

# 0 Connecticut Citizen Election Audit

## Connecticut Can Do Better: Citizen Post-Election Audit Report

Independent Observation and Analysis  
of Connecticut's Audit of the 2019 General Election

February 21, 2020

We conclude, based on citizen observations and analysis of official municipal audit reports, post-election vote audits of the November 2019 elections failed to meet basic audit standards. Again, the Secretary of the State's Office failed to require local officials to conduct audits according to law. As a result, voters cannot have confidence in the accuracy of election results.

Officials made strides in the following areas:

- ▲ Officials demonstrated strides toward a publicly verifiable Machine-Assisted Post-Election Audit.
- ▲ Only two districts attributed differences in vote and ballot counts to Human Error. Fewer large differences were reported, increasing our confidence in officials and scanners.

The public and candidates expect, and the Secretary of the State should require, that local election officials organize audits and produce accurate, complete audit reports. The public should expect the Secretary of the State's Office to take the lead in ensuring that each audit report is complete:

- ▼ 41% of official audit reports from registrars were incomplete.
- ▼ Weaknesses in ballot chain-of-custody and security procedures remain. Ballot security is necessary to assure ballots were not tampered with between the election and the municipal audit counting sessions.
- ▼ Use of electronic audits that are not publicly verifiable.

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# Executive Summary

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## Introduction

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Connecticut statutes require the Secretary of the State and local registrars of voters to conduct audits after every election and primary.

After the November 2019 Election, Connecticut conducted its 21st large-scale post-election audit.<sup>1</sup> This was also the 21st large-scale audit observation for the Connecticut Citizen Election Audit (“Citizen Audit”).

The purposes of our observations are to *create election integrity*, demonstrate citizen interest in the process, increase citizen involvement in elections, provide feedback for improvement to the Secretary of the State and the Connecticut General Assembly on the audit process, and provide the public with the information necessary to determine confidence in Connecticut's elections.

Citizen Audit volunteer observers invested 19 days observing 26 audit counting sessions. Without the service of these volunteers, Connecticut’s post-election audits would take place without public observation, and the insights in this report would not be possible.

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<sup>1</sup> In this document we will frequently use the term “audit” when we mean “post-election audit,” “post-election audit counting session,” or other parts of the process, from the random selection of districts to be audited to the official report of each post-election audit produced by the University of Connecticut Voter Center (UConn).

## Findings

We conclude, based on citizen observations and analysis of official municipal audit reports, Post-election vote audits of the November 2019 elections failed to meet basic audit standards. Again, the Secretary of the State's Office failed to require local officials to conduct audits according to law. As a result, voters cannot have confidence in the accuracy of election results.

We are pleased that officials made strides in the following areas:

- ▲ Officials demonstrated strides toward a publicly verifiable Machine-Assisted Post-Election Audit.
- ▲ Only two districts attributed differences in vote and ballot counts to Human Error. Fewer large differences were reported, increasing our confidence in officials and scanners.

The public and candidates expect, and the Secretary of the State should require, that local election officials organize audits and produce accurate, complete audit reports. The public should expect the Secretary of the State's Office to take the lead in ensuring that each audit report is complete:

- ▼ 41% of official audit reports from registrars were incomplete.
- ▼ Weaknesses in ballot chain-of-custody and security procedures remain. Ballot security is necessary for confidence that ballots were not tampered with between the election and the municipal audit counting sessions.
- ▼ Use of electronic audits that are not publicly verifiable.

We emphasize that this report does not question any election official's integrity. Most election officials are well-motivated and of high integrity, as are other public officials. However, unquestioned trust and lack of knowledge can lead to a lack of vigilance that allows errors to be overlooked and opportunity for the occasional bad actor to manipulate elections and audits.

# Connecticut Continues Flawed Electronic Audits

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## Summary

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For four years several municipalities, the Secretary of the State's Office, and the UConn Voter Center<sup>2</sup> conducted electronic audits. **In 2016, Connecticut became the first and remains the only state in the United States to replace publicly verifiable audits with unverifiable electronic audits. Yet, this year there is some good news to report.**

**Electronic audits represent several steps backward from the traditional manual, hand-count audits:**

- Unlike hand-count audits, the electronic audits were not publicly verifiable.<sup>3</sup> This is unacceptable. The public and the Citizen Audit cannot determine the accuracy of such audits.
- The audits were conducted without written procedures approved by the Secretary of the State.

**The Citizen Audit strongly recommends *Electronically-Assisted Manual Post-Election Audits*:**

- The sound science of *Evidence Based Elections* provides the basis for manually checking and transparently verifying the results of an electronic audit. If efficiently conducted, such audits would take approximately the same effort for election officials as the unverifiable electronic audits used for this election.
- Electronically-Assisted Post-Election Audits could provide confidence with less tedious work, high accuracy, and greater confidence.

**This year we applaud the Secretary of the State's Office and UConn for demonstrating and prototyping a system of manually verifying the audits as we have been requesting. We encourage them to take the moderate remaining steps to implement Electronically-Assisted Post-Election Audits that are completely transparent and publicly verifiable.**

For complete details on the shortcomings of Connecticut's electronic audits and the alternative of Electronically-Assisted Post-Election Audits, see Appendix B.

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<sup>2</sup> <https://voter.engr.uconn.edu/voter/>

<sup>3</sup> Unlike most government agency and business audits, post-election audits are traditionally not conducted independently. They are conducted by the same organizations and individuals responsible for conducting the elections and specifying election equipment. Elections are also highly political. The solution is publicly verifiable audits – audits that can be independently verified by candidates and the public.

## Audit Background

After the November 2019 Election, Connecticut conducted its 21<sup>st</sup> large-scale post-election audit.<sup>4,5</sup> This was also the 21<sup>st</sup> large-scale audit observation by the Connecticut Citizen Election Audit (Citizen Audit).

The purposes of our observations are to *create election integrity*, to demonstrate citizen interest in the process, increase citizen involvement in elections, provide feedback to the Secretary of the State (SOTS) and the Connecticut General Assembly on the audit process, and provide the public with the information necessary to determine its confidence in Connecticut's elections.

By law, the Secretary of the State is required, after each election, to select at random 5%<sup>6</sup> of districts for audit from the full list of Connecticut's voting districts. In the random drawing 34 voting districts were selected. The districts we audited were located in 27 municipalities.<sup>7</sup> The audit counting sessions were required to be conducted between November 20, 2019 and December 16, 2019.

Citizen Audit volunteer observers invested 19 days observing 26 (of 27 randomly chosen) counting sessions during this period. Observers frequently attended audits on short notice, observed multiple audits, and accommodated last minute changes to the audit schedule. **Without the service of these volunteers, Connecticut's post-election audits would take place without public observation, and the insights in this report would not be possible.**

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<sup>4</sup> In this document we will frequently use the term "audit" when we mean "post-election audit" or "post-election audit counting session." Technically, we believe that the whole process encompassing everything from the preservation of records, random drawings, counting in municipalities, the report by the University of Connecticut, and the evaluation of that report by the Secretary of the State would be the "audit." However, for readability we will usually follow the common practice of using "audit" to refer to parts of the whole.

<sup>5</sup> Connecticut statutes require the Secretary of the State and registrars of voters to conduct audits after every election and primary.

<sup>6</sup> Effective July 1, 2016 the post-election audits were reduced by the General Assembly from 10% to 5% of districts.

<sup>7</sup> SOTS press release after the random drawing:

<https://portal.ct.gov/SOTS/Press-Releases/2019-Press-Releases/Election-Results-to-be-Audited-from-Selected-Polling-Locations-2019>

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## Purpose of Connecticut's Random, Post-Election Audits

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As stated in the Office of the Secretary of the State's Post-Election Audit Procedures:<sup>8</sup>

*The primary purpose of the hand count<sup>9</sup> audit is to assess how well the optical scan voting machines functioned in an actual election and to ensure that votes cast using these machines are counted properly and accurately.*

Good government groups support the "Principles and Best Practices for Post-Election Audits,"<sup>10</sup> which includes the following definition and benefits:

*Well-designed and properly performed post-election audits can significantly mitigate the threat of error, and should be considered integral to any vote counting system. A post-election audit in this document refers to hand counting votes on paper records and comparing those counts to the corresponding vote counts originally reported, as a check on the accuracy of election results, and resolving discrepancies using accurate hand counts of the paper records as the benchmark. Such audits are arguably the most economical component of a quality voting system, adding a very small cost for a large set of benefits.*

*The benefits of such audits include:*

- *Revealing when recounts are necessary to verify election outcomes*
- *Finding error whether accidental or intentional*
- *Deterring fraud*
- *Providing for continuous improvement in the conduct of elections*
- *Promoting public confidence*

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## Citizen Observation: Challenges and Limitations

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We recognize that there may be occasional errors in our raw data derived from observations. However, when taken as a whole, the observations tell a collective story that is quite consistent and provides valuable feedback to the public and for the continuing education of elections officials.

**Without our volunteer observers willing to invest a day of their time, being available for short-notice scheduling, and observing to the best of their ability, no one except local election officials would know how post-election audits are conducted in Connecticut. Our observers care about democracy and ensuring that measures are in place to protect the integrity of our elections.<sup>11</sup>**

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<sup>8</sup> Official Procedures: <http://ctelectionaudit.org/2016/AuditProcedure201605.pdf>

<sup>9</sup> Hand count means the manual counting of ballots and votes without relying on voting machines such as optical scanners.

<sup>10</sup> [https://electionaudits.org/files/bestpracticesfinal\\_0-2008.pdf](https://electionaudits.org/files/bestpracticesfinal_0-2008.pdf)

<sup>11</sup> Upon request of any registrar of voters participating in the audit, we would be pleased to discuss volunteer observation reports and provide feedback applicable to their municipality.



# Analysis

## We Do Not Question Any Election Official's Integrity

**This report does not question any election official's integrity. Most elections officials are well-motivated and of high integrity, as are other public officials. However, unquestioned trust and lack of knowledge can lead to a lack of vigilance that allow errors to be overlooked and the opportunity for the occasional bad actor to manipulate elections and audits.**

**At a minimum, lack of attention to detail and opportunities for error and fraud leave voters without justified confidence in our election system and election officials.**

## Citizen Observation Analysis

Volunteer citizen observers observed local counting sessions and reported their observations on Observation Report Forms.<sup>12</sup> Analysis in this section is based on those reports. Appendix A is a table showing the percentage of "yes" responses on all yes/no questions on Observation Report Forms for this audit. Appendix C describes in detail our methodology of observation and analysis.

## Even-Year Elections vs. Odd-Year Elections vs. Primary Elections

In several aspects, it is more appropriate to compare even-year elections with even-year elections, odd-year elections with odd-year elections, and primary elections with primary elections. Even-year elections include statewide races and involve more ballots, yet generally are easier to count manually than municipal elections. Odd-year elections are municipal elections. They involve fewer ballots due to lower turnout, yet present more challenging counts of vote-for-multiple races (for example, "Vote for 6 of the 12 candidates"). Primary election audits require counting only a single race, have far fewer ballots, do not involve cross-endorsements or write-ins, and seldom have vote-for-multiple contests.

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## A. Procedures Are Unenforceable, Current Laws Are Insufficient

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As noted in previous reports, discussions with representatives of the Secretary of the State's Office and the State Elections Enforcement Commission (SEEC) indicated that many, if not all, of the post-election audit procedures, including those covering chain-of-custody, are unenforceable. There has been disagreement between past SEEC Directors and some members of the General Assembly regarding the enforceability of regulations, but there is agreement that current post-election audit procedures are not enforceable.<sup>13</sup>

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<sup>12</sup> Our latest forms used for this observation is available at: <http://ctelectionaudit.org/Forms/ObservationReportM.pdf> and <http://ctelectionaudit.org/Forms/ObservationReportE.pdf> for the manual and electronic audits, respectively.

<sup>13</sup> In 2015, Public Act 15-224 authorized the Secretary of the State to designate enforceable procedures, yet the audit procedures have not been so designated.

## A.1 Ballot Security Laws Are Insufficient for Credible Audits

Laws that govern the post-election sealing of ballots, memory cards, and tabulators are unclear and insufficient. After over a decade of optical scanner use, the laws have not been updated to recognize that polling place voting with optical scanners involves paper ballots. Most officials interpret the law to imply that polling place ballots are required only to be sealed only until the 14<sup>th</sup> day after the election. Yet the audits do not start until the 15<sup>th</sup> day after the election. We note that the adherence to prescribed chain-of-custody and ballot security procedures varies widely among audited districts.

Ballots are not uniformly maintained in secure facilities, and access to these storage facilities is not reliably logged or recorded, even though the law requires two individuals to be present when these facilities are accessed. In many towns, each registrar could have undetected lone access to the sealed ballots<sup>14</sup> for extended periods. In many towns, several other individuals also have such access. The lack of uniform security of the ballots diminishes confidence in the integrity of the ballots. This diminishes confidence in the integrity of election results.

**Ballots are the basis for the data reported in audits and the foundation for the integrity of elections. Secure, credible chain-of-custody procedures should preclude the opportunity for a single individual to have any unobserved extended access to ballots, which provides the opportunity for an individual to substitute or modify ballots.**

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## B. Laws and Procedures Are Not Followed or Understood

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Problems uncovered in this year's observation include: incorrectly completed forms, chain-of-custody concerns, inconsistent counting methods, error-prone, confusing totaling processes, and problems with totaling results.

The Official Audit Procedures<sup>15</sup> were frequently not followed, were not enforced, and, as noted previously, may not be enforceable. Also, the procedures still lack detailed guidance in efficient counting methods that would provide accurate and observable results. See Section C below.

Our observations indicate that some towns do a good job of using the procedures in the audit, following each step, in order, and enhancing them with effective detailed counting methods. However, in other towns it was clear that election officials were not referencing or following the procedures. Some who attempt to follow the steps do not seem to understand them or their purpose and appear to be reading the procedures for the first time at the start of the counting session. Frequently, effective counting procedures are coupled with *ad-hoc*, disorganized totaling procedures. This causes inaccuracies and

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<sup>14</sup> While useful, ballot bag seals, which are small plastic or plastic and metal numbered devices, are not supposed to be reusable, offer little protection, especially when used to protect ballots from those who are responsible for applying and checking seal integrity: *Security Theater: Scary! Expert Outlines Physical Security Limitations* <http://ctvoterscount.org/security-theater-expert-outlines-physical-security-limitations/> See a video demonstration of how to compromise such seals here: [https://www.youtube.com/watch?time\\_continue=2&v=ZtzLifULnbl](https://www.youtube.com/watch?time_continue=2&v=ZtzLifULnbl)

<sup>15</sup> The latest SOTS procedures: <http://ctelectionaudit.org/2016/AuditProcedure201605.pdf>

frustration for officials and makes it difficult to observe the accumulating vote totals from teams and their batches to reach the final totals.

### B.1 Write-in Problems Reduced

Unlike the previous three years, 2019 produced no reports of significant numbers of write-in ballots read through scanners twice on Election Day. As noted in previous reports, our past highlighting of these problems and surfacing them at the electronic audits under the supervision of the Secretary of the State's office likely contributed to more attention to this area.

We are pleased with this development. Perhaps officials paid attention to our previous reports. Perhaps the surfacing of such problems at last year's electronic audits at the Secretary of the State's offices lead to more emphasis of the problem in the annual training of registrars.

### B.2 In the Past, Official Audit Reports Were Not Sent to or Tracked by the SOTS Office

We have no reason to believe this has changed. After several years of disappointing results asking the Secretary of the State's office for all results and delays in getting those results, we no longer attempt to obtain them that way. Instead we are using the completed, signed forms collected by observers or obtained by Citizen Audit Freedom of Information requests to individual registrars.

### B.4 Fourteen Incorrectly Completed Forms, and Incomplete Audit Counting

Several registrars' reports were incomplete due to insufficient data to determine the actual results of the audits, and if and how they were performed. As in the past, for some reports we can make assumptions and fill in missing data. In this audit some reports are so incomplete that we cannot make reasonable assumptions. This includes eight of the reports from the electronic audits completed under the supervision or lack thereof by the Secretary of the State's staff.

Voters should expect that the SOTS reviews such reports and returns them to local officials to be completed and, where necessary, require the audit be repeated. We are equally concerned that such reports in the past were accepted by the Secretary of the State's Office and UConn as representing the actual results of the audit.

**Without complete reports we cannot analyze or verify the results of the audit. So we cannot provide any level of confidence in the optical scanners in those districts, nor in the officials charged with supervising and performing the audits. This, after all, is the statutory purpose of the audits.**

### Audit Report

Town Name: \_\_\_\_\_ Voting District (and polling place name): \_\_\_\_\_

District Numbers:(Cong \_\_\_\_\_) (State Senate \_\_\_\_\_) (Assembly \_\_\_\_\_)

Ballot Carrying Case Seal Number: \_\_\_\_\_ Audit Date: \_\_\_\_\_

Total of tabulator-counted ballots - hand counted at the audit:

Totals ballots counted by tabulator as shown on tabulator tape produced on election night:

Ballot Carrying Case Seal Number (When Resealed After Audit): \_\_\_\_\_

A	B	C	D	E	F
Office	Candidate	Machine Totals (Tape)	Undisputed Vote Totals	Questionable Vote Totals	Overall Hand Count Totals (D + E)

Explanation of Differences:

*Submit completed forms within 48 hours by fax to 1-866-392-4023*

Registrar of Voters: \_\_\_\_\_  
(Signed) (Printed)

Registrar of Voters: \_\_\_\_\_  
(Signed) (Printed)

### Official Audit Report Form - Figure 1

	2019	2017	2015	2013 <sup>16</sup>
Number of ballots counted by hand or machine not filled in or filled in incorrectly	2	2	1	1
Some columns not completed and/or incorrectly completed	8	5	6	6
Minor arithmetic/transcription errors	1	5	3	1
Reports with negative counts of questionable ballots	1	0	1	3
Fewer races or candidates counted than required by law	2	0	1	7
Missing reports from SOTS		2	2	3
Differences attributed to questionable votes, but not reported in Col. E	2	3	0	3
Cross-endorsed candidates not counted as such	0	0	3	
Differences attributed to questionable votes, but not enough reported	0	0	0	1
Total incorrect or missing reports	14	14 <sup>17</sup>	15	22
Districts selected	34	34	68	66
Rate of incomplete reports	41%	41%	22%	29%

**Errors in Official Report Forms - Table 1**

**Incomplete data should be taken seriously. The Secretary of the State should not accept incomplete forms. She should insist that forms be filled out correctly and that enough races are counted. Where necessary, SOTS should perform investigations, including recounting ballots or votes.** These investigations should be announced publicly in advance to allow public observation. Every significant difference is an opportunity for an election error or malfeasance to remain undetected. Images of the actual official Audit Report Forms and our data compiled from those reports can be viewed at: <http://www.CTElectionAudit.org>.

**Eight of the ten errors in the first two columns this year were in the electronic audits where registrars either did not copy all the data needed to the official forms or did not add all the required data to the print-outs from the Audit Station. This all occurred under the supervision or lack thereof by the Secretary of the State's staff.** As noted elsewhere, major flaws in using the Audit Station are that there are no published procedures, and the Audit Station reports do not include fields for registrars to add required data from the election night tabulator tapes.

<sup>16</sup> We present several tables in this report from the 2015, 2013, and 2011 audits. The odd-year 2011, 2013, and 2015 elections are similar municipal elections and are more directly comparable than State and Federal even-year elections.

<sup>17</sup> Some district reports had more than one error, counted only once in this total.

**B.5 “Human Error” Should Not Be Accepted as an Explanation of Differences**

	2019	2017	2015	2013
Reports attributing differences in counts to “Human Error”	2	6 <sup>18</sup>	19	20
Rate of “Human Error” excuse in official reports	5%	22%	28%	30%

**Official Forms Listing “Human Error” as Cause of Differences - Table 2**

**Officials routinely attribute differences in counts to “Human Error.” Accepting that as the reason or excuse completely negates the purpose of the audit.** Without reliable, accurate counting in the audit it is impossible to attribute errors to either machines or humans. Hand counts which are inaccurate do not imply that machine counts were accurate.

Registrars submitting and the SOTS Office accepting reports with “Human Error” as explanations are also contradictory to the published procedures, which state:

*Small differences of one or two unexplained votes can often occur, but such differences should be verified by at least two counts. It is your responsibility to be thorough and comfortable that your counts of the ballots are accurate. If you are not confident in your counts then you should continue counting and recounting until you are satisfied that your hand count result is accurate.*

Differences excused by “Human Error” should not be accepted by the SOTS Office nor by the University of Connecticut in their reporting of scanner accuracy. They should be investigated, analyzed, and reported accurately.

**This year’s results represent a significant improvement. Much of it can be attributed to the significant increase in electronic audits.**

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<sup>18</sup> Counts are significantly reduced, because the audit was reduced to 5% of districts from 10% of districts prior to 2016. Also, “Human Error” is not a reasonable explanation for electronic audits.

### B.6 Multiple Chain-of-Custody Concerns

In several municipalities,<sup>19</sup> observers expressed concerns with chain-of-custody and ballot security.

% Yes:	2019	2017	2015	2013
Do you have any concerns with the chain of custody?	60%	29%	32%	23%
A single individual can access ballot containers in storage.	60% <sup>20</sup>	48%	42%	52%

**Municipalities Where Observers Noted Chain of Custody Concerns - Table 3**

Single officials delivered ballots, single individuals were left with ballots, and ballots were left alone with observers. Numbered seals were improperly applied, were left open, or were not used. In one small town no seals and ballot bags were used to save money.

A larger concern is that, in many towns, single individuals may access the ballots undetected for extended periods of time. In 60% of towns surveyed in this audit, a single individual can access the ballot storage. In other towns, even though policies require more than one person to access ballots, there are few or no protections in place to prevent a single person from accessing the ballots.<sup>21</sup> In some towns this is not considered a violation. This is a serious problem, since single individuals could change the ballots and be undetected. **At minimum it destroys the credibility of audits and elections.**

In 2018 we changed/clarified our ‘individual access’ question such that we no longer accept an *honor system* as sufficient to prevent a single official from accessing ballots.

From observers:

*No seal on bag - said lost on the way to electronic audit. The registrars were concerned.*

*One bag was not sealed properly: it was possible to open the bag without breaking the seal.*

*Numbered seals were not used; the boxes were taped and had signatures of election officials on them. I was permitted to view and photograph the sealed boxes. Regular duffel suitcases - how safe are the zippers from being compromised?*

*Ballot bags stored in open shelves in registrars’ office.*

<sup>19</sup> We did not observe every characteristic of every audit counting session that we attended. Some questions did not apply; in some audits observers could not fully observe audits that continued beyond one day, etc.

<sup>20</sup> Rates cannot be compared year to year, as the question was changed in 2018 to more accurately reflect physical security. Previous questions accepted two person security based only upon an *honor system*.

<sup>21</sup> Numbered tamper-evident seals are a useful protection, but without extensive procedures for their verification and other strong ballot protections, at best they provide a few seconds of protection from possible compromise. For examples, see:

<http://www.cs.princeton.edu/~appel/voting/SealsOnVotingMachines.pdf> and <http://www.cs.princeton.edu/~appel/voting/Johnston-AnalysisOfNJSeals.pdf>

## C. Training and Attention to Counting Procedures Are Inadequate and Inconsistently Followed

### C.1 Audit Organization and Counting Procedures:

Observers expressed concerns that many of the audits were not well-organized. Observers noted the following concerns, which frequently occurred within the same municipalities:

Question	%Yes:	2019	2017	2015	2013
MA <sup>22</sup> : Do you have any concerns that the auditing was not well-organized?		9%	29%	36%	13%
MA: Do you have any concerns that the manual count was inaccurate?		36%	33%	21%	0%
Do you have any concerns that the officially reported information is inaccurate?		10%	5%	16%	0%
Do you have any concerns with the transparency/observability of the process?		0%	6%	3%	3%

**Municipalities Where Observers Noted Procedural Concerns - Table 4**

We note that over time, concerns with the manual audit have been decreasing.

From observers:

*Though procedures were explained, some of the teams were inexperienced and would have benefited from more detail/individualized training.*

*Registrars started counting and stopped instructing. Each team then started to do it however they thought best*

<sup>22</sup> “MA” indicates observations applicable only to *manual audits*.



**C. 2 Need for Dual Verification**

**Official audit counting procedures require “two eyes,” i.e., dual verification of the count of each individual ballot, were frequently ignored.** When ballots are counted by a single individual, miscounts can require tiring recounts and unnecessary investigation. When single individuals count hundreds of ballots or votes, errors are almost inevitable.

Question	% Yes:	2019	2017	2015	2013
Were the ballots counted by each team such that a second election official verified each count?		80%	62%	66%	61%
IF HASH MARKING USED: Did a second official observe that each vote was read accurately?		30%	50%	36%	53%
IF HASH MARKING USED: Did a second official make duplicate hash marks observe that each hash mark was recorded accurately?		20%	62%	28%	56%
IF STACKING/PILES USED: Was the vote counting process such that two election officials verified that each vote was stacked as marked?		50%	67%	82%	57%
IF STACKING/PILES USED: Were the stacks of ballots counted such that two election officials verified that each stack was counted accurately?		75%	67%	62%	86%

**Municipalities Audited Manually Where Observers Noted Dual Verification Concerns - Table 5**

**Comparing only the manual count statistics over time, the use of double checking continues to vary.**

From observers:

*Not a very organized method for totaling between teams and questionable process when recounting and making small adjustments.*

*They had a lot of ballots to count. The registrars expressed an interest in further training and more accessibility to electronic auditing; they seemed frustrated that, in spite of ample counting teams and well-thought out systems, the process was a struggle.*

Question	Electronic Audit	%Yes:	2019	2017
While you were observing, in your judgment, did two local election officials focus their attention on each ballot?			42%	88%
While you were observing, in your judgment, did local officials have enough time to confirm that the Audit Station correctly classified each bubble on a ballot for 90% of the ballots?			43%	13%
While you were observing, in your judgment, did local officials have enough time to confirm that the Audit Station correctly counted each vote on each ballot, in the columns on the right for 90% of the ballots?			43%	0%

**Electronic Audit Concerns - Table 6**

**Electronic Audit:** The system prevented the observation of actual ballots being counted. Observers judged that in about half the audits, most ballot images displayed were observed by two officials. Yet where two individuals observed ballot images, they could not actually have verified the counts on the right. Because the officials chose to view ballots for only one to three seconds the ballot images were displayed. In addition, this is true, since in most municipal elections with large ballots, all count results were not displayed on the screen because of Audit Station limitations and the large number of candidates and races.

For complete details on the shortcomings of Connecticut’s electronic audits and the alternative of Electronically-Assisted Post-Election Audits, see Appendix B.

From observers:

*One was preoccupied and occasionally looking at cell phone.*

*a) Not all races displayed on right column and b) They completed a batch w/o looking at all ballots.*

### C.3 The Importance of Blind Counting

Blind counting is a method of counting without pre-conceived knowledge of the expected outcome. When counting teams know the machine totals or know the differences between their counts and the machine totals, there is a natural human tendency to make the hand count match the machine count. This risks taking shortcuts and seeking unjustified explanations for discrepancies which, in turn, lower the credibility of the process and undermine confidence in the audit results.

Question	% Yes:	2019	2017	2015	2013
Were counters kept unaware of the election totals for the ballots or races they were counting until counting and recounting each race was finally complete?		82%	87%	75%	67%
If initial counts were off, were counters kept unaware of the exact and approximate level of difference?		60%	62%	50%	40%

**Municipalities Where Observers Noted Blind Counting Concerns - Table 7**

**In November 2019 when manual counts were off, 40% of the time counters were informed of the exact or approximate number of discrepancies. 18% of the time the scanner counts were available to the counters. This wide-spread lack of blind counting greatly reduces the credibility of the audit.**

From observers:

*"Need 3 more", Cheering when finding one more vote etc.*

*The counters were told the first count was off and by how many. They recounted each pile until the discrepancy was found.*

*Read the totals from the tape, and announced the difference as each was read.*

**Electronic Audit:** One advantage of the Electronic Audit is that knowledge of results by local election officials cannot change the machine results. Yet we note that without a manual audit of actual ballots against the Audit Station results, there is no way to confirm that the reported electronic audit results accurately reflect the cast ballot and vote totals.

#### C.4 Lack of Written Electronic Auditing Procedures

**Electronic Audit:** There were no written procedures for the Electronic Audit. There was some training by University of Connecticut staff, who also assisted the election officials and answered their questions.

The law passed in 2015 authorized Electronic Audits:

*...provided (1) the Secretary of the State prescribes specifications for (A) the testing, set-up and operation of such equipment, and (B) the training of election officials in the use of such equipment...*

Without written procedures, it is difficult to determine if the Secretary of the State in fact authorized the procedures employed and impossible to assess if authorized procedures, if any, were uniformly followed.

# Official Audit Report Data Analysis

After the counting sessions, registrars complete and submit the Official Audit Report Forms to the SOTS. Where possible, observers collect copies of the forms after the counting session. The Citizen Audit obtained the rest of the official forms by Freedom of Information Act request of registrars.

The statistics in this section were produced from the official forms. The images of those forms and our detailed data compiled from those forms are available at <http://CTElectionAudit.org>.

**As stated earlier: Without complete reports we cannot analyze and verify the results of the audit, or provide any level of confidence in the optical scanners in those districts, nor in the officials charged with supervising and performing the audits.**

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## Ballot Count Accuracy

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Any unexplained difference greater than or approaching the automatic canvass trigger of 0.5% should be a concern.<sup>23</sup>

Unlike vote counts (discussed later) there can be no “questionable” ballot counts. Any difference in ballot counts must be due to optical scanner or human error, or both. Human errors<sup>24</sup> are not limited to audit hand counts. Scanners or ballots could have been mishandled and incorrectly counted on Election Day, read through the scanner twice, misplaced on Election Day, or subsequently misplaced.

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<sup>23</sup> In state-wide contests the margin is much less. The canvass trigger is 2000 votes, which in a presidential election is approximately 0.12%.

<sup>24</sup> Ultimately, almost all errors are human errors in counting, software programming, election setup, or failing to follow procedures. Exceptions would include hardware errors or fraud.

Machine Totals (Tape)	Audit Count	Difference	Percent Difference
304	285	19	6.3 %
350	338	12	3.4 %
1277	1275	2	0.2 %
2477	2478	-1	0.0 %
723	722	1	0.1 %
471	472	-1	-0.2 %

**All Ballot Count Differences in the Audit - Table 8**

This table does not include the 9 districts:

- One where there was a satisfactory explanation that blank ballots were included in the hand count.
- One hand count and one electronic audit where the tape count of ballots was not reported.
- Six electronic audits where no tape counts for ballots or races were reported.

In these districts it is unlikely that a significant number, if any, of write-in ballots were fed twice into the scanner.

Most likely some of those incomplete reports are due to lack of attention to detail and a lack of motivation by officials, yet we have no basis to conclude that some of them do not hide errors or intentional fraud. The integrity and value of the audit depends on complete, accurate work and oversight.

**Without reasonable explanations or investigations, we have no basis to blame scanners or humans for these differences. We can conclude that the audits leave us with no basis for confidence in scanners or in officials.**

## Vote Count Accuracy

Col C Machine Totals (Tape)	Col D Undisputed Vote Totals	Col E Questionable	Col F Total Hand Count (D + E)	Difference (F - D or E - D)	Percent Difference
825	840	0	840	-15	-1.8 %
367	359	0	359	8	2.2 %
740	733	0	733	7	0.9 %
328	322	0	322	6	1.8 %
918	923	0	923	-5	-0.5 %
137	142	0	142	-5	-3.6 %
353	348	0	348	5	1.4 %
376	372	0	372	4	1.1 %
877	881	0	881	-4	-0.5 %
317	313	0	313	4	1.3 %
569	572	0	572	-3	-0.5 %
350	347	0	347	3	0.9 %
358	355	0	355	3	0.8 %
32	26	3	29	3	9.4 %
1325	1328	1	1329	-3	-0.2 %
387	384	0	384	3	0.8 %
502	505	0	505	-3	-0.6 %
90	93	0	93	-3	-3.3 %
325	328	0	328	-3	-0.9 %
858	861	0	861	-3	-0.3 %

### Candidate Count Differences Greater than 2 in the Audit- Table 9

The table above presents, by number and percentage, vote differences greater than three between hand-counted votes and machine-counted votes, after all ballots with questionable votes are considered and all votes for cross-endorsed candidates are totaled.

Based on observer reports, **we do not believe that all of the hand counts of votes are accurate. Yet there is no way to judge the accuracy of the optical scanners in these districts, leaving little to provide trust in the election results, scanner accuracy, or confidence in officials' abilities to perform their duties.**

We note that the highest nine count differences, from -15 to -4, were all from two districts in two towns.

The following tables show the number of candidate counts, with varying count differences between the optical scanners and the hand counts, after considering that so called questionable votes may or may not have been counted by the scanners:<sup>25</sup>

Candidate Vote Count Difference Range	Number of Differences in Range	% of All Candidate Counts in range 2019	2017	2015	2013
0	265	80.1%	62.5%	67.6%	60.1%
1-3	56	16.9%	22.5%	26.4%	35.5%
4-6	28	7.2%	7.2%	4.2%	4.0%
7-9	7	2.1%	2.6%	0.9%	1.1%
>9	2	0.6%	2.6%	0.9%	1.3%
Average Difference in Votes:		0.45	1.3	0.80	0.96

**Summary of Vote Count Differences-Table 10**

Once again, without credible audit reports, the data in this table are of little use in evaluating accuracy of the scanners or comparing results to earlier elections and primaries.

**We do note a significant improvement in the agreement between the audits and the reported results. Some of this is due to the accuracy of electronic auditing, yet a nearly equal number can be attributed to more attention to detail by election officials performing hand counts.**

Range of % of Count Difference	Number of Candidate Counts	2019 % Of All Counts In Range	2017	2015	2013
0	265	80.1%	62.5%	67.6%	60.1%
> 0 and < 0.5 %	35	10.3%	28.7%	13.7%	17.6%
0.5 % and < 1.0 %	18	5.4%	6.4%	6.1%	12.1%
1.0 % and < 2.0 %	7	2.1%	4.1%	5.6%	7.0%
2.0 % and < 5.0 %	4	1.2%	5.1%	3.7%	2.8%
5.0 % and < 10.0 %	2	0.6%	0.5%	0.4%	0.4%
10.0 % and greater	0	0	0	0.9%	0.3%
Average Difference %		0.08%	0.24%	0.22%	0.14%

**Trend of Vote Count Differences by Percent -Table 11**

<sup>25</sup> The maximum benefit of any doubt is given to the scanners, recognizing a difference only when a scanner counted more votes than the sum of questionable votes and undisputed votes, or when a scanner counted less than the number of undisputed votes.





## Confusion about “Questionable” Votes

Observations and comments from election officials indicate confusion about classifying “undisputed ballots” and about counting “questionable votes.” An undisputed ballot is a ballot with no apparent problem or questionable votes on it. A questionable vote is a mark on a ballot that may not have been read properly by the optical scanner. Based on observations, counting teams and registrars demonstrated a variety of interpretations of what constitutes “undisputed” and “ballots with questionable votes.” Audit statistics confirm these observations.

Col C Machine Totals (Tape)	Col D Undisputed Vote Totals	Col E Questionable	Col F Total Hand Count (D + E)	Difference (F-D or E-D)	Percent Questionable
1612	1570	42	1612	0	2.6 %
1565	1529	39	1568	0	2.5 %
1560	1526	36	1562	0	2.3 %
1635	1603	32	1635	0	2.0 %
1232	1209	27	1236	0	2.2 %
1189	1166	27	1193	0	2.3 %
1374	1350	24	1374	0	1.7 %
1696	1685	11	1696	0	0.6 %
1050	1046	6	1052	0	0.6 %
1134	1129	6	1135	0	0.5 %
1238	1233	5	1238	0	0.4 %
1014	1010	5	1015	0	0.5 %
964	960	5	965	0	0.5 %
1114	1112	4	1116	0	0.4 %
515	511	4	515	0	0.8 %
962	958	4	962	0	0.4 %
1157	1154	4	1158	0	0.3 %
471	467	4	471	0	0.8 %
1112	1108	4	1112	0	0.4 %

**Questionable Votes Over 3 - Table 12**

We note that all of the questionable counts of 24 and higher are from a single town and district.

	2019	2017	2015	2013
Overall % Questionables	0.23%	0.26%	0.73%	0.63%
Counts over 12 Questionables	7	8 <sup>26</sup>	23	19

Questionable Votes -Table 13

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<sup>26</sup> 2017 was a 5% audit, so compared to 10% audits in previous years, the count would likely have been about 16.

# About the Citizen Audit

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## The Connecticut Citizen Election Audit ("Citizen Audit")

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Our purpose is to increase integrity and confidence in elections, for the benefit of the voters of Connecticut. We provide independent audit observations, independent audits, and independent reports focusing on the integrity of elections and election administration. We are non-partisan and strive for objectivity and integrity in our work. The Citizen Audit has observed and reported on every general primary and election since the statewide implementation of optical scan voting in Connecticut in 2007.

### EXECUTIVE DIRECTOR/BOARD

Significant decisions and reports are approved by majority vote of the Board. Members of the Board are experienced volunteer observers, with diverse skills, political affiliation, and geographic representation. Current members of the Board are:

- Luther Weeks, Executive Director
- Kathleen Burgweger, Jean de Smet, Aaron Goode, Julie Lewin, Tessa Marquis, Mary Rydingsward, Jan-Maya Schold, Douglas Sutherland, and Victoria Usher

### CITIZEN-POWERED

The Citizen Audit is an entirely volunteer, citizen-powered organization. We appreciate every Citizen Audit volunteer. Without dozens of volunteers spending days and hours on each election objectively observing, auditing, and reporting, the promise of publicly verifiable elections could not be pursued and will never be attained.

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## Acknowledgments

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Coordination for this project by Luther Weeks with editing of this report by Julie Lewin.

We appreciate the responsive and cordial replies to our requests for information from registrars of voters across Connecticut.

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## Contact/Additional Information

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Luther Weeks, Executive Director, [Luther 'at' CTElectionAudit.org](mailto:Luther@CTElectionAudit.org), 860-918-2115. All reports and additional supporting data are available at <http://www.CTElectionAudit.org>.

## Appendix A. Observation Report Statistics

Percentage Answer Yes:	Nov 2019	Nov 2018
Did the supervisor review the audit procedures with the counting team?	100%	50%
Did the supervisor review the official audit procedures with the counting team?	100%	68%
Did the supervisor clarify procedures for everyone before beginning to count ballots?	60%	0%
Did the supervisor clarify procedures for everyone before beginning to count ballots?	89%	87%
Did the supervisor review that two individuals should verify the counts on the right of the screen match the bubbles on each ballot?	20%	0%
Did the supervisor review the ballot and vote counting procedures in detail with the counting teams?	33%	79%
Were the ballots delivered to the site by at least two individuals?	100%	100%
Were you permitted to observe that the ballot seals were not tampered with?	94%	100%
Were the ballot seals intact?	81%	100%
Was there a separate envelope for hand counted ballots in the ballot container?	86%	69%
Was there a separate envelope for write-in ballots in the ballot container?	60%	50%
Was the total number of ballots counted before the votes were counted for races?	64%	81%
Were the ballots counted by each team such that a 2nd official verified each count?	80%	63%

<b>If multiple teams ballots, was the totaling independently verified by a 2nd official?</b>	67%	75%
<b>If you concentrated could you confirm that the Audit Station correctly classified each bubble on each ballot?</b>	43%	25%
<b>If you concentrated could you confirm that the Audit Station correctly counted each vote on each ballot, in the columns on the right of the screen?</b>	43%	0%
<b>While you were observing, in your judgement, did two local election officials focus their attention on each ballot?</b>	42%	38%
<b>While you were observing, did one of the officials ask to slow down or to go back to review previous ballots?</b>	55%	88%
<b>While you were observing, in your judgment, did local officials have enough time to confirm that the Audit Station correctly classified each bubble on a ballot for 90% of the ballots?</b>	43%	50%
<b>While you were observing, in your judgment, did local officials have enough time to confirm that the Audit Station correctly counted each vote on each ballot, in the columns on the right for 90% of the ballots?</b>	43%	50%
<b>If hashmarking was used: Did a 2nd official observe that each vote was read accurately?</b>	30%	67%
<b>If hashmarking was used: Did a 2nd official make duplicate hashmarks OR observe that each hashmark was recorded accurately</b>	20%	53%
<b>If sorting and stacking was used: Was the vote counting such that a 2nd official verified that each vote was stacked as marked?</b>	50%	50%
<b>If sorting and stacking was used: Were the stacks of ballots counted such that a 2nd official verified that each stack was counted accurately</b>	75%	50%

<b>Did the Audit Station have problems reading ballots on colored/tinted stock?</b>	17%	0%
<b>Did the Audit Station have problems reading ballots on colored/tinted stock?</b>	45%	33%
<b>Did the Audit Station have problems reading absentee or Election Day Registration ballots?</b>	14%	0%
<b>Did the Audit Station have equipment/hardware problems with the scanner, computer, or projector?</b>	31%	33%
<b>Did the Audit Station have problems that required reprogramming/relearning the Audit Station district ballot format?</b>	0%	17%
<b>Did the Audit Station have other software problems with the scanner or computer?</b>	15%	17%
<b>If hashmarking was used: Were you permitted to observe that each vote was read Accurately?</b>	100%	100%
<b>If hashmarking was used: Were you permitted to observe that each hashmark was recorded accurately?</b>	100%	100%
<b>If sorting and stacking was used: Were you permitted to observe that each vote was placed in the correct stack?</b>	75%	100%
<b>If sorting and stacking was used: Were you permitted to see that the count of ballots in piles for each race was accurate?</b>	100%	100%
<b>Were counters kept unaware of the tabulator totals for the ballots or races they were counting until counting and recounting each race was finally complete?</b>	82%	75%

<b>If initial counts were off, were counters kept unaware of the exact and approximate level of differences? I.e. No indication was given of the amount a count was off.</b>	60%	43%
<b>Were questionable votes on ballots ruled upon separately, vote by vote, rather than all votes on such ballots all classified as questionable, when some were not questionable?</b>	89%	87%
<b>Were questionable votes ruled on prior to the tallying of votes for each race AND counts not adjusted based on knowledge of the results of the differences in counts for each race?</b>	75%	92%
<b>Did officials find a match between machine counts and manual counts at the end of the initial count of each race?</b>	18%	27%
<b>Did officials try to resolve mismatched counts by counting again?</b>	67%	62%
<b>Did officials try to resolve mismatched counts by changing counting teams ?</b>	56%	8%
<b>Did officials resolve mismatched counts by the end of the audit?</b>	63%	58%
<b>Were you able to observe that hashmarks and totals of batches for each team were tallied accurately?</b>	100%	100%
<b>Were you able to observe that the number of ballots from multiple teams and batches were totaled accurately?</b>	89%	86%
<b>Were you able to observe that the number of votes from multiple teams and batches were totaled accurately?</b>	75%	100%
<b>Did elections officials record counts, including unresolved discrepancies, if any, on the Official Audit Report Form by the end of the audit?</b>	79%	86%



<b>Were you given an opportunity to have/make a copy of the Audit Report Form?</b>	96%	95%
<b>Did the ballot counts on the optical scanner tape(s) printed on election-night match the tabulator tape ballot count transcribed on the official audit report form(s)?</b>	75%	88%
<b>Did the race counts on the optical scanner tape(s) printed on election-night match the tabulator tape counts transcribed to Column 'C' on the official audit report form(s)?</b>	75%	93%
<b>Were the ballots under the observation of at least two officials at all times?</b>	91%	62%
<b>Could you confirm that the ballots were returned to their proper containers?</b>	100%	95%
<b>Were the ballot containers resealed?</b>	96%	95%
<b>Were seal numbers recorded correctly on the official report forms?</b>	100%	100%
<b>Do you have any concerns with the way the room was laid out?</b>	9%	6%
<b>Do you have any concerns with the way the room was laid out?</b>	14%	0%
<b>Do you have any concerns that the audit was not well-organized?</b>	9%	31%
<b>Do you have any concerns that the audit was not well-organized?</b>	0%	57%
<b>Do you have any concerns with the counting and totaling process?</b>	36%	63%

<b>Do you have any concerns with the counting and totaling process?</b>	7%	0%
<b>Do you have any concerns that the counts were inaccurate?</b>	36%	20%
<b>Do you have any concerns that the counts were inaccurate?</b>	14%	0%
<b>Do you have any concerns that the officially reported information is inaccurate?</b>	10%	14%
<b>Do you have any concerns that the officially reported information is inaccurate?</b>	7%	0%
<b>Do you have any concerns with the transparency/observability of the process</b>	0%	0%
<b>Do you have any concerns with the transparency/observability of the process</b>	14%	0%
<b>Do you have any concerns with the chain-of-custody?</b>	60%	25%
<b>Do you have any concerns with the chain-of-custody?</b>	31%	25%
<b>How many people are required to access ballot storage? One</b>	60%	63%
<b>Were there any memory card problem in pre-election testing or on election day?</b>	17%	5%
<b>Were there any problems with the IVS voting system?</b>	4%	0%
<b>Were there any other significant events, such as ballot problems, scanner problems, or occurrences before, during, or after election day?</b>	38%	41%

Observation Report Statistics -Table 14

## Appendix B. Electronic Audit Details

This appendix presents in detail the electronic audit methods employed by election officials and a far more credible alternative. It is adapted from the November 2016 Post-Election Audit Report.

### The Unverifiable Methods Used for the Electronic Audits

The electronic audits were conducted using the UConn Audit Station. The UConnVoter Center developed the Audit Station over the last few years.<sup>27</sup> The audits generally followed the methods and claims made in a 2013 paper authored by UConn and the SOTS Office:<sup>28</sup>

- Ballots are rescanned, analyzed, and recounted in batches by the Audit Station.
- Simultaneously projected on a screen are the scanner ballot images, the system's interpretation of marks on the image, and how the votes were counted for each image. These are in a column on the right of the projection.
- Two local election officials view each image, check the interpretation, and check the votes counted. They may override the system's interpretation of each image. On the projected ballot images, bubbles interpreted and counted by the system as votes or as possible (questionable) votes are over-marked by shades of light green and light red.
- At the end of counting a voting district, a summary report of the totals of the counts for the district for each contest is printed by the Audit Station. This report is used to create the Official Audit Report.

**The Audit Station is creative in its method of displaying images for verification and adjudication by officials. Unfortunately, that creativity adds nothing to the public verifiability of the audit, while requiring unnecessary, tedious, and challenging work for local officials. Leading scientists in the field of post-election auditing have explained why such audits fall short:<sup>29</sup>**

- **Like all electronic and computer equipment, the scanner is subject to error and fraud from hacking:**
  - **There is no guarantee that the images displayed represent an accurate depiction of the actual ballots.**
  - **There is no guarantee that counts displayed for each image are faithfully added to the totals printed at the end of the district audit.**

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<sup>27</sup> University of Connecticut, School of Engineering, Center for Voting Technology Research: <https://voter.engr.uconn.edu/voter/>

<sup>28</sup> <https://voter.engr.uconn.edu/voter/2013/06/computer-assisted-post-election-audits/>

<sup>29</sup> [statistics.berkeley.edu/~stark/Preprints/retabNotAudit13.pdf](https://statistics.berkeley.edu/~stark/Preprints/retabNotAudit13.pdf)

- It has not been established that individual officials can and will faithfully review hundreds or thousands of individual images, the system's interpretation, and the system's associated vote counts.

Note: Such claims need to be verified in theory and in practice. The officials reviewing images and counts for hours are likely to believe in the accuracy of the AccuVoteOS and the Audit Station. At minimum, it should be proven that individuals with such beliefs could and would reliably detect differences less than 0.5% (the legal recount threshold) affecting a single candidate in an election with many races, while reviewing thousands of ballots for a voting district.

- Our observation indicated that faithful evaluation of images was not possible in the November 2016 audit. Under the control of officials, images and counts were displayed for one to three seconds.
  - In six of seven teams of officials, two officials did not faithfully watch the projected display of all ballots. As ballots were displayed under the control of one official, the other official at times looked away, stood and turned away to prepare the next batch of ballots for scanning, or were reading and typing on their cell phones.
  - At the speed of one to three seconds, we believe it would be difficult for officials to determine if the Audit Station had marked a bubble that was not filled in.
  - At the speed of one to three seconds, we believe it would be difficult for officials to notice if the Audit Station missed a mark that was filled in elsewhere on the ballot.
  - At the speed of one to three seconds, we believe it was not possible to verify that all bubbles highlighted were correctly counted and that those not highlighted were not counted.

In 2016, at about three seconds, observers found it barely possible to verify that the race for President was accurately marked and counted. Doing that for even a handful of votes in succession took extreme concentration. Its not reasonable to think that officials could maintain the necessary concentration for dozens of ballots, let alone thousands!

  - The November 2016 election ballot, like every even year election, was a relatively simple 8.5" x 11" single-sided ballot, with five vote-for-one races. November Municipal election ballots range from 11 columns with a couple of vote-for-multiple races, to back-to-back 8.5" x 17" pages with many large vote-for-multiple races. The UConn researchers explained that in those cases both sides of the ballots and all the candidate counts would appear on a single projected screen.
  - In November 2017, November 2018, and November 2019 there were larger, multi-page ballots. The results on the right hand of the display did not show results of all the races and candidates being audited. Thus *those counts could not have been verified by the officials, even if the ballot were displayed for an extended period.*

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## A Simpler Way, a Better Way, a Publicly Verifiable Way

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### Electronically-Assisted Manual Post-Election Audits

There is a way to get the efficiency and accuracy benefits of electronic auditing with the confidence of public verifiability. It is to manually audit the electronic counting and to verify both the interpretations of ballots and the totaling of results. The sound science of Evidence Based Elections<sup>30</sup> points the way to performing such a manual audit of an electronic audit:

- As each ballot is interpreted by the system, a "Cast Vote Record" (CVR) is created that is associated with the ballot. The Cast Vote Record is a database record that lists the interpretation of each bubble as voted, possibly voted, or not voted.
- At the completion of the scanning and interpretation of a district, all the CVRs are exported in a standard computer readable format (such as .csv) and made available to a number of observers on a standard media (such as CDs or thumb drives). The file of CVRs can then be independently counted by observers to assure that the sum of the CVRs equals the totals printed by the Audit Station<sup>31</sup>. Such counting could use software trusted by observers and, if necessary, it could be verified by a hand count of each CVR.
- A relatively small number of CVRs are randomly selected and compared to the associated ballots. Any differences between the CVRs and the actual ballots as interpreted by officials must be recorded.
- Since ballots are in order and in batches, it is relatively easy to locate each randomly selected ballot. If the system printed out an easily read page for each randomly selected ballot with the batch number, ballot number in the batch, and the bubble interpretations for the CVRs, it would be relatively easy for officials to locate ballots and compare them to the printed CVRs. It could be done openly such that observers could verify that the printed CVRs matched the exported CVRs, and that the officials correctly compared the CVRs to the ballots and correctly recorded any differences.
- Any differences between the CVRs and the selected ballots are a cause for concern with the accuracy of the Audit Station and may be cause to question the accuracy of the audit. With a well-designed and functioning system, differences, if any, should be rare.

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### Laudable Progress in 2019

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In the 2019 electronic audits officials from the Secretary of the State's Office and UConn demonstrated and prototyped capabilities to perform electronically-assisted post-election audits. After results were

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<sup>30</sup> <http://www.stat.berkeley.edu/~stark/Preprints/evidenceVote12.pdf>

<sup>31</sup> A quick survey of election officials and advocates indicates that CVRs for entire elections or audits are regularly provided to requesters in the states of AZ, NY, CO and SC. In SC, they are published online.

produced by the audit station one out of each 250 ballots was randomly selected to compare to the associated CVR for that ballot. In each case officials found an exact match.

The Citizen Audit applauds this work, but it does not go far enough toward public verifiability. We have provided detailed suggestions to solve this problem to the Secretary of the State, her Office, and UConn. These suggestions can be implemented with a moderate amount of work and expenditure. Here is our letter:

## 0 Connecticut Citizen Election Audit

12/17/2019

TO: Ted Bromley, Office of the Secretary of the State  
Alexander Russell, UConn, Voter Center  
Thomas Miano, Office of the Secretary of the State

CC: Denise Merrill, Secretary of the State

RE: Compliments and Suggestions for the Electronic Audit and Audit Station

It was our pleasure to observe the latest electronic post-election audits at 30 Trinity Street on December 9-11, 2019, covering districts in fourteen municipalities. We compliment everyone on how far the *Audit Station* has come and how close the system and the surrounding procedures bring us toward an audit process that could provide justified confidence in the audit and ultimately justified confidence in the tabulation of Connecticut elections.

I recall a meeting in the Deputy Secretary's office in 2010 between that office, the UConn Voter Center, and several computer scientists. At that time, I was an enthusiastic supporter of the concept of electronically assisted post-election auditing, yet skeptical of the State's and UConn's ability to create a system to compete with commercial products emerging at that time. Since that time, *Electronically Assisted Manual Audits* has become the basis for the emerging method of *Risk Limiting Tabulation Auditing*. We are pleased to see that you have provided a nearly complete product that has far exceeded my skeptical expectations. The Audit Station has several features which make it more effective for auditing than other products designed for or being used for independent post-election tabulation audits. It is also great to see the demonstration of a comprehensive prototype of the manual checking system that was suggested several years ago.

Attached are detailed suggestions for improving the Audit Station and associated processes such that they would provide a high level of *justified confidence* to the public in post-election audits and in the tabulations of our elections. I am pleased that Mr. Russell, Mr. Miano, and I were able to discuss many of these suggestions over the three-day audit period, improving ideas by our interactive discussion. I am sure those ideas can be further improved. While these suggestions involve many details, they could be implemented without great expense, both for development and for execution. The major areas of suggestion include:

- **Refining the Manual Check** such that it is transparent and publicly verifiable, leaving no doubt that the process is secure from being electronically or manually compromised.
- **Creating partially printed forms** that can serve as alternatives to the manual forms required today - forms that have all the same fields and provide for the need to manually interpret and account for ballots that cannot be read by the Audit Station.

- **Creating written procedures** for the process so that management of the process can be expanded with less day-to-day involvement from UConn, so that local officials conducting the audit will know exactly what to do, the public can evaluate the design, and observers can verify the execution of the process.

With these changes Connecticut could be at the forefront of electronic auditing. the Citizen Audit could then enthusiastically recommend that Connecticut do only such electronically assisted manual auditing going forward.

As always, we are available to discuss or provide further detail on these suggestions at any time.

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## Suggestions for the Electronic Audit and Audit Station

### Refining the “Manual Check”

The principle of *Evidence Based Elections* demands that every aspect of elections be transparent, publicly verifiable, and *software independent*.

For instance, in Connecticut we have optically-scanned, voter-marked, paper ballots. In instances where all paper ballots in a contest are counted by hand under close public view, the results of such a process would satisfy the principle of Evidence Based Elections. Contest results can also be verified to a desired degree of accuracy through the developing science of *Risk Limiting Tabulation Audits* where a randomly chosen sample of ballots are counted publicly and transparently.

Similarly, Connecticut’s audits, while not risk limiting, can be accomplished by the Audit Station. And with appropriate enhancements, the Manual Check can become a transparent, publicly verifiable, and software independent check on the Audit Station, providing reasonable confidence in the audit’s purpose of checking polling-place optical scanners. The following major requirements must be satisfied by the Manual Check:

- CVRs (Cast Vote Records) must be committed, exported and publicly available for access prior to the start of the Manual Check - including the random selection of CVRs for a district. Besides checking individual CVRs the public must be able to independently add all the CVRs to verify the purported audit results.
- The random selection of ballots/CVRs (Cast Vote Records) to check must be accomplished in a transparent, publicly verifiable procedure.
- The selection and comparison of actual voter marked ballots to CVRs must be transparent and publicly verifiable.
- Paper records should be made of the critical aspects of the process to provide later independent verification and to encourage a process that works even if it is not publicly observed.

Detailed suggestions that could satisfy these requirements:

- As Mr. Russell suggested, CVRs could be immediately exported to a publicly available website and immediately available for public download. They should also include a hash/encryption code so that they cannot be modified without detection.
- Random selection could be most transparently accomplished by public rolling of 10-sided dice for each ballot selection. An alternate method would be to use a published open source random selection algorithm, with a seed selected by public rolls of dice. Then the public could rerun and check the algorithm. In any case, all dice rolls and random selections should be recorded on paper and become a part of the permanent record of the audit.
- The current spreadsheet display of CVRs can be improved to support public verification.
  - It should be projected so that the public can easily follow along.
  - Cast votes should not be identified in the sheet as ‘x’ etc. Each cell voted could be the cell-id of each vote and if it is questionable, e.g. 1a, 2b, 4a?, 5c...
- A paper *Selection Sheet* should be used to pull and record the votes for each selected ballot. The sheet would have the ballot sequence number, ballot pile, sequence within the pile from top to bottom, and



room to record the votes. The sheet could be automatically printed or it could be a standard sheet with the sequence numbers filled in by hand. It would not need to resemble the ballot, but just provide room to fill in the voted locations e.g. 1a, 2b, 4a?, 5c... Such sheets would become the permanent record of the audit.

- The selection sheets should be filled out without reference to the CVRs and in a separate step compared to the actual CVR. Any difference should be documented and investigated. If the wrong ballot was pulled, the correct one should be evaluated on another sheet and the sheet for the incorrect ballot retained with the correct one. Any error by the Audit Station is serious and should be investigated thoroughly and immediately, starting with recounting the results of the batch manually and by the Audit Station until the source of the error is resolved (without destroying the original Audit Station data).
- To be complete we need to mention that there are even more involved and transparent methods of developing, displaying, and recording the results for ballots selected. We do not see those as necessary for the Manual Check performed here. They involve a half a dozen people, multiple video screens, and extensive, available, open-source software that currently needs customization and further refinement. Such software has been used in CO, VA, and RI for regular and prototype Risk Limiting Tabulation Audits.

### Creating Partially Printed Forms

Currently, at the end of counting a district, the Audit Station prints the results with district name, ballot count, and, for each contest and selection, the undisputed, questionable, and total votes. To comply with current procedures, all those numbers need to be transcribed to the official forms adding several items including tape counts. Another issue is that numbers from AccuVoteOS scanned ballots that cannot be read by the Audit Station and must be hand counted and added to those totals.

We suggest items should be added to the Audit Station printed forms for hand filling-in and filing of the report using the Audit Station printed forms:

- Add all the items in the header of the current header of the official report form to the Audit Station forms. Plus, along with the existing Audit Station ballot counts, space should be added for additional hand counted ballots and the total of ballots counted.
- The following columns should provide space for each contest option/candidate for hand filling-in (perhaps the form would need to be printed in landscape):
  - o Hand counted undisputed votes of Hand counted questionable votes of Total votes, Audit Station and hand counted

### Creating Written Procedures for the Process

Currently there are no written procedures for the process. This causes some problems, confusion, unnecessary work, and limitations:

- Registrars complain that they are not told what to bring to the session such as seals, scanner tapes, and copies of the Moderators' Returns. These items should all be required. (In addition, they would like parking advice.)

- Training is brief and varies from trainer to trainer and year to year. Often registrars and observers are left wondering what is actually expected.
- Observers evaluate the process and the Citizen Audit reports on the process are based on our assumptions of the expected process based on various training procedures and procedures in a years-old paper on the Audit Station which seems no longer to apply.
- Without written procedures, operating the Audit Station, training, and conducting the audit will always require seasoned UConn Voter Center staff and staff of the SOTS Office. This limits the deployability of the system.

Written procedures would provide a basis for all of the steps to be articulated, followed, and evaluated, especially for reviewing ballots on the screen, filling out the reporting forms, and performing the Manual Check.

### Additional General Suggestions and Suggestions for Electronic Auditing

- At some point, the critical aspects of the procedures, especially those for Manual Verification, transparency, and public observation, should be covered by regulations or better by law. This will make it more difficult for future Secretaries of the State to change the procedures in a negative way, or after election results are known. Perhaps the procedures should be honed through two or three audit cycles before they are covered by regulations or law.
- The Electronic Audit should cover all contests on the ballots audited. This is such a small extra effort, perhaps five extra minutes in a process that takes one to three or more hours per district.
- A better venue would be a single larger room where many Audit Stations and districts can be setup and run. This way observers and staff do not have to keep moving from room to room to observe and supervise the operation. (For example, Glastonbury, has a moderate sized former cafeteria with lots of rectangular tables in a former school converted to town offices. In that one cafeteria up to a dozen Audit Stations could be setup, with lots of separation, and room to project on the walls.)
- State team(s) should be trained to run the Audit Station, train local officials when they arrive at the audit, and supervise the process. There should be a schedule for to conduct audits in a number of venues across the state - perhaps a hand-full of audit stations in each venue (perhaps one or two days in each venue over five to eight days across the State.) Perhaps one State team member for each station to be used and an extra station or two for backup at each venue. Each State team should be capable of taking blank ballots and programming the Audit Stations.
- The random district drawing should be via ten-sided die and if desired use an open source standard algorithm pseudo-random number generator. Drawings from raffle barrels are not truly random as often there is a correlation between drawn districts (e.g. See the Nov 2018 drawing demonstrating a huge over-selection of districts in towns starting with 'B', especially Bridgeport or a bit less of a correlation in Nov 2019 with districts starting with 'N'). Raffle drawings are known for such problems. Several years ago, we supplied extensive information and a video from another state demonstrating drawing from 10-sided die. There are also videos and information available on public random seed generation and the use of pseudo-random number generation.
- All critical data relevant to the audit should be published to the web or otherwise made available to the public. This should include 1) All the collected, detailed data from the Election Night Reporting system including original reported scanner counts and hand counts for contests and ballots. 2) The completed,

filled-in reports printed by the Audit Station and filled-in by officials. 3) The random numbers generated for the Manual Check and forms associated with each checked ballot. 4) The CVRs exported from the audit station - posted to the web for download to spreadsheets.

- Voted ballot security needs to be improved in Connecticut. Connecticut has one of the worst levels of ballot security anywhere. In other states, ballots are stored in vaults under human surveillance or video surveillance. In Connecticut, in a large majority of municipalities, ballots can be accessed by either registrar undetected for hours. In many municipalities, multiple additional officials can access ballots undetected for hours. Tamper-evident seals, even under good seal protocols, provide little protection when ballot bags and boxes can be accessed for even a few minutes. Connecticut has no seal protocols, opening the process for even easier undetected compromise. In every audit, the Citizen Audit observes several instances of ballots not being sealed even in a cursory way and many cases where the seals are applied in ways not intended by the seal or ballot container vendors.

Connecticut at minimum should require a protocol that effectively limits access such that two officials of opposing parties are required to unlock ballot storage, perhaps with two distinct keys and locks, with logging each access by a third party such as the Municipal Clerk, perhaps with a distinct key or in the clerk's vault; improved seal protocols; and independent *Compliance/Procedural Audits* of those procedures. Compliance with such procedures must be made enforceable by the SEEC and the courts.

- We need more effective public notice of audits and audit related events. The public has no effective means of obtaining notice of audits and random drawings sufficiently in advance. One solution would require that all local counting sessions, Audit Station counting sessions, and random drawings be noticed at least three business days in advance on the SOTS website. The current law has no standards for notices. Currently, a municipality could post a counting session on the registrars' office door at 7:45 am announcing an audit at 8:00am that same day. The SOTS could do the same short notice for the random district drawing. This is unacceptable.

## Appendix C. Methodology

The following activities were performed in the course of the project to organize observers and collect and analyze data for the report. They are in approximate time sequence.

- Just prior to the election, we emailed past observers an invitation to sign up on the web to observe local counting sessions specifying the dates they were available to observe and the distance they were willing to travel. Observers were encouraged to provide at least three availability dates and volunteer to travel at least 35 miles. Observers were also instructed to sign up for a conference call training session and were emailed training materials that included access to video training.
- Our observers attended and participated in the random drawing of districts to be audited. After the drawing, the SOTS Office issued a press release with the list of selected districts and selected alternate districts.
- Municipalities and districts in the drawing were recorded in our Audit Database. To learn the dates and times of their local audit counting sessions, we sent emails, made calls, and left voice mails with registrars of voters of the selected municipalities. Observers participated in conference call and web video trainings in the days prior to the start date of the local audit counting sessions, which began 15 days after the election.
- Starting shortly after the drawing and extending through the audit period, while audit dates were obtained from local officials, observers were matched and tentatively scheduled for upcoming local audit counting sessions. Often schedule changes were made when observers were unable to observe a tentatively scheduled audit. Some observers signed up for additional dates. Others volunteered to observe additional audits.
- Observers attended audits, completed paper Observation Report Forms, and, where possible, collected draft or final copies of the official SOTS Audit Report. Copies of Audit Report Forms were mailed or scanned by observers to us for early data entry. Observers submitted most Observation Report Forms, using the LimeSurvey tool, while some mailed or emailed paper forms for Citizen Audit's data entry.
- Citizen Audit volunteers observed and reported on the electronic audits which were held in the Secretary's offices at 30 Trinity Street, Harford.
- Observation Report Forms for counting sessions not observed or those not obtained by observers, the Citizen Audit obtained the forms through FOI requests to the registrars.
- We completed data entry of all Official Audit Report Forms based on the official data.
- Data and Observation Reports were analyzed and compared with past results, and this report was created.