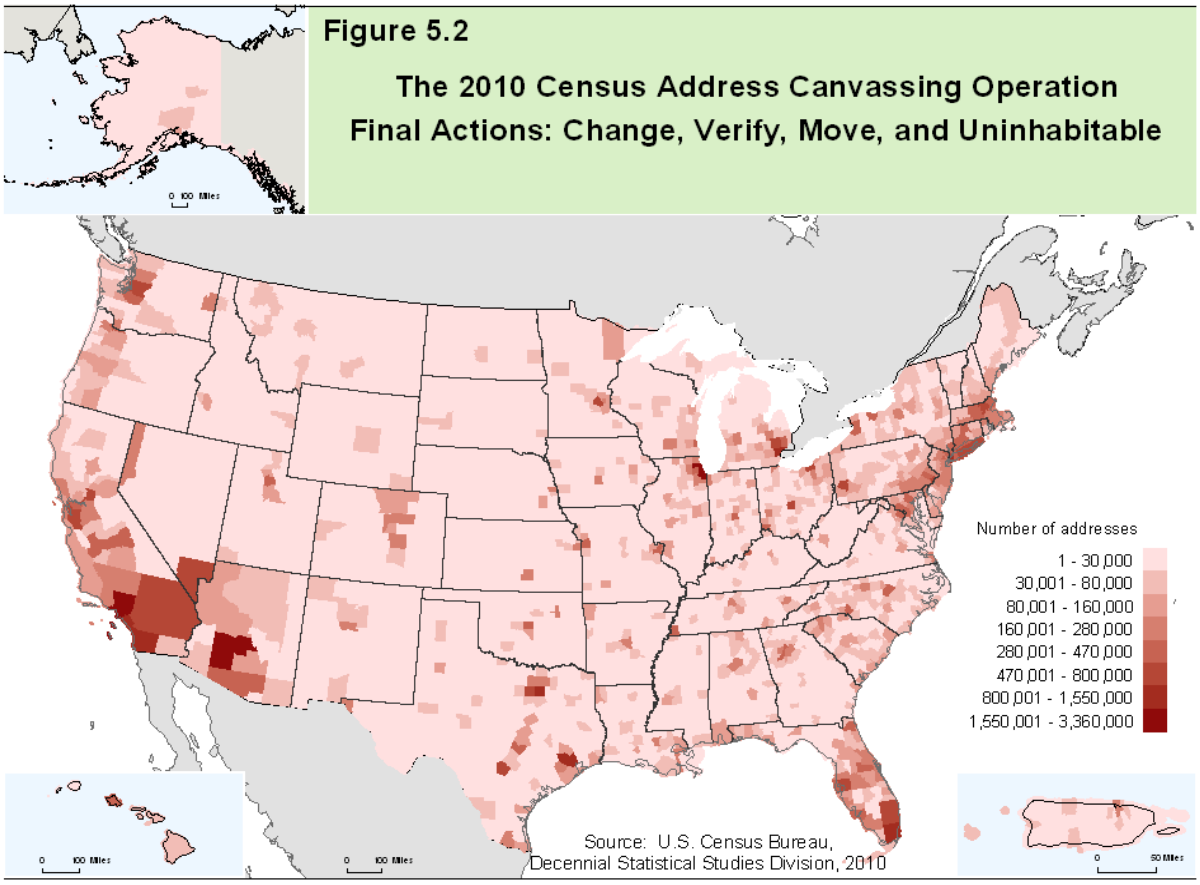
*Counts are combined AC and LBAC actions.
Negative Actions and Uninhabitable in this table is the same as "Delete" category in Burcham, 2002.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables.

The 2010 AC operation had over 10,000,000 Adds representing nearly 7 percent of the universe after final GEO processing. These Adds were a combination of new records to the MTdb and matches to existing MTdb records. Of the added addresses that could be matched to existing MTdb records, according to specified matching rules, 3,915,995 addresses were initially not eligible for the AC operation due to the address filter criteria, mainly addresses not geocoded, or were added to the MTdb after the AC extract file creation. For further information regarding these Adds see Section 5.2.15. Changes to existing records encompassed 13 percent and block moves represented 4 percent of actions. Verifications of existing address records were 63 percent of the universe. Negative actions, including Double Deletes, single Deletes, identification of Duplicates, and changes to Nonresidential status, were 14 percent of all actions. Finally, less than 1 percent of actions identified units as Uninhabitable.

The outcomes for final address actions in AC were similar to the dress rehearsal outcomes. The percent of 2010 AC Adds, Uninhabitable, and negative actions are virtually identical to the dress rehearsal rates. The percentage of addresses with a Change action decreased in 2010 while the percentage of addresses with a Move or Verify action increased.

Figure 5.2 displays the coverage of AC final address Change, Verify, Move, and Uninhabitable actions by address records in each county. Source data for this figure were the GQV extract files.

Figure 5.2: Final Actions – Change, Verify, Move, and Uninhabitable



The address records shown in this map represent the addresses remaining in the Census universe after AC final actions. It is important to note that address representation on the HHC affected the Delete and Add rates. For instance, if an address shown on the HHC with only a location description was the same as a structure on the ground with a house number, the Lister may have deleted the address on the HHC and re-added it using its city-style address. Section 5.2.11 examines potential explanatory variables for these results of updates to the MTdb. Characteristics of records that received certain actions in the field are considered by creating counts of the final action codes by variables on the MTdb in the following sections of this assessment report.

Figure 5.3 displays the coverage of AC final address Delete, Duplicate, and Nonresidential actions by address records in each county. The address records shown in this map represent the 2,205,702 addresses removed from the Census universe by AC final actions. Source data for this figure were the GQV extract files.

Figure 5.3: Final Actions – Delete, Duplicate, and Nonresidential

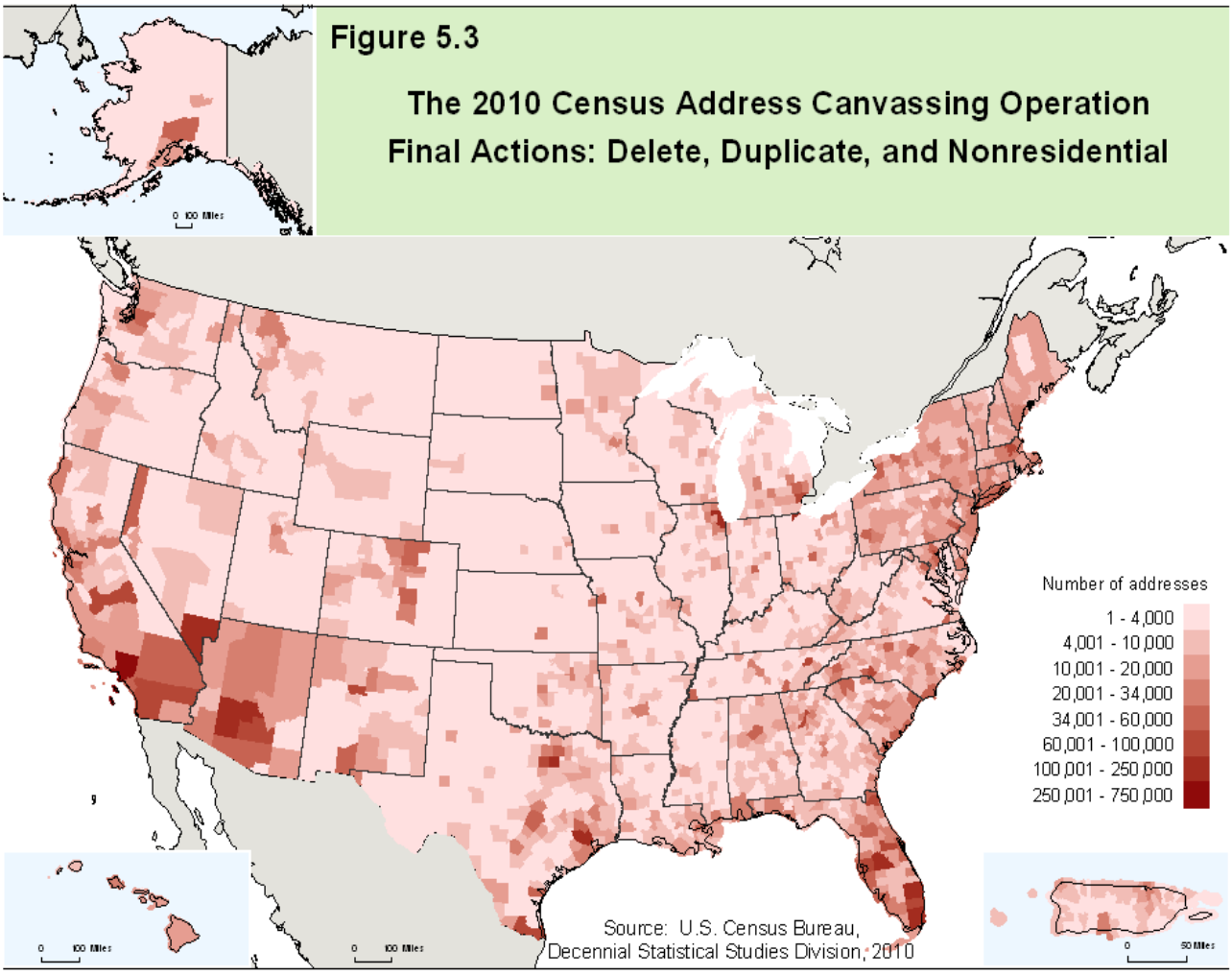


Table 5.14 explores the distribution of collection blocks with HU Deletes (includes both single Deletes and Double Deletes) by total number of Deletes within a collection block. Collection blocks with two to nine deleted records had the largest rate of deletions at 53 percent.

Table 5.14: Number of Deletes Within a Collection Block on the MTdb

Table 5.14
The 2010 Census Address Canvassing Operation:
Number of Deletes within a Collection Block on the MTdb

Deletions per Block	Number of Blocks	Percent of total	Blocks with All Units Deleted	Percent of total
Total Blocks	4,774,329	100.00	4,774,329	100.00
0	1,856,937	38.89	4,647,768	97.35
1	825,012	17.28	66,249	1.39
2-9	1,539,732	32.25	48,200	1.01
10-19	243,627	5.10	5,952	0.12
20-59	173,825	3.64	3,873	0.08
60-99	38,998	0.82	1,265	0.03
100-499	59,936	1.26	960	0.02
500-999	11,885	0.25	52	0.00
1000+	24,377	0.51	10	0.00

Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and COLBLKST, COLBLKCOU, and COLBLK extract variables.

The 825,012 blocks with one deleted unit represent approximately 28 percent of collection blocks with any Delete action (excluding blocks with no deletes). Collection blocks with large numbers of Deletes, greater than 500 in the block, represent less than 1 percent of all collection blocks with a Delete action. Less than 3 percent of all blocks had all units deleted in the block. Blocks with large numbers of deletes may have been caused by major address changes within a block or large multiunit structure(s) originally coded to the wrong address or block.

5.2.6 Final Actions by Census 2000 Status

Table 5.15 contains the final 2010 Census AC actions and whether the address was in the final Census 2000 universe. Of the 155,167,805 addresses that received a final action during 2010 Census AC, nearly 74 percent were units contained in the final Census 2000 universe. The distribution of final actions for those units in the final Census 2000 universe closely follows the overall distribution of final actions. The exception is for the Add actions. Just over 16 percent of final actions for units not in the final Census 2000 universe were classified as "New" records. Units not in the final Census 2000 universe had a higher rate of negative actions, in all categories, but mostly attributed to Deletes, at nearly 19 percent. They also had a lower rate of Verifies, 34 percent compared to 73 percent, which, taken together, implies that a large payoff from AC was the inclusion of units added since Census 2000. These results may indicate the increased cost and complexity of adding valid units to the address list by having to follow-up on a higher rate of invalid units.

Table 5.15: Final Address Actions Applied to MTdb by Inclusion in the Census 2000 Universe

Table 5.15
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb by Inclusion in the Census 2000 Universe

Final Address Actions Applied to MTdb	Count*	Percent of total	Unit in the Final Census 2000 Universe		Unit not in the Final Census 2000 Universe	
			Count*	Percent of total	Count*	Percent of total
Total	155,167,805	100.00	114,788,595	100.00	40,379,210	100.00
Add	10,776,894	6.95	152,167	0.13	10,624,727	26.31
New	6,624,155	4.27	16	0.00	6,624,139	16.40
Matches to Existing Record	4,152,739	2.68	152,151	0.13	4,000,588	9.91
Change	19,608,785	12.64	15,306,011	13.33	4,302,774	10.66
Move	5,450,563	3.51	4,003,764	3.49	1,446,799	3.58
Verify	97,635,517	62.92	83,817,786	73.02	13,817,731	34.22
Negative Actions	21,144,480	13.63	11,057,645	9.63	10,086,835	24.98
Does Not Exist (Delete)	15,820,664	10.20	8,290,688	7.22	7,529,976	18.65
Double Delete	15,819,921	10.20	8,290,126	7.22	7,529,795	18.65
Single Delete	743	0.00	562	0.00	181	0.00
Duplicate	4,085,556	2.63	2,414,915	2.10	1,670,641	4.14
Nonresidential	1,238,260	0.80	352,042	0.31	886,218	2.19
Uninhabitable	551,566	0.36	451,222	0.39	100,344	0.25

*Counts are combined AC and LBAC actions.

Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the CENSUS2000 extract variable.

5.2.7 Final Actions by Type of Enumeration Area

The final 2010 Census AC actions by the TEA variable on the MTdb are outlined in Table 5.16. TEA specifies which operations, subsequent to AC, were utilized for questionnaire delivery. MO/MB was used for the majority of addresses in the country and was intended for areas where most HUs had city-style addresses and received mail by the USPS. In the MO/MB areas, Census questionnaires were mailed to the addresses and delivered by the postal service. HUs in military areas were enumerated in MO/MB, but were a separate TEA. In U/L and Urban Update/Leave (UU/L) areas, the Census Bureau delivered the questionnaires instead of the postal service but respondents returned questionnaires via the postal service like respondents do in MO/MB areas. The UE TEA was assigned to areas where deliverability was troublesome and response rates were predicted to be so low that MO/MB followed by Nonresponse Followup operation would be less efficient than sending field staff directly to do the enumeration.

Table 5.16: Final Address Actions Applied to the MTdb by Type of Enumeration Area

Table 5.16
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb by Type of Enumeration Area

Final Address Actions Applied to MTdb	Count	Percent of total	1-Mailout/Mailback		6-Military		2-Update/Leave and 7-Urban Update/Leave		5-Update Enumerate		Other	
			Count*	Percent of total	Count*	Percent of total	Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	155,167,805	100.00	137,127,326	100.00	379,376	100.00	15,798,844	100.00	1,862,258	100.00	1	100.00
Add	10,776,894	6.95	7,650,147	5.58	69,133	18.22	2,710,162	17.15	347,452	18.66	0	0.00
New	6,624,155	4.27	4,055,240	2.96	32,057	8.45	2,248,824	14.23	288,034	15.47	0	0.00
Matches to Existing Record	4,152,739	2.68	3,594,907	2.62	37,076	9.77	461,338	2.92	59,418	3.19	0	0.00
Change	19,608,785	12.64	15,270,008	11.14	40,469	10.67	3,907,613	24.73	390,695	20.98	0	0.00
Move	5,450,563	3.51	5,145,985	3.75	29,698	7.83	237,000	1.50	37,880	2.03	0	0.00
Verify	97,635,517	62.92	91,870,202	67.00	102,534	27.03	5,035,159	31.87	627,622	33.70	0	0.00
Negative Actions	21,144,480	13.63	16,765,839	12.23	134,844	35.54	3,795,414	24.02	448,382	24.08	1	100.00
Does Not Exist (Delete)	15,820,664	10.20	12,738,555	9.29	128,114	33.77	2,645,859	16.75	308,135	16.55	1	100.00
Double Delete	15,819,921	10.20	12,737,917	9.29	128,114	33.77	2,645,755	16.75	308,134	16.55	1	100.00
Single Delete	743	0.00	638	0.00	0	0.00	104	0.00	1	0.00	0	0.00
Duplicate	4,085,556	2.63	2,923,564	2.13	4,407	1.16	1,035,709	6.56	121,876	6.54	0	0.00
Nonresidential	1,238,260	0.80	1,103,720	0.80	2,323	0.61	113,846	0.72	18,371	0.99	0	0.00
Uninhabitable	551,566	0.36	425,145	0.31	2,698	0.71	113,496	0.72	10,227	0.55	0	0.00

*Counts are combined AC and LBAC actions.

Verify in this table means that the address was found in AC and there were no changes to the address component of the record.

Other in this table includes 4-Remote Alaska, 3-Remote Update/Enumerate and 9-Island Areas List/Enumerate. All of 1,995,746 address actions in Puerto Rico were assigned TEA 2-Update/Leave.

Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the TEA extract variable.

The MO/MB addresses comprised 88 percent of the total actions after GEO processing and had approximately only one-third as many Adds and substantially fewer negative actions than the other TEAs. Conversely, the U/L, UU/L, and UE categories, encompassing rural and urban areas, had over two times the rate of Adds and almost double the rate of negative actions compared to MO/MB areas. For these addresses, over 16 percent of all final actions were Deletes, and over 6 percent were Duplicates. These results were consistent with expectations in hard-to-enumerate areas or areas consisting of different address types that usually prompt more changes to the address list, such as non-city-style addresses or conversion to city-style addresses. The military TEA had higher rates of Adds, at 18 percent, as well as negative actions, at 36 percent. The distribution of TEA for addresses is approximated because enumeration area was not determined during GEO processing for addresses with a negative action.

5.2.8 Final Actions by Housing Type

Table 5.17 presents records applied to the MTdb with final AC actions sorted by housing types. The basic street address consists of the location house number, street name, ZIP Code, and collection block identification. The records that had been identified as a mobile home or trailer by either HU type, within location or mailing address description variables, are indicated by the Mobile Home/Trailer category.

Table 5.17: Final Address Actions Applied to the MTdb by Housing Unit Type

Table 5.17
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb by Housing Type

Final Address Actions Applied to MTdb	Count*	Percent of total	Single Unit		Multi-unit		Mobile Home/ Trailer	
			Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	155,167,805	100.00	102,290,167	100.00	44,380,494	100.00	8,497,144	100.00
Add	10,776,894	6.95	6,344,195	6.20	2,942,270	6.63	1,490,429	17.54
New	6,624,155	4.27	3,596,062	3.52	1,872,623	4.22	1,155,470	13.60
Matches to Existing Record	4,152,739	2.68	2,748,133	2.69	1,069,647	2.41	334,959	3.94
Change	19,608,785	12.64	10,061,352	9.84	7,772,998	17.51	1,774,435	20.88
Move	5,450,563	3.51	3,291,884	3.22	1,625,130	3.66	533,549	6.28
Verify	97,635,517	62.92	68,896,082	67.35	24,355,542	54.88	4,383,893	51.59
Negative Actions	21,144,480	13.63	13,381,776	13.08	7,522,959	16.95	239,745	2.82
Does Not Exist (Delete)	15,820,664	10.20	10,356,439	10.12	5,275,549	11.89	188,676	2.22
Double Delete	15,819,921	10.20	10,356,137	10.12	5,275,111	11.89	188,673	2.22
Single Delete	743	0.00	302	0.00	438	0.00	3	0.00
Duplicate	4,085,556	2.63	2,200,155	2.15	1,838,281	4.14	47,120	0.55
Nonresidential	1,238,260	0.80	825,182	0.81	409,129	0.92	3,949	0.05
Uninhabitable	551,566	0.36	314,878	0.31	161,595	0.36	75,093	0.88

*Counts are combined AC and LBAC actions.

Verify in this table means that the address was found in AC and there were no changes to the address component of the record.

Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the COLBLKST, COLBLKCOU, COLBLK, HUTYP, LOCDESC, LOCWDESC1, LOCHNPRE, LOCHN1, LOCHNSEP, LOCHN2, LOCHNPR, LOCNAME, LOCPREDIR, LOCPREQUAL, LOCPRETYP, LOCSUFDIR, LOCSUFQUAL, LOCSUFTYP, LOCZIP, and MAILWSDESC1 extract variables.

Looking at the totals as shown in Table 5.17, 66 percent of the addresses listed in AC with a final action code were single unit structures while multi-unit structures accounted for 29 percent, and mobile homes made up the remaining 5 percent. Sixty-seven percent of single unit structures were

verified compared to 63 percent for all types of structures. Multi-unit structures had a higher rate of negative actions, at 17 percent, compared to the overall 14 percent for all types of HUs. The Add rates for single and multi-unit structures were slightly below the overall rate. For mobile homes, there were higher rates of Add and Change actions as compared to the overall rates, which was understandable given the transient nature of mobile homes.

5.2.9 Final Actions by Local Update of Census Addresses Program Action

Addresses submitted through the 2010 LUCA operation and then subsequently added to the MTdb were verified in the field at a lower rate, 14 percent compared to 63 percent overall, and were deleted at a rate over five times higher than the overall Double Delete rate, 52 percent compared to 10 percent. These findings raise some concern about the quality of LUCA address submissions. See Section 5.4 for further LUCA information.

5.2.10 Final Actions by Type of Living Quarters

The final actions presented so far in this report have been for all LQs. LQs on the MTdb were further classified as HU, GQ, TL, or special place not for decennial purposes. The classification of LQs is important to consider since there are different enumeration methods and coverage implications for the different types of LQs. For example, a missing GQ can have a larger impact on the final population count than a missing HU. Records designated as a GQ coming into the operation or those that receive an OLQ flag during the operation were usually retained as GQs in subsequent operations. LQs flagged as GQs before AC and designated as Double Deletes or Duplicates as a result of AC were no longer valid for future operations either as GQs or as HUs.

Table 5.18 presents the final action codes by the GQ/HU Flag on the post-AC MTdb.

Table 5.18: Final Address Actions Applied to the MTdb by Type of Living Quarters

Table 5.18
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb by Type of Living Quarters

Final Address Actions Applied to MTdb	Count*	Percent of total	Housing Unit		Group Quarters		Transitory Location		Special Place (not for decennial purposes)	
			Count*	Percent of total	Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	155,167,805	100.00	154,623,972	100.00	491,562	100.00	48,041	100.00	4,230	100.00
Add	10,776,894	6.95	10,537,200	6.81	238,474	48.51	46	0.10	1,174	27.75
New	6,624,155	4.27	6,387,301	4.13	236,847	48.18	0	0.00	7	0.17
Matches to Existing Record	4,152,739	2.68	4,149,899	2.68	1,627	0.33	46	0.10	1,167	27.59
Change	19,608,785	12.64	19,546,270	12.64	50,224	10.22	11,798	24.56	493	11.65
Move	5,450,563	3.51	5,446,596	3.52	3,021	0.61	921	1.92	25	0.59
Verify	97,635,517	62.92	97,561,330	63.10	65,576	13.34	7,678	15.98	933	22.06
Negative Actions	21,144,480	13.63	20,981,640	13.57	133,780	27.22	27,459	57.16	1,601	37.85
Does Not Exist (Delete)	15,820,664	10.20	15,728,302	10.17	78,030	15.87	13,762	28.65	570	13.48
Double Delete	15,819,921	10.20	15,727,566	10.17	78,025	15.87	13,761	28.64	569	13.45
Single Delete	743	0.00	736	0.00	5	0.00	1	0.00	1	0.02
Duplicate	4,085,556	2.63	4,035,625	2.61	40,071	8.15	9,050	18.84	810	19.15
Nonresidential	1,238,260	0.80	1,217,713	0.79	15,679	3.19	4,647	9.67	221	5.22
Uninhabitable	551,566	0.36	550,936	0.36	487	0.10	139	0.29	4	0.09

*Counts are combined AC and LBAC actions.
Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and GQHUFLAG and DSAF extract variables.

As can be derived from Table 5.18, HUs represented almost 100 percent of all final actions and GQs represented less than 1 percent of all final actions. The distribution of final actions for HUs closely matched the distribution of overall actions, since they comprised the bulk of the universe. GQs had a higher percentage of Adds, specifically new records (236,847 records or 48 percent) and a higher overall percent of negative actions (133,780 records or 27 percent). Only 13 percent of GQs were verified. TLs also had a low verify rate, at 16 percent. TLs had a 57 percent rate of overall negative actions of which most were Double Deletes and Duplicates. This is understandable, since TLs were more difficult to list compared to the OLQ categories.

5.2.11 Address Changes – Characteristics of a Change Record

Further analysis of addresses with a Change final action code was conducted by comparing the location and mailing address fields on the pre-AC MTdb extract against the post-AC MTdb extract which defined the GQV universe. These records had *at least* one change to a location address field, mailing address field, unit status, or OLQ designation, but may have had more than one change. Table 5.19 displays counts for unique single or a combination of correction types, meaning the correction type counts sum to the total number of 19,608,785 change actions.

Table 5.19 shows that 44 percent of final change actions had only a change to the location address information. The data show that 20 percent of the actions were changes to the description, 10 percent were street name changes, 6 percent were unit designation changes, and 1 percent reflected house number changes.

In addition, 5 percent of final change actions involved only ZIP Code changes. For combinations of correction types, 21 percent of the addresses had changes to both the location address and the city-style mailing address. Another 11 percent of the changed addresses had location address changes in combination with ZIP Code, unit status, and/or city-style mailing address changes. Finally, 18 percent of all change actions involved some other type of address correction or combination of unique correction types.

Table 5.19: Change Actions by Unique Correction Type

Table 5.19
The 2010 Census Address Canvassing Operation:
Change Actions by Unique Correction Type

Correction Type	Correction Type Count*	Percent of total
Total	19,608,785	100.00
Unit Status Difference	46,148	0.24
ZIP Code Difference	987,432	5.04
OLQ Difference	11,389	0.06
Location Address Change	8,582,218	43.77
Location House Number Change	232,547	1.19
Blank to nonblank	737	0.00
Other change	231,810	1.18
Location Street Name Change	1,989,804	10.15
Blank to nonblank	13,140	0.07
Other change	1,976,664	10.08
Location Unit Designation Change	1,252,030	6.39
Blank to nonblank	88,259	0.45
Other change	1,163,771	5.93
Location Description Change	3,883,922	19.81
Blank to nonblank	2,906,179	14.82
Other change	977,743	4.99
Combination of Location Address Changes	1,223,915	6.24
City-Style Mailing Address Change	119,584	0.61
Rural Route Address Change	967	0.00
Blank to nonblank	772	0.00
Other change	195	0.00
P.O. Box Address Change	201	0.00
Blank to nonblank	165	0.00
Other change	36	0.00
Location Address Change and City-Style Mailing Address Change	4,140,408	21.12
Location Address Change and ZIP Code Difference	960,695	4.90
Location Address Change and City-Style Mailing Address Change and Unit Status Difference	795,453	4.06
Location Address Change and City-Style Mailing Address Change and ZIP Code Difference	505,248	2.58
Other Correction Type or Combination of Correction Types	3,458,916	17.64
Not Matched to Pre-AC record	126	0.00

*Counts are combined AC and LBAC actions.
Source: AC Eligible Records and GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and UNITSTAT, ISOLQ, LOCDESC, LOCZIP, and LOCSUFTYP extract variables.

5.2.12 Final Actions by Delivery Sequence File Status

The DSFs from the USPS were the main source of additional addresses to the MTdb after Census 2000. There are two DSF updates to the MTdb each year; one update in the spring and one in the fall. The MTdb indicates if an address in the database was not on the DSF and distinguishes three categories for addresses on the DSF and MTdb. The possible classifications of DSF status for addresses on the MTdb are:

- Residential record on the DSF
- Commercial record on the DSF
- EDS record on the DSF
- Not on the DSF

Records on the MTdb that are not on the DSF were most likely Census 2000 records or records added by LUCA. The latest DSF indicator on the GQV extract reflects updates from the spring 2009 DSF updates to the MTdb. Of the records included in AC, 81 percent were also on the DSF.

Table 5.20 compares the 2010 AC results by the latest DSF indicator on the MTdb.

Table 5.20: Final Address Actions Applied to the MTdb by Spring 2009 Delivery Sequence File Status

Table 5.20
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb by Spring 2009 DSF Status

Final Address Actions Applied to MTdb	Count*	Percent of total	No DSF Indicator		Residential		Commercial		EDS Record	
			Count*	Percent of total	Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	155,167,805	100.00	29,002,455	100.00	117,914,294	100.00	950,530	100.00	7,300,526	100.00
Add	10,776,894	6.95	6,907,680	23.82	3,241,408	2.75	69,027	7.26	558,779	7.65
New	6,624,155	4.27	6,624,155	22.84	0	0.00	0	0.00	0	0.00
Matches to Existing Record	4,152,739	2.68	283,525	0.98	3,241,408	2.75	69,027	7.26	558,779	7.65
Change	19,608,785	12.64	5,623,502	19.39	13,062,170	11.08	71,153	7.49	851,960	11.67
Move	5,450,563	3.51	175,435	0.60	5,100,614	4.33	8,048	0.85	166,466	2.28
Verify	97,635,517	62.92	4,627,770	15.96	90,258,909	76.55	174,753	18.38	2,574,085	35.26
Negative Actions	21,144,480	13.63	11,502,038	39.66	6,010,874	5.10	624,888	65.74	3,006,680	41.18
Does Not Exist (Delete)	15,820,664	10.20	8,365,245	28.84	4,796,387	4.07	146,271	15.39	2,512,761	34.42
Double Delete	15,819,921	10.20	8,365,029	28.84	4,795,963	4.07	146,261	15.39	2,512,668	34.42
Single Delete	743	0.00	216	0.00	424	0.00	10	0.00	93	0.00
Duplicate	4,085,556	2.63	2,756,581	9.50	1,021,375	0.87	18,898	1.99	288,702	3.95
Nonresidential	1,238,260	0.80	380,212	1.31	193,112	0.16	459,719	48.36	205,217	2.81
Uninhabitable	551,566	0.36	166,030	0.57	240,319	0.20	2,661	0.28	142,556	1.95

*Counts are combined AC and LBAC actions.

Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the DELPTTYPE extract variable.

The results presented in Table 5.20 indicate that addresses marked as Residential on the DSF were a good source of addresses for the AC operation. They were more likely to be found in the field than other types of records and had a high rate of Verify action codes. Over three quarters of the Add addresses that matched to existing records were marked as Residential on the DSF. This is not surprising since some DSF-added records are not geocoded and would have been ineligible for AC.

Addresses indicated as Residential on the DSF were verified in the field at a 77 percent rate which was higher than either of the other two categories of DSF records or records not on the DSF. The next highest category is the EDS records which were verified 35 percent of the time. These two categories include records verified in previous operations. The residential DSF records had the lowest percentage of negative actions at 5 percent. Negative actions represented 41 percent of all actions for EDS records.

Listers marked 48 percent of the commercial records on the DSF as Nonresidential. These Nonresidential actions contributed to the high percentage (66 percent) of negative actions on records marked as Commercial on the DSF. However, based on this result, the address filter rules do not exclude records based only on a DSF commercial status indicator since these records were marked as valid in previous operations. Note that the filter used spring 2008 DSF status, while this analysis uses spring 2009 DSF status. The USPS standard for designation of commercial addresses is different than the Census Bureau standard.

5.2.13 Excluded from Delivery Statistics Records

EDS records are an important subcategory of addresses to examine because these are records that may be valid by the time the census enumeration occurs, many months after the AC operation. As EDS records continue to increase on the MTdb, it becomes more important to understand their effects on Census programs. ACS and decennial census filters essentially treat EDS records the same. However, the ACS does not accept DSF updates (including EDS records) in isolated areas of the country where less than 85 percent of the addresses are city-style. As mentioned in Section 3.3, which describes the eligibility for the AC filter, certain types of EDS records were included in the universe based on their delivery point type. The residential Delivery Point Type codes associated with EDS records that were eligible for AC are:

- R – Residential curbline (traditional curbside mailbox delivery)
- S – Residential Neighborhood Delivery Collection Box Unit (NDCBU) (neighborhood cluster box delivery, such as in town home communities)
- T – Residential central (these are records in buildings with more than one ZIP+4 code assigned to a bank of boxes)
- U – Residential other (these are records where the delivery point is one serviced by other than curb, central, or NDCBU and include door-to-door and door slot)

The residential Delivery Point Type codes associated with EDS records that were not eligible for AC are:

- V – Residential facility box (these are boxes in a postal facility)
- W – Residential contract box (these are boxes in a contract facility)
- Y – Residential detached box (these are similar to boxes in a contract facility)
- Z – Residential non-personnel unit (this is a self-service unit that is not staffed)

The combined residential category is comprised of 6,523,903 final AC actions (89 percent of the EDS records that were updated in AC). The unknown category is 579,705 records (8 percent of EDS records) that were updated in AC and the business category makes up the remaining 196,918 records (3 percent of EDS records). The AC results from the MTdb for the EDS record categories are examined in Table 5.21.

Table 5.21: Final Address Actions Applied to the MTdb for Delivery Sequence File EDS Address Records by Delivery Point Type

Table 5.21
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb for DSF EDS Address Records by Delivery Point Type

Final Address Actions Applied to MTdb	Count*	Percent of total	Business		Residential		Unknown	
			Count*	Percent of total	Count*	Percent of total	Count*	Percent of total
Total	7,300,526	100.00	196,918	100.00	6,523,903	100.00	579,705	100.00
Add	558,779	7.65	13,507	6.86	521,343	7.99	23,929	4.13
New	0	0.00	0	0.00	0	0.00	0	0.00
Matches to Existing Record	558,779	7.65	13,507	6.86	521,343	7.99	23,929	4.13
Change	851,960	11.67	13,905	7.06	761,472	11.67	76,583	13.21
Move	166,466	2.28	1,521	0.77	159,382	2.44	5,563	0.96
Verify	2,574,085	35.26	32,199	16.35	2,434,331	37.31	107,555	18.55
Negative Actions	3,006,680	41.18	134,699	68.40	2,508,580	38.45	363,401	62.69
Does Not Exist (Delete)	2,512,761	34.42	50,100	25.44	2,266,192	34.74	196,469	33.89
Double Delete	2,512,668	34.42	50,098	25.44	2,266,105	34.74	196,465	33.89
Single Delete	93	0.00	2	0.00	87	0.00	4	0.00
Duplicate	288,702	3.95	5,195	2.64	163,029	2.50	120,478	20.78
Nonresidential	205,217	2.81	79,404	40.32	79,359	1.22	46,454	8.01
Uninhabitable	142,556	1.95	1,087	0.55	138,795	2.13	2,674	0.46

*Counts are combined AC and LBAC actions.
Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the DELPTTYPE extract variable.

Table 5.21 shows the EDS records were verified in the field at a lower rate, 35 percent, as compared to 63 percent overall as shown in Table 5.13. Of these, the residential records were the most stable. The verification rate for the residential EDS records was slightly higher, at 37 percent, and the negative actions rate for the residential records was the lowest among the categories at 38 percent. The EDS records classified as business addresses received the highest percentage of negative actions, at 68 percent, with 40 percent of these as Nonresidential. Compared to dress rehearsal, with the assumption that the error associated with Listers deleting addresses would be less than

adding addresses for a dependent listing, Residential EDS records were either verified or deleted 72 percent of the time, while Business EDS records were either deleted or classified as Nonresidential 66 percent of the time. Therefore, they were beneficial to include in the AC filter.

5.2.14 Address Canvassing and Subsequent Census Operations

GQV was the first field operation to use the updates from the 2010 Census AC operation. During GQV, field staff visited addresses designated as OLQs during AC. Units previously designated as GQs and not deleted in AC retained their GQ status after AC processing for GQV even if AC designated them as HUs. Table 5.22 indicates the counts of records flagged as potential GQs on the MTdb prior to and after the AC operation. For this analysis, the GQ flag (GQHU flag) was used on the pre-AC MTdb extract to get the counts prior to AC. The counts after AC come from the GQV universe flag and OLQ source variables from the GQV extract of the MTdb. When the OLQ source variable on the MTdb is blank, the address is most likely a Census 2000 GQ.

Table 5.22: Other Living Quarter Addresses by Eligibility for the Next Census Operation

Table 5.22
The 2010 Census Address Canvassing Operation:
Other Living Quarters Addresses by Eligibility for the next Census Operation[1]

Other Living Quarters Addresses	Count	Percent of total+	Eligible		Not Eligible	
			Count	Percent of total+	Count	Percent of total+
OLQ Addresses before AC	351,409	100.00	319,912	91.04	31,497	8.96
OLQ Addresses after AC/before GQV	574,539	100.00	399,397	69.52	175,142	30.48
GQ per 2008 DR LUCA or 2010 LUCA	36,953	100.00	3,777	10.22	33,176	89.78
OLQ per 2008 AC DR or 2010 AC	338,124	100.00	337,656	99.86	468	0.14
GQ per ACS Time of Interview	3	100.00	0	0.00	3	100.00
GQ per FSCPE Admin Records Update	19,447	100.00	6,271	32.25	13,176	67.75
OLQ per SBE Research by NPC	22,536	100.00	10,283	45.63	12,253	54.37
OLQ per ACS GQ Frame Research	1,611	100.00	1,598	99.19	13	0.81
2010 AC Large Blocks	3,762	100.00	3,742	99.47	20	0.53
Unknown OLQ status	152,103	100.00	36,070	23.71	116,033	76.29

+Percentages are of total OLQs for the next operation.
[1]Eligibility for the OLQ Addresses after Address Canvassing is for the Group Quarters Validation operation.
Source: AC and GQV Extract files as defined by DSAF and GQHUFLAG variables on both sets of files.

Following AC, there were over 200,000 additional OLQ addresses on the MTdb, as shown in Table 5.22. Of the total 574,539 OLQ addresses, 70 percent of those were considered eligible for the next Census operation or valid for decennial purposes. Of those eligible for GQV, 95 percent were GQs and 5 percent were TLs.

The OLQ addresses by GQ Type are detailed in Table 5.23. Fifty-seven percent (226,831 records) of the OLQ addresses eligible for GQV had no information or were not assigned. This is understandable since the GQV operation was intended to determine the type of GQ at each eligible OLQ.

Table 5.23: Group Quarters Type by Eligibility of Other Living Quarters Addresses

Table 5.23
The 2010 Census Address Canvassing Operation:
Group Quarters Type by Eligibility of Other Living Quarters Addresses[1]

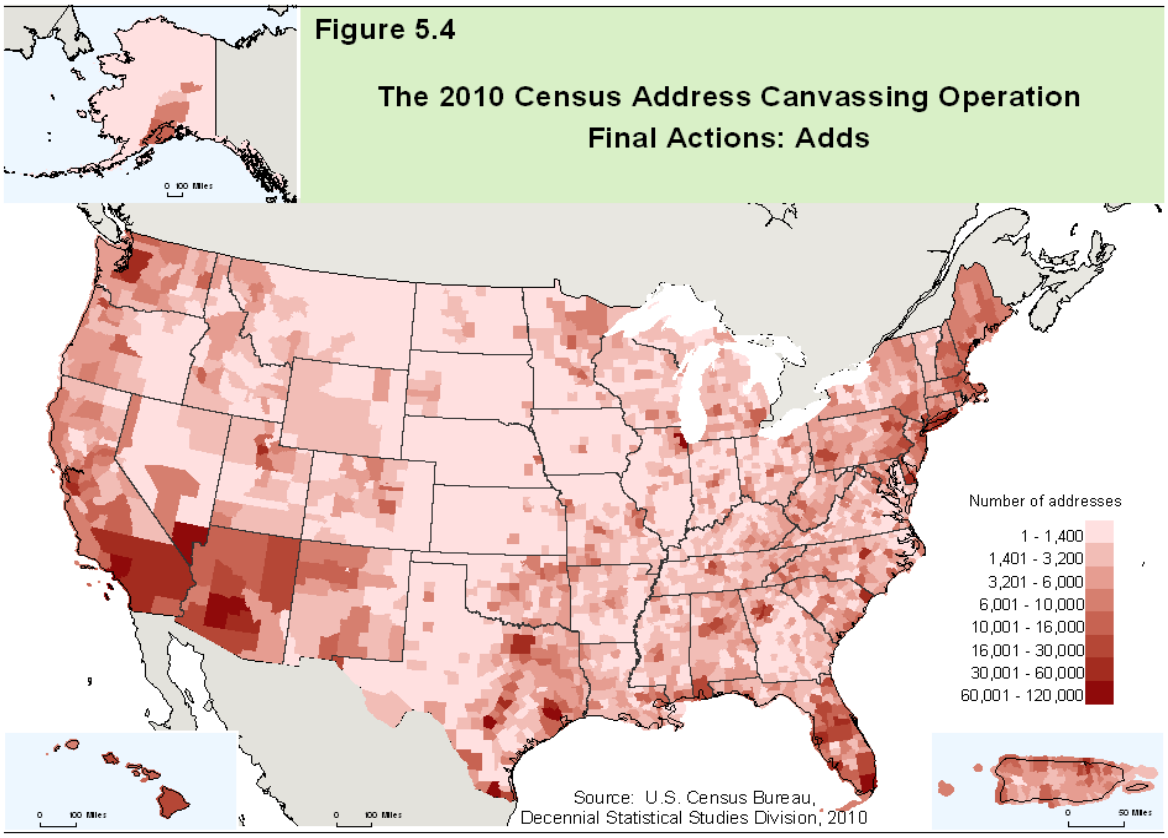
Group Quarters Type	Count	Percent of total	Eligible		Not Eligible	
			Count	Percent of total	Count	Percent of total
Total	574,539	100.00	399,397	100.00	175,142	100.00
Correctional Facilities for Adults	17,154	2.99	8,646	2.16	8,508	4.86
Juvenile Facilities	12,242	2.13	7963	1.99	4279	2.44
Skilled Nursing Facilities	37,020	6.44	20,549	5.15	16,471	9.40
Hospitals/In Patient Hospices	6,329	1.10	3323	0.83	3006	1.72
Residential Schools for People w/Disabilities	3,542	0.62	1,715	0.43	1,827	1.04
College/University Student Housing	29,468	5.13	16,921	4.24	12,547	7.16
Military Quarters/Ships	7,774	1.35	2,575	0.64	5,199	2.97
Shelters/Service Locations	26,121	4.55	12,810	3.21	13,311	7.60
Group Homes Intended for Adults	123,356	21.47	78,660	19.69	44,696	25.52
Residential Treatment Centers for Adults	8,730	1.52	4,631	1.16	4,099	2.34
Maritime/Merchant Vessels	360	0.06	0	0.00	360	0.21
Workers' Group Living Quarters (Staff Housing)	12,029	2.09	6,167	1.54	5,862	3.35
Religious Group Quarters (convents, etc.)	13,528	2.35	8,708	2.18	4,820	2.75
Living Quarters for Natural Disaster Victims	18	0.00	8	0.00	10	0.01
Other Group Quarters (Unknown type)	43	0.01	28	0.01	15	0.01
No information or unassigned	276,825	48.18	226,693	56.76	50,132	28.62

[1]Footnote: Eligibility for the OLQ Addresses after Address Canvassing is for the Group Quarters Validation operation.
Source: GQV Extract files as defined by DSAF, GQTYPCUR, and GQHUFLAG variables.

5.2.15 Adds in Address Canvassing

The AC final Add actions by address records in each county are displayed in Figure 5.4. These records represent the addresses added to the Census universe by AC final actions. The map suggests a clustering of Add actions in the Southwest, which corresponds to the movement of the population to that area, and in urbanized areas. Source data used for this figure were the AC and GQV extract files, FDCA Assessment File, Large Collection Block MAFUF, and GEO Reject File.

Figure 5.4: Final Actions – Adds



The number of HU Adds within a collection block is presented in Table 5.24. Similar to the number of deleted records in collection blocks, 48 percent (934,035 records) of the collection blocks with Adds had between two and nine addresses added. A relatively small number of collection blocks, just over 1 percent of blocks with Adds, had more than 500 units added. These collection blocks may have had several large multi-unit structures added during AC or may have had a large collection of single-unit structures added.

Table 5.24: Number of Adds Within a Collection Block on the MTdb

Table 5.24
The 2010 Census Address Canvassing Operation:
Number of Adds within a Collection Block on the MTdb

Number of Units Added per Collection Block on the MTdb	Number of Blocks	Percent of total
Total Blocks	4,774,329	100.00
0	2,819,511	59.06
1	671,212	14.06
2-9	934,053	19.56
10-19	145,131	3.04
20-59	113,791	2.38
60-99	25,748	0.54
100-499	41,057	0.86
500-999	8,051	0.17
1000+	15,775	0.33

Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and COLBLKST, COLBLKCOU, and COLBLK extract variables.

Records Not Eligible for Address Canvassing Adds

Listers were instructed to add an address if they observed an LQ on the ground that was not listed in the block they were working. However, many of these added records from the field matched back to existing MTdb address records not initially eligible for the AC operation. GEO examined records with the final action code of an Add that matched to existing MTdb records. One caveat to this analysis was the examination relied on the accuracy of GEO's matching software applied to the data to be matched. For example, some cases coded as unmatched may have matched to an MTdb record but the software did not recognize the match, due to the difficulty in matching non-city style addresses. The update requirements for matching records prevented linking of addresses in some cases.

Table 5.25 details the eligibility status or earliest source for added addresses that matched to existing records.

Table 5.25: Eligibility Status for Added Addresses Matching Existing Records

Table 5.25
The 2010 Census Address Canvassing Operation:
Eligibility Status for Added Addresses Matching Existing Records

Eligibility for AC Added Addresses Matching Existing Records	Count	Percent of total
Total	4,152,739	100.00
Eligible for Address Canvassing	236,744	5.70
Census 2000 Address	113,311	2.73
CQR add or reinstatement	1	0.00
DSF add	108,638	2.62
Census delete persisting on DSF	3,498	0.08
DAAL or ACS validated address	438	0.01
Census Test	423	0.01
LUCA add	10,435	0.25
Ineligible for Address Canvassing	3,220,999	77.56
Geocoded	542,333	13.06
Ungeocoded	2,678,666	64.50
Records added to MTdb from other sources	694,996	16.74
2009 Spring Delivery Sequence File	345,821	8.33
2009 Fall Delivery Sequence File	267,634	6.44
2010 LUCA on September 2008	3	0.00
Special Census on August .2008	264	0.01
DAAL Listing August 2008	832	0.02
DAAL Listing March 2009	886	0.02
DAAL GQ Listing August 2008	1	0.00
DAAL GQ Listing March 2009	2	0.00
Address Canvassing action	79,553	1.92
Added by both AC and LBAC final actions	281	0.01
LBAC add	79,272	1.91

Source: AC Extract Files, as defined by ADCANAF and COLBLK variables, GQV Extract Files, as defined by MAFSRC, DSF series, and UNITSTAT variables, and matched to GQV Operation Files MAFSRC and ACTION variables.

An *ungeocoded* record is an address on the MTdb that does not have a block code assigned to it. A record with a block code is *geocoded.* If it is determined that a record's block code on the MTdb is incorrect, it is referred to as a *geocoding error*.

In Table 5.25, the largest category of added records that matched to the MTdb (65 percent) was ungeocoded and excluded from the AC initial workload. This is a larger percentage than the 61 percent in dress rehearsal (Dixon, et al, 2008).

The records added to MTdb from the other sources category, 17 percent, details the records added to the MTdb from other sources after the AC extract files were delivered and could not be matched back from the GQV extract files.

5.2.16 Ungeocoded Records

One of the primary ways that ungeocoded records get added to the MTdb is through the DSF from the USPS. The block numbers used by Census do not exist on the DSF, so the Census Bureau attempts to assign block codes to new records. Ungeocoded records may have a state and county code, but not a block code.

Records added to the MTdb from other sources comprised less than a third of matches in all states, 17 percent overall, with the exception of the District of Columbia where they accounted for 61 percent.

Table 5.26 presents the breakdown of matched Added records by region and state, and in Puerto Rico. By region, excluding Puerto Rico, the highest rate of matches to geocoded records occurred in the Northeast (28 percent). The region with the lowest rate was the South (16 percent). With the exception of Puerto Rico at 99 percent, less than half of all matches were geocoded within states, districts, and territories.

Added records that match to existing ungeocoded records received a geocode from the AC fieldwork. Subsequent decennial census operations, as well as ACS and other Census Bureau surveys that use the MTdb as a source of eligible address records, benefited from the block code captured during AC.

Table 5.26: Census Region and Division Added Addresses Matched to an Existing Record by Geocoding Status

Table 5.26
The 2010 Census Address Canvassing Operation:
Census Region and Division Added Addresses Matched to an Existing Record by Geocoding Status

Census Region and Division[1]	Count	Percent of total	Records added to MTdb from other sources		Existing Record is ungeocoded		Existing Record is geocoded	
			Count	Percent of total	Count	Percent of total	Count	Percent of total
Total	4,152,739	100.00	694,996	100.00	2,678,666	100.00	779,077	100.00
Region 1: Northeast	471,158	11.35	75,140	10.81	265,745	9.92	130,273	16.72
Division 1: New England (CT,ME,MA,NH,RI,VT)	145,281	3.50	21,597	3.11	92,771	3.46	30,913	3.97
Division 2: Middle Atlantic (NJ,NY,PA)	325,877	7.85	53,543	7.70	172,974	6.46	99,360	12.75
Region 2: Midwest	687,980	16.57	97,221	13.99	467,140	17.44	123,619	15.87
Division 3: East North Central (IL,IN,MI,OH,WI)	414,916	9.99	57,922	8.33	271,956	10.15	85,038	10.92
Division 4: West North Central (IA,KS,MN,MO,NE,ND,SD)	273,064	6.58	39,299	5.65	195,184	7.29	38,581	4.95
Region 3: South	2,159,873	52.01	377,546	54.32	1,444,281	53.92	338,046	43.39
Division 5: South Atlantic (DC,DE,FL,GA,MD,NC,SC,VA,WV)	968,998	23.33	177,675	25.56	591,831	22.09	199,492	25.61
Division 6: East South Central (AL,KY,MS,TN)	395,179	9.52	62,668	9.02	289,686	10.81	42,825	5.50
Division 7: West South Central (AR,LA,OK,TX)	795,696	19.16	137,203	19.74	562,764	21.01	95,729	12.29
Region 4: West	832,136	20.04	145,089	20.88	501,484	18.72	185,563	23.82
Division 8: Mountain (AZ,CO,ID,MT,NM,NV,UT,WY)	327,043	7.88	60,928	8.77	177,693	6.63	88,422	11.35
Division 9: Pacific (AK,CA,HI,OR,WA)	505,093	12.16	84,161	12.11	323,791	12.09	97,141	12.47
Puerto Rico	1,592	0.04	0	0.00	16	0.00	1,576	0.20

[1]Prior to June 1984, the Midwest Region was designated as the North Central Region.
Source: AC and GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and COLBLKST, COLBLKCOU, COLBLK, and DSF series extract variables.

5.2.17 Move Actions

When a Lister discovered that an address on the HHC did not exist in the block they were working, the procedure was to delete the address from the block. At times, the address existed in the block just across the street and the Lister could see it. Even if this was the case, they would still delete it from the block they were working in and either they, or the Lister who was assigned to the block where the address existed, would add it when working the correct block. These addresses came into GEO for processing with two records, one with a Delete action and one with an Add action. GEO assigned these types of records an "M" or Move final action code on subsequent extract files. The assignment of this M action code depended on the ability to match the two address records. For LBAC, Listers were instructed to use the same procedure as the AC Listers, even though the ALMI allowed the Lister to move the unit directly while the HHC did not. Table 5.27 shows the distribution of moves by type of address.

Table 5.27: Address Move Actions After the 2010 AC Operation by Type of Address Information

Table 5.27
Address Move Actions after the 2010 Census Address Canvassing Operation by Type of Address Information

Type of Address Information	Count	Percent of total
Total	5,450,563	100.00
Complete City-Style	5,448,644	99.96
With complete Rural Route and/or complete P.O. Box and/or location description	401,556	7.37
Without complete Rural Route or complete P.O. Box or location description	5,047,088	92.60
Complete Rural Route	2,874	0.05
With location description	2,097	0.04
Without location description	777	0.01
Complete P.O. Box	12	0.00
With location description	12	0.00
Without location description	0	0.00
Incomplete address information	326	0.01
With location description	86	0.00
Without location description	240	0.00
No address information	327	0.01
With location description	87	0.00
Without location description	240	0.00

Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and LOCDESC, LOCHNPRE, LOCHN1, LOCHNSEP, LOCHN2, LOCHNSUF, LOCHNPR, LOCNAME, LOCZIP, MAILHNPRE, MAILHN1, MAILHNSEP, MAILHN2, MAILHNSUF, MAILPREQUAL, MAILPREDIR, MAILPRETYP, MAILNAME, MAILSUFTYP, MAILSUFDIR, MAILRRID, MAILRRBOXID, MAILPOBOXID, and MAILZIP extract variables.

Nearly all of the addresses with a final move action were complete city-style addresses. Almost 8 percent of these complete city-style addresses had a complete rural route and box number address and/or complete P.O. Box and/or location description. Note that it was difficult to match addresses without a complete city-style address. There may have been other geocoding errors that were corrected in AC through move action, but the addresses could not be successfully matched to designate these cases as moves.

5.2.18 Summary of Address Canvassing Updates to the MTdb

The AC operation updated the MTdb with results from the fieldwork conducted using the HHCs and laptop computers with ALMI. The results were a product of the production Lister's actions, QC Lister actions or listing check (LBAC), the ADDUP action code (calculated from the previous two items), and GEO's processing to update the MTdb. Erroneous records were deleted, corrected, or assigned to appropriate blocks, and missing records were added to the MTdb. These updates improved coverage of the MTdb and therefore further improved Census operations. Some of the key findings from analyzing the updates to the MTdb are as follows:

- Rural areas were more likely to have address records with negative actions taken and Adds as compared to urban areas
- The presence of a record on the DSF as a residential unit was a good indicator of whether or not it was verified in the AC operation or updated from the operation as a Move.
- EDS records were a good source of valid addresses. Some sub-categories of EDS records were a better source than others.
- Many added addresses matched to ungeocoded records on the MTdb or records geocoded to the wrong block. Ungeocoded and incorrectly geocoded records continue to be a problem for the MTdb.

5.3 Collection of Global Positioning System Structure Points

This section discusses the manual map spots and GPS collection of coordinates, presents summary data for the GPS coordinate collection, and summarizes GPS metadata. This section also answers Assessment Questions 8 (a-e) and 9. The location of additional data to answer these questions is shown below.

Assessment Questions Answered in Section 5.3	Additional Information
8a What were the field outcomes for map-spot coordinate collection?	Sections: 5.3.2, 5.3.5 Table: 5.28
8b. How many map-spot coordinate collection attempts resulted in capturing GPS coordinates?	Section: 5.3.3 Tables: 5.29 – 5.31
8c. How many times was the map-spot coordinate collection attempted or not attempted due to a dangerous situation or other problem?	Section: 5.3.4 Table: 5.32
8d. What information was gathered from the GPS metadata?	Section: 5.3.6 Tables: 5.36, 5.37
8e. How many GPS coordinates fell inside/outside of the collection block?	Section: 5.3.7 Table: 5.38
9. What were the results of the MTdb update process for map-spot coordinates?	Sections: 5.3.8, 5.3.9 Table: 5.39

5.3.1 Map Spot Collection Overview

Listers were instructed to collect a map spot for each structure containing a valid LQ they encountered including single-family homes, apartment buildings, town or row houses, trailers, and non-traditional LQs such as boats. A valid LQ is one the Lister added, verified, corrected, or identified as uninhabitable. Listers used the HHC to collect manual map spots and GPS coordinates, for each valid residential structure. Only one map spot was collected to represent a multi-unit structure.

Listers were to collect the manual map spot while standing near the front entrance of the structure containing the LQ and tapping that location on the HHC map screen. If the GPS on the HHC was active and had a strong enough signal, a YAH indicator appeared on the map screen to help Listers determine their location while map spotting. When the Lister tapped the map screen to indicate the manual map spot, the HHC automatically attempted to collect GPS coordinates. The collection of the GPS coordinates occurred behind-the-scenes; hence the Lister was unaware of the success or failure of the GPS collection attempt. Listers were not required to collect a map spot for deletes.

The procedures for the 2010 AC map collection were similar to the 2008 Census Dress Rehearsal and 2006 Census Test AC operations. The collection of map spots for uninhabitable records was a

change from the 2006 Census Test procedures. Since uninhabitable records move on to subsequent census operations with other valid records from AC, a map spot was required to aid in future attempts at locating the unit.

5.3.2 Summary of Results for GPS Collection

Assessment Question 8a: *What were the field outcomes for map-spot coordinate collection?*

The goal of GPS map spot collection was to collect accurate GPS coordinates within the correct block for all valid structures containing LQs. This assessment defines the number of structures as the number of records with a populated GPS attempt variable or a normal collection attempt plus cases where the Lister opted out of collection. At the end of AC, a map spot that met this criterion represented approximately 92 percent of structures containing LQs. The GPS coordinates were used as the default map spot for subsequent operations. Otherwise, the structure was represented by the manual map spot when available. Table 5.28 presents the following information, defined below:

- *Valid residential address records*: The total number of valid residential records that needed linkage to a map spot.

- *Structures*: The number of actual structures that required the collection of a map spot. Listers were instructed to collect manual map spots for every unit with a separate main entryway at ground level.

- *Collection attempts*: The number of times Listers attempted to collect map spots. Listers were able to opt out of map spot collection if they felt they were in a dangerous situation or were working on a military installation.

- *GPS coordinates collected*: The number of successfully collected GPS coordinates. A successful GPS collection attempt is defined as a record with populated GPS latitudinal and longitudinal coordinates. An unsuccessful GPS collection attempt is defined as a normal collection attempt with missing GPS latitudinal and/or longitudinal coordinates.

- *GPS coordinates inside the active block*: The number of collected GPS coordinates that fell inside the block the Lister was working, known as the *active block*.

Table 5.28: Overall GPS Collection Results

Table 5.28
The 2010 Census Address Canvassing Operation:
Overall GPS Collection Results

	Count	Percent of Structures	Percent of Attempts	Percent of GPS Coordinates
Valid Residential Address Records	132,911,346			
Structures (lister prompted to collect map spot)	105,923,905	100.00		
Collection Attempts	105,298,999	99.41	100.00	
GPS Coordinates Collected (successful attempts)	103,995,369	98.18	98.76	100.00
GPS Coordinates Inside the Active Block	97,885,042	92.41	92.96	94.12

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, and GPSATTEMPT_FINAL variables.

As shown in Table 5.28, the universe of cases decreased with each step from valid records to structures to actual collection attempts. Therefore, the number of GPS coordinates collected represents a collection success rate of about 99 percent when considering the universe of attempts.

5.3.3 Collection Attempts and GPS Success Rate

Assessment Question 8b: *How many map-spot coordinate collection attempts resulted in capturing GPS coordinates?*

Almost 99 percent of GPS map spot collection attempts were successful. There were a total of 105,298,999 attempts to collect a map spot for structures and 103,995,369 GPS map spots were collected. Of those collected map spots, approximately 95 percent were in the correct block. Table 5.29 presents the results for the success rate of the GPS map spot collection.

Table 5.29: GPS Collection Success Rate

Table 5.29
The 2010 Census Address Canvassing Operation:
GPS Collection Success Rate

Addresses	Count	Percent of total
Total Map Spot Collection Attempts	105,298,999	100.00
Successful GPS Attempts	103,995,369	98.76
Unsuccessful GPS Attempts	1,303,630	1.24

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, and GPSATTEMPT_FINAL variables.

The success rate of 98.76 percent was slightly higher than the dress rehearsal success rate of 96.80 percent. Unsuccessful GPS coordinate collections more than likely represent situations where:

- The GPS was not active. For instance, the GPS may not have been able to locate satellites due to obstructions.
- The HHC had some other unknown problem.
- Accessibility issues in some areas.

Table 5.30 presents the breakdown of successful collection rates by HU type. The rate of successful attempts by HU type is similar for single (98.8 percent) and multi-units (97.3 percent).

Table 5.30: Housing Unit Structure Type by GPS Collection Attempts

Table 5.30
The 2010 Census Address Canvassing Operation:
Housing Unit Type by GPS Collection Attempts

Housing Unit Type[1]			Successful		Unsuccessful	
	Count	Percent of total	Count	Percent of total	Count	Percent of total
Total Map Spot Collection Attempts	105,298,999	100.00	103,995,369	100.00	1,303,630	100.00
Single Unit.....	98,837,063	93.86	97,695,643	93.94	1,141,420	87.56
Multi-Unit	5,415,000	5.14	5,269,773	5.07	145,227	11.14
Unknown	844,300	0.80	829,616	0.80	14,684	1.13
Other	202,636	0.19	200,337	0.19	2,299	0.18

[1]Footnote: Single unit includes trailer/mobile units
Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, HUTYPE_LIS and GPSATTEMPT_FINAL variables.

Table 5.31 presents the results for the success rates of GPS collection attempts by region. The success rate was between 98 to 99 percent.

- All states had a success rate of approximately 98 percent or higher,
- Puerto Rico's success rate was 99 percent or 1,195,050 out of 1,208,593 attempts,
- The District of Columbia had the lowest success rate at 94 percent.

Table 5.31: Census Region and Division by GPS Collection Attempts

Table 5.31
The 2010 Census Address Canvassing Operation:
Census Region and Division by GPS Collection Attempts

Census Region and Division[1]	Count	Percent of total	Successful		Unsuccessful	
			Count	Percent of region	Count	Percent of region
Total Map Spot Collection Attempts	105,298,999	100.00	103,995,369	98.76	1,303,630	1.24
Region 1: Northeast	16,893,976	16.04	16,616,072	98.36	277,904	1.64
Division 1: New England (CT,ME,MA,NH,RI,VT)	4,919,233	4.67	4,850,761	98.61	68,472	1.39
Division 2: Middle Atlantic (NJ,NY,PA)	11,974,743	11.37	11,765,311	98.25	209,432	1.75
Region 2: Midwest1	24,618,036	23.38	24,356,464	98.94	261,572	1.06
Division 3: East North Central (IL,IN,MI,OH,WI)	16,891,786	16.04	16,707,589	98.91	184,197	1.09
Division 4: West North Central (IA,KS,MN,MO,NE,ND,SD)	7,726,250	7.34	7,648,875	99.00	77,375	1.00
Region 3: South	40,493,715	38.46	39,956,757	98.67	536,958	1.33
Division 5: South Atlantic (DC,DE,FL,GA,MD,NC,SC,VA,WV)	21,245,350	20.18	20,948,237	98.60	297,113	1.40
Division 6: East South Central (AL,KY,MS,TN)	7,212,649	6.85	7,107,383	98.54	105,266	1.46
Division 7: West South Central (AR,LA,OK,TX)	12,035,716	11.43	11,901,137	98.88	134,579	1.12
Region 4: West	22,084,679	20.97	21,871,026	99.03	213,653	0.97
Division 8: Mountain (AZ,CO,ID,MT,NM,NV,UT,WY)	7,683,421	7.30	7,623,337	99.22	60,084	0.78
Division 9: Pacific (AK,CA,HI,OR,WA)	14,401,258	13.68	14,247,689	98.93	153,569	1.07
Puerto Rico	1,208,593	1.15	1,195,050	98.88	13,543	1.12

[1]Prior to June 1984, the Midwest Region was designated as the North Central Region.
Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, GPS_ST, GPSATTEMPT_FINAL variables.

5.3.4 Defining GPS Collection Attempts

Assessment Question 8c: *How many times was the map-spot coordinate collection attempted or not attempted due to a dangerous situation or other problem?*

The HHCs prompted the Listers to collect a map spot. The only time the Lister could enter additional details was if they selected 'Cannot Collect'. Listers then had to enter specifics as to why they could not collect the map spot. There were 624,906 records where Listers were unable to collect map spots due to their location on a military installation, a dangerous situation, or other problems. Table 5.32 presents the incidence of Lister attempts to collect map spots.

Table 5.32: Lister Map Spot Collection Attempts

Table 5.32
The 2010 Census Address Canvassing Operation:
Lister Map Spot Collection Attempts

Map Spot Prompts	Count	Percent of total
Total Prompts for Lister to Collect Map Spot Structure	105,923,905	100.00
Lister Attempted Coordinate Collection	105,298,999	99.41
Lister Did Not Attempt Coordinate Collection	624,906	0.59
Dangerous Address	603,902	0.57
Other Problem	21,004	0.02

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, and GPSATTEMPT_FINAL variables.

5.3.5 Map Spot Results for All Valid Residential Address Records

There were 26,892,839 valid residential address records returned with neither a GPS nor a manual map spot. Table 5.33 presents the types of map spot coordinates collected for all valid residential address records. These records had no negative final actions on the MTdb. Note that individual units within a multi-unit structure are treated as separate valid residential records in this table.

Similar to dress rehearsal, less than 1 percent of all valid address records (1,303,630 address records) had only a manual map spot at the close of AC.

Table 5.33: Type of Map Spots Collected

Table 5.33
The 2010 Census Address Canvassing Operation:
Type of Map Spots Collected

Type of Map Spots Collected	Count	Percent of total
Total Valid Residential Address Records	132,911,346	100.00
Both GPS and a Manual Coordinate	103,995,369	78.24
Only a Manual Coordinate	1,303,630	0.98
Neither a GPS nor a Manual Coordinate	26,892,839	20.23

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, and GPSATTEMPT_FINAL variables.

In cases where an address record had both GPS and manual coordinates, subsequent census operations received the GPS coordinate as the preferred map spot as long as it fell in the correct collection block. See Section 5.3.7 for more information about GPS coordinates falling inside or outside the collection block. The manual map spot was provided if the GPS coordinates were not collected. If the address record was without coordinates, Listers relied on the house number and street name or location description.

Table 5.34 breaks down the missing map spots by structure type when neither GPS nor manual coordinates were collected.

Table 5.34: Housing Unit Structure Type of Missing Map Spots by GPS Collection Status

Table 5.34
The 2010 Census Address Canvassing Operation:
Housing Unit Structure Type of Missing Mapspots by GPS Collection Status

Housing Unit Structure[1]	Count	Percent of total	Unable to Collect or Dangerous Access		No Collection Attempt	
			Count	Percent of total	Count	Percent of total
Total	26,892,839	100.00	624,906	100.00	26,267,933	100.00
Single Unit	515,442	1.92	514,278	82.30	1,164	0.00
Multi-Unit	25,899,770	96.31	31,309	5.01	25,868,461	98.48
Blank	471,201	1.75	72,895	11.66	398,306	1.52
Other	6,426	0.02	6,424	1.03	2	0.00

[1]Single unit includes trailer/mobile units.
Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, HUTYPE_LIS and GPSATTEMPT_FINAL variables.

Table 5.35 presents the breakdown of map spot types for added units. Of the 17,260,151 valid residential addresses that were added, 75 percent had both a GPS and manual map spot recorded.

Table 5.35: Type of Map Spots Collected for Added Address Records

Table 5.35
The 2010 Census Address Canvassing Operation:
Type of Map Spots Collected for Added Address Records

Type of Map Spots Collected	Count	Percent of total
Total Valid Residential Added Records	17,260,151	100.00
Both GPS and a Manual Coordinate	12,885,133	74.65
Only a Manual Coordinate	116,990	0.68
Neither a GPS nor a Manual Coordinate	4,258,028	24.67

Source: FDCA Assessment File, as defined by F_ACTION, F_RESSTAT, F_UNITSTAT, and GPSATTEMPT_FINAL variables.

5.3.6 Metadata for GPS Collection

Assessment Question 8d: *What information was gathered from the GPS metadata?*

Two GPS metadata items from the FDCA Assessment File provide information about the quality of the collected GPS points. The number of satellites and the GPS signal quality were two attributes recorded in the metadata for each set of GPS coordinates.

Number of Satellites

In the United States, GPS receivers can access at least 24 operational satellites. A typical GPS receiver has 12 channels, which means that the receiver can access up to 12 satellites at the same time. The GPS receivers in the HHCs were 12-channel. To calculate a coordinate, the receiver must lock onto the signal of at least three satellites. If the receiver accesses additional satellites, the GPS coordinates would appear to be more accurate because each additional satellite directs the intelligence of the receiver to find a solution.[7] Table 5.36 shows the number of satellites accessed to collect the GPS coordinates in the AC operation. Over 98 percent of coordinates were collected while the receiver accessed six or more satellites, demonstrating that the HHCs had at least twice the intelligence required to calculate the GPS coordinates accurately.

[7] A GPS receiver must be locked on to the signal of at least three satellites to calculate a two-dimensional position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's three-dimensional position (latitude, longitude and altitude). The more satellites a GPS receiver can "see," the better the accuracy Global Positioning System (GPS) Field Data Collection Procedures, GPSAS Working Group – Version 2.0 4/17/2003.
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Table 5.36: Number of GPS Satellites Accessed

Table 5.36
The 2010 Census Address Canvassing Operation:
Number of GPS Satellites Accessed

Addresses	Count	Percent of total
Total GPS Structure Coordinates	103,995,369	100.00
3-5 Satellites	2,066,470	1.99
6-10 Satellites	86,235,110	82.92
10-12 Satellites	15,693,789	15.09

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, GPSNUMSAT, GPSLAT, and GPSLONG variables.

Less than 2 percent were collected using five or fewer satellites, which may indicate that the GPS signal was blocked. Large buildings, terrain, electronic interference, or dense foliage can sometimes block GPS satellite reception and cause positional data errors. The decrease in accuracy of GPS coordinates collected using five or fewer satellites may contribute to coordinates failing to appear within the active block. Of the 2,066,470 GPS coordinates collected with five or fewer satellites, about 12 percent were outside the active collection block. Of the 86,235,110 coordinates collected accessing 6 to 10 satellites, and the 15,693,789 coordinates collected accessing 10 to 12 satellites, only 6 percent, or half of those collected with five or fewer satellites, fell outside the active block. This parallels the experience in dress rehearsal where the ratio was 6 percent to 3 percent.

GPS Signal Quality

The Wide Area Augmentation System (WAAS), consisting of satellites and ground stations, provides GPS signal corrections to improve positional accuracy. With a WAAS signal, the GPS receiver in the HHC was capable of 3-meter or better positional accuracy 95 percent of the time. The HHC collected GPS coordinates whether or not the WAAS signal was available, and the metadata indicated this for each set of GPS coordinates. Table 5.37 shows the number of GPS structure coordinates collected via WAAS.

Table 5.37: GPS Coordinate WAAS Status

Table 5.37
The 2010 Census Address Canvassing Operation:
GPS Coordinate WAAS Status

Wide Area Augmentation System Status	Count	Percent of total
Total GPS Structure Coordinates	103,995,369	100.00
Collected via GPS non-WAAS Signal	56,955,819	54.77
Collected via GPS WAAS Signal	47,039,550	45.23

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, GPSSIGNAL, GPSLAT, and GPSLONG variables.

Approximately 45 percent of GPS coordinates were collected using a GPS WAAS signal and 55 percent were collected without a WAAS signal. The position of the WAAS satellites over the equator may have hampered signals when trees or mountains obstruct the view of the horizon. The presence of such obstructions may have contributed to the lower percentage of coordinates collected via a WAAS than a non-WAAS signal.

Since the availability of a WAAS signal was believed to enhance the accuracy of the GPS coordinates, GEO examined the occurrences of GPS coordinates falling outside the active collection block, with and without the WAAS signal. Although it was anticipated that GPS coordinates collected via a non-WAAS signal might have higher occurrences, the rates were the same at approximately 6 percent. The conclusion was that availability of WAAS was not a major contributor to the collection block status.

5.3.7 Active Block Status for GPS Coordinates

Assessment Question 8e: *How many GPS coordinates fell inside/outside of the collection block?*

Even though a Lister may have successfully collected GPS coordinates for a valid residential address, the coordinates sometimes fell outside the block where the Lister indicated the structure was located (active block). A total of 6,110,327 GPS coordinates, approximately 6 percent, fell outside of the active collection block. Table 5.38 shows how many GPS structure coordinates were placed inside or outside of the active collection block.

Table 5.38: GPS Structure Coordinate Accuracy in the Active Block

Table 5.38
The 2010 Census Address Canvassing Operation:
GPS Structure Coordinate Accuracy in the Active Block

GPS Structure Coordinate Accuracy of Address Records	Count	Percent of total
Total GPS Structure Coordinates	103,995,369	100.00
Inside the Active Block	97,885,042	94.12
Outside the Active Block	6,110,327	5.88

Source: FDCA Assessment File, as defined by F_RESSTAT, F_UNITSTAT, GPSINBLK, GPSLAT, and GPSLONG variables.

The vast majority of GPS structure coordinates (94 percent) fell inside the active block

Reasons for the GPS coordinates falling outside active collection block included:

- Lister error was caused when the Lister stood in the wrong block while collecting the coordinates. Thus, the GPS reflected the block where they were standing and not the active collection block. However, the HHC should have notified the Lister that he or she was standing outside the active block.
- The street feature centerlines that defined the block were not accurate. Although many features had been realigned before AC, some were still inaccurate. In such cases, even if the Lister had been standing in the correct location, it instead reflected an adjacent block on the census maps.
- The actual location of the structure was close to a block boundary. The GPS device assured that the collected coordinates reflected a point within 3 meters of the actual location. However, this accepted error of 3 meters may place the coordinate in an adjacent (wrong) block.

5.3.8 Structure Records Rejected During Processing

Assessment Question 9: *What were the results of the MTdb update process for map-spot coordinates?*

The FDCA contractor provided GEO with the GPS and manual structure coordinates collected during AC via the STRUCT. The STRUCT was a file of the coordinates collected for a structure, rather than an address-level file. Overall, GEO successfully processed 96.7 percent of the structure records. The dress rehearsal successful process rate was 99.7 percent. Table 5.39 displays the number of structure records the GEO received but rejected.

GEO received 107,853,856 structure records in the STRUCT, for which 104,292,813 records had GPS coordinates. GEO rejected records if they discovered a problem associated with the address record during the address update process. Records with map spots in military blocks and structure

records falling directly on another structure coordinate or feature line were not allowed in the database.

Table 5.39: Reject Reason of GPS Collection Coordinates

Table 5.39
The 2010 Census Address Canvassing Operation:
Reject Reason of GPS Collection Coordinates

Reject Reason	Count	Percent of total
Total Rejected GPS coordinates	1,695,135	100.00
Illegal or missing value in the STRUCT	1,586	0.09
MTdb record rejected	717,934	42.35
Wrong collection block	21,755	1.28
STRUCT record missing coordinates	591,029	34.87
MSP falls on top of an existing node or edge	18,624	1.10
Address is excluded	110,499	6.52
Collected in a LB	4,855	0.29
LB Delete or Duplicate and moved original tabulation block	1,793	0.11
Military Block (Sensitive location)	202,185	11.93
No address information	24,875	1.47

Source: GEO Map Spot Tally File.

5.3.9 GPS Collection Summary

Listers successfully collected a total of 103,995,369 GPS structure coordinates in the 2010 AC operation. This number represents approximately 99 percent of GPS collection attempts and 78 percent of the total valid LQs. However, a small percentage of collected coordinates fell outside of the appropriate collection block and could not be used as map spots in later operations. In these cases a manual map spot was used.

Approximately 74 percent of valid LQs had GPS coordinates that were in the correct collection block. Future operations involving the remaining 26 percent of LQs used the manual map spot, when available.

Although Listers collected coordinates for the majority of valid structures, they encountered problems with the HHC and maps in the process. Listers reported that at times, the software problems made the collection process slow and/or difficult. These problems may have led Listers to avoid attempting to collect coordinates for a small number of cases.

5.4 Local Update of Census Addresses Program

One major objective of the 2010 AC operation was to verify the address list submissions from tribal, state, and local government participants in the 2010 LUCA program. Since LUCA addresses were included as part of the AC workload, this assessment documents the verification results and provides data as to the final actions taken on these addresses. There are no specific assessment questions regarding the LUCA program.

The Census Bureau included LUCA address submissions that did not match MTdb records in AC to ensure their existence could be verified in the field. The Listers did not have information on which units came from the LUCA program. The success of the 2010 LUCA program was tied to the quality of the 2010 LUCA addresses submitted and the 2010 AC operation provided this information. The 2008 Census Dress Rehearsal LUCA assessment report addressed 2008 LUCA participation, submissions, and processing of the submissions (Tomaszewski, 2007b).

5.4.1 Local Update of Census Addresses Program Overview

The 2010 Census LUCA program was a precursor to the 2010 Census AC operation. Eligible governmental units chose one of three participation options to review and comment on the Census Bureau's address list.

The Census Bureau required the governmental units participating in the 2010 Census LUCA program to submit block-geocoded, city-style addresses. Only city-style addresses were accepted because of difficulties associated with duplication and complications related to matching addresses via computer software. Other changes were also allowed, depending on the option selected.

Option 1 participants corrected, deleted, or marked as Duplicate or Nonresidential any city-style address on the Census Bureau's address list. For each block in their jurisdiction, Option 1 participants either updated the city-style addresses or challenged the block count. They could also add city-style addresses in a specific block to the Census Bureau's address list. They received feedback materials that the Census Bureau returned to the participant and could appeal the results of the AC operation.

Option 2 participants viewed, but could not correct or update the Census Bureau's address list. They could submit a local address list, they received AC feedback materials, and could appeal the results of the AC operation.

Option 3 participants could provide their own address list, but could not view the Census Bureau's address list. However they received the Census Bureau's address count list for reference purposes only; therefore they could not challenge the count of addresses for census blocks on the address count list. In addition, they could not appeal the results of the AC operation.

The addresses from the Option 2 and Option 3 participant lists were matched to the Census Bureau's address list in the MTdb. By design, neither Option 2 nor Option 3 participants were permitted to challenge block counts (Tomaszewski, 2007b).

5.4.2 Local Update of Census Addresses Program - Verification Results

There were a total of 8,265,004 address records submitted to the MTdb from the 2010 LUCA operation (as determined by original source code). Table 5.40 shows the final address actions for LUCA Adds. Note that none of the records are classified as "New" because they were added to the MTdb prior to the AC operation. Table 5.40 shows the 1,196,212 verify count which in reality is field verified LUCA Adds. Less than 1 percent of the total address records (6,489 records), recorded in the field as Adds, matched to records already existing in LUCA so they were not Adds to the MTdb. The percent of addresses (14 percent) verified as valid addresses was much lower than the overall AC verify rate of 63 percent. There is also a much higher rate of negative actions such as Duplicates and Double Deletes for the LUCA Adds. For example, LUCA addresses had a 52 percent Double Delete rate, compared to a 10 percent Double Delete rate for non-LUCA address records during AC. In many instances LUCA addresses duplicated other addresses and were not able to be linked by automated matching

Table 5.40: Final Address Actions Applied to the MTdb for LUCA Adds

Table 5.40
The 2010 Census Address Canvassing Operation:
Final Address Actions Applied to MTdb for LUCA Adds

Final Address Actions Applied to MTdb	Count*	Percent of total
Total	8,265,004	100.00
Add	6,489	0.08
New	0	0.00
Matches to Existing Record	6,489	0.08
Change	1,056,015	12.78
Move	73,974	0.90
Verify	1,196,212	14.47
Negative Actions	5,463,048	66.10
Does Not Exist (Delete)	4,316,653	52.23
Double Delete	4,316,579	52.23
Single Delete	74	0.00
Duplicate	904,075	10.94
Nonresidential	242,320	2.93
Uninhabitable	30,043	0.36

*Counts are combined AC and LBAC actions.
Verify in this table means that the address was found in AC and there were no changes to the address component of the record.
Source: GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the MAFSRC extract variable.

5.4.3 Local Update of Census Addresses Program Other Living Quarters Adds

Some of the LUCA participants submitted GQ addresses, which were considered OLQs during AC. Listers indicated whether an address record was a HU or an OLQ and the OLQ went to the GQV operation to determine if the OLQ actually contained GQs.

The OLQ flag on the AC extract identified the LUCA OLQ addresses added from the LUCA 2008 Dress Rehearsal or the 2010 LUCA operation. Table 5.41 compares LUCA OLQ addresses eligible for the 2010 AC operation to the same records on the GQV extract to examine if the records were still flagged as OLQs after the GEO processed the 2010 AC operation results. In general, records

tagged as OLQs by any source were considered eligible for validation in GQV. However, the GQV operation had a very tight schedule, which made it high risk for completing on time.

In the dress rehearsal, it was found that LUCA participants often submitted invalid GQs. As a result, the procedures changed for 2010 Census so that participants were required to supply a GQ name for all GQs. An initial review of the records coming from LUCA showed that participants still submitted records incorrectly for OLQs. For example, they submitted commercial establishments or apartment buildings as OLQ adds. In light of this finding, processing was changed such that LUCA GQ records designated as HUs in AC needed a valid GQ name to be considered eligible for GQV. This reduced much of the GQV workload.

Table 5.41: Other Living Quarters LUCA Addresses by Eligibility for the Next Census Operation

Table 5.41
The 2010 Census Address Canvassing Operation:
Other Living Quarters LUCA Addresses by Eligibility for the next Census Operation[1]

Other Living Quarters Addresses	Count	Percent of total+	Eligible		Not Eligible	
			Count	Percent of total+	Count	Percent of total+
OLQ LUCA Addresses before AC.....	154,786	100.00	153,308	99.05	1,478	0.95
OLQ LUCA Addresses after AC and before GQV.....	117,626	100.00	33,741	28.68	83,885	71.32

+Percentages are of total LUCA OLQs for the next operation.
[1]Eligibility for the OLQ Addresses after Address Canvassing is for the Group Quarters Validation operation.
Source: AC Eligible Records, as defined by the ISOLQ variable and the GQV Extract files, as defined by the ISOLQ and GQUNV variables.

Prior to 2010 AC, there were 154,786 OLQ records from either the LUCA dress rehearsal or the 2010 LUCA Program. Ninety-nine percent of those records were flagged as eligible for the 2010 Census AC operation. Following the AC operation and GEO processing, there were 117,626 OLQ records from the 2010 LUCA operation on the extract produced for GQV. However, only 29 percent of those were considered eligible for the 2010 GQV operation. Based on this low percentage of eligibility, it appears that the OLQ adds for 2010 LUCA experienced similar issues to the 2008 Dress Rehearsal.

5.5 Miscellaneous Assessment Results

The following section answers the AC Assessment Question 2 and questions 10 through 18, as approved by the ALDOIT. Question 2 relates to the LBAC workload and question 17 provides data for both the AC and LBAC operations. The following table lists each of these questions and the location of any additional information or data for review.

Assessment Questions Answered in Section 5.5	Additional Information
2. How many blocks were identified as large blocks to be worked in the Demographic Area Address Listing environment during the Large Block Address Canvassing operation (pre-identified versus field-identified blocks)?	Sections: 2.3.3.5, 2.3.3.7, 5.5.1, 5.1.1 Tables: 2.18, 2.21, 5.1
10. What were the final field outcomes for road feature updating?	Section: 5.5.2 Table: 5.42
11. What were the results of the MTdb update process for road features?	Section: 5.5.2 Table: 5.43
12. What were the results of the Delete Verification phase of the operation?	Section: 5.5.3 Table: 5.44
13. What were the results of the Dependent Quality Control phase of the operation?	Section: 5.5.3 Table: 5.44
14. What were the major findings from the Asset Management System data regarding hand-held computers and Secure Digital cards?	Section: 5.5.4 Table: 5.45
15. What were the major findings from the Help Desk operation?	Section: 5.5.4 Table: 5.46
16. What were the major findings from the Time and Motion study?	Section: 5.5.5 Table: 5.47
17. What were the production rates (cases completed per hour) for both the regular Address Canvassing operation and the Large Block Address Canvassing operation?	Address Canvassing: Sections: 2.3.1.2, 2.3.2.4, 5.5.6 Tables: 5.51 – 5.52 Large Block Address Canvassing: Section: 2.3.3.7 Table: 2.20
18. What data were collected for the addresses/areas identified through the Information Communication project?	Section: 5.5.7 Table: 5.53

5.5.1 Large Block Workload

Assessment Question 2: *How many blocks were identified as large blocks to be worked in the Demographic Area Address Listing environment during the Large Block Address Canvassing operation (pre-identified versus field-identified blocks)?*

There were 2,526 collection blocks worked in the LBAC operation (which translated to 12,988 tabulation blocks). Of these, 2,086 collection blocks (82.6 percent) were pre-identified large blocks and were removed from the AC workload prior to the start of the operation. Only 440 collection blocks (17.4 percent) were field-identified large blocks. See Table 2.21 for a breakdown of these blocks.

5.5.2 Feature Updating Field Codes and Results

Assessment Question 10: *What were the final field outcomes for road feature updating?*

Assessment Question 11: *What were the results of the MTdb update process for road features?*

Feature Update Introduction and Background

Except for LBAC, the 2010 AC operation was completed by using the GPS-enabled HHC. Listers could add, rename, delete, and split street features in the active block in which they were working. When adding a feature using GPS, Listers began collecting GPS points a short distance before the start point of the new street and finished a short distance after the point where the new street feature ended. The HHC collected GPS data points and drew the new or revised feature on the map.

When the GPS signal was not available, Listers added a new feature manually by tapping points on the map as they walked or drove along the new street.

Extract deliveries from the FDCA database to GEO began in earnest on February 23, 2009 and the last one delivered were dated July 10, 2009. The early deliveries were from live training work for AC as well as from the LBAC operation already in the field. All 733,636 AAs (including split AAs) were canvassed for HUs and new road features and 238,174[8] AAs (32.6 percent of the AAs) had feature updates.

The road feature data returned from AC exhibited high variability. In some instances where the HHC received GPS signals, the collected features seemed to coincide with satellite imagery. In other instances features were incomplete possibly due to procedural error and possibly due to the software trimming algorithm (software coding rules that determined if a GPS-collected map spot or street feature was inside or outside the active collection block). Overall, structure points from the AC operation were collected properly and fell within the correct block.

[8] From the NUTS.ADCAN_AA Table (NUTS = Normalized Update Transaction Table). The WebCS reports 239,899 AAs but may be including large blocks and AA splits in the field.

Road Feature Update Results

In answering Assessment Question 10, Table 5.42 shows 2,756,444 feature updates were performed during the AC operation, including road feature adds, deletes, name changes, and splits. From these updates, 623,544 new road features were added, with 608,688 (97.6 percent) collected via GPS. There were 758,166 deleted features.

Two reasons contributed to the large number of deletes:

- Misaligned features (street features that were incorrectly displayed as a result of incomplete reconciliation from batch operations) were deleted and collected using the GPS enabled HHC.

- A number of 'paper' streets (streets that no longer existed or planned streets never constructed) included in the input data set were deleted by AC and LBAC Listers.

Table 5.42: Feature Update Return Statistics – Number of Records by Action and Capture Methodology

Action	GPS		Manual		Total Actions by Type	Percent Total Actions by Type
Feature Adds	608,688	97.6%	14,856	2.4%	623,544	22.6%
Deletes	0	0.0%	758,166	100.0%	758,166	27.5%
Name Changes	0	0.0%	1,189,403	100.0%	1,189,403	43.1%
Splits	0	0.0%	185,331	100.0%	185,331	6.7%
Total	**608,688**	**22.1%**	**2,147,756**	**77.9%**	**2,756,444**	**100.0%**

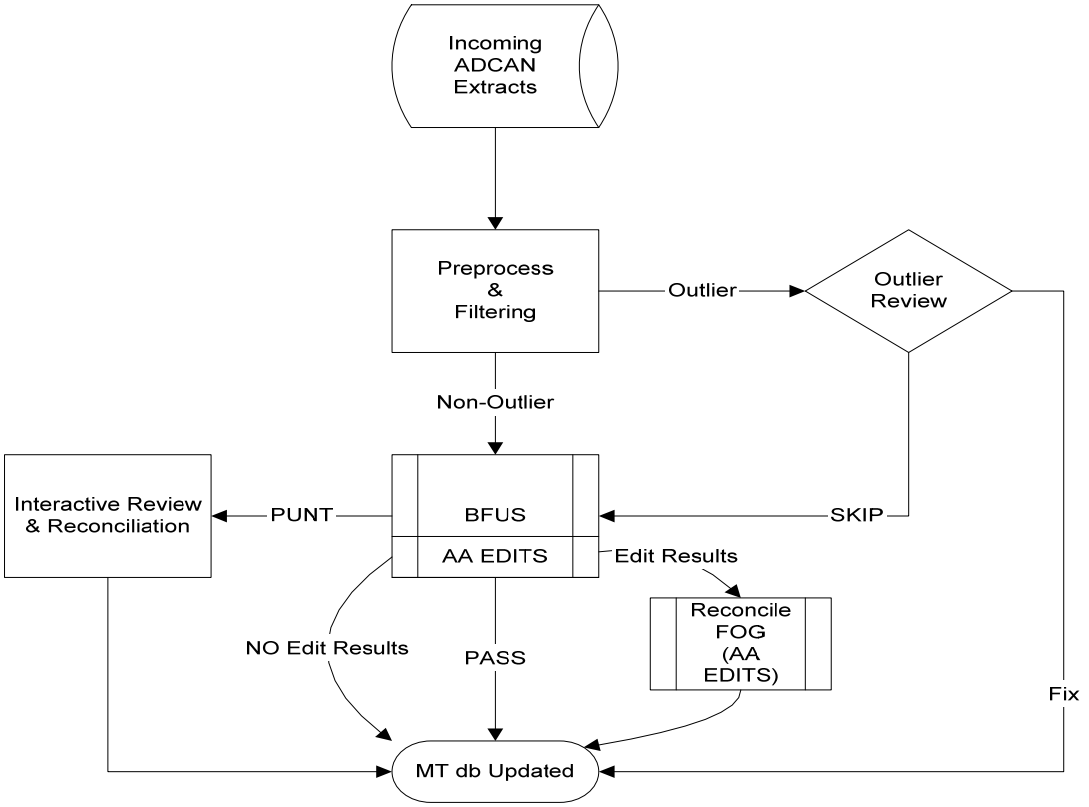
Source: U.S. Census Bureau, Geography Division, national_lineshapefile_07_07_2009.dbf, which reflects the union of all 2010 AC extracts up to and including those from July 7, 2009.
Note: Percentages may not total 100 percent due to rounding.

One reason for the number of feature deletes and adds was the historical background of the MTdb. An early precursor to road features in the current MTdb was work completed to create the Census Bureau's TIGERLine in the 1980s. Some of the original TIGERLine was based on 1:100,000 scale U.S. Geological Survey paper maps from the 1970s and 1980s; roads, railroads, and other features that no longer existed on the ground in 2010. Feature deletes may also have been necessary because the features were no longer valid as they were based on older vintages of updates to the TIGER Database. Another reason for the number of Adds and Deletes was that GEO identified 125,997 pairs of reshaped features for which deleted features matched to added features. This accounted for 20.2 percent of added features and 16.6 percent of deleted features. The largest groups of updates were to the road names at 43.1 percent.

Hierarchical Operation Flow

A hierarchical approach to the control of the feature update operation was taken to ensure that all deadlines would be met with complete accountability. Figure 5.5 shows a simplified AC spatial update flow process from the point of extract delivery to the upload into the MTdb. At each stage of interactive processing, the responsible branches identified and corrected any delays to assure process flow was maintained.

Figure 5.5: Spatial Update Workflow



Note: FOG = Floaters, Overshoots, and Gaps edit. BFUS = Batch Feature Update System.

Processing Through the Batch Feature Update System

Once an AA passed the outlier review it went into Batch Feature Update System (BFUS) processing where the feature updates were applied to the MTdb. The majority of the updates were applied without any interactive intervention. As a rule, GEO reviewed a portion of the successful updates to make sure they were appropriately added and did not duplicate existing features or cause other feature anomalies. GEO reviewed 5 percent of the successful updates, known as PASSes, and 100 percent of the feature updates that failed to be added for a variety of reasons, which are called PUNTs.

For the 2010 AC spatial update operation: 91.2[9] percent of all spatial updates delivered were directly incorporated (combination of Reviewable and Automated Passes) into the MTdb without any interactive assistance. In answering Assessment Question 11, Table 5.43 summarizes the numbers and percentages of PASS and PUNT by Action Type and Reviewable Status. As noted in

[9] Calculation: 202,574 reviewable passes + 2,251,946 automatic passes = 2,454,520 passes/2,691,667 total updates. Please note there are small accounting discrepancies mostly due to the definitions of the updates. Recall that a split can be treated as a partial add and partial delete. Several extracts were run more than once; this and other programmatic issues can explain the discrepancy between the universe of 2,756,444 from the national_lineshape_07_07_2009.dbf file and the NUTS.ADCAN_AA Table.

footnote 3, Table 7.2 shows the processed files with the splits, fragments and eliminated updates (those that fell outside the block or AA).

Table 5.43: Address Canvassing Processing Through Batch Feature Update System

	Reviewable Status				Automated Status		Total by Action Type	Percent Total by Action Type
Type	**PASS**		**PUNT**		**PASS**			
Add	137,370	20.7%	172,858	26.0%	355,469	53.4%	666,057	24.7%
Delete	10,308	1.5%	24,535	3.6%	648,099	94.9%	682,942	25.4%
Name	20,874	1.7%	18,866	1.5%	1,210,307	96.8%	1,250,047	46.4%
Split	33,662	36.3%	20,888	22.6%	38,071	41.1%	92,621	3.4%
Total by Status	**202,574**	**7.5%**	**237,147**	**8.8%**	**2,251,946**	**83.7%**	**2,691,667**	**100.0%**

Source: U.S. Census Bureau, Geography Division, NUTS.ADCAN_AA Table (NUTS = Normalized Update Transaction Table).
Note: Percentages may not total 100 due to rounding.

Note the review of the 5 percent QC records with a 'PASS' status through BFUS was dropped after approximately one month of review and once all of the operators were sufficiently familiar with the operation. Ordinarily, GEO would have continued this sample review, but this would have doubled the workload and it was more important for GEO to assure the updates, particularly new features, were applied to the MTdb. As expected, the largest number of PUNTSs came from added features. Only 1.5 percent of the name changes were PUNTs, while 26 percent of the feature Adds were PUNTs. This vast difference was mainly a result of coincidence issues[10].

Feature Update Data Problems

- Analysis of the data was complicated due to the lack of ground reference data (particularly digital imagery), which required reviewers to make assumptions about Lister intent and the desirability of results.

- Overall, the GPS shape points returned for the linear street features appeared smooth and were located close to road centerlines. Procedures used in the field had more impact on the results than hardware limitations or data processing. Often features were not completely collected or were collected for both sides of the street.

[10] Coincidence issues are defined as situations where the new line that is being added is too close to or touches an existing line. This occurs when a feature is already in the file and the Enumerator attempts to add and reshape the feature (for better accuracy), and the pre-existing edge is in the way.

5.5.3 Quality Control Results

Assessment Question 12: *What were the results of the Delete Verification phase of the operation?*

Assessment Question 13: *What were the results of the Dependent Quality Control phase of the operation?*

This section provides summary data on the DSSD QC program. To fully answer Assessment Questions 12 and 13, additional sub-questions were developed to provide more granularity for these two questions. Table 5.44 provides high level metrics for the QC operation. These data do not include metrics from the initial observations. More detailed information about the AC QC program can be found in the *Quality Control Profile for the 2010 Census Address Canvassing Operation*.

The Quality Profile will provide a detailed assessment of the quality control phase of both the AC and LBAC operations. This document is expected to be completed in 2012.

QC Listers used the AC QC software on their HHCs to perform the various stages of QC (DQC, DV, and FDV). The AC QC software used algorithms to determine whether an AA passed or failed QC. AAs that did not pass DQC were recanvassed. Once an AA passed DQC or was recanvassed, the AA moved to the DV stage where all duplicate and deleted address records were reviewed. If the DV QC Lister deleted any additional addresses or identified duplicate address records, those deletes and duplicates were reviewed again in FDV. Once an AA completed DQC, DV, and FDV (as needed), the AA was marked complete in the HHC and ultimately transmitted to the FDCA contractor and transferred to GEO for processing.

In summary, 25,443,124 Delete and Duplicate records were checked a second time, and 782,560 were sent to FDV. The 55 address records sent erroneously to DV and 565 records erroneously sent to FDV were not included in these totals. There were 845,025 deletes/duplicates reinstated by DV and 61,654 reinstated by FDV. There were 1,324 records that did not complete DV and received only a single delete and eight records that did not complete FDV and received only a single delete.

Overall, 61,843 AAs failed QC out of 733,636 total AAs. Out of 111,105 production Listers, 40,889 had at least one AA that failed DQC. On average, a production Lister worked seven production AAs, while QC Listers worked an average of 19 AAs.

Table 5.44 lists the sub-questions for the QC related assessment questions and supporting data and metrics.

Table 5.44: Address Canvassing Quality Control Assessment Question Metrics

Question Number	Question	Actual	Universe	Percent
12	How many AC Lister records were checked a second time in DV?	25,443,124	25,444,448 (total AC Lister Deletes/Duplicates)	99.99%
	How many QC Delete and Duplicate records were sent to FDV?	782,560	782,568 (total QC Lister Deletes/Duplicates)	100.00%
	How many records were erroneously sent to DV?	55	159,494,710 (total AC records, Large Blocks not included)	0.00%
	How many records were erroneously sent to FDV?	565	44,323,317 (total DV, QC, and Recanvass records)	0.00%
	How many AC Lister Deletes and Duplicates were reinstated by DV?	845,025	25,444,448 (total AC Lister deletes/duplicates)	3.32%
	How many QC Lister Deletes and Duplicates were reinstated by FDV?	61,654	783,125 (total FDV records including the 565 records erroneously sent to FDV)	7.87%
	How many records did not complete DV and received only a single delete?	1,324	159,494,710 (total AC records)	0.00%
	How many records did not complete FDV and received only a single delete?	8	44,323,317 (total DV, QC, and Recanvass records)	0.00%
13	How many AAs failed QC?	61,843	733,636 (total AAs with splits)	8.42%
	How many AC Listers had at least one AA that failed DQC?	40,889	111,105 (total production Listers)	36.80%
	On average, how many AAs did one production Lister work?	7	111,105 (total production Listers	-
	On average, how many AAs did one QC Lister work?	19	37,784 (total QC Listers)	-

Source: Decennial Statistical Studies Division, FDCA address file.

5.5.4 Asset Management System and Help Desk Findings

Assessment Question 14: *What were the major findings from the Asset Management System data regarding hand-held computers and Secure Digital cards?*

Planners anticipated the loss of approximately 1 percent of the equipment during AC. The data show that only 0.07 percent of the HHCs and 0.06 percent of the SD cards were classified as lost, missing, or stolen, much lower than the expected 1 percent loss. It is thought that the diligent efforts by the field managers to stress the importance of safeguarding the hardware, as well as the intentional unattractive design, contributed to low loss rates.

Table 5.45 summarizes the findings for Assessment Question 14.

Table 5.45: Summary Data of Lost, Missing, or Stolen Secure Digital Cards and Hand-Held Computers

Hardware	Total Items	Lost/Missing/Stolen	Expected Loss Equals 1% of Total	Actual Loss (%)
Hand-Held Computers	154,802	110	1,501	.07%
Secure Digital Cards	322,782	190	2,083	.06%

Source: Asset Management System dated 9/28/2010.

Assessment Question 15: *What were the major findings from the Help Desk operation?*

The goal of the Help Desk was to provide technical assistance at the lowest possible service level. The initial calls were routed to the ELCO (Level 1). If the problem could not be solved, the help ticket was escalated to the RCC (Level 2) and then to HQ and the FDCA contractor (Level 3). NPC provided overflow for the Level 1 HHC support which utilized the existing infrastructure at the NPC call centers.

From February through July 10, 2009 there were 223,394 trouble tickets submitted to the Help Desk; 218,379 tickets were resolved, and 5,015 tickets were canceled due to resolution. Table 5.46 shows the number of tickets by category.

Table 5.46: Help Desk Tickets by Category and Number Resolved

Category	Number of Submitted Tickets	Percent of Total Submitted Tickets	Resolved Tickets	Canceled Tickets
Hand-Held Computers	178,987	80.1%	177,297	1,690
Remedy	9,071	4.1%	6,593	2,478
Decennial Applicant, Personnel, and Payroll System	8,418	3.8%	8,268	150
Field Data Collection Automation Accounts	6,036	2.7%	5,866	170
Asset Management	5,558	2.5%	5,468	90
Field Operations Supervisor Laptops	4,634	2.1%	4,468	166
Telephones	3,340	1.5%	3,282	58
Procedural	3,009	1.3%	2,914	95
Callfinity	2,213	1.0%	2,144	69
Network	2,128	1.0%	2,079	49
Total	**223,394**	**100.0%**	**218,379**	**5,015**

Note: Tickets could be canceled if the ticket was initially submitted and the problem was resolved before the Help Desk resolution.

According to the *Top 10 Category Cumulative Report* from Remedy, dated August 25, 2010:

- Out of the 177,297 resolved HHC trouble tickets, 79 percent were resolved in the ELCOs, 12 percent were resolved in NPC, and 5 percent were resolved in the RCC. The remaining 4 percent required resolution through Decennial Operations Technical Support and Level 3 Help Desk assistance.

- Only 1,294 HHC trouble tickets or 0.73 percent required resolution at Level 3 (HQ/FDCA).

- Asset Management (1,796 tickets), telephones (1,334 tickets), and FOS laptops (987 tickets) were the other most frequently referred Level 3 trouble tickets.

The mean resolution time (from submission to resolution) for all categories was 26.3 hours. HHC issues had a mean resolution of 18.3 hours. FOS laptop and telephone issues usually took the longest and had a mean resolution time of 78.3 and 77 hours, respectively.

Of the HHC tickets, 93,500 tickets (52 percent) involved software, 28,021 tickets (16 percent) involved wireless transmission, 18,866 tickets (11 percent) involved hardware, and 14,837 tickets (8 percent) involved enrollment.

5.5.5 Time and Motion Study Findings

Assessment Question 16: *What were the major findings from the Time and Motion study?*

The AMSD Program Management and Services Branch and NPC conducted a T&M study for the AC production and QC operations from April 14 through May 22, 2009. The purpose of this study was to gather metrics for an operation run for the very first time nationwide using a handheld computer device (HHC). Data gathered, produced results, which helped determine the overall average cases per hour. The data will provide information for planning and implementation of similar activities for the 2020 Census. The study also provided data to evaluate the use of the HHC provided by the FDCA contractor.

The study included twenty-seven ELCOs, requiring about 35 observers who conducted the study using personal data assistants (PDAs) with specialized software designed for T&M studies. Although there were previous AC observation operations, this was the first time PDAs were used in a nationwide study. Observers also completed diary questionnaires to capture specific problems encountered with the HHCs.

Observers recorded information on the PDAs for 8,511 addresses during the AC production phase and 4,452 addresses for the AC QC phase for a total of 12,963 addresses observed. This amounted to a total of 535 hours of production observation and 256 hours of QC observation.

Performance Levels

The T&M study report provided findings based on performance levels. Performance levels measure the average level of effort for a qualified worker to perform their tasks. The average worker, when taking into account a fatigue factor of 15 percent, performs at an 85 percent level. Table 5.47 shows the number of cases completed at various performance levels for the 2006, 2008, and the 2010 AC operations.

Table 5.47: Estimates of Production for the Address Canvassing Operation Compared to Previous Time and Motion Studies

Level of Effort	Number of Completed Cases/Hour for Address Canvassing		
	2006 Census Test	2008 Dress Rehearsal	2010 Census
At 100%	11.5	6.0	21.0
At 85%	10.0	5.0	19.0
At 70%	8.0	4.0	17.0

Source: Time and Motion Study, *Address Canvassing Hand-Held Computer, Fieldwork Observations for the 2010 Census*, November 2009.
Note: Does not include travel to assignment and from address to address.

The HHC improved production for the 2010 AC operation, almost doubling the 2006 Census Test and more than triple that of the 2008 Census Dress Rehearsal, conducted in April 2007. Please note that these observations do not account for changes in procedures.

Based on observers' notes and comparisons of the data collected during three T&M studies conducted in 2005, 2007, and 2009, the HHC performed better in terms of efficiency and stability during the 2010 AC operation than in previous operations. The prototype HHC used in the 2006

Census Test performed better than the first iteration of the FDCA HHC used for the dress rehearsal. For further details refer to "Douglas, 2009."

Table 5.48 shows average screen change times for the 2010 Census AC operation. There were no comparable statistics collected during prior HHC tests. The AA/block screens took approximately the same time to load, while the address list screen took longer to load in production than during QC.

Table 5.48: Average Time Between Screen Changes – 2010 Production

Screen Items	Average Times Minutes:Seconds	
	Production	Quality Control
Power Up	02:01	03:27
Assignment Area/Block Screen	00:56	01:01
Address List Load	00:48	00:38
Update Address List	00:41	N/A
Accept Address	N/A	00:33
Reject Address	N/A	01:23
Map Spot	00:32	00:31
Back to Address List from GPS	00:15	00:10

Source: Time and Motion Study, *Address Canvassing Hand-Held Computer, Fieldwork Observations for the 2010 Decennial Census*, November 2009.
Note: N/A means not applicable.

Timed Element Observations

Table 5.49 shows the results (hours:minutes:seconds) for each grouping of elements timed in the PDA for production AC. The averages are computed by dividing the total duration times by the number of instances to reach the particular element(s). The number of instances varies because each observer did not necessarily reach all elements during each observation. Total duration is the total time (cumulative) each element was observed. Table 5.50 displays similar data for the QC phase of the AC operation.

Table 5.49: Observed Times Aggregated by Element Groupings and Average Durations – Production

Element Grouping (Component)	**Total Duration Hours: Minutes: Seconds**	**Average Duration Minutes: Seconds**
Update Address	97:42:48	00:41
Screen Changes (Power Up, AA Block Screen, Address List Appears, Back to Address List)	42:12:20	01:00
Mapping (Collect Map Spot, Map Feature Updates)	168:56:20	01:27
Travel* (Walking, Driving Address to Address, Locate Address)	190:02:22	01:50
HHC Delays (Address List Freeze, Update Address Freeze, Map Spot Freeze, Map Update Freeze, and Other)	8:20:40	03:02
Delays (Lunch, Breaks, Idle, Other)	92:45:16	12:34

*Excludes the time to drive from the Lister/observer meeting location to the Lister's AA and back to meeting location. Also excludes time driving to and from Crew Leader meetings.

Table 5.50: Observed Times Aggregated by Element Groupings and Average Durations – Quality Control

Element Grouping (Component)	Total Duration Hours: Minutes: Seconds	Average Duration Minutes: Seconds
Update Address (Accept Address)	33:18:11	00:33
Update Address (Reject Address)	11:56:51	01:23
Screen Changes (Power Up, AA Block Screen, Address List Appears, Back to Address List)	16:50:55	01:19
Mapping (Collect Map Spot, Map Feature Updates)	18:51:12	01:01
Travel* (Walking, Driving Address to Address, Locate Address)	84:07:20	01:23
HHC Delays (Address List Freeze, Update Address Freeze, Map Spot Freeze, Map Update Freeze, and Other)	6:35:54	05:05
Delays (Lunch, Breaks, Idle, Other)	35:01:23	10:00

* Excludes the time to drive from the Lister/observer meeting location to the Lister's AA and back to meeting location. Also excludes time driving to and from Crew Leader meetings.

5.5.6 Production Rates

Assessment Question 17: *What were the production rates (cases completed per hour) for both the regular Address Canvassing operation and the Large Block Address Canvassing operation?*

National Production Rate for Address Canvassing

Using the total workload canvassed during production (159,494,710) divided by the number of Lister hours worked (10,331,016) provides a national production rate of 15.44 cases per hour.

Using the same approach taking the total workload addresses for QC (44,323,317) divided by the number of QC Lister hours worked (3,223,852) provides a national production rate of 13.75 cases per hour.

Production Rates by Production Rate Area for Address Canvassing

For the production phase, the overall average production rate was 15.37 cases per hour. With the exception of PRA 1 in the production phase of AC, all the production rates for the PRAs exceeded expectations. Perhaps the production rate was too high. In PRAs 2 and 3, the actual production exceeded the expected production rate, which could mean that the production rates were too low.

Table 5.51 shows the actual and expected production rates for the production phase of the AC operation.

Table 5.51: Calculated Hourly Production Rates by Production Rate Area for Production Work

PRA	Cases*	Weighted Workload	Hours	Actual Production Rate	Expected Production Rate
PRA 1	109,795,745	0.74	6,005,164	18.28	19.20
PRA 2	36,456,593	0.25	3,321,781	10.98	7.80
PRA 3	2,019,500	0.01	318,355	6.34	2.90
Total	**148,271,838**	**-**	**9,645,300**	**15.37**	**-**

Source: Field Division, 7/28/10.
* Data taken from the 220C level reports reflects work done by Listers, not CLAs or Crew Leaders. Total represents approximately 93.3 percent of the production workload.

The actual and expected production rates for the QC phase of the AC operation are shown in Table 5.52. For the QC phase, the overall average production rate was 12.18 cases per hour. The actual production exceeded the expected production rates in all three PRAs. In this case, the T&M study showed the 'accept address' screen took 8 seconds less than in production and the 'collect map spot' screen was 26 seconds quicker in QC. Travel time between addresses was 27 seconds less than during production.

Table 5.52: Calculated Hourly Production Rates by Production Rate Area for Quality Control Work

PRA	Cases*	Weighted Workload	Hours	Actual Production Rate	Expected Production Rate
PRA 1	29,288,334	0.71	2,120,928	13.81	9.00
PRA 2	11,050,059	0.27	1,126,459	9.81	7.00
PRA 3	629,874	0.02	116,084	5.43	2.00
Total	**40,968,267**	**-**	**3,363,471**	**12.18**	**-**

Source: Field Division email, 7/28/10.
*Data taken from the 220C level reports reflects work done by Listers, not CLAs or Crew Leaders. Total represents approximately 93.3 percent of the QC workload.

Large Block Address Canvassing Production Rate

The national average production rate (cases completed per hour) for the LBAC operation was 25.2 units per hour and the average time spent canvassing each tabulation block was 12.44 hours. See Section 2.3.3.7, Table 2.20 for further details. The higher production rate per hour is most likely related to the fact that Listers in LBAC worked in very large, densely populated blocks and did not collect GPS coordinates or structure type data.

5.5.7 Information Communication Project Data

Assessment Question 18: *What data were collected for the addresses/areas identified through the Information Communication project?*

During the AC operation, HQ received reports that QC Listers were finding addresses that were not included in their HHC address lists. The QC Listers were unable to add the missing addresses because the AAs had already passed the DQC, thus the AAs were therefore "locked" against any further updates. This issue was not the result of a problem with the HHC. One of the explanations for the missing addresses was QC Listers were seeing addresses that were actually in a different block.

To resolve this issue, FLD requested that an Information Communication (INFO-COMM) form be completed if a QC Lister discovered an address missing from the HHC after the AA had passed DQC. An INFO-COMM was a form used by field staff to communicate information about a particular case or AA, such as a dangerous situation. QC Listers provided information about the location and estimated number of potential missed addresses on INFO-COMMs. Upon review of the INFO-COMMS, HQ and the RCCs determined that a contingency plan was necessary to ensure that any potentially missed addresses had an opportunity for enumeration. These INFO-COMM addresses were included in the Nonresponse Followup supplemental universe and had an opportunity for enumeration in the Vacant Delete Check. These addresses were not mailed a questionnaire.

Table 5.53 shows the number of addresses per region collected during the INFO-COMM project.

Table 5.53: Summary of the Number of Addresses Collected by Information Communication

Region	Estimated Number
Atlanta	11,282
Boston	8,769
Charlotte	3,640
Chicago	5,344
Dallas	8,124
Denver	18,260
Detroit	3,075
Kansas City	4,528
Los Angeles	5,525
New York	13,832
Philadelphia	1,159
Seattle	10,540
Total	**94,078**

The addresses were provided to GEO to match against the MTdb. Of the 94,078 addresses received during this effort, 26,561 addresses were sent to the Vacant/Delete operation to be checked in the field and enumerated if necessary.

5.6 Address Canvassing Closeout – Evaluation and Analysis

This section provides summary data and analysis comparing the AC operation planning assumptions with results. Observation report summaries are included in this section as well as recommendations to aid in 2020 Census planning.

This section does not include large block data as there was no cost model data for the LBAC operation; the budget was based on FLD estimates and did not account for the undetermined field-identified workload. Actual costs including training, production hours, and miles were not tracked in the DMD C&P system. The only data tracked in the DMD C&P system was progress data. Costs were tracked in the Census Bureau's Financial Management Reports. There were no baseline hours and miles with which to compare the actual figures. Details of actual costs can be found in Section 5 and the basic assumptions that went into determining the budget allocation for LBAC can be found in Appendix D.

Please note that actual staffing tallies for field positions are inflated as they show all unique employees, which accounts for staff that dropped out or were released, in addition to their replacements. Staff, who worked multiple positions within an operation, were only counted in the position they worked the most hours.

5.6.1 Address Canvassing Budgeted Metrics versus Actual Metrics

The following provides a summary of the budget assumptions for workload, staffing, costs, and other items and compares the assumptions to actual data. The budgeted data are derived mostly from the DMD cost model, and the actual data came from the C&P system and DAPPS.

These data are provided in:

- Table E-4: Total costs, workload, and production data (Appendix E)
- Table E-5: Workload and production data for the QC phase (Appendix E)
- Table 5.54: Planned versus Actual Address Canvassing Recruiting, Training, and Overtime Data

Although some areas of the country had recruiting challenges, AC recruited 67 percent more staff than expected. The staff exceeded production goals in all areas except PRA 1, where they were very close. Note that the actual staffing numbers were developed by FLD and staff was counted where they worked the longest period of time. CLAs were trained with Listers in some ELCOs, but were also trained with Crew Leaders in other offices. These issues, as well as promotions during the operation, make estimating staff by position difficult and sometimes the numbers are inaccurate.

Production

For production budgeted versus actual costs, workload, and staffing refer to Table E-4 located in Appendix E.

- The initial budgeted production workload (137,755,042 addresses) was 5 percent less than the total delivered workload (144,890,808 addresses). AC Listers canvassed a total of 159,494,710 addresses (not including LBAC), a 14 percent increase over the initial budgeted workload.

- The larger-than-estimated production workload increased the number of staff required to complete the work and the number of miles driven.

    - The number of Listers working production was 20 percent more than budgeted.

    - The number of Crew Leaders and FOSs generally exceeded the budget.

    - The increased workload resulted in an 8 percent increase in the actual Lister production hours and a 35 percent increase in the total Lister miles driven.

    - The total number of miles driven for production (Lister, Crew Leader, CLA, FOS) was 20 percent over budget.

- Production rates were close to or exceeded the budgeted rates.

- Total field production hours used (13,674,953 hours) for all field positions (Lister, Crew Leader, CLA, FOS) was 99.73 percent of the budgeted number of hours.

Overall Budget

- The final cost of the AC operation ($443,591,299) was 19 percent more than the starting budget.

- The operational budget was $371,383,683 and increased to $397 million. The C&P system reflects the initial starting budget data.

- The overage can be attributed to underestimating the initial and QC workloads, as well as the resulting increases in training and staffing required to complete the fieldwork.

Quality Control

For QC budgeted versus actual costs, workload, and staffing refer to Table E-5 located in Appendix E.

- The QC workload was more than twice the budgeted workload. The 2010 Census AC initial budgeted workload for the QC phase of the operation was 17,908,156 address records. The actual QC workload was 44,323,317 address records. This large increase in workload can be attributed to the fact that the QC workload was a set percentage of the initial address workload. Consequently, when the actual production workload increased by 14 percent, all phases of the QC workload showed a corresponding increase. More importantly, the initial

QC workload estimates did not include any recanvassing estimates for the 61,843 recanvassed AAs.

- More training hours were necessitated for QC Lister, Crew Leader, and FOS positions due to the significantly larger QC workload. The number of QC Listers trained was 58 percent more than budgeted and exceeded the training hour budget by 59 percent. There were 85 percent more QC Crew Leaders trained than budgeted for, which exceeded the Crew Leader training hour budget by 75 percent.

- The number of miles driven and hours it took to complete the AC operation also increased due to the larger QC workload. The mileage budget for QC was severely underestimated. QC Listers had to travel to reach their AAs, and then travel to other AAs to conduct DV and FDV. Deletes were often widely scattered and required additional driving time. Overall, QC Listers drove 33,919,922 miles which was over budget by 275 percent. Total QC mileage was budgeted at 15,172,114 and the total actual miles driven by *all* QC field staff was 43,900,816 or 189 percent over initial budget estimates.

- The large workload significantly increased QC Lister hours worked. QC Listers worked a total of 3,223,852 hours, which was 48 percent over budget. The total QC staff charged a total of 4,301,555 hours which was 37 percent over budget.

Administrative

- FLD exceeded the testing goal by 67 percent, testing 1,189,944 applicants.

- There were 920,494 applicants qualified after testing, which exceeded the goal by 80 percent.

- The Lister no-show rate was 11 percent, which was 56 percent less than expected.

- The Lister training dropout rate was 55 percent less than expected.

- The AC operation was completed one week earlier than expected.

Table 5.54: Planned versus Actual Address Canvassing Recruiting, Training, and Overtime Data

Administrative				
Category	**Planned**	**Actual**	**Percent Change**	**Explanation**
Testing Goal	710,770	1,189,944	67%	There were many more people interested in census work due to the poor economic conditions in the country.
Qualified Goal	511,754	920,494	80%	High unemployment provided well qualified candidates for testing.
Lister No-Show Rate	25%	11%	-44%	Fewer no-shows meant that there were fewer replacement training sessions. These numbers are not included in the DMD cost model except in the frontloading rate, which was only applied at 50 percent to Lister and QC Lister positions.
Lister Training Drop-Out Rate	11%	5%	-45%	Fewer drop-outs meant there were fewer replacement training sessions. These numbers are not included in our cost model except in the frontloading rate, which was only applied at 50 percent to Lister and QC positions.
Completion of Operations	07/17/09	07/10/09	N/A	The one week difference in operations complete date can be attributed to higher than expected productivity in 2 out of the 3 PRAs for production phase and all PRAs for QC phase, lower than expected attrition rates, and more hours worked by Listers than expected.
Total Additive Cost for Overtime	N/A	$17,586,294	N/A	These costs were accrued because the distance within ELCOs required additional travel, there was more work than anticipated in PRA 2 where the production rates was 60 percent lower than PRA 1, and there was a 247 percent larger QC workload than planned, requiring more staff and additional hours to complete. These charges are included in the overall costs for the AC operation.

Source: Prepared 06/29/09, updated 09/11/09. Revised with C&P numbers on 06/3/10 and Field Division staffing numbers.
Note: N/A means not applicable.

Field Cost per Case

Table 5.55 reflects the cost per case baseline for the production phase of AC was $2.20, while the baseline cost per case for the QC phase was $3.83. The various costs associated with cost per case in both phases include training, production hours, and mileage for the FOS, Crew Leader, CLA, and Lister positions. No development or infrastructure costs are included in the data provided.

Table 5.55: Calculated Cost per Case Baseline for Address Canvassing

Item	Budget	Budgeted Workload	Baseline Cost per Case
Production	$302,771,426	137,755,042	$2.20
Quality Control	$68,612,211	17,908,156	$3.83
Production and QC Total	**$371,383,638**	**155,663,197**	**$2.39**

Table 5.56 reflects the actual cost per case for the production phase of AC was $2.07, approximately 6 percent less than expected. The actual cost per case for QC was $2.48, which was 54.2 percent less than the baseline.

Table 5.56: Actual Cost per Case for Address Canvassing

Item	Actual Cost: Training Hours, plus Field Work Hours, and Miles Costs	Actual Workload	Cost per Case	Baseline Cost per Case	Variance Percent
Production Total	Training: $63,272,141 Hours: $214,556,772 Miles: 51,416,987	-	-	-	N/A
Production Workload Total	$329,700,900	159,494,710	$2.07	$2.20	-6.0%
Quality Control Total	Training: $17,703,156 Hours: $68,167,518 Miles: 24,145,831	-	-	-	N/A
QC Workload Total	$110,016,505	44,323,317	$2.48	$3.83	-54.2%

Source: Actual costs via C&P, actual workload Decennial Statistical Studies Division, Tables 5.5 and 5.11, Sections 5.1 and 5.2.
Note: N/A means not applicable.

The actual cost per case for the LBAC operation is shown in Table 5.57. The original budget did not include specific funds for the field-identified workload which could not be estimated, so no baseline cost per case could be calculated. The cost per case includes production, listing check, and all charges incurred in fielding the operation. The costs per case are comparable to the AC QC cost per case.

Table 5.57: Actual Cost per Case for Large Block Address Canvassing

Item	Actual Cost	Actual Workload	Cost per Case
Production and QC Total	$10,275,874	4,096,642	$2.51

Note: No breakdown for Listing check and Production. No baseline was established, as original budget was not based on Field ID Large Blocks.

5.6.2 Observation Reports Summary

Observation visits were critical in helping the Census Bureau test and evaluate training materials, procedures, and overall census operations. AC observers included staff from FLD HQ, DSSD, GEO, DMD, TMO, as well as Housing and Household Economics Statistics Division and the Statistical Research Division.

Participants were required to submit reports that showed where and when the observation took place, the number and type of staff observed, the observer's interest in the particular activity, and what was learned. For example, an observer who writes Crew Leader training materials might observe Crew Leader training to determine how effective the materials were; to obtain feedback from trainers, trainees, supervisors, and office staff; and to develop recommendations on how the materials can be improved.

Observers assessed the AC operation, listed problems discovered, and made recommendations. They were not asked specifically to indicate what worked well. Designated Branch Chiefs and staff members reviewed and approved the reports before they were released.

Address Canvassing Observation Reports Summary

The 35 observation reports for the AC operation can be obtained from the FLD shared drive. They include reviews of production and QC Lister training, fieldwork for production, and all phases of QC (DQC, DV, Recanvassing, and FDV), ELCO operations, inventory control, the Help Desk, and HHC performance. ELCO operations encompassed the work of Assistant Managers for Field Operations, Assistant Managers for Quality Assurance, production and QC FOSs. The reports do not include reviews of administrative procedures.

The observation locations spanned the nation and Puerto Rico. Fieldwork in the selected AAs involved the full range of listing and verification situations: single-family homes, large apartments, small hard-to-find multi-units, mixed housing, apartment buildings with addresses on two streets, apartment buildings with inconsistent unit indicators, trailers, mobile homes, on-going demolition, new construction, gated communities, and seemingly non-residential structures. All-terrain vehicles, helicopters, or horses were required to reach isolated and

sparsely populated areas, such as the remote barrios of Puerto Rico, hard-to-find HUs along the Texas-Louisiana border, and some locations in Colorado.

Successes

Observers were not asked to comment specifically on successes, but were instructed to assess the operation, report on problems, and give recommendations. The following notable successes were gleaned from the observation reports:

- The HHCs worked well overall. Most of the difficulties experienced early in the process were resolved.
- The Listers, Crew Leaders, CLAs, FOSs, Assistant Managers, Regional Technicians, and Area Managers were knowledgeable, competent, professional, dedicated, and friendly.
- Training at all levels was mostly effective.
- The Help Desk was effective.

Challenges

Hand-Held Computer Issues

- The inability of Crew Leaders to see an AA on the HHC unless they assigned it to themselves before assigning it to a Lister slowed down the assignment management process, especially in rural areas.

- The inability to sort or search the address list by map spot number delayed work in large blocks when the Lister had to scroll through a large address list, which sometimes contained 600 lines.

- Failure of the auto pan feature to stay turned off prevented Listers from using the HHC maps to find and travel to an AA. When the auto pan feature was enabled, the YAH indicator automatically kept the current location on the map centered on the HHC screen. To move the map beyond the present viewing range, auto pan had to be disabled.

- The HHC performance slowed down as the address list became longer.

Hand-Held Computer Hardware

- The screen was difficult to read in the sun.

- There was not an indicator to gauge wireless signal strength.

Training Materials

- The training needed greater clarification on the interviewing process and a consistent reference to the courtesy contact. Some trainers called it a "courtesy knock." Some Listers were confused about when to do a courtesy knock and when to ask for a

mailing address. Note that the manual clearly instructs Listers to always make a "courtesy contact" at each LQ. In the manual, the interviewing scripts clearly indicate that the HHC will prompt for a mailing address when one is required.

- The training materials needed to expound upon the explanations of several points:
  - How to distinguish Duplicates and Deletes on the address list
  - How to identify, distinguish, and list multi-units and duplexes, and provide more practice for each task
  - When to perform a courtesy knock when contacting respondents; when to conduct a brief interview; and how to follow HHC prompts for collecting other data, such as the mailing address
  - How to follow the rules of canvassing on treacherous or impassable roads
  - For QC Listers, selecting the original address or production Lister's edited address on the HHC "edit address" screen. Note that the manual instructions state to select the address with the most information.
  - Staff needed more practice in collecting map spots, with greater emphasis on collecting them at the front door of LQs. Map spots that were not collected at the front door, at times, showed up on the street centerline on the HHC map. Note that there could be no true practice collecting map spots, as the GPS was not active in training cases. The first time that Listers could actually collect a map spot was when they worked their first live case during their assignment.

- Errata sheets did not contain an alert to trainers regarding major issues that needed to be reviewed in class.

- When trainers did not mark errata in their training materials, Listers became confused and sometimes were given incorrect information.

Early Opening Local Census Office Equipment and Setup

- The voicemail volume on phones was too low, which required time-consuming playbacks.

- In large geographic areas (e.g., Cheyenne, Wyoming ELCO), the drive to the office was long, sometimes taking up to 4 hours from an AA.

- Special arrangements to unload equipment and supplies at the ELCO were not always made, such as accessing loading docks after hours and ensuring entrances to storage areas were wide enough to accommodate the pallets.

Communications

- Trainers did not always receive errata to training materials.

- ELCOs were not always aware of new materials posted on the FDCA portal. Consequently, in some ELCOs, the latest versions of materials were not being used. For example, in one ELCO, the Help Desk was not using the latest version of the Property Management Manual.

Puerto Rico

- The Spanish word and abbreviation for street, *Calle* and *Cll*, are used interchangeably; however, if the Lister did not spell out *Calle* when entering a street name on the address list, the QC Lister failed the address. Early in the operation, this caused many AAs to fail.

- Most Listers only spoke Spanish and the overflow Help Desk at NPC had no Spanish-speaking staff to assist with HHC issues.

6. Related Evaluations, Experiments, and Assessments

This section provides a summary of the other assessments and evaluations related to the AC operation. All of these are being developed under the 2010 Census Evaluation and Experiments Program.

AC Quality Profile

The AC Quality Profile will provide a detailed assessment of the quality control phase of both the AC and LBAC operations. This document is expected to be completed in 2012.

LUCA Program Assessment

The LUCA Program Assessment will provide data about the planning, development, and implementation of the LUCA program. It will include the participation rates for eligible governmental entities and the workload created by their address list submissions. The Address Canvassing assessment documents the field operation in which those addresses were verified or found to be erroneous submissions. This document is scheduled to be completed in 2012.

GQV Assessment

The GQV Assessment will provide further information on records that were identified as OLQs through the AC operation and the LUCA program. The GQV operation provided the final determination of the OLQs identified through AC and LUCA. This assessment is scheduled to be completed in 2011.

MAF Content Quality Post AC Summary Report

This report evaluates the content quality of the Master Address File (MAF) after the 2010 Address Canvassing. (Doc. #2010-4.0-G-16, Version 1.0)

7. Key Lessons Learned, Conclusions, and Recommendations

The following sections provide information for the key lessons learned and the final conclusions and recommendations for the 2020 Census planning and development.

7.1 Key Lessons Learned

ALDOIT identified four main categories of lessons learned from the AC operation. The Implementation Planning Team provided the same for the LBAC operation. Lessons learned include both successes and challenges.

Section 7.1.1: Lessons Learned - Address Canvassing General Planning
Section 7.1.2: Lessons Learned - Address Canvassing Software Testing/Security
Section 7.1.3: Lessons Learned - Address Canvassing Operations
Section 7.1.4: Lessons Learned - Large Block Address Canvassing Operation

Section 7.1.1: Lessons Learned – Address Canvassing General Planning

<table>
<tr><th colspan="2">Task: Defining Requirements</th></tr>
<tr><td colspan="2">Successes:
The Census Bureau provided requirements to the FDCA contractor. Multiple iterations and extensive negotiations were necessary to address funding and performance challenges early in the program.
The contractor met the essential requirements and the AC operation proved a success.</td></tr>
<tr><th>Challenges</th><th>Lessons Learned</th></tr>
<tr><td>There was a need to refine the requirements and constantly monitor the contractor. Stakeholders needed to provide significant input in all phases of development.</td><td>Do not provide any incentives for contractors to redo work, unless it is based on faulty requirements obtained from stakeholders.

Make it clear from the start that a simple solution may not always work (e.g., the FDCA contractor believed that all operations could be designed similarly).

Define risk at each step.

Provide adequate HQ staff to oversee the work of the contractor and all sub-contractors.</td></tr>
<tr><td>By design, not all requirements had been finalized during the bidding process; this was to allow for a “solutions based” contract, which resulted in some misunderstandings and faulty assumptions.</td><td>Firm requirements must be available prior to contract solicitation and during the Request for Proposal process.</td></tr>
</table>

Task: Defining Requirements (continued)	
Challenges	**Lessons Learned**
The requirements were ambiguous.	Implement SMART (Specific, Measurable, Achievable, Realistic/Repeatable, Testable) requirements. Census needs to provide training to all staff involved in the requirements process. We should publish requirements prior to release of the RFP to get industry feedback on the quality of our requirements.
The notion that "it worked last time and will work this time" contributed to a lack of flexibility, contingencies, and workarounds. The Census Bureau faced difficulties getting the contractors to understand the nature and complexities of Census operations.	Stress the need for greater flexibility during the design and planning stages to allow for changing requirements. The Decennial Census is inherently a government function. The Bureau needs to define if/what components should or should not be contracted out.
Requirements kept changing and some details were overlooked, which may have contributed to misguided assumptions and design decisions.	When defining requirements, think through and view operational and deliverable requirements from start to end.
Performance standards were undefined for all systems.	Define performance characteristics/standards early in the requirements process.
It was unclear if the contractor was making decisions or misinterpreting requirements.	Early and close collaboration on requirements will ensure effectiveness. Contractor must meet with staff/government officials to provide a post-delivery pass back to customers for review, discussion, and clarification. Need to develop a strong partnership with the contractor.
Some security requirements were new and evolving.	Early collaboration with the Census Bureau and the Department of Commerce security to better develop security requirements and include changing security requirements as a risk to planning.

Task: Defining Requirements (continued)	
Challenges	**Lessons Learned**
Data outputs were not always clearly defined at the time the contract was put in place. In some cases we did not know all that was necessary early in the decade and prior to the research.	All data outputs must be signed off on by the stakeholders' early and made part of the formal requirements. Research plans must be made early enough to inform the requirements process, so that data requirements can be included in early development specifications and plans.
The needs of some stakeholders were not addressed early enough in the development of AC software and hardware.	Data stakeholders (e.g., GEO and DSSD) must be adequately represented in early planning of AC software and instrument development.
The decision to exclude certain areas had unforeseen consequences (e.g., not ingesting water blocks had unforeseen consequences).	Careful consideration must be given when excluding any portion of the block universe from the operation.

Task: Managing Changes from the 2008 Census Dress Rehearsal	
Success: The 2010 AC operation successfully incorporated changes based on the results of the 2008 Census Dress Rehearsal.	
Challenges	**Lessons Learned**
The multitude of changes had a severe impact on planning and testing for the 2010 AC operation.	Prioritize and limit changes to allow time to correct problems prior to the census.
The 'Replan' after the dress rehearsal put major strains on the development of the 2010 AC operation.	Test more frequently in smaller test to avoid major operational changes late in the planning cycle. Extra time is necessary to assess technical and budgetary constraints to institute changes.

Task: Headquarters Planning and Development	
Success: • The 2010 AC was completed on schedule. • Detailed workflows were successful and useful.	
Challenges	**Lessons Learned**
Planning teams were sometimes isolated from the 'big picture' and could not conceive of the full vision of the operation.	Planning teams and workgroups need to have an accurate vision of the overall operation. They need early understanding of the operational development plan and overall approach. Contingencies need to be planned for and put into place. Crisis management plans need to be conceptualized in advance.
Some roles and responsibilities were not clearly defined; as a result, efforts were sometimes duplicated.	Clearly define staff assignments. Obtain stakeholder agreement on roles and responsibilities.
The same core reviewers did not examine all the materials during the various stages of the operation.	Assign a core team of reviewers to evaluate materials from development of requirements to implementation.
There were concerns regarding the length of time involved in developing detailed workflows and narratives.	Detailing the workflow and providing narratives promoted greater understanding among stakeholders and the time spent developing them was worthwhile.
There was a lack of adequate HQ and FDCA contractor resources for Puerto Rico.	Provide adequate resources to plan and implement AC in Puerto Rico earlier in the development timeline.
Formal testing of back-end systems was insufficient, which led to issues.	The schedule and operational planning must include full testing of back-end systems.
Field staff lacked feedback as to the quality of the data collected.	Develop a mechanism to provide real-time feedback to the field based on observations from data received.

Task: Development of Field Manuals and Training	
Successes: • HQ developed an enormous quantity of well-written reference manuals and training materials. • The reference materials were well-received. • Verbatim training was effective for providing consistency to large groups across the nation. • HQ used errata sheets to correct errors in materials on a timely basis in the effort to ensure consistent procedural changes. • Simulations in the OCS CBT were useful for learning the system.	
Challenges	**Lessons Learned**
In some cases, the contractor needed to expedite completion of finished materials, which resulted in a lower quality than desired.	Stress quality over speed in contract deliverable monitoring. Need to balance the importance of meeting a deadline and doing the job right.
The materials did not cover some aspects of the canvassing work in enough detail.	Provide better and more detailed guidance on how to manage multi-units, especially poorly labeled units and hidden housing units. Training supplements were provided, although overall training time was reduced due to budget constraints.
Supplement verbatim training with more practice with the HHC and multimedia.	Explore the use of supplemental training that allows trainees to practice the job with real materials. DVD presentations by professional trainers and other multimedia would enhance the training.
Training was lacking in certain critical topic areas, such as map spotting and the YAH indicator.	Incorporate more training on map spotting and what to do when the YAH indicator was not in the correct location or not present at all.
Some errata sheets were sent too late. In some cases the errata contradicted each other.	Eliminate the need for errata sheets by doing a full expert review of all reference materials and providing late changes electronically on-line.
There were some issues establishing OCS accounts, which made it difficult to train effectively. Without an account, the CBT training could not be taken.	There is a need to improve the account creation phase of the orientation process in regard to establishing systems accounts in order to receive timely OCS CBT training.

Task: Development of Field Manuals and Training (continued)	
Challenges	**Lessons Learned**
Managers wanted more practice with the HHC.	Provide HHCs to all managers so they can familiarize themselves with the system before the operation starts. Explore what can be done to allow managers to practice without the DAPPS account requirement for access to a functioning HHC.
Staff training writers did not have a clear understanding of the AC operational requirements.	Training writers must know the system and provide workable solutions to potential problems. Use feedback from earlier operations to ensure compliance with all requirements. Suggest that training writers become more involved in team operational planning activities.

Task: Schedule Development	
Success: HQ developed a workable schedule that allowed AC to meet the constrained end date.	
Challenges	**Lessons Learned**
There were some late schedule changes due to inaccurately projected workloads.	Anticipate workloads more effectively to avoid schedule changes. Have stakeholder division heads sign off on all workload projections before baselining the schedule.
The timeframes given for review were unrealistic.	Provide realistic timeframes for development and review. Take into account the schedules of the people who review the material. Allow adequate time for multiple rounds of review for lengthy or complicated materials.
There were no standards put in place to develop schedules across various divisions.	Use sound project management principles to develop the schedule; it should have been work-package driven.
The time to learn from and utilize lessons from mid-decade tests was very limited.	Provide more scheduled time to implement lessons learned between mid-decade site tests.

Task: Cost Model Development	
Success: HQ developed a workable cost model.	
Challenges	**Lessons Learned**
Parameters were unrealistic for AC.	Cost model parameters should be determined by the operation - one size does not fit all. Need ability to estimate spending on other objects and their impact on operational costs.
The QC phase was not adequately addressed in the model.	Cost modelers need a greater understanding of QC operations, including recanvassing results from failed DQC. Consider adding specific parameters regarding recanvass/rework, such as do not pull CLAs from Lister/Enumerators staff, and workload distribution by RCC.
There was an inconsistency in the definition of terms.	HQ and RCCs must use the same definitions and concepts, such as “urban” versus “rural” areas and PRAs.
The AC experience impacted other downstream census operations.	The AC experience with the Cost Model helped improve the accuracy of estimating the costs of other field operations.
Develop more realistic out-year budgets.	Prepare out-year budgets based on realistic assumptions from involved stakeholders. Do not assume that what worked in the last cycle is realistic.
There was a lack of funding for some tasks.	Plans that are laid out and communicated must be in line with plans and funding. There is a need to develop contingency plans, if money is not available. Consider the best approach to "going after" funding initiatives.

Task: Cost and Progress System Development	
Success: HQ developed a workable C&P system for the 2010 AC operation.	
Challenges	**Lessons Learned**
FDCA systems down time lead to problems processing updates to the cost and progress system.	Stress the importance to contractors of providing a daily progress data file delivery. Better integration between the systems by the owners.
There was some inconsistency between the C&P system, DAPPS, and OCS data.	Ensure consistency between all automated systems by testing the interface and reviewing outputs. Plan to validate data between systems to ensure reports are accurate.
Needed daily confirmation that data were delivered as scheduled to confirm that data were delivered.	Develop a system for ensuring daily delivery of data with accountability as a part of the system. Reports should not have to be run to determine if updates have occurred regularly.
There was no standard way to identify overtime hours in the reports.	Implement a standard code or other variable to clearly distinguish between regular hours and overtime hours.
The list of persons who needed access to C&P kept changing.	Create a list of critical staff that requires access to C&P prior to public release. Design system flexibility to change/alter access.
Some reports and elements were not updated or updates were received late in the day.	Utilize real-time reports to the greatest extent possible. Reduce lag between FDCA and C&P systems updates. All reports should be updated once daily.
Report templates were insufficient as some custom report building was required.	Build a smarter system to include control and QC charts. Work with all stakeholders to build a system which includes formatting for the most frequently used reports, minimizing the need and time to create custom reports.

Task: Risk Mitigation Planning	
Success: HQ effectively anticipated risks.	
Challenges	**Lessons Learned**
Several risks were identified late.	Identification of risks (based on past experiences) earlier in the process would be more helpful. Situations occurred where risks had not been previously identified.
There was some uncertainty about who should address each identified risk.	Identify stakeholders who understand the risk, can provide an immediate solution, and who can address the longer-term consequences.

Section 7.1.2: Lessons Learned – Address Canvassing Software Testing/Security

Task: Software Testing/Security	
Successes: • HQ implemented a testing plan for all software required for the 2010 AC operation. • HQ conducted a full-scale field test to ensure that all deliverables met the requirements (dress rehearsal). • The OFT went well and provided a testing opportunity to prove that many of the dress rehearsal issues had been addressed. • HQ developed adequate security for the HHCs.	
Challenges	**Lessons Learned**
A small percentage of issues were not identified before production started, which led to problems.	Plan testing early enough to fix issues identified in Problem Tracking Reports. Testing needs to examine performance.
The testing environment was inconsistent.	Use the same environment for testing each component – all production or all testing, not a mix of the two. HQ could test in training mode which did not allow testing of the YAH, although all functionality was tested.
The full system was not production stressed (load).	A full system testing needs to be conducted in the production environment.
There was insufficient time to learn from the tests.	Allow time to evaluate the results from testing and implement changes, if necessary, before the next test.
The goals and criteria for each test were not completely defined for each phase.	Develop comprehensive test plans, which define testing efforts (goals, criteria) for all components of operations (processes, interfaces, systems, and materials).
The delay in getting the Authority to Operate (ATO) prevented early testing with realistic data.	Include time in the planning schedule to obtain the IT security ATO.
The delay and compression of testing schedules put more pressure on staff trying to participate in testing to simultaneously complete their regular work. Additionally, there was not sufficient staff to participate in the tests.	Allow staff to give highest priority to testing work and consider it a full-time task. There is a need for more SMEs and testing staff to participate in testing. The shortage of staff was mostly due to overlapping priorities as multiple operations were being planned by the same teams.

Task: Software Testing/Security (continued)	
Challenges	**Lessons Learned**
Lack of stakeholder involvement and collaboration early on.	There should be more collaborative efforts between stakeholders and IT developers/testers from the beginning of development.
Tests needed more user involvement.	Involve SMEs in developing realistic and complete test scripts and include sufficient user testing.
Software and system performance standards were not defined upfront.	Performance testing needs to be done incrementally and throughout the software development and testing lifecycles.
The testing cycle was very expensive.	Testing should be more well-thought, giving special consideration to the most critical components as preparations for 2020 get underway.
The scope of testing should include more variables to identify potential problems.	Because of Title 13 data, a wider variety of areas need to be tested, with end-to-end testing using more defined inputs and expected outputs.
Users and stakeholders did not always provide sufficient insight into the development process or conduct their own quality assurance.	Contractor must plan for significant input from stakeholders. This will allow for more insightful software development and build in accommodations for intensive user testing.
There was insufficient time to learn from the OFT.	Conduct an OFT early enough to allow additional time for evaluation.

Section 7.1.3: Lessons Learned – Address Canvassing Operations

Task: Recruiting and Staffing	
Success: The FLD hired sufficient staff to complete the 2010 AC operation on time.	
Challenges	**Lessons Learned**
QC staff were hired later than production staff in many offices. Assuming that those individuals hired for production staff achieved better test scores, this may have contributed to a more qualified production staff.	Use test scores and responses to effectively hire staff and distribute them equally between production and QC. Establish the staff distribution in the hiring protocol.
RCCs did not expect the lengthy Census hiring and employment check.	Attempt to simplify the Census hiring and employment check process and look at alternative ways to perform applicant geocoding. Ensure schedules allow sufficient time for all hiring process requirements.
The fingerprinting process caused issues. Some applicants could not be authenticated because their fingerprints were difficult to obtain.	Attempt to simplify the fingerprinting process to perform security clearances and explore alternative ways for collection, such as a digital process.

Task: Office Computing Environment	
Successes: • The OCE was an effective resource for managing the AC operation. • Real-time reports were very useful.	
Challenges	**Lessons Learned**
Some reports were removed from the OCE during the requirements descope; including financial reports. Thus, this information was not available to the field.	All essential reports and data must be developed and implemented to effectively manage the operation. In this case, removing financial reports impacted awareness of budget expectations.
There was no way to measure the effectiveness of the training CBT materials.	A training database needs to be established for trainees to use to get real-time hands-on experience, and to provide a way to determine if the trainees learned the material for the OCE.

Task: Office Computing Environment (continued)	
Challenges	**Lessons Learned**
System and load issues occurred when everyone looking at a report generated at the same time.	Ensure sufficient computing power to allow multiple users to review the same report simultaneously. Include testing of systems' ability to generate and display reports to multiple users.
There was confusion in how to set up accounts and a lack of understanding about access rights.	Clarify which staff should have full account access and simplify the set-up process. Consider a tiered approach, whereby supervisors have a higher level of access than their clerks.
The development of the OCE How To Guides was dependent upon the completion of the software.	Training and software developers should collaborate from the inception of software design to provide sufficient development time.

Task: Hand-Held Computers	
Successes: • HHCs worked well. • HHCs were more secure than paper address registers. • HHC software patches were successfully released and corrected the intended defects. • Overall, the staff thought the HHC was an effective tool. Most comments from the field were positive. • Ability to have regional (rather than individual ELCO) map images allowed greater flexibility. • Minimal loss of SD cards and HHCs. • Stakeholders believed that the intentional unattractive design of the HHC was one of the most effective deterrents to theft and loss.	
Challenges	**Lessons Learned**
The small screen size led to some Puerto Rico data being entered into the wrong fields.	Use an HHC with a bigger screen or modify the procedures for capturing addresses in Puerto Rico.
The HHC screen was difficult to read in the sunlight.	Provide a screen shield or require that the HHC screen be fully readable in sunlight.
The process of replacing the SD cards was difficult and costly as instructions conflicted and changed quickly.	Allow for emergency transmission to pick up the necessary software updates.

Task: Hand-Held Computers (continued)	
Challenges	**Lessons Learned**
When testing HHC software patches, there was no way to limit the group that could access the patch.	The design needs to limit download access to the system to allow only specific users to test in a live environment.
Managers could not see the data on the HHCs.	Provide managers with the functionality to see the data on Lister HHCs via remote access or other technology.
There was some uncertainty in HQ about how to dispose of the HHCs after AC.	A determination must be made for post-operational use of HHCs before deciding on leasing versus purchasing.
Inventory control was not standardized.	Inventory control needs to be an integral part of the requirements package.
There were some biohazard concerns.	Disposal of SD cards and other hardware had potential biohazard risks that must be addressed.
Access was limited for some managers who needed full functionality. Some managers could only use the HHC in training mode and could not see the GPS.	Provide full HHC access and functionality to Regional Techs who need it.
Setting up the FOS laptop was tedious as there was a specific sequence.	Simplify the laptop setup process or provide a specially equipped HHC to the FOS.

Task: Electronic Maps	
Successes: • Availability of GPS and electronic maps was more effective than having paper maps. • GPS was a valuable tool when it worked correctly.	
Challenges	**Lessons Learned**
Listers had some trouble using electronic maps.	Block level view was workable, but small view made it difficult to locate assignments.
The YAH indicator usage was not always understood.	Need to do a better job at training staff about GPS work with census maps.
It was difficult to see map spots on the screen.	Provide a bigger screen or a screen with sufficient resolution to allow Listers to see map spots. Improve zoom function and expand instructions on its use. Have the zoom level for collecting or verifying map spots in QC automatically set to the same zoom level (default) used to collect the map spot in production.

Task: Data Management	
Successes: • Data flow in near real time facilitated early error detection and the investigation of DQC failure rate. • Prior to AC there was a series of checks and balances between GEO and FDCA which established an acknowledgment process that accounted for every record.	
Challenges	**Lessons Learned**
The relationship between DAPPS and OCS was not entirely clear.	Provide a tool to allow managers to understand the status of data in each system.
Managers needed the ability to generate custom reports outside the normal system.	Provide training on how to generate and run custom queries using local software, such as Microsoft Excel.
There was limited time to test systems integration and metadata delivered with every file.	All development and testing should include components related to data quality to ensure that all activities produce timely, high-quality information.
Errors were suspected outside of QC sample.	Design supplemental review type function.

Task: Transmissions	
Success: Cellular transmissions were very successful as long as a Sprint cellular tower was nearby.	
Challenges	**Lessons Learned**
There were many gaps in wireless coverage which required long travel (mileage) and use of dial-up.	Coverage is and will continue to be an issue, until there is a national WIFI. Avoid limitations of having only one carrier. Ensure the contract with the network provider includes data lines and national coverage.
Listers without landlines had to travel long distances to find a coverage area.	Develop alternative transmission procedures using modems or other technology.

Task: Automated Quality Control and Dependent Quality Control	
Success: QC reports were very useful in the field.	
Challenges	**Lessons Learned**
If the YAH indicator was inaccurate, it could have resulted in geocoding errors.	Ensure that issues with the HHC, such as the YAH indicator and the GPS, do not impact data quality.
Managers could not reopen an AA if they suspected data quality issues.	Allow managers to view AAs, if they suspect data quality issues.

Task: Operations Management/Communication/Oversight	
Successes: Daily HQ meetings to discuss problems during production were extremely successful for quick resolution of problems, thereby minimizing the impact on field staff and maintaining contractor accountability.	
Challenges	**Lessons Learned**
SMEs did not always have sufficient time to review and provide feedback on deliverables.	Allow sufficient time for SMEs to review and provide comments on deliverables.
Electronic documents management was not an effective tool; it was very difficult to find specific files.	Implement a document management system to provide easy access and identification of document versions.
Contractor Program Management Reviews lacked Census Bureau review or consensus on program status.	Ensure sufficient program manager and stakeholder review. Obtain consensus on program status reports.
Need more effective communication for all outreach and community entities.	Give high priority to early outreach and community activities to inform the public of various operations. Start early enough to cover the pre-Census Day operations.

Task: Systems	
Success: • Successful transmission of encrypted data between the HHC and the FDCA contractor mission database, as well as between the FDCA contractor mission database and the MTdb with no breach. • Remedy's knowledge base was an excellent resource. • DAPPS ensured staff was paid weekly.	
Challenges	**Lessons Learned**
Late addition of Help Desk staff in the ELCOs impacted space utilization.	Plan to have Help Desk staff in the ELCOs.
System outages impacted critical activities, such as DAPPS.	Allow adequate time to test all systems to minimize downtime.
Systems, storage, and memory were not scalable and the scale may not be known until work actually begins.	Provide a realistic picture of the scale involved to all stakeholders. Allow for scalability in all requirements.

Section 7.1.4: Lessons Learned – Large Block Address Canvassing Operation

The purpose of the LBAC operation was to manage challenges listing census blocks containing a large number of addresses while reducing the risk associated with the HHCs performance. The operation faced numerous challenges with the current survey systems and software. These were known in advance and made to work in the decennial environment. All known risks were accepted, and mitigated where possible. See Section 2.3.3 for further details.

The overall general challenges and the summary lessons learned are presented in the table below.

Task: LBAC General	
Success: • LBAC was an effective contingency for large blocks in AC, but with known limitations. • ALMI was able to handle the large listing and listing check workloads without major application problems.	
Known Risks/Limitations	**Lessons Learned**
Tracking the number of staff hired across two systems was difficult and labor intensive. RCCs/ROs employed both experienced survey staff (managed by the National Finance Center) and new hires from the DAPPS system.	Provide a way for managers to more easily track the number of applicants hired for special supplemental work.
The QC check was not done on a timely basis due to a system software bug.	More complete testing of the system is required to allow QC to be conducted on a timely basis.
Map spot numbers were limited in the ALMI, so all units after 9999 received a map-spot number of 0001.	Limitations were learned and the team developed workarounds wherever possible.
Converting from MAF Update File (MAFUF)/ATUF to ADDUP and STRUCT files was difficult.	GEO had to take the additional time for conversions; these were known limitations. Explore identifying a flexible geography to use for decennial and current surveys that would eliminate conversions.
Once a block was sent from the field to LBAC, there were no procedures to reinstate the work back to AC.	This was a known limitation. If employed in future censuses, a process needs to be included to redeliver large blocks identified in error back to AC.
There was no time to test ALMI's ability to use 2010 Collection Block geography.	Develop geography to avoid the conversion from tabulation to collection.
ALMI did not have the same features, prompts or action codes as the HHC.	While this was a known limitation, DSSD was able to address some of these codes during QC.

Task: Large Block Address Canvassing Training	
Success: Overall, training was effective.	
Challenges	**Lessons Learned**
Regular DAAL training was different from the LBAC training. By providing the regular DAAL training to new hires first, the trainees learned procedures that did not apply to LBAC. This led to some confusion.	Ensure that training is appropriate for the operation and does not lead to confusion due to the provision of incorrect materials.
Time constraints prevented the development of LBAC-specific training.	All training material development must include dry runs, various reviews with revisions incorporated, and other activities to contribute to a robust training.
There was not enough time to test training new employees and conduct dry runs in large blocks.	This was a known limitation. Include sufficient time in the schedule to test training and conduct dry runs to ensure high-quality training for staff.

Task: LBAC Listing Check – Quality Control	
Successes: • DSSD devised solutions for several unforeseen problems that impacted the QC check. • Listing check worked well to resolve problems encountered during listing, to resolve LUCA cases, and to ensure multiple transmission blocks had the correct processing updates.	
Known Limitations/Challenges	**Lessons Learned**
The QC decision tools were inappropriate for determining pass/fail of the original listing.	Provide appropriate and meaningful decision tools for QC so there is no ambiguity.
There were errors in the listing and table features that made QC difficult to perform correctly.	Test all QC software and table creation features before releasing the material to the field.
The scope of the listing check was much larger than expected.	Take all parameters into consideration when developing a QC program so it can be done efficiently.
The QC procedure was different than normal DAAL/ALMI, so some QC Listers did more work than was expected because ALMI did not control sample size and QC assisted in cleaning up listing work.	It is important to be consistent between procedures; clearly explain any differences in the training materials.

Task: LBAC Production/Transmission of Update Files	
Successes: • GEO was proactive in changing requirements to resolve problems with the update files. • The GEO restricted area created on DSSD's server worked well; it was an easily accessible place for GEO and DSSD to place update files or files needed for research or evaluation.	
Challenges	**Lessons Learned**
Revisions to the update file creation and delivery procedures slowed things at the beginning of processing.	Be prepared to change requirements during production when unforeseen problems impact processing schedules.
Simultaneously providing the progress file and control file during update file delivery was confusing.	This system would have benefited from prior testing particularly since this was the first time these delivery pieces were used in production.
DSSD noticed a lot more duplicates in files. DSSD/GEO had to wait for listing and listing check files. There were more ALMI US failures to determine what to deliver to GEO.	GEO was vigilant to ensure they received everything from the field. GEO/DSSD staffs worked tirelessly to allow the system to work for LBAC, despite many known risks and limitations.

Task: Geography Division Processing	
Successes: • GEO processing was successful. • GEO was proactive in changing requirements to resolve problems with update files.	
Challenges	**Lessons Learned**
The duplicate ATUF records for a single MAFID proved the biggest challenge for GEO processing. It was difficult to determine which of the multiple map-spot coordinates to associate to a specific unit.	Develop and test innovative ways to handle duplicate records in the data processing.
Converting MAFUF/ATUF outputs to the standard AC ADDUP and STRUCT was difficult and complicated.	Processes that seem simple may be much more complicated under the stress of actual production.
ALMI provided invalid combinations of certain codes (e.g., residential status and unit status).	The requirements must be flexible enough to handle unexpected data issues.

Task: Geography Division Processing (continued)	
Challenges	**Lessons Learned**
The 'spillover units' (worked by both AC and LBAC) were problematic for duplicates and deletes, and it was difficult to determine the correct outcomes.	Carefully plan for data anomalies when there is overlap between field operations.
Updating the MTdb was difficult when using the LBAC procedure to move a unit, rather than using AC procedures to add/delete.	Try to maintain procedural consistency in overlapping operations and have flexible processing requirements.
Revisions to the update file creation and delivery procedures slowed things at the beginning of processing.	Be prepared to change requirements on the fly when unforeseen problems impact processing schedules.
Needed better QC on the whole process to ensure that update files were created for all counties.	Design effective QC on the updating process to ensure high-quality deliverables.

Task: Tracking Progress	
Successes: • The development of the Daily Listing and Listing check progress report used by both GEO and DMD helped track completion and investigate production problems. • FLD modified the reports to more closely track work progress. • ROSCO reports were modified to be more useful.	
Challenges	**Lessons Learned**
Listing check progress reports were not defined prior to the LBAC operation. There were consistency issues between the Listing check progress report and the standard daily operation progress report.	Define all report requirements prior to starting any work in the field to identify any internal inconsistencies.

Task: Coordination Across Divisions	
Successes: • The operations planning team provided a good forum for discussion of issues and troubleshooting. • The team found ways to share data for all areas across the operation (e.g., LTSO shared drive, FLD Ops Logs).	
Challenges	**Lessons Learned**
There was no central repository for maintaining a log of issues/problems that occurred during LBAC production.	Establish and maintain a central site to maintain problem logs so that stakeholders can easily find vital documentation.
There was no issues log maintained after production work began for LBAC.	It is critical to maintain an issues/problems log for future planners to reference.

7.2 Conclusions – Key Recommendations for 2020

AC was the first census operation to deploy a completely automated data collection methodology of this scope in a decennial census. Through the planning, development, and execution of this operation, the Census Bureau ALDOIT stakeholders accumulated knowledge and experience that will assist in more effective and efficient planning and development of future automated census operations. Readers should refer to the lessons learned to assess the enhanced knowledge base that was gained during this experience.

Planning and Development

- The Census Bureau needs to carefully evaluate which projects can or should be contracted outside of the agency. A cost-benefit analysis must be performed on the time and effort required to make an outside contractor knowledgeable enough to develop critical census tools for conducting a very complex operation of the census.

- If there are major contracts involved in future Census operations, the contract management office and stakeholders need to foster better communications with the outside contractor(s) to ensure the best interests of the agency.

- The Census Bureau must develop a user-friendly document management system that allows census planners to easily research successes, failures, and recommendations from previous census efforts.

- Early in the decade, provide a fully functioning listing instrument ready for final testing to ensure software is stable and ready to use.

- Late design changes must be minimized.

- Continue the 2010 Census legacy of integrating QC planning into the overall operational planning. The 2010 Census quality program was immensely successful primarily because quality managers were at the table for most planning and development phases.

- Allot sufficient time for subject matter experts (SMEs) to review and provide comments on deliverables.

- Timing is everything. Automated devices, how-to guides, job aids, training, and CBTs should be fairly well developed by 2016 and fully refined by dress rehearsal. Training materials can then incorporate all relevant information, the lack of which was problematic for the regions in 2010. Use of a corporate device would assist in meeting this timeline. This is a similar timeline for 2010, as the LAMI was developed in 2005 for use in the spring of 2006.

Cost Modeling and Reporting

- Cost modelers need a better understanding of QC operations, including recanvassing that resulted from failed QC. Consider adding specific parameters such as recanvass and rework, CLAs (do not pull from Lister/Enumerators), and workload distribution by RCC.

- Create a list of the critical staff that require access to the Cost and Progress system prior to public release. Design system flexibility to change/alter access.

- Build a 'smart' system with control charts and QC charts.

Funding

- Secure sufficient funding to ensure early development and testing.

Budget

- Adequate time, staff, and funding *must* be in place to ensure comprehensive testing and the error resolution process of all automated systems; functionality, load, interface, and user.

Challenges

Predicting Technology

- Predict and choose the technology as soon as possible to be used in 2020.

- Consider bar codes for information storage as they hold a remarkable amount of data.

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9. References

Barrett, Diane, John Jones, Doug Olson, and Kimberly Nether (2005), ″Final Report for the 2004 Census Test Implementing Global Positioning System Coordinate Collection Methods with Hand Held Computer-Based Data Collection System, Evaluation 11″, DSSD 2004 Census Test Memorandum Series #G-19, Bureau of the Census, September 23, 2005.

Burcham, Joseph A. (2002), "Census 2000 Evaluation F.5 - Block Canvassing Operations," April 5, 2002.

Marquette, RJ, Haas, Heather (2012), "Quality Control Profile for the 2010 Census Address Canvassing operation," April, 2012 (Expected).

Colosi, Robert W. (2010), "Decennial Testing Overview", November, 2010.

Dixon, Kelly, Melissa Blevins, Bob Colosi, Nancy Johnson, Karen Owens, Matt Stevens, and Christine Tomaszewski (2008), "2008 Dress Rehearsal Address Canvassing Assessment Report," DSSD 2008 Census Dress Rehearsal Memoranda Series, No. D-20, U.S. Census Bureau, April 15, 2008.

DMD, CP_2010_ADCN_Tran_01_Test_Plan.doc (2008).

Douglas, Dorothy (2009), "Time and Motion Study: Handheld Computer Performance for the Address Canvassing (AC) Operation for the 2010 Decennial Census," October 6, 2009.

FLD, Labor and Crime Surveys Branch, J. Godenick and N. Hillila. "Demographic Area Address Listing Large Block Address Canvassing Assessment." November 5, 2009.

Marquette, RJ (2009), "Analysis of the Sudden Drop in Dependent Quality Control Check Failure Rates During the 2010 Census Address Canvassing Operation", Decennial Census Memorandum Series #F-13, August 13, 2009.

Marquette, RJ, Haas, Heather, "Quality Control Plan for the 2010 Census Address Canvassing Operation", August 27, 2008.

McNally, Tracey (2008), "2008 Census Dress Rehearsal Address Canvassing Quality Control Profile," 2008 Census Dress Rehearsal Memorandum Series No. B-18, U.S. Census Bureau, September 11, 2008.

Owens, Karen (2007), "Customer Requirements for the 2008 Census Dress Rehearsal Address Canvassing Address Products," DSSD 2008 Census Dress Rehearsal Memoranda Series, No. D-03, U.S. Census Bureau, April 19, 2007.

Owens, Karen (2009), "Customer Requirements Document for the Adjudication of DAAL Updates for 2010 LBAC," DSSD, 2010 Decennial Census Memorandum Series, No. D-04R1, U.S. Census Bureau, March 30, 2009.

Riley, Paul L., Daniel Sweeney, Shawn C. Hanks, Jeremy Hilts, John Powers (2009), "Software Requirements Specification for Address Updates from the 2010 Decennial Census Address Canvassing Operation, Version 2.3," U.S. Census Bureau, Geography Division, August 11, 2009.

Ruhnke, Megan C. (2002), "Census 2000 Evaluation F.2 - The Address Listing Operation and Its Impact on the Master Address File," January 30, 2002.

Schneider, Glenn C. (2001a), "DMD Block Canvassing Assessment", November 20, 2001.

Schneider, Glenn C. (2001b), "DMD Address Listing Assessment", November 30, 2001.

Schneider, Glenn C. (2007), "2006 Census Test Address Canvassing Operational Assessment", July 2007.

Schneider, Glenn C. (2008), "2010 Address Canvassing Testing Plan," June 6, 2008.

Schneider, Glenn C. (2008), Detailed Operation and Systems Plan, 2008.

Swartz, Rebecca, Irby, S. (2011), "Study Plan for the Local Update of Census Addresses (LUCA) Program Assessment**",** 2010 Census, Planning Memoranda Series, No. 119

Tomaszewski, Christine Gibson (2007a), "2008 Census Dress Rehearsal Local Update of Census Addresses (LUCA) Assessment Study Plan," DSSD 2008 Census Dress Rehearsal Memoranda Series, No. O-02, U.S. Census Bureau, July 10, 2007.

Tomaszewski, Christine (2007b), "2008 Census Dress Rehearsal Local Update of Census Addresses (LUCA) Assessment Report," DSSD 2008 Census Dress Rehearsal Memoranda Series, No. O-05, U.S. Census Bureau, December 4, 2007.

Vitrano, Frank A., Robin A. Pennington, and James B. Treat (2004), "Address List Development in Census 2000," Census 2000 Testing, Experimentation, and Evaluation Program Topic Report No. 8, TR-8, U.S. Census Bureau, March 2004.

Appendix A: Address Canvassing Assessment Acronyms and Abbreviations

AA	Assignment Area
AC	Address Canvassing
ACD	Automated Call Distribution
ACOB	Address Coverage Operations Branch
ACS	American Community Survey
ADDUP	Address Update (file)
ALDOIT	Address List Development Operations Implementation Team
ALMI	Address Listing and Mapping Instrument
AMSD	Administrative and Management Systems Division
ATO	Authority to Operate
ATUF	Automated TIGER Update File
BFUS	Batch Feature Update System
C&P	Cost and Progress system
CBT	Computer Based Training
CEE	Census Evaluation and Experiments
CIG	Census Integration Group
CLA	Crew Leader Assistant
CM	Case Management
CQR	Count Question Resolution
DAAL	Demographic Area Address Listing
DAPPS	Decennial Applicant, Personnel, and Payroll System
DMD	Decennial Management Division
DQC	Dependent Quality Control Check
DSF	Delivery Sequence File
DSSD	Decennial Statistical Studies Division
DV	Delete Verification
EDS	Excluded from Delivery Statistics
ELCO	Early Opening Local Census Office
FDCA	Field Data Collection Automation
FDV	Final Delete Verification
FLD	Field Division
FLD HQ	Field Division Headquarters
FOS	Field Operations Supervisor
GEO	Geography Division
GPS	Global Positioning System
GQ	Group Quarters
GQV	Group Quarters Validation
GRF-C	Geographic Reference File-Codes
HHC	Hand-Held Computer
HU	Housing Unit
IFALMI	Input Files for the DAAL/ALMI
INFO-COMM	Information Communication
IPT	Integrated Project Team
IVR	Interactive Voice Response

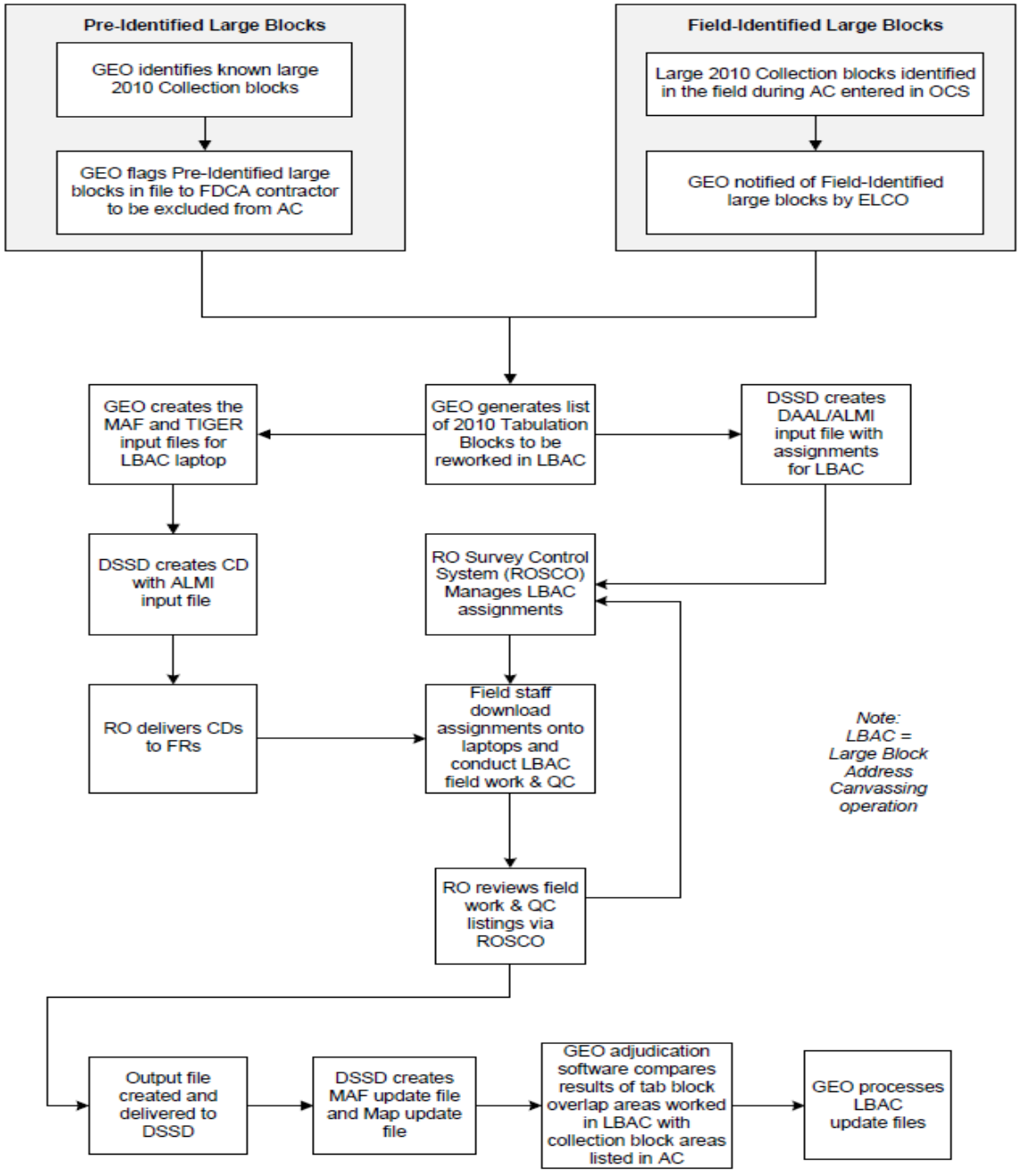
Acronyms continued

LAMI	Listing and Mapping Instrument
LBAC	Large Block Address Canvassing
LCO	Local Census Office
LQ	Living Quarter
LUCA	Local Update of Census Addresses
MAF	Master Address File
MAFID	Master Address File Identifier
MAFUF	Master Address File Update File
MAILHNPR	Puerto Rico Mailing House Number
MCE	Mobile Computing Environment
MIS	Management Information System
MO/MB	Mailout/Mailback
MTdb	MAF/TIGER database
NDCBU	Neighborhood Cluster Box Delivery
NPC	National Processing Center
NUTS	Normalized Update Transaction Table
OCE	Office Computing Environment
OCS	Operations Control System
OFT	Operational Field Test
OLQ	Other Living Quarters
OMB	Office of Management and Budget
PDA	Personal Data Assistant
PDB	Product Database
PIT	Product Integration Testing
PMO	Project Management Office
PRA	Production Rate Area
PRAO	Puerto Rico Area Office
PSMQ	Product Services Message Queuing
QC	Quality Control
RCC	Regional Census Center
RO	Regional Office
ROSCO	Regional Office Survey Control Operation
SD	Secure Digital (card)
SME	Subject Matter Expert
STRUCT	MAF Structure Point Update File
T&M	Time and Motion
TEA	Type of Enumeration Area
TIGER	Topologically Integrated Geographic Encoding and Referencing (system)
TL	Transitory Location
TMO	Technologies Management Office
TOI	Time of Interview
U/L	Update/Leave
UC&M	Universe Control and Management
UE	Update Enumerate
USPS	United States Postal Service
UU/L	Urban Update/Leave

Acronyms continued

VST	Validated Systems Testing
WAAS	Wide Area Augmentation System
YAH	You Are Here (indicator)

Appendix B: Large Block Address Canvassing Operation Workflow Diagram



Appendix C: Address Canvassing Selected Data Tables

The following tables were created by DSSD and provide additional AC data.

Table C-1.1
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb

Addresses	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,819,921	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
United States	143,356,106	132,445,198	-7.61	6,149,446	4,151,147	15,529,724	3,968,495	1,227,915	18,635,783	5,445,699	538,415	97,524,708
Puerto Rico	1,534,702	1,578,127	2.83	474,709	1,592	290,197	117,061	10,345	973,002	4,864	13,151	110,809
Total Initial AC Workload	141,822,612	131,827,879	-7.05	6,624,153	3,958,466	15,105,706	4,066,137	1,231,221	17,640,804	5,449,615	545,426	97,609,415
United States	140,287,910	130,249,752	-7.16	6,149,444	3,956,874	14,815,509	3,949,076	1,220,876	16,667,802	5,444,751	532,275	97,498,606
Puerto Rico	1,534,702	1,578,127	2.83	474,709	1,592	290,197	117,061	10,345	973,002	4,864	13,151	110,809
Total Initial LBAC Workload	3,068,196	2,195,446	-28.45	2	194,273	714,215	19,419	7,039	1,967,981	948	6,140	26,102
United States	3,068,196	2,195,446	-28.45	2	194,273	714,215	19,419	7,039	1,967,981	948	6,140	26,102
Puerto Rico	0	0	0.00	0	0	0	0	0	0	0	0	0

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded).
Sources: AC Eligible Records, as defined by the COLBLKST extract variable and GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and COLBLKST extract variables

Table C-1.2
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by Housing Unit/OLQ

Housing Unit Type	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,819,921	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
Housing Unit	144,567,813	133,642,332	-7.56	6,387,301	4,149,899	15,727,566	4,035,625	1,217,713	19,546,270	5,446,596	550,936	97,561,330
Single Unit	101,785,663	88,795,388	-12.76	3,527,231	2,747,080	10,319,526	2,188,106	817,828	10,045,656	3,288,378	314,694	68,872,349
Multi-Unit	41,888,583	36,610,732	-12.60	1,724,619	1,067,868	5,219,373	1,800,405	395,939	7,726,969	1,624,678	161,168	24,305,430
2 - 4 Units	11,962,362	10,543,127	-11.86	708,914	168,118	1,726,905	965,248	180,551	2,543,831	211,474	65,047	6,845,743
5 - 9 Units	6,670,359	5,918,036	-11.28	161,461	104,051	671,479	219,186	76,587	1,074,374	214,404	33,087	4,330,659
10 - 19 Units	4,961,359	4,449,644	-10.31	148,085	134,692	511,014	137,111	47,239	792,868	268,188	19,325	3,086,486
20 - 49 Units	5,465,907	4,849,831	-11.27	192,461	174,075	575,713	164,058	40,391	863,696	288,401	14,521	3,316,677
50+ Units	12,828,596	10,850,094	-15.42	513,698	486,932	1,734,262	314,802	51,171	2,452,200	642,211	29,188	6,725,865
Mobile Home/Trailer	893,567	8,236,212	821.72	1,135,451	334,951	188,667	47,114	3,946	1,773,645	533,540	75,074	4,383,551
Other Living Quarter	322,995	380,993	17.96	236,854	2,840	92,355	49,931	20,547	62,515	3,967	630	74,187

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded).
Sources: AC Eligible Records and GQV Extract Files, as defined by the ADCANUNV, COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, HUTYP, LOCDESC, LOCWDESC1, LOCHNPRE, LOCHN1, LOCHNSEP, LOCHN2, LOCHNPR, LOCNAME, LOCPREDIR, LOCPREQUAL, LOCPRETYP, LOCSUFDIR, LOCSUFQUAL, LOCSUFTYP, LOCZIP, MAILWSDESC1, and ISOLQ extract variables and the matched MAFSRC and ACTION operation variables.

Table C-1.3
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by Address Information

AddressType	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,819,921	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
Complete City-Style	139,662,501	130,507,603	-6.56	4,488,552	4,147,457	14,112,366	3,045,455	1,193,902	18,343,265	5,448,644	490,954	97,588,731
With complete Rural Route and/or complete P.O. Box and/or loc. desc.	5,805,322	11,156,173	92.17	1,105,945	433,274	990,092	356,240	39,888	6,460,526	401,556	121,238	2,633,634
Without complete Rural Route or complete P.O. Box or location description	133,857,179	119,351,430	-10.84	3,382,607	3,714,183	13,122,274	2,689,215	1,154,014	11,882,739	5,047,088	369,716	94,955,097
Complete Rural Route	1,611,843	837,670	-48.03	35,443	3,696	488,665	327,071	7,639	730,596	2,874	14,992	50,069
With location description	1,410,634	769,935	-45.42	33,468	2,870	431,277	304,584	6,236	696,565	2,097	14,522	20,413
Without location description	201,209	67,735	-66.34	1,975	826	57,388	22,487	1,403	34,031	777	470	29,656
Complete P.O. Box	913,831	210,961	-76.91	19,237	20	242,055	148,783	5,531	181,251	12	6,163	4,278
With location description	684,036	205,414	-69.97	15,738	20	209,000	137,121	4,392	179,218	12	6,148	4,278
Without location description	229,795	5,547	-97.59	3,499	0	33,055	11,662	1,139	2,033	0	15	0
Incomplete address information	1,165,046	2,754,923	136.46	2,024,567	3,020	460,533	236,702	17,421	647,542	326	40,075	39,393
With location description	541,794	2,592,838	378.57	1,961,729	2,216	281,616	150,159	7,835	558,402	86	39,120	31,285
Without location description	623,252	162,085	-73.99	62,838	804	178,917	86,543	9,586	89,140	240	955	8,108
No address information	3,175,558	2,855,847	-10.07	2,093,673	3,229	1,089,084	609,928	33,798	676,354	327	42,531	39,733
With location description	2,550,340	2,693,762	5.62	2,030,835	2,425	910,167	523,385	24,212	587,214	87	41,576	31,625
Without location description	625,218	162,085	-74.08	62,838	804	178,917	86,543	9,586	89,140	240	955	8,108

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded).

Sources: AC Eligible Records and GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and LOCDESC, LOCHNPRE, LOCHN1, LOCHNSEP, LOCHN2, LOCHNSUF, LOCHNPR, LOCNAME, LOCZIP, MAILHNPRE, MAILHN1, MAILHNSEP, MAILHN2, MAILHNSUF, MAILPREQUAL, MAILPREDIR, MAILPRETYP, MAILNAME, MAILSUFTYP, MAILSUFDIR, MAILRRID, MAILRRBOXID, MAILPOBOXID, and MAILZIP extract variables.

Table C-1.4
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by Block Size Based on Number of Addresses on MTdb

Block Size Based on Number of Addresses	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	5,961,492	5,933,656	-0.47	1,257,042	626,575	2,217,408	805,406	460,724	2,025,472	749,291	279,834	3,958,363
0	1,312,235	1,332,252	1.53	91,174	37,845	11,879	1,034	1	12,324	60,946	73	43
1	300,064	307,536	2.49	38,422	13,043	69,524	4,433	18,544	70,114	20,406	4,548	109,773
2-9	1,422,670	1,457,703	2.46	269,777	106,127	533,943	129,094	86,917	502,086	156,165	51,024	1,099,136
10-19	1,097,414	1,101,380	0.36	229,515	104,686	486,025	150,893	75,946	418,114	143,947	51,489	1,013,304
20-49	1,193,286	1,155,839	-3.14	318,901	158,712	621,246	250,084	116,234	564,209	184,407	83,041	1,129,816
50-99	368,003	337,545	-8.28	161,127	95,466	267,938	137,821	73,318	246,405	87,574	45,362	351,181
100-499	250,906	227,676	-9.26	138,555	100,653	210,927	122,001	81,583	196,927	88,519	40,703	240,011
500-999	14,833	12,248	-17.43	9,531	8,338	13,894	9,250	7,375	13,249	7,229	2,879	14,252
1000+	2,081	1,477	-29.02	40	1,705	2,032	796	806	2,044	98	715	847

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded).
Sources: AC GRFC file and GQV Extract Files, defined by the COLBLKST, COLBLKCOU, COLBLK, COLBLKSUFX2, FLDOPCODE, HOUSING, and LWBLKTYP variables and the matched MAFSRC and ACTION operation variables.

Table C-1.5
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by Original Source

Original Source	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,819,921	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
1990 Address Control File (ACF)	74,800,427	71,091,858	-4.96	0	216,799	3,182,949	453,906	168,100	7,394,670	2,490,072	256,662	60,733,655
Pre-Census 2000 Delivery Sequence Files (DSF)	20,965,782	18,424,556	-12.12	0	288,776	1,930,737	401,153	419,403	2,604,037	1,206,121	67,090	14,258,532
11/97 (or earlier) DSF	703,838	647,762	-7.97	0	4,445	42,736	5,273	9,948	95,011	26,947	1,618	519,741
09/98 DSF	14,797,923	13,067,952	-11.69	0	151,454	1,272,927	221,754	339,328	1,697,870	801,079	50,493	10,367,056
11/99 DSF	1,361,686	1,189,140	-12.67	0	22,667	139,832	33,772	18,029	198,109	85,457	4,439	878,468
02/00 DSF	3,335,293	2,828,456	-15.20	0	81,529	399,204	120,730	45,891	500,536	233,551	8,859	2,003,981
04/00 DSF	767,042	691,246	-9.88	0	28,681	76,038	19,624	6,207	112,511	59,087	1,681	489,286
Pre-Census 2000 Test/Operation	46,694	37,728	-19.20	0	505	7,237	1,697	514	8,254	1,397	411	27,161
1998 Dress Rehearsal	46,694	37,728	-19.20	0	505	7,237	1,697	514	8,254	1,397	411	27,161
Census 2000	23,854,110	17,711,980	-25.75	0	195,343	4,197,812	1,849,244	215,837	5,703,954	541,291	160,270	11,111,122
Address Listing	14,561,482	11,067,433	-24.00	0	55,852	2,305,784	1,138,010	71,284	3,394,846	198,602	104,416	7,313,717
Block Canvassing	1,373,797	1,019,101	-25.82	0	57,787	316,393	79,377	11,419	249,933	47,331	7,189	656,861
Questionnaire Delivery	402,043	211,986	-47.27	0	2,525	133,269	51,994	4,456	132,000	4,070	3,668	69,723
Nonresponse Follow-Up (NRFU)	510,934	320,447	-37.28	0	1,693	140,785	44,722	4,476	218,112	7,835	3,988	88,819
New Construction	132,129	102,184	-22.66	0	3,054	26,279	5,512	667	25,046	9,478	345	64,261
Coverage Improvement Follow-Up (CIFU)	75,822	42,530	-43.91	0	1,180	24,972	6,665	844	20,755	2,892	566	17,137
SP/GQ Enumeration	56,253	25,126	-55.33	0	1,800	20,333	9,520	2,827	10,980	538	187	11,621
SP/GQ Master File	148,002	71,749	-51.52	0	1,553	38,216	28,571	10,597	37,965	1,811	358	30,062
LUCA	3,846,068	3,267,673	-15.04	0	42,537	418,069	104,448	85,962	556,334	250,511	10,658	2,407,633
Non-ID Processing	639,374	316,073	-50.57	0	13,518	228,372	100,081	6,842	157,226	6,501	9,281	129,547
Update/Enumerate	27,889	18,002	-35.45	0	82	7,532	3,846	208	11,389	262	197	6,072
Update/Leave	2,080,317	1,249,676	-39.93	0	13,762	537,808	276,498	16,255	889,368	11,460	19,417	315,669
Pre-Census 2010 DSFs	16,098,537	16,976,964	5.46	0	3,357,207	1,795,732	342,878	165,635	2,432,451	1,123,595	27,718	10,035,993
09/00 DSF	515,177	462,592	-10.21	0	28,183	52,057	21,602	4,752	87,108	36,343	1,616	309,342
2001 DSFs (Spring & Fall)	2,040,417	1,961,607	-3.86	0	175,289	181,122	41,842	19,005	287,106	134,481	4,116	1,360,615
2002 DSFs (Spring & Fall)	2,062,521	2,036,749	-1.25	0	232,792	182,460	43,106	18,627	286,787	139,354	4,411	1,373,405
2003 DSFs (Spring & Fall)	2,270,225	2,300,260	1.32	0	311,198	197,635	41,176	20,804	332,202	164,210	3,860	1,488,790
2004 DSFs (Spring & Fall)	1,774,283	1,842,591	3.85	0	289,737	159,950	27,281	15,267	265,541	134,758	2,748	1,149,807
2005 DSFs (Spring & Fall)	2,041,357	2,161,412	5.88	0	395,593	188,397	32,819	17,891	314,854	167,331	2,964	1,280,670
2006 DSFs (Spring & Fall)	2,046,974	2,183,004	6.65	0	451,308	230,847	31,206	20,239	332,975	153,729	2,792	1,242,200
2007 DSFs (Spring & Fall)	1,810,014	1,882,662	4.01	0	444,656	290,636	34,697	24,979	292,970	116,650	2,555	1,025,831
2008 DSFs (Spring & Fall)	1,537,569	1,532,336	-0.34	0	414,975	312,577	69,137	24,068	232,837	76,725	2,655	805,144
2009 DSFs (Spring & Fall)	0	613,751		0	613,476	51	12	3	71	14	1	189
2010 DSFs (Spring & Fall)	0	0		0	0	0	0	0	0	0	0	0
Pre-Census 2010 Test/Operation	473,702	282,240	-40.42	7	4,480	121,292	64,557	4,239	144,971	4,375	5,315	123,092
2004 Census Test	6,243	3,921	-37.19	0	5	1,428	827	55	1,434	29	43	2,410
2006 Census Test	6,094	3,306	-45.75	7	9	1,270	1,400	115	1,658	25	22	1,585
2008 Dress Rehearsal	44,885	28,559	-36.37	0	189	9,710	6,295	359	10,785	622	446	16,517
LUCA 2008	21,111	13,652	-35.33	0	393	4,946	2,734	146	4,220	414	163	8,462
Demographic Area Address Listing (DAAL)	355,729	204,853	-42.41	0	3,687	95,920	49,161	3,322	114,059	2,907	4,282	79,918
ACS Time of Interview (ToI)	39,640	27,949	-29.49	0	197	8,018	4,140	242	12,815	378	359	14,200
Census 2010	7,874,484	9,303,289	18.14	6,624,148	86,546	4,370,747	923,336	243,665	1,256,517	75,738	31,703	1,228,637
Address Canvassing (AC)	0	6,931,100		6,624,148	80,056	51,506	17,204	1,306	192,422	1,629	1,639	31,206
LUCA	7,874,484	2,372,189	-69.87	0	6,490	4,319,241	906,132	242,359	1,064,095	74,109	30,064	1,197,431
All Other Sources/Combinations	477,328	194,642	-59.22	0	3,082	213,402	48,774	20,866	63,903	7,974	2,396	117,287
No Original Source Available	299,744	68	-99.98	0	1	13	11	1	28	0	1	38

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded).
Sources: AC Eligible Records and GQV Extract Files, as defined by the matched MAFSRC and ACTION operation variables and the DSF series of extract variables.

Table C-1.6
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by Census Region and Division

Census Region and Division[1]	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
				New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,820,664	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
Region 1: Northeast	25,610,142	23,899,605	-6.68	996,087	471,149	2,153,217	797,512	171,217	3,553,664	778,422	73,975	18,026,308
Div. 1: New England (CT,ME,MA,NH,RI,VT)	6,831,867	6,453,354	-5.54	294,922	145,287	553,508	217,665	35,560	856,909	202,182	11,672	4,942,382
Div. 2: Middle Atlantic (NJ,NY,PA)	18,778,275	17,446,251	-7.09	701,165	325,862	1,599,709	579,847	135,657	2,696,755	576,240	62,303	13,083,926
Region 2: Midwest	31,651,745	29,759,551	-5.98	919,688	687,975	2,546,108	682,174	237,124	3,316,180	1,075,274	128,794	23,631,640
Div. 3: East North Central (IL,IN,MI,OH,WI)	21,945,269	20,560,360	-6.31	543,391	414,916	1,724,151	426,367	171,081	2,161,390	748,451	85,232	16,606,980
Div. 4: W. N. Cent. (IA,KS,MN,MO,NE,ND,SD)	9,706,476	9,199,191	-5.23	376,297	273,059	821,957	255,807	66,043	1,154,790	326,823	43,562	7,024,660
Region 3: South	55,421,111	50,089,363	-9.62	2,859,982	2,159,878	7,890,382	1,718,727	478,187	7,720,216	2,226,516	274,448	34,848,323
Div. 5: S. Atl. (DC,DE,FL,GA,MD,NC,SC,VA,WV)	30,372,011	26,798,239	-11.77	1,317,430	968,979	4,441,737	942,410	298,812	4,036,274	1,368,013	110,659	18,996,884
Div. 6: East South Central (AL,KY,MS,TN)	8,958,000	8,272,312	-7.65	578,345	395,199	1,290,631	285,928	67,606	1,150,940	286,012	57,241	5,804,575
Div. 7: West South Central (AR,LA,OK,TX)	16,091,100	15,018,812	-6.66	964,207	795,700	2,158,014	490,389	111,769	2,533,002	572,491	106,548	10,046,864
Region 4: West	30,673,108	28,696,679	-6.44	1,373,689	832,145	2,940,744	770,082	341,387	4,045,723	1,365,487	61,198	21,018,437
Div. 8: Mtn. (AZ,CO,ID,MT,NM,NV,UT,WY)	10,421,900	9,550,611	-8.36	625,141	327,048	1,308,574	352,620	86,303	1,662,558	524,763	29,717	6,381,384
Div. 9: Pacific (AK,CA,HI,OR,WA)	20,251,208	19,146,068	-5.46	748,548	505,097	1,632,170	417,462	255,084	2,383,165	840,724	31,481	14,637,053
Puerto Rico	1,534,702	1,578,127	2.83	474,709	1,592	290,213	117,061	10,345	973,002	4,864	13,151	110,809

[1]Prior to June 1984, the Midwest Region was designated as the North Central Region.
[2]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded). Delete actions include double and single delete records.
Sources: AC and GQV Extract Files, as defined by the matched ADCANAF and ACTION operation variables and COLBLKST extract variables

Table C-1.7
The 2010 Census Address Canvassing Operation:
Pre-Identified Workload versus Final Address Actions Applied to MTdb by FIPS State

FIPS Code	Postal Code	State	AC Eligible	AC Result[1]	Percent Change	Adds		Negative Actions			Other Actions			
						New Add	Matching Record	Delete	Duplicate	Nonresidential	Change	Move	Uninhabitable	Verify
		Total	144,890,808	134,023,325	-7.50	6,624,155	4,152,739	15,820,664	4,085,556	1,238,260	19,608,785	5,450,563	551,566	97,635,517
01	AL	Alabama	2,392,399	2,171,672	-9.23	169,520	108,234	409,893	69,823	13,848	283,825	91,022	17,384	1,501,687
02	AK	Alaska	323,729	282,551	-12.72	39,995	8,239	65,698	20,969	2,431	61,295	6,254	1,000	165,768
04	AZ	Arizona	3,079,537	2,866,177	-6.93	180,255	84,653	345,626	85,658	15,127	419,711	168,803	8,607	2,004,148
05	AR	Arkansas	1,495,132	1,327,804	-11.19	93,728	50,908	229,402	66,301	13,954	229,183	36,142	11,972	905,871
06	CA	California	14,786,733	13,733,715	-7.12	422,395	289,585	1,216,836	297,798	208,998	1,640,051	624,638	20,444	10,736,602
08	CO	Colorado	2,481,981	2,224,167	-10.39	83,243	50,915	271,213	80,571	30,187	333,933	99,651	4,743	1,651,682
09	CT	Connecticut	1,561,318	1,486,196	-4.81	31,665	18,913	87,081	27,616	8,405	180,136	35,524	2,982	1,216,976
10	DE	Delaware	390,685	400,972	2.63	24,743	35,826	39,834	8,969	1,119	45,915	19,229	703	274,556
11	DC	District of Columbia	316,702	303,522	-4.16	10,346	4,273	19,631	5,055	2,445	56,037	4,597	1,953	226,316
12	FL	Florida	10,074,594	8,933,533	-11.33	343,045	308,927	1,378,371	196,533	102,249	1,459,308	598,939	19,780	6,203,534
13	GA	Georgia	4,722,254	4,079,079	-13.62	236,706	208,728	874,034	156,301	46,167	645,956	236,613	23,629	2,727,447
15	HI	Hawaii	510,915	519,421	1.66	50,759	23,025	41,326	18,072	2,239	117,986	16,772	970	309,909
16	ID	Idaho	714,914	673,699	-5.77	56,483	29,839	97,828	20,126	8,913	98,273	29,912	1,623	457,569
17	IL	Illinois	5,725,484	5,336,247	-6.80	126,772	87,922	437,441	94,707	61,931	734,470	189,229	17,576	4,180,278
18	IN	Indiana	2,983,246	2,810,766	-5.78	82,138	75,390	256,720	51,804	19,239	229,940	138,468	12,503	2,272,327
19	IA	Iowa	1,424,062	1,349,547	-5.23	26,335	26,383	97,180	18,334	11,110	105,611	40,384	5,430	1,145,404
20	KS	Kansas	1,332,225	1,248,383	-6.29	33,790	26,360	102,935	32,368	7,738	118,489	34,528	6,694	1,028,522
21	KY	Kentucky	2,137,824	1,966,697	-8.00	153,406	82,258	292,083	94,889	15,083	304,810	48,368	10,530	1,367,325
22	LA	Louisiana	2,191,867	2,005,064	-8.52	127,848	70,799	323,550	42,336	17,594	256,338	69,710	32,360	1,448,009
23	ME	Maine	758,206	724,996	-4.38	93,247	45,326	123,286	39,919	4,896	164,865	14,961	1,823	404,774
24	MD	Maryland	2,576,381	2,362,084	-8.32	48,635	33,642	219,525	46,504	21,216	247,239	107,258	12,089	1,913,221
25	MA	Massachusetts	2,989,250	2,830,406	-5.31	81,722	37,996	197,565	63,349	14,086	268,096	105,970	4,060	2,332,562
26	MI	Michigan	4,937,894	4,602,862	-6.78	144,528	80,671	386,962	137,203	31,946	541,555	164,595	26,694	3,644,819
27	MN	Minnesota	2,477,056	2,366,080	-4.48	90,679	67,476	171,400	78,141	16,842	289,117	98,981	5,578	1,814,249
28	MS	Mississippi	1,382,145	1,295,293	-6.28	117,847	80,393	225,273	49,491	9,073	209,365	54,001	13,868	819,819
29	MO	Missouri	2,912,526	2,741,681	-5.87	155,767	100,563	315,766	86,623	17,527	431,136	100,846	17,317	1,936,052
30	MT	Montana	552,225	489,789	-11.31	49,894	12,442	82,662	33,175	8,086	96,075	8,500	2,995	319,883
31	NE	Nebraska	841,435	803,426	-4.52	25,606	24,076	63,764	16,473	6,892	90,149	27,697	3,906	631,992
32	NV	Nevada	1,289,122	1,140,163	-11.56	45,184	57,258	175,397	47,381	5,453	333,352	115,428	2,586	586,355
33	NH	New Hampshire	617,944	615,539	-0.39	51,431	31,385	59,270	21,748	3,324	100,950	20,891	747	410,135
34	NJ	New Jersey	3,760,872	3,556,540	-5.43	99,898	82,608	313,998	47,208	15,659	453,318	189,689	9,816	2,721,211
35	NM	New Mexico	1,064,325	911,191	-14.39	111,418	27,301	220,159	55,052	10,405	204,045	47,634	6,390	514,403
36	NY	New York	9,020,048	8,302,068	-7.96	326,853	98,325	706,621	338,625	74,988	1,524,388	141,287	27,318	6,183,897
37	NC	North Carolina	5,089,038	4,341,521	-14.69	233,146	148,533	835,368	223,697	60,333	626,197	129,854	20,195	3,183,596
38	ND	North Dakota	350,163	321,932	-8.06	20,274	11,154	41,957	13,669	3,659	61,231	18,302	2,413	208,558
39	OH	Ohio	5,527,907	5,172,363	-6.43	107,028	112,654	472,528	71,013	27,938	413,487	185,350	22,398	4,331,446
40	OK	Oklahoma	1,739,262	1,671,982	-3.87	145,403	77,534	215,171	62,414	7,018	292,196	57,836	12,309	1,086,704
41	OR	Oregon	1,738,982	1,695,909	-2.48	72,007	58,856	116,915	37,654	16,104	234,457	67,051	2,853	1,260,685
42	PA	Pennsylvania	5,997,355	5,587,643	-6.83	274,414	144,929	579,090	194,014	45,010	719,049	245,264	25,169	4,178,818
44	RI	Rhode Island	473,978	468,814	-1.09	15,943	8,165	23,794	3,440	1,477	56,251	19,860	973	367,622
45	SC	South Carolina	2,557,629	2,144,544	-16.15	113,198	68,823	489,670	68,646	26,128	312,875	93,021	13,665	1,542,962
46	SD	South Dakota	369,009	368,142	-0.23	23,846	17,047	28,955	10,199	2,275	59,057	6,085	2,224	259,883
47	TN	Tennessee	3,045,632	2,838,650	-6.80	137,572	124,314	363,382	71,725	29,602	352,940	92,621	15,459	2,115,744
48	TX	Texas	10,664,839	10,013,962	-6.10	597,228	596,459	1,389,891	319,338	73,203	1,755,285	408,803	49,907	6,606,280
49	UT	Utah	952,299	980,528	2.96	73,764	57,577	75,822	20,777	3,570	128,054	43,189	1,244	676,700
50	VT	Vermont	431,171	327,403	-24.07	20,914	3,502	62,512	61,593	3,372	86,611	4,976	1,087	210,313
51	VA	Virginia	3,709,987	3,352,188	-9.64	133,859	118,509	414,343	148,299	34,319	382,255	160,731	12,762	2,544,072
53	WA	Washington	2,890,849	2,914,472	0.82	163,392	125,392	191,395	42,969	25,312	329,376	126,009	6,214	2,164,089
54	WV	West Virginia	934,741	880,796	-5.77	173,752	41,718	170,961	88,406	4,836	260,492	17,771	5,883	381,180
55	WI	Wisconsin	2,770,738	2,638,122	-4.79	82,925	58,279	170,500	71,640	30,027	241,938	70,809	6,061	2,178,110
56	WY	Wyoming	287,497	264,897	-7.86	24,900	7,063	39,867	9,880	4,562	49,115	11,646	1,529	170,644
72	PR	Puerto Rico	1,534,702	1,578,127	2.83	474,709	1,592	290,213	117,061	10,345	973,002	4,864	13,151	110,809

[1]AC Result reflects the sum of AC adds and AC other actions (AC negative actions are excluded). Delete actions include double and single delete records.

Sources: AC and GQV Extract Files, as defined by the matched ADCANAF and ACTION operation variables and COLBLKST extract variables

Appendix D: Large Block Address Canvassing Budget Assumptions

Table D-1: Cost Estimate Assumptions for Large Block Address Canvassing Staffing

Regional Office Staff Positions	
Position	**Assumption**
Regional Office Coordinator	One person month (174 hours) spread across the duration of the project. GS 13, step ten, full benefits.
Regional Office Supervisor	One full-time in each RO for the duration of the project. Ten ROs need a second supervisor; six ROs need a third supervisor; two ROs need a fourth supervisor. Generally, one supervisor will supervise listing production while the second supervisor is in charge of listing check. ROs that require a third or fourth supervisor have the largest workloads. The cost estimate assumes GS 12, step ten for all supervisors, although there might be a mix of GS 9, 11, and 12.
Regional Office, Administrative, and Mail Support Staff	All ROs need one LBAC office support person, one administrative support person, and one mail support person; several ROs need a second LBAC or administrative support person; and one to two ROs may need a third DAAL or administrative support person. The LBAC office support and administrative personnel are assumed to be full-time for the duration of the project, while the mail-support person and any additional LBAC office support/administrative personnel are needed for a portion of the time. The cost estimate assumes GS five, step five primarily full benefits, although there might be a mix of GS 3, 4, and 5.
Regional Office Computer Specialist and Assistant	One of each per RO, at one person month (174 hours) each. Most of their time is needed in December 2008 and January 2009 to prepare laptops for new field staff and distribute the DAAL/ALMI data sets. Time during the project may be needed for laptop troubleshooting. Time will be needed at the project's conclusion to retrieve laptop computers.
Regional Office Field Staff Positions	
Position	**Assumption**
New Hires	2,008 (or 77%) of the field staff are New Hires and paid through DAPPS. The DAPPS staff are subject to the Partial Personnel Benefits rate of 7.45% and zero overheads. The DAPPS staff will be assigned as Listers, QC Listers, Crew Leaders, and FOSs.
Current Survey Staff	605 (or 23%) of the field staff are current survey staff and paid through the National Finance Center. Of the Field Representatives (FRs), about 25% receive Full Benefits and 75% receive Partial Personnel Benefits. Of the Supervisory Field Representatives (SFRs), 100% receive Full Personnel Benefits. The Full Personnel Benefits rate is 63.5% and the Partial Personnel Benefits rate is 10%. No overheads (Bureau, PDO, or Common Services) are applied. The current survey staff will be assigned as Listers, QC Listers, Crew Leaders, and FOSs. About one-third of the current survey field staff has no prior DAAL Listing experience.
Breakdown of Listers	New Hires vs. Current Survey = **1,662** new hire Listers vs. **331** current survey Listers
Breakdown of Quality Control Listers	New Hires vs. Current Survey = **151** new hire QC Listers vs. **145** current survey QC Listers.
Breakdown of Crew Leaders	New Hires vs. Current Survey = **179** new hire Crew Leaders vs. **108** current survey Crew Leaders.
Breakdown of Field Operations Supervisors	New Hires vs. Current Survey = **16** new hire FOSs vs. **21** current survey FOSs.
Total Field Staff	**2,613**

Source: Email from Field Division, Labor and Crime Surveys Branch, dated 11/29/2008.

There were 20 categories of field staff, broken down by position, new hire versus current survey staff, DAAL/ALMI experience versus no DAAL/ALMI experience, and receipt of partial benefits versus full personnel benefits. See the detailed Staffing and Training Charts in the *Demographic Area Address Listing Large Block Address Canvassing Assessment* (U.S. Census Bureau, FLD, Labor and Crime Surveys Branch, J. Godenick and N. Hillila, November 5, 2009) for additional details and the specific quantities of staff and training hours listed in Table D-2.

Table D-2: Cost Estimate Assumptions for Large Block Address Canvassing Training

Position		Assumption
New Hire	Listers	**58 hours:** Pre-Classroom DAAL Training, Generic Laptop Training, Administrative Training, DAAL Classroom Training, and LBAC Self-Study
	Quality Control Listers	**64 hours:** Pre-Classroom DAAL Training, Generic Laptop Training, Administrative Training, DAAL Classroom Training, DAAL QC Training, LBAC Self-Study, and LBAC QC Self-Study
	Crew Leaders	**66 hours:** Pre-Classroom DAAL Training, Generic Laptop Training, Administrative Training, DAAL Classroom Training, DAAL QC Training, LBAC Self-Study, LBAC QC Self-Study and LBAC Crew Leader Training
	Field Operations Supervisors	**68 hours:** Pre-Classroom DAAL Training, Generic Laptop Training, Administrative Training, DAAL Classroom Training, DAAL QC Training, LBAC Self-Study, LBAC QC Self-Study, LBAC Crew Leader Training, and LBAC FOS Training
Current Survey Experienced DAAL Listers as:	Listers	**2 hours:** LBAC Self-Study Training
	Quality Control Listers	**8 hours:** DAAL QC Training, LBAC Self-Study, and LBAC QC Self-Study
	Crew Leaders	**10 hours:** DAAL QC Training, LBAC Self-Study, LBAC QC Self-Study, and LBAC Crew Leader Training
Current Survey Experienced Supervisory Field Representatives DAAL Listers as:	Crew Leaders	**6 hours:** LBAC Self-Study, LBAC QC Self-Study, and LBAC Crew Leader Training
	Field Operations Supervisors	**8 hours:** LBAC Self-Study, LBAC QC Self-Study, LBAC Crew Leader Training, and LBAC FOS Training
Current Survey No DAAL Experienced Field Representatives as:	Listers	**48 hours:** Pre-Classroom DAAL Training, DAAL Classroom Training, and LBAC Self-Study
	Quality Control Listers	**54 hours:** Pre-Classroom DAAL Training, DAAL Classroom Training, QC Training, LBAC Self-Study, and LBAC QC Self-Study
	Crew Leaders	**56 hours:** Pre-Classroom DAAL Training, DAAL Classroom Training, QC Training, LBAC Self-Study, LBAC QC Self-Study, and LBAC Crew Leader Training
Current Survey No DAAL Experienced Supervisory Field Representatives as:	Crew Leaders	**56 hours:** Pre-Classroom DAAL Training, DAAL Classroom Training, QC Training, LBAC Self-Study, LBAC QC Self-Study, and LBAC Crew Leader Training
	Field Operations Supervisors	**58 hours:** Pre-Classroom DAAL Training, DAAL Classroom Training, QC Training, LBAC Self-Study, LBAC QC Self-Study, LBAC Crew Leader Training, and LBAC FOS Training

Source: Email from Field Division, Labor and Crime Surveys Branch, dated 11/29/2008.

In addition to the previous staffing and training assumptions, the LBAC cost estimate was also based on the assumptions in Table D-3.

Table D-3: Other Large Block Address Canvassing Cost Estimate Assumptions

Task	Assumptions
Observations	• New Hire Listers, New Hire QC Listers, and current survey FRs who are new to DAAL will be observed. • Most observations will be conducted by New Hire Crew Leaders and FOSs.
Listing Production	• This cost estimate includes the pre-identified workload: 11,400 tabulation blocks with 3,300,000 addresses. • This cost estimate ***does not*** include the field-identified workloads. • The average workload is greater for new hires than for current survey field staff. • This estimate assumes that the new hire Listers will be assigned 90% of the workload, but this ratio will vary by region. • Assumes a national average production rate of 60 units per hour in Urban (high density, large multi-structure, compact land area) vs. 25 units per hour in Urban Fringe (suburban, low density, large land area). • Assumes 35% of the tabulation blocks and 85% of the HUs are in the Urban blocks. This represents 3,990 blocks, with 2,805,000 HUs, averaging 703 HUs per block. At 60 units per hour, this is 11.72 hours per block, requiring 46,750 hours. Also assumes 30 miles per block, totaling 119,700 miles. At an hourly pay rate of $14.81 (the average enumerator pay rate across all LCOs), the total direct Listers' salaries in the urban blocks is about $700,000. • Assumes 65% of the tabulation blocks and 15% of the HUs are in the Urban Fringe blocks. This works out to be 7,410 blocks, with 495,000 HUs, averaging 66.8 HUs per block. At 25 units per hour, this is 2.67 hours per block, requiring 19,800 hours. Also assumes 50 miles per block, totaling 370,500 miles. At an hourly pay rate of $14.81 (the average enumerator pay rate across all LCOs), the total direct Listers' salaries in the urban fringe blocks is about $300,000. • The weighted average productions rates are 5.84 hours and 43 miles per block, totaling 66,550 hours and almost 500,000 miles.
Quality Control	• Assumes 100% QC of all blocks. • Assumes a recheck of the entire block if block fails QC. • Assumes 100% delete verification.
Crew Leader and Field Operations Supervisor Team Leading	• Assumes each Crew Leader and FOS will spend 15-20 hours per week with their teams during the duration of the project. • Assumes Crew Leaders and FOSs will drive an average of 300 miles per week (about 50-60 miles per day).
Conferences	• Assumes 8 hours of video or teleconferencing time spread over the duration of the project, with RO supervisors, coordinators, and support staff.
Recruiting	• No recruiting costs are assumed because DAPPS is used to select new hires for this project.
Laptop and DAAL/ALMI Datasets Shipping Costs	• More than 2,000 laptops need to be shipped to and returned from the New Hire field staff at a cost of $25 each way, totaling about $100,000. • More than 2,600 LBAC datasets for DAAL/ALMI software need to be shipped to and returned from the field staff at a cost of $12 each totaling about $62,000.

Source: Email from Field Division, Labor and Crime Surveys Branch, dated 11/29/2008.

Appendix E: Selected Table References

Table E-1: Comparing Address Canvassing with Similar Census Operations

2000 Block Canvassing	2000 Address Listing	2008 Address Canvassing	2010 Address Canvassing
Paper-based	Paper-based	Automated	Automated
Address list to start (Dependent canvassing)	No address list to start (Independent canvassing)	Address list to start (Dependent canvassing)	Address list to start (Dependent canvassing)
GEO provided address extracts to print paper listings	No GEO address extract	GEO provided address extracts to be loaded into the control system	GEO provided address extracts to be loaded into the control system
Listers were assigned paper address binders	Listers were assigned paper address listing pages	Listers downloaded assignments electronically	Listers downloaded assignments electronically
No separate QC staff	No separate QC staff	Separate QC staff	Separate QC staff
Manual QC sample selection	Manual QC sample selection	Automated QC sample selection	Automated QC sample selection
Manual determination pass/fail QC	Manual determination pass/fail QC	Automated determination pass/fail QC	Automated determination pass/fail QC
No Delete Verification	No Delete Verification	Delete Verification	Delete Verification
Predominantly city-style (house number and street name) addresses	Predominantly non-city style addresses	Mix of city-style and non-city style addresses	Mix of city-style and non-city style addresses
Attempted contact at every third address (contact at multi-units/adds)	Attempted contact at every address	Attempted contact at every address	Attempted contact at every address (courtesy contact at LQs with posted address)
Duplicate address linkage on paper	Not applicable since this was an independent listing	Listers used the HHC to link duplicate addresses	Identified duplicate addresses in field, but no linking of the duplicate to the surviving or better address
Manual map spot not collected, only entered address ranges on paper maps	Manual map spot collection on paper maps	Manual map spot collection on automated electronic maps and GPS structure coordinate collection where available	Manual map spot collection on automated electronic maps and GPS structure coordinate collection where available

2000 Block Canvassing	2000 Address Listing	2008 Address Canvassing	2010 Address Canvassing
No map spotting	A map spot was placed on the map along with a map spot number. The number was associated with each address located at that spot on the listing pages. Thus, all units at a multi-unit structure were linked to a single map spot.	Linkage of multi-units to a single map spot	No linkage of multi-units to a single map spot
Post-processing paper keying and map digitizing	Post-processing paper keying and map digitizing	Complete assignments transmitted electronically to FDCA, then GEO for automated address and map updating	Complete assignments transmitted electronically to FDCA, then GEO for automated address and map updating
No separate Large Block operation	No separate Large Block operation	No separate Large Block operation	ALMI used to conduct AC in large blocks

Table E-2: Summary of Risk Assessments for Address Canvassing

Brief Risk Description	Mitigation Strategy	Contingency Plan	Outcome
Due to major changes after dress rehearsal, the delivery schedule between the FDCA contractor and the Census Bureau was very restricted. It provided no room for delays and could impact the start of AC.	• Close monitoring of deliverables • Daily meetings with the contractor • Embedding HQ staff with the contractor	• Request staff overtime and work with contractor for deliverables that tracked late. • Weekly operational readiness reviews.	Scheduled deliverables did not impact the start of AC.
There was limited time available to update the MTdb between the end of AC and the start of GQV. Delays would impact the start of GQV and the delivery of the label tape used for questionnaire mail-out.	• Field materials need to stress the importance of timely completion and transmission of work. • Monitor progress reports. • GEO to receive test files for processing well in advance of AC.	• GEO would process as much as they could. There may be a possible short delay in the start for GQV. • Additional work would be processed and sent in a supplemental delivery.	Progress was better than anticipated and processing went as scheduled.
The vintage of the Puerto Rico address database could have resulted in an increase in inaccurate or incomplete addresses to the workload.	• Accept risk. Cover these situations in the training materials. • Monitor QC results.	• None. AC to update address file prior to the census.	AC was conducted successfully in Puerto Rico.
The reliability of the OCS and MCE systems for Puerto Rico were not field-tested during dress rehearsal.	• Conduct as much testing as possible. • Developed a non-Title 13 testing database. • Established a Puerto Rico team to review and assist in testing and development of materials.	None.	The OCS and MCE performed well and there were no impacts to the operation.

Brief Risk Description	Mitigation Strategy	Contingency Plan	Outcome
Number of days worked and hours per day were lower than expected in dress rehearsal. The number of days per week and the number of hours per day needed to be increased for AC in order to complete the operation on schedule.	• Stress the need for Listers to work full days versus partial days. • Monitor daily progress to ensure Listers met production standards.	• Ensure ability to move staff to areas of low productivity. • Provide reserve data cards and reallocate HHCs as necessary.	A solid recruitment effort yielded quality applicants who exceeded estimated weekly hours worked. Production rates were exceeded in PRAs 2 and 3, and just missed the expected rate in PRA 1.
Uncertainty whether the FDCA contractor would be able to obtain the Authority To Operate (ATO) in time for the start of AC.	• Census security staff worked closely with the contractor. • Embedded Census technical staff with the contractor.	None.	Census management signed a limited ATO for testing. Limited ATO did not impact the start of AC.
There could be a negative impact on the quality and completeness of the address list if the Lister is relied on to determine whether a structure with a posted house number contained an LQ and, if a Lister is prohibited from obtaining information from proxy residents.	• Reinforce observation techniques.	None. Accepted risk and relegated this risk to an issue.	Undetermined at this time. Further analysis tracing the address records through subsequent census operations may yield data.

Brief Risk Description	Mitigation Strategy	Contingency Plan	Outcome
The impact on Crew Leaders being able to complete training and observations as scheduled, following the decision to drop the second CLA, who was intended to assist in training during the first week of the operation.	Determined to be an issue and accepted risk	Not applicable.	No negative impacts reported. Operation was conducted as scheduled.
Dropping the linking of duplicate addresses increased the risk of over-coverage.	Listers were still able to identify duplicate addresses.	Not applicable.	Tracing the address records through subsequent census operations may yield further data on over-coverage issues.

Table E-3: Other Address Canvassing and Large Block Address Canvassing Support Systems and Descriptions

System/Operation	Description	Testing
Cost and Progress (C&P) Operations: AC/LBAC	The C&P is a system developed by DMD that reports expenditures versus budget for the Decennial Census. C&P is the official source for tracking and reporting the cost and progress for the 2010 Census. The C&P retrieves, summarizes, stores, and reports decennial operations data from source systems, primarily DAPPS and the OCS. The production progress goals provided by the FLD budget office were used to determine expected percentages of workload and costs to be completed by the RCCs and ELCOs by the end of each week of the operation.	Throughout the decade, the DMD system programmers and operations project management worked to test, and refine the system for the 2010 Census. The AC planning Subteam conducted user acceptance testing (UAT), obtaining test data to see how columns were calculating on the reports, providing feedback to developers, and tracking resolution of test results. For the first time in developing C&P reports, live test data from the FDCA OFT of the HHC and OCS in January 2009 was available. Output from several days of the OFT was put into the C&P UAT, simulating several days of data transfer between the two systems. See DMD, 2008 for further details.
Decennial Applicant, Personnel, and Payroll System (DAPPS) Operations: AC/LBAC	The DAPPS System is an integrated human resources and payroll system that meets financial and regulatory reporting requirements for temporary decennial field staff. This web-based enterprise-wide system supports the recruiting and applicant process, hiring of employees, processing personnel actions, paying employees, providing reports and outputs, and maintaining historical data; that is, it tracks temporary decennial field employees from recruitment to background check to payroll.	DAPPS conducted their own series of system tests and was tested during the 2008 AC OFT.
Asset Management System (AMS) Operation: AC	The FDCA AMS tracked hardware items (assets) purchased for FDCA throughout their lifecycles. • The AMS initially consisted of four servers in two Data Processing Centers.	FDCA testers were responsible for testing the AMS

System/Operation	Description	Testing
Asset Management System (continued)	• The asset location, current custodian and other metadata, as applicable, were tracked using Computer Associates Unicenter® Asset Portfolio Management (APM) tool within the AMS. The APM tool, which included its own Web Server, was Internet accessible. • The FDCA contractor Asset Management (AM) team tagged, entered, and tracked assets in the AMS. Contractors at the Deployment Provisioning Center tagged and entered OCE and MCE (laptops only) into the AMS. • Once an asset was deployed, custodianship was transferred to the Census Bureau. The Census Bureau was responsible for notifying the FDCA contractor AM team of location updates as they occurred. • Once inspected, movement and custody of hardware assets were tracked in the AMS tool.	
MAF/ TIGER Database (MTdb) Operations: AC/LBAC	The MTdb is the Census Bureau's national database that contains all known LQ addresses and geographic/spatial data needed to support censuses and statistical programs.	In the development environment, unit and developer integration tests were completed. In a separate test environment, the Independent Test and Verification (ITV) Team conducted system testing. Data quality edits and UATs were conducted by SMEs in both testing and production environments. GEO established acceptance criteria and developed a Quality Control Plan. For further details refer to the *2010 Address Canvassing Testing Plan*, dated June 6, 2010.
Demographic Area Address Listing (DAAL)/Automated List and Mapping Instrument	The DAAL/ALMI is software that was developed to support current Demographic Surveys and the ACS.	Three rounds of testing of the DAAL/ALMI software were conducted prior to the start of the LBAC operation. These tests are

System/Operation	Description	Testing

(ALMI)
 	
Operation:
LBAC
 	
Demographic Area Address Listing (DAAL)/Automated List and Mapping Instrument (ALMI) (continued)
	It updates the Census Bureau's address lists and map features in specific geographic areas. See Section 5.	outlined in the *2010 Census LBAC Test Plan*. Below is a brief explanation of each test:
		
		• **HQ Performance Testing:** Assessed performance of ALMI when listing large blocks, in effort to test timing and other specific functionalities within the ALMI.
		• **Field Performance Testing:** Focus of testing was on verification of performance in a field setting.
		• **OFT:** This tested the following:
		  • Transmitting large blocks from GEO to DSSD
		  • Transmitting assignments to laptops
		  • Use of a different initial workload file version for AC
		  • Procedures for listing large blocks
		  • Transmitting field-identified large block listing assignments from GEO to DSSD and to the Listers
		  • Transmitting complete and incomplete assignments to headquarters
		  • Check-in of large block assignments
		  • Transmitting files to DMD for cost and progress system
		  • Creating update files for GEO
		  • Listing check
		  • Adjudication of Listing and Listing check results by GEO as specified by DSSD

System/Operation	Description	Testing
		• Processing Update Files by GEO, including the handling of areas listed using both HHCs and the ALMI
Callfinity Operation: AC	Callfinity provided an internet based Automated Call Distribution (ACD) and Interactive Voice Response (IVR) system for Census personnel in support of the FDCA program. Listers connected through Callfinity's systems to Help Desks at ELCOs, national overflow centers, and HQ based upon business rules established by administrators. This system was used to answer and queue calls, appropriately route caller to Census staff based upon specific criteria called Prioritized Skill Routing™.	FDCA testers were responsible for testing Callfinity.
Regional Office Survey Control Operation (ROSCO) Operation: LBAC	Manages assignments for DAAL ALMI field staff.	In production for current surveys.
Cost and Response Management Network (CARMN) Operation: LBAC	Produces the cost data for surveys.	In production for current surveys.
Hard To Enumerate Database Operation: LBAC	Oracle database managed by ACSO containing address data extracted from the MTDB. This database is used to create data sets and placing them onto discs that are used for listing with the ALMI.	In production for use in the ACS and DAAL.

Table E-4: Budgeted versus Actual Costs, Workload, and Staffing for AC Production

Category	Budgeted	Actual	Percent Change	Explanation
ADDRESS CANVASSING COSTS/WORKLOAD				
Cost	$371,383,683	$443,591,299	19%	The initial $355M budget was increased to $371M when approved by the Office of Management and Budget (OMB) on March 17, 2009, as reflected in the C&P system. An additional $20.5M was approved for AC by OMB on June 17, 2009, as there was more work than anticipated. QC workload was underestimated by a factor of 2.5, which also increased the Delete Verification and Final Delete Verification workloads. The QC recanvass work was not calculated in the initial budget.
Canvassing Workload	Initial 133,711,121 Revised 137,755,042	Initial 144,890,808 Final (DSSD) 159,494,710	Initial/Initial 8% Revised/Initial 5% Revised/Final 14%	Additional addresses from MTdb updates and the LUCA program contributed to budget increases. The largest address increase was in PRA 2 where the production rate was only 7.8 cases per hour. The initial actual workload was 8 percent higher than the initial budgeted workload and 5 percent higher than the revised budgeted workload. The final actual workload of 159,494,710 does not include large blocks and was 14 percent higher than the revised budgeted workload.
TOTAL MILES PRODUCTION AND QUALITY CONTROL				
Total Miles	92,788,243	137,384,734	48%	Miles for production were 20.4 percent over budget, while miles for QC were 289 percent over budget. This was due to increased staff and a much larger workload than anticipated.
ADDRESS CANVASSING PRODUCTION DATA				
LISTERS				
Listers Trained	104,581	111,105	6%	The increased Listers workload required more Listers, which increased training costs.
Total Hours of Lister Training	2,635,442	3,500,969	33%	The increase in cost is attributed to training for more Listers than initially planned. In addition, this increase may be a result of longer than expected training duration and longer distances traveled to training sessions, which was included in time for the training day.
Production Listers Working	92,957	111,105	20%	More Listers were hired than budgeted in the cost model to complete the larger than expected workload.

Category	Budgeted	Actual	Percent Change	Explanation
Total Lister Production Hours	9,557,666	10,331,016	8%	Reflects the increased number of Listers on the payroll.
Total Lister Miles	50,814,107	68,389,666	35%	The budget did not consider the increased distance traveled within ELCOs. Due to the increased workload, overall canvassing mileage for production was underestimated by 20 percent.
Lister Miles/Case Including Training	0.37 calc.	0.43 calc.	16%	Miles per case were 16.2 percent higher than expected. The final larger workload and the higher number of miles driven accounted for the increase.
CREW LEADERS				
Crew Leaders Trained	7,267	8,213	13%	This increase can be attributed to a higher production workload. Actual staffing numbers were used for training staff, as more accurate numbers were not available.
Production Crew Leaders	5,814	8,213	41%	Increased workload and over-hiring for production contributed to the over-staffing of Crew Leaders. Promotions of existing field staff have made it difficult to estimate the actual number.
Total Hours of Crew Leader Training	241,267	338,526	40%	The increase in cost was a function of training more Crew Leaders than budgeted. In addition, this increase may reflect the longer distances traveled to training sessions, which were included in time for the training day. Over hiring for training (10 percent) and production Crew Leaders (41 percent) also contributed.
Total Crew Leader Production Hours	2,169,741	1,878,838	-13%	Factors that may have influenced less actual production hours than budgeted may be: improved communication with HHC, wireless transmission of assignments, electronic payroll. The fact that there were 10 percent more Crew Leaders and their mileage was only 1 percent more than budgeted, also may reflect the impact that automation had on the Crew Leader core job duties. In addition offices generally completed work in less time than scheduled.

Category	Budgeted	Actual	Percent Change	Explanation
Total Crew Leader Miles	13,504,228	13,594,187	1%	That a 10 percent increase in the number of Crew Leaders increased their mileage by only 1 percent more than budgeted may reflect the impact of automation on the Crew Leader core job duties. Improved communication with HHC, wireless transmission of assignments, and electronic payroll eliminated the need for daily in-person contact between Crew Leaders and Listers.
CREW LEADER ASSISTANTS				
Crew Leader Assistants (CLAs) Trained	5,814	6,320	9%	Actual staffing numbers were used for training as CLAs were trained as Listers and training estimates were inaccurate.
Production Crew Leader Assistants	5,814	6,320	9%	Since CLAs were Listers and were trained with Listers and received Lister pay rates it was difficult tracking of the number of working CLAs.
Total Hours of Crew Leader Assistant Training	146, 513	216,359	48%	More CLAs were hired and trained than budgeted. The C&P reports show only training hours used. No hours were budgeted as CLAs were trained as Listers.
Total Crew Leader Assistant Production Hours	1,599,462	1,085,605	-32%	Many of these CLAs used the Lister code on payroll, which may have contributed to the lower than expected hours.
Total Crew Leader Assistant Miles	9,905,494	7,703,437	-22%	This decreased mileage use could reflect over-budgeting for CLA mileage or the possible impacts of automation on the traditional role of the Crew Leaders and CLAs. They could take advantage of electronic payroll and communications as well as not having to collect and disperse paper assignments which decreased the overall daily mileage they would have driven in a paper environment.
FIELD OPERATIONS SUPERVISORS				
Field Operations Supervisors Trained	913	1,160	27%	Increase in FOSs was due to a larger-than-anticipated workload and larger Crew Leader workforce. Actual staffing numbers were used for training estimates.
Production Field Operations Supervisors	730	1,160	63%	DAPPS shows the peak number of FOSs as 856 working week 8 of the operation. The budget called for 730 production FOSs. The increase is related to the 41 percent increase in Crew Leaders. Promotions of existing field staff may have also been a contributing factor.

Category	Budgeted	Actual	Percent Change	Explanation
Total Hours of Field Operations Supervisors Training	30,302	49,124	62%	This is mostly due to training more FOSs than were budgeted. No data are available to determine if FOS training ran longer than planned.
Total Field Operations Supervisors Production Hours	385,352	379,494	- 2%	The total hours are slightly less than budgeted and may reflect the impact of automation.
Total Field Operations Supervisors Miles	3,392,300	3,796,628	12%	The cause for this increase in mileage may be attributed to the long distance between Crew Leader districts in the ELCO, increased distances between Crew Leader training sessions, as well as under-budgeting based on a lower workload.
CANVASSING MILES				
Total Canvassing Miles	77,616,129	93,483,918	20%	Several factors may have accounted for the 20.44 percent underestimation in mileage. Having only 151 ELCOs with long distances between assignments; having staff from other ELCOs travel to assist in nearby ELCOs; hiring more staff than budgeted. Total miles driven for production and QC were 137,384,734.

Note: Actual staffing tallies for field positions are inflated as they show all unique employees, which accounts for staff that dropped out or were released, in addition to their replacements. Staff who worked multiple positions within an operation are only counted in the position they worked the most hours.

Table E-5: Budgeted versus Actual Costs, Workload, and Staffing for AC Quality Control

Category	Budgeted	Actual	Percent Change	Explanation
Address Canvassing Quality Control Data				
Quality Control Workload				
Quality Control Workload	17,908,156	44,323,317 (Total DV, QC, and Recanvass Records)	247%	The large increase is due to additional QC work for DV and FDV. MTdb updates and LUCA added more work than anticipated. The DMD cost model did not include recanvass, which was completed in 61,843 AAs. The AC Quality Profile shows the recanvass workload to be 13.36 million addresses.
Quality Control Listers				
Quality Control Listers Trained	23,868	37,784	58%	The large increase was due to additional QC work. Actual staffing numbers were used to estimate trainees. This number may exceed the total number trained as it includes production Listers who received gap training, but were then moved to QC and not accounted for in the QC Lister training.
Total Quality Control Hours of Lister Training	601,457	959,102	59%	The budgeted training hours were underestimated based on the workload assumptions for increased numbers of QC Listers trained and the assumptions for training hours. Training hours for QC Listers were 59 percent over budget because FLD trained 41 percent more staff than budgeted.
Quality Control Listers Working	21, 200	37,784	78%	The peak staffing level reflected in DAPPS shows 24,754 staff during week 13 of the operation. More staff was required since the workloads were much larger than expected.
Total Quality Control Lister Production Hours	2,180,871	3,223,852	48%	The 78 percent increase in the number of QC Listers working resulted in the 48 percent overage in production hours.
Total Quality Control Lister Miles	9,055,819	33,919,922	275%	The much larger workload (247 percent over budget), created a 62 percent increase in the number of Listers working and a 50 percent overage in miles per case resulted in the 275 percent overage. Overall, the budget for miles for QC was

Category	Budgeted	Actual	Percent Change	Explanation
				severely underestimated and did not reflect the true nature of the work. To complete DV and FDV required increased mileage as these cases tended to be spread throughout an AA.
Quality Control Lister Miles/Case Including Training	0.51calc	.77 calc	50%	QC miles per case were underestimated in the budget assumptions. This may be caused by delete verification where the deletes were not clustered and require more mileage between verification attempts.
Quality Control Crew Leaders				
Quality Control Crew Leaders Trained	1,662	3,083	85%	DAPPS shows 1,984 staff was the peak employment number in week 13. A major contributor to the overage in the QC Crew Leader training budget was the increased training needed to complete the larger-than-planned QC workload.
Quality Control Crew Leaders	1,332	3,083	231%	1,984 was the peak employment number in week 13, as shown in DAPPS. This number includes Crew Leaders who received gap training to move from production to QC work. There was a major increase in staffing due to a larger-than-planned QC workload.
Total Quality Control Hours of Crew Leader Training	55,173	96,279	75%	Increased staffing to complete the increased QC workload required additional training sessions.
Total Quality Control Crew Leader Production Hours	495,077	590,392	19%	A larger workload than expected created this overage in production QC hours. One would expect the hours to be well over 200 percent; in line with the larger staffing numbers. Factors that may have influenced

Category	Budgeted	Actual	Percent Change	Explanation
				less actual production hours than expected may be improved communication with HHC, wireless transmission of assignments, and electronic payroll.
Total Quality Control Crew Leader Miles	3,081,818	5,138,648	67%	The significant increase in QC work along with an increase in the number of QC Crew Leaders contributed to the excess mileage. Most of these increases were necessary to complete the large QC workload. The mileage budget did not reflect the distances involved in Delete Verification work, as these cases tend to be spread throughout the AA.
Quality Control Crew Leader Assistants				
Quality Control Crew Leader Assistants Trained	1,332	2,484	86%	When more Crew Leaders were hired, the number of CLAs increased. Because one CLA was authorized per Crew Leader, the number of actual CLAs for QC is likely understated.
Quality Control Crew Leader Assistants	1,332	2,484	86%	DAPPS shows a peak staffing level of 1,712 CLAs in week 13. The larger number expected than trained may reflect the movement of production staff to QC. In these cases, gap training was provided, which may not be included in the training number.
Total Quality Control Hours of Crew Leader Assistant Training	33,566	61,062	82%	The larger number of CLAs required an increase in training time, which was an 82 percent overage in training hours.
Total Quality Control Crew Leader Assistant Production Hours	364,969	349,991	-4%	The number of production hours was slightly less than budgeted due to improved communication with HHC, wireless transmission of assignments, and electronic payroll.
Total Quality Control Crew Leader Assistant Miles	2,260,233	3,491,709	54%	The significant increase in QC work and more staff hired, which contributed to the mileage overage.

Category	Budgeted	Actual	Percent Change	Explanation
Quality Control Field Operations Supervisors				
Quality Control Field Operations Supervisors (FOSs) Trained	212	461	217%	Additional FOSs were needed to manage the larger-than-expected QC workload and subsequent increases in all field staff positions.
Quality Control Production Field Operations Supervisors	172	461	268%	DAPPS shows a peak level of 299 QC FOSs in weeks 11 and 13. Increased workload and the large increases in field staff to complete this work are the most likely causes of the overage.
Total Quality Control Hours of Field Operations Supervisor Training	7,031	12,461	77%	The increase in FOS training hours is a direct result of having more FOSs than budgeted for, and training taking longer to complete than planned.
Total Quality Control Field Operations Supervisors Production Hours	87,879	137,320	56%	The overage was caused by having more QC FOSs than budgeted for, and having QC FOSs work longer days than budgeted
Total Quality Control Field Operations Supervisor Miles	774,244	1,350,537	74%	The overage reflects larger workload and underestimated mileage per case. Another possible reason is that the FOS districts for QC represented combined production FOS districts. The cost model estimate for this mileage did not account for this.
Quality Control Miles				
Total Quality Control Miles	15,172,114	43,900,816	189%	The larger-than-expected QC workload resulted in more mileage and staff cost.

Note: Actual staffing tallies for field positions are inflated as they reflect unique employees, which accounts for staff that dropped out or were released, in addition to their replacements. Staff who worked multiple positions within an operation are only counted in the position they worked the most hours.

Table E-6: Tracing the Address Canvassing Workload from Initial Delivery, Field Actions, and Final MTdb Updating