

Putting Election Integrity to the Test

A Case Study of New Jersey's First Pilot of Risk-Limiting Audits

BY: JENNIFER MORRELL, DEMOCRACY FUND ELECTION VALIDATION PROJECT

DATE: OCTOBER 2019

EXECUTIVE SUMMARY

In November 2018, state and local officials in New Jersey took part in the Garden State's first-ever pilot risk-limiting audit (RLA) of voting equipment. A risk-limiting audit is nationally recognized as a reliable method to validate the integrity of the voting equipment and verify the accuracy of election results with a high degree of certainty. This innovative audit has a specified chance of confirming a correct outcome—or alternately, of correcting an incorrect outcome, if original results were wrong.

The pilot audits were led by New Jersey Secretary of State Tahesha Way and Division of Elections Director Robert Giles and staff, as well as election administrators from Essex, Gloucester, Mercer, Union and Warren counties. Representatives from the New Jersey Attorney General's Office and the New Jersey Office of the State Comptroller provided support, along with voting system vendors ES&S and Dominion Voting Systems. Jennifer Morrell, a consultant from the Democracy Fund, offered technical guidance and project management.

The pilot took place in five different jurisdictions, using three different voting systems and comprising ballots for three contests. In total, more than 260 voted ballots among the five jurisdictions were randomly selected, carefully retrieved and examined during the audit, and returned to their original batches for official storage. In every jurisdiction, the pilot audit wrapped up in a single round, with no errors or discrepancies identified.

For election administrators and auditors in New Jersey, the pilot project was a unique opportunity to learn about the requirements for risk-limiting audits and gain first-hand knowledge of the steps, supplies and systems necessary for this type of audit. This exercise also helped election officials begin to contemplate voting system purchases and regulatory changes, which would be necessary in order to successfully implement official risk-limiting audits at a larger scale in future elections.

BACKGROUND: Requirements for RLA in New Jersey

In 2007, the New Jersey Legislature had the foresight to pass legislation that would advance election integrity through more robust post-election audit requirements, using a method akin to a risk-limiting audit. [NJ Rev Stat § 19:61-9]

The legislation, while innovative, was years ahead of voting technology in New Jersey. As written, the law depends upon the use of voting equipment that would provide a voter-verifiable paper record of every ballot. However, due to funding limitations, New Jersey's 21 counties continued to use legacy voting systems with paperless Direct Recording Electronic voting machines well into 2018, making it difficult to implement risk-

limiting audits. As a result of lack of funding in 2009, the State suspended the requirement that all voting systems produce a voter-verifiable paper ballot.

The 2007 statute also contains language that would make risk-limiting audits challenging and potentially statistically inadequate for official elections. Such limitations include:

- The law calls for only two percent of voting districts in a county to be audited, instead of all ballots cast for an entire contest.
- The law mandates arbitrary risk limits of 1 percent for federal, gubernatorial or other statewide elections, and 10 percent for state office, other than Governor and Lieutenant Governor, and for county and municipal elections. (A good rule of thumb for a statistically valid RLA is a risk limit of five to 10 percent, depending on the type of election.)
- The law presumes the error rate in any precinct could not exceed 20 percent of the votes cast.
- The law requires the audit to be performed prior to certifying the results of the election, which is a best practice, but one that conflicts with NJ Rev Stat § 19:52-6, requiring all ballots be impounded until after the deadline for a recount.

OPPORTUNITY: Fast-Tracking an RLA Pilot

In 2018, Gloucester, Union and Essex counties in New Jersey deployed new paper-based voting equipment to a handful of precincts for the November 2018 election, as part of New Jersey's Voter Verified Paper Audit Trail (VVPAT) Voting System Pilot Program.

As a result of this new voting equipment in an official election, the New Jersey Department of State revisited state law and its implications for conducting a post-election risk-limiting audit.

The State Division of Elections reached out to Jennifer Morrell, a nationally recognized elections official who specializes in risk-limiting audit procedures and policies. Morrell leads the Election Validation Project, a project funded by the Democracy Fund focused on increasing trust in elections through rigorous audits, standards and testing. She previously was an elections administrator in Utah and Colorado, and was instrumental in the successful implementation of the first statewide risk-limiting audit in Colorado.

Morrell guided state officials through a thorough review of the state's existing audit law. She then suggested conducting a pilot risk-limiting audit in the three impacted counties, with a goal of helping election administrators understand the fundamentals of an RLA and practice the concepts in a comfortable learning environment.

New Jersey officials jumped at the opportunity to pilot RLAs—the first of its kind in the state— and decided to fast-track audit pilots for November 2018. The State engaged the three counties to participate in the audits and recruited representatives from the State Office of the Comptroller for auditing support and technical expertise.

Planning efforts began in September 2018, with an ambitious target set for the audits to be completed immediately after the November election.

Following the success of the three pilot RLAs in November, Mercer County and Warren County asked to participate as well with pilot RLAs for special elections that they conducted respectively in January and March

2019. Like the three counties that participated in the fall, both Mercer and Warren County deployed new paper-based voting equipment to a handful of precincts.

Thanks to support from the Democracy Fund and the Election Validation Project, Morrell provided guidance and project management from start-to-finish at no cost to New Jersey taxpayers.

GOAL: Benefits of a Pilot Audit

The primary goal of conducting pilot RLAs was to provide an opportunity for state and local election officials to become familiar with risk-limiting audit terms and procedures, and help to inform future policy decisions and voting system considerations.

Through hands-on experience, county and state staff would perform as many of the audit functions as possible, including the role of audit teams retrieving and examining ballots. Since these were not official RLAs and in order to provide a comfortable learning environment, it was decided that these pilot audits would not be open to the public. This ensured election administrators could ask questions, learn from mistakes and express concerns without fear of impacting official election results.

IMPLEMENTATION: From Design to Audit in Three Months

AUDIT PREPARATION

Planning and preparation for the audits began in September 2018. Remarkably, the pilot audits were completed in November 2018, just days after the participating counties had conducted and canvassed an official election. A similar aggressive timeline was followed for the Mercer and Warren County audits.

From an elections administration perspective, this accelerated timeline during an election year was impressive. The three-month pilot project reflected the strong collaboration, commitment and focus of the counties, state agencies and voting system vendors.

The pilots were conducted immediately after each election had been certified and the period to request a recount had passed. This ensured that the processes for handling, scanning and accounting for ballots were still fresh in the minds of election officials.

Because the pilot was limited to a handful of districts that had new voting equipment, it also limited the number of ballots that could be audited. This helped to create ideal conditions for a pilot that could be conducted in a single day.

Since New Jersey election officials were using new equipment and had never conducted an RLA, the stakeholders invested considerable time and effort beforehand to:

- Learn RLA concepts and vocabulary;
- Review the necessary steps for a risk-limiting audit;
- Develop an audit plan for all the counties;
- Test voting systems to export a cast-vote record;

- Prepare a ballot manifest;
- Prepare forms, reports and batch and container labels;
- Prepare physical space and practices for staging ballot storage containers;
- Prepare physical space and practices for retrieving and examining ballots;
- Assign roles; and
- Test the audit software.

METHODOLOGY

The Gloucester and Union County pilots were conducted as a **ballot-level comparison audit**, as were the subsequent audits for special elections in Mercer and Warren counties. The Essex County pilot was conducted as a **ballot-polling audit**.

Both types of audits depend upon **audit software**, which produces the random list of ballots to be examined, tracks the auditors' interpretations and measures the audit progress. The software used in these pilots was provided courtesy of Democracy Works¹, and was the same open-source software created by the State of Colorado and used in its first statewide risk-limiting audit in 2017.

Officials kicked off the audit by rolling 20 ten-sided dice to generate a random 'seed number,' which was entered into the audit software to randomly select the ballots to be audited.

Ballot-Level Comparison Audit

In a **ballot-level comparison audit**, teams of officials retrieve a specific number of randomly selected voted ballots. An audit team examines each ballot and identifies the voter's markings on the specified contest. They compare their 'human interpretation' of the voter's selection to the voting system's interpretation (i.e., how the vote was counted for that contest.)

This type of audit can be performed when ballots are scanned centrally and can be associated with their corresponding **cast vote record (CVR)**, which is an electronic record of the voting system's interpretation of each ballot. Ballots can be traced to their corresponding CVR by imprinting ballots with alphanumeric identifiers during scanning.

It is also critical that election administrators maintain a **ballot manifest**, which is a catalogue of every voted ballot by the batch in which it was scanned, the storage container in which the batch was stored, and the total



STATE OFFICIALS ROLL 10-SIDED DICE TO GENERATE A RANDOMIZED SEED NUMBER FOR THE AUDIT SOFTWARE.



OFFICIALS FROM MERCER COUNTY AND THE STATE OF NEW JERSEY RETRIEVE PAPER BALLOTS AS PART OF A BALLOT-LEVEL COMPARISON AUDIT.

¹ Similar software is now being developed and hosted by VotingWorks <https://voting.works/rla/>

number of ballots in each batch. This allows auditors to retrieve the exact ballot that was specified by the audit software, and compare it to the correct CVR.

However, the new voting systems used in New Jersey could not export CVRs in a way that links them to the corresponding paper ballot due to the ballots being scanned at the polling location. This limitation is also true for similar systems used across the United States that are not scanned centrally.

For this reason, four of the pilot counties relied upon an RLA method of sampling known as a **transitive audit**. Transitive audits involve rescanning the collection of ballots to be audited and processing the scans with software that can create and export individual CVRs, allowing a ballot-level comparison audit to be conducted.

After rescanning the ballots and processing the images to export CVRs, auditors can confirm that the CVRs reproduced the same results reported by the official voting system. If the results are the same, the auditors can check the accuracy of those unofficial CVRs using the ballot-level comparison method.

Transitive audits do not confirm the accuracy of the voting system of record, but they do confirm whether the winner(s) reported by the official system are the true winners. They require a greater level of effort to batch and rescan ballots, but provide the detailed feedback and confidence that election officials appreciate from a ballot-level comparison audit.

In a ballot-level comparison audit, another critical function of auditors is to determine “voter intent” on ballots where the voter’s markings are unclear. Voters may circle, draw an ‘x’ or dot, write notes, scribble or strike through a selection with their pen, making it difficult to determine how they meant to vote. In this circumstance, it is helpful to have a uniform set of guidelines that describes how audit workers should differentiate ambiguous marks from an intentional vote. In some cases, the auditors may decide that the vote should be counted differently than the voting system’s interpretation.

Ballot-Polling Audit

In a **ballot-polling audit**, such as the one completed in Essex County, teams of officials retrieve a specified number of randomly selected ballots. An audit team examines the ballot and identifies and records the voters’ markings on the specified contest. The votes are tallied to determine if the sample shows a large enough majority of votes for the reported winner.

A ballot-polling audit cannot identify whether a specific ballot was mistabulated by the voting system, but it can provide convincing evidence about whether the reported outcome is correct.



SECRETARY OF STATE TAHESHA WAY REVIEWED PAPER BALLOTS IN THE BALLOT-LEVEL COMPARISON PILOT AUDIT.



AUDIT OFFICIALS UNROLL A RESULTS TAPE FROM A REEL TO REEL VOTING MACHINE IN ESSEX COUNTY IN ORDER TO EXAMINE SPECIFIC BALLOTS.

This is an RLA method that can be used with any voting system that produces voter-verifiable paper records. In Essex County, the paper audit trail was a summary ballot printed on reel-to-reel thermal paper, which could not be rescanned. A ballot-polling audit does not require a CVR or data export from the voting system, nor does it involve comparing human interpretation of voter intent to the machine interpretation. It does, however, require a ballot manifest documenting the location and quantities of the voted ballots.

OUTCOME: Lessons Learned

The specific audit design and outcome of each audit is detailed in the [Appendix](#) of this report. In every jurisdiction, the pilot audit wrapped up in a single day and just one round, with no errors or discrepancies identified.

Each of the five RLA pilot experiences generated thoughtful conversation between state and local officials. One of the central concerns involved ballot handling and storage. Physical space in county election offices was designed to secure and store DRE memory cards. Additional space may be necessary to accommodate a large volume of paper ballots if counties move entirely to a paper-based voting system.

Creating and maintaining a ballot manifest was a new concept, but one that election officials unanimously agreed was beneficial not only to the audit process, but also to ensure thorough ballot accounting and reconciliation. This is a process that election officials can undertake immediately upon acquiring a paper-based voting system. It was also evident that election officials should adopt standard naming conventions for the ballot manifest. This will ensure that the list of ballots to be audited is more easily generated and prepared by the audit software.

The size and form of each physical ballot plays a role in the time and effort required to conduct an audit. For example, in Essex County, where the paper audit trail was printed on reels of thermal paper, it took auditors a considerable amount of time to unwind each reel and carefully count down to the correct ballot to be audited. This prevented divvying up the work to multiple audit teams or using other methods to find the randomly selected ballot for audit. In addition, having all the ballots from a voting location printed in order on a single reel poses potential concerns for voter anonymity.

Another important lesson learned was that there are some situations where the statistics of risk-limiting audits cannot help you. In Mercer County, the ballot-level comparison pilot audit involved a small contest with a microscopic margin. Situations like this often require a full hand count. For purposes of the pilot, the risk limit was set quite high, so it would still serve as a learning experience with a reasonable number of ballots to inspect/audit and generate discussion.

In addition, state and local officials agreed that using audit software allowed for greater transparency, as it allowed for everyone participating to watch how each ballot was interpreted by the auditors and entered into the software. This type of software would be necessary to conduct future risk-limiting audits for official elections in New Jersey.

Although additional RLA pilots were scheduled to be conducted following the June 4, 2019 primary election in Bergen and Hunterdon counties, another lesson was learned. New Jersey has closed primary elections and many times candidates in a political party will run unopposed which negates the ability to perform RLAs. The pilots in Bergen and Hunterdon were conducted in small towns and resulted in the candidates running unopposed.

RECOMMENDATIONS

The 2018/2019 pilot project provided an opportunity for New Jersey State and local officials to better understand the process of preparing for and conducting risk-limiting audits, and to benefit from hands-on experience. This exercise helped to bring sophisticated audit and statistical concepts within reach, and to unite diverse agencies in the practice of an RLA.

Jennifer Morrell, consultant with the Democracy Fund, provided technical guidance for the pilot. She provides the following recommendations and insights based on her experience. These are solely suggestions to help ease the transition toward risk-limiting audits in New Jersey. Conducting universal RLAs does not need to be an immediate destination, but can be viewed as a path with steps along the way to achieve greater election integrity and modernity.

RECOMMENDATION 1

Form a collaborative working group whose mission is to recommend election rules and statutory changes in order to advance risk-limiting audits in New Jersey. The group should be comprised of State election officials, members of the State Comptroller's Office, local election officials, and recognized election auditing experts.

Key regulatory considerations for the advisory group should include²:

- Definition of risk-limiting audit in New Jersey;
- Roles and responsibilities of state agencies and counties in oversight and implementation;
- The timeline to conduct an RLA after official elections. (Current statute requires impounding ballots until the recount deadline has passed. It is recommended to implement dates and deadlines to allow time for a post-election RLA prior to the certification of election results.);
- Calculation for an acceptable risk-limit or range with a maximum limit;
- Protocol for selecting target contest(s) to be audited; and
- Plan for scaling up from narrow pilots to official, statewide post-election RLAs.

RECOMMENDATION 2

The New Jersey Department of State should create statewide **Voter Intent Guidelines**. This document should provide guidance for election workers on how to discern a voter's markings on their paper ballot, especially when those markings are unclear. This document should be incorporated into training and should be a job aid for election workers who are involved in scanning, adjudicating or duplicating hand-marked paper ballots, as well as for audit team members. This is especially important given the increase New Jersey is seeing in returned mail ballots.

² The author recommends the advisory group consider all of the questions on pages 18-20, Knowing It's Right: Risk-Limiting Audit Implementation Workbook.

RECOMMENDATION 3

Support counties, via technical guidance, to **purchase modern voting systems** that produce a voter-verifiable paper ballot.

Key consideration for the counties will include:

- The size and form of each physical ballot for ease of handling, retrieving for audit, and storage;
- Imprinting capability for hand-marked ballots when centrally scanned; and,
- Plan for ballot storage and organization.

RECOMMENDATION 4

The Department of State should procure audit software to meet the needs of New Jersey in future risk-limiting audits.

APPENDIX: Audit Design and Outcome in Five Counties

ESSEX COUNTY

Precincts/Districts Audited: Montclair 4-5 & 4-8
Target Contest: US Senate Race
Risk Limit: 1%
Type of Audit: Ballot-Polling Audit
Voting Equipment: Dominion ImageCastX w/VVPAT

Total Ballot Cards in Manifests: 942
Total CVRs in CVR Export Files: 942
Total Ballot Cards Audited: 14
Number of Audit Rounds: 1
Discrepancies: 0

Choice	W/L	Votes	Margin	Diluted Margin %
Robert Menedez	W	784	684	72.61
Bob Hugin	L	100		
Murray Sabrin	L	3		
Tricia Flanagan	L	6		
Natalie Lynn Rivera	L	11		
Hank Schroeder	L	10		
Kevin Kimple	L	4		
Madelyn R. Hoffman	L	1		
Write-In	L	-		

GLOUCESTER COUNTY

Precincts/Districts Audited: Borough of National Park
 Target Contest: U.S. Senate Race
 Risk Limit: 1%
 Type of Audit: Ballot-Level Comparison Audit
 Voting Equipment: ES&S ExpressVote XL with rescan/retabulation on ES&S DS850

Total Ballot Cards in Manifests: 908
 Total CVRs in CVR Export Files: 908
 Total Ballot Cards Audited: 118
 Number of Audit Rounds: 1
 Discrepancies: 0

Choice	W/L	Votes	Margin	Diluted Margin %
Robert Menedez	L	428	68	7.48%
Bob Hugin	W	496		
Murray Sabrin	L	27		
Tricia Flanagan	L	12		
Natalie Lynn Rivera	L	11		
Hank Schroeder	L	1		
Kevin Kimple	L	1		
Madelyn R. Hoffman	L	12		
Write-In	L	2		

MERCER COUNTY

Precincts/Districts Audited: Princeton School Districts 3
 Target Contest: Princeton School District Question
 Risk Limit: 65%
 Type of Audit: Ballot-Level Comparison Audit
 Voting Equipment: Hand-marked paper ballots rescanned on Dominion ImageCast Central

Total Ballot Cards in Manifests: 653
 Total CVRs in CVR Export Files: 653
 Total Ballot Cards Audited: 175
 Number of Audit Rounds: 1
 Discrepancies: 0

Choice	W/L	Votes	Margin	Diluted Margin %
YES	W	325	3	0.459418
NO	L	328		

UNION COUNTY

Precincts/Districts Audited: Westfield 1-4, 1-6, 1-7, 2-2, 2-3, 2-6, 3-6, 4-1, 4-3 (randomly selected)
Target Contest: US Senate Race
Risk Limit: 1%
Type of Audit: Ballot-Level Comparison Audit
Voting Equipment: ES&S ExpressVote XL with rescan/retabulation on ES&S DS850

Total Ballot Cards in Manifests: 4,098
Total CVRs in CVR Export Files: 4,095₃
Total Ballot Cards Audited: 96
Number of Audit Rounds: 1
Discrepancies: 0

Choice	W/L	Votes	Margin	Diluted Margin
Robert Menedez	L	2,174	410	10.01%
Bob Hugin	W	1,764		
Murray Sabrin	L	11		
Tricia Flanagan	L	11		
Natalie Lynn Rivera	L	16		
Hank Schroeder	L	10		
Kevin Kimple	L	21		
Madelyn R. Hoffman	L	38		
Write-In	L	0		

₃Three Union County ballots were unreadable by the scanner during the rescanning to produce a CVR. They had a black line running through the barcodes. The most likely explanation is that the cards were scratched against the lid when they were removed from the cartridge for rescanning. Because the ballot cards are printed on thermal paper, officials can expect this to occasionally occur through handling. There was no issue manually examining the summary ballot printed on the cards.

WARREN COUNTY

Precincts/Districts Audited: Oxford Township Districts 1 & 2
Target Contest: Oxford School District Special Election
Risk Limit: 1%
Type of Audit: Ballot-Level Comparison Audit
Voting Equipment: ES&S ExpressVote XL with rescan/retabulation on ES&S DS850

Total Ballot Cards in Manifests: 190
Total CVRs in CVR Export Files: 190
Total Ballot Cards Audited: 51
Number of Audit Rounds: 1
Discrepancies: 0

Choice	W/L	Votes	Margin	Diluted Margin %
YES	W	111	32	16.84210526
NO	L	79		