House Bill 1278
Election Law – Postelection Tabulation Audit
SUPPORT WITH AMENDMENTS

Ways and Means
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I am a Professor of Computer Science at The George Washington University. My research of the last fifteen years has been in the general area of computer security and privacy, with a special emphasis on the integrity of electronic voting systems. My qualifications and complete CV, as well as more details about my work, may be found on my website[1]. As some of you might recall, I testified at a joint hearing of this committee and the Senate Education, Health and Environmental Affairs Committee in September last year. Some of that testimony is included here for context.

My testimony today represents what I have learned from my own research and that of hundreds of others over about four decades. The literature in this field is clear, unequivocal and non-partisan: computerized election systems present multiple opportunities for intentional alteration of election outcomes and are also vulnerable to error. This assessment applies to the optical scan voting systems used in Maryland, and includes voting machines that are not on the internet. Experts recommend that, in addition to making every attempt to secure the voting systems used, an independent, public, risk-limiting audit[2] of the voter-verified paper ballots should be performed after every election to verify that the election outcome correctly represents the voter-verified evidence[3]. An election should be certified only after it passes the audit.

I strongly support many features of this Bill: it requires that some of the voter-verified paper ballots be manually examined; it includes the examination of absentee, provisional and early votes, and it includes quite a bit of public information and reporting. I fear, however, that the goal of an audit⸺independent, public verification of the election outcome⸺will not be met. **Hence, I support it with amendments.**

First, this Bill does not require that an audit be held before certification. The key purpose of an audit is to detect if the election outcome is incorrect, and, if so, to manually examine and count the paper ballots to determine who the true winner is. Holding an audit after certification does not serve this purpose, though it could help identify some problems in process and technology. **I recommend that the current Bill be amended to require that a manual audit be carried out before certification.**

Second, this Bill is not clear about the specifics of choosing ballots. For example, it does not appear to require the examination of a sufficiently large number of randomly-chosen ballots. It only requires the choice of one

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[1] http://www.seas.gwu.edu/~poorvi/

[2] Post-election audits of both the election outcome and the election technology are recommended by the Presidential Commission on Election Administration, see: "The American Voting Experience: Report and Recommendations of the Presidential Commission on Election Administration", January 2014, pg 66, https://law.stanford.edu/wp-content/uploads/sites/default/files/publication/466754/doc/slspublic/Amer%20Voting%20Exper-final%20draft%2001-04-14-1.pdf and "Report on Election Auditing" by the Election Audits Task Force of the League of Women Voters of the United States, January 2009, http://lwv.org/files/Report_ElectionAudits.pdf

[3] P.B. Stark and D.A. Wagner, "Evidence Based Elections", IEEE Security and Privacy, special issue on electronic voting, 2012. www.stat.berkeley.edu/%7Estark/Preprints/evidenceVote12.pdf

randomly-chosen precinct per county, but this could be a small precinct. While it requires that 2% of the precincts be audited, covering at least 1% of absentee, provisional and early votes, it does not say the precincts have to be randomly chosen or that at least 1% of all votes need to be examined. It also does not require that the audit should be based off voter-verified evidence, including the original voted paper ballots for in person and absentee voters, and the vote itself (not the bar code) for Express Vote ballots generated for voters with disabilities.

An audit is meaningless if the ballots that will be examined are chosen ahead of time, and if not enough voter-verified ballots are examined!

I recommend that the current Bill be amended to additionally require that the manual audit examine at least 2% of all votes, that the precincts are randomly chosen in a public ceremony, and that original voter-verified evidence be examined for absentee ballots and ballots completed with a tool such as Express Vote ballots.

Third, best practices require a risk-limiting audit. The risk of an audit is the probability of missing the fact that the election outcome is wrong. It is generally recommended that the risk be limited to 5-10% (the lower the risk, the larger the number of ballots or batches that need to be examined). The number of ballots that need to be examined in a risk-limiting audit is not fixed ahead of time, though it can be estimated to some degree. Smaller margins require a larger number of ballots. Conversely, larger margins require the examination of fewer ballots. In fact, for the typical Presidential or Senate race in Maryland—a risk-limiting audit would require the examination of fewer votes than prescribed by this Bill.

I understand that the Administrators are concerned about manpower planning and ballot custody issues in the event of small margins, which could lead to essentially-open-ended audits accessing a large number of ballots.

As this Bill does not require a risk-limiting audit, it should, at the very least, require a risk-measuring audit. **I recommend that the audit report be required to include information on the measured risk of the audit.**

Fourth, a risk-limiting audit requires that, if the manual audit points to an incorrect election outcome, it be expanded till the correct outcome is determined. Even if the Administrators are concerned that they cannot carry out a risk-limiting audit for a low risk level, such as 5-10%, there has to be some risk level that is too large to be acceptable, and at which risk level the manual count needs to be expanded to determine what the outcome is.

I recommend that the State set a maximum acceptable risk level beyond which the manual audit has to be expanded till the correct outcome is determined.

A note on software retabulation of ballot images:
Note that the "automated software audit" of the electronic ballot images has many shortcomings, which have been described on several occasions by me in person to the State Board of Elections and in letters written with other experts. I also described the problems with this approach to the joint meeting last year. I repeat the description here for completeness.

Let's consider the 2016 retabulation procedure. The state contracted a third party vendor to retabulate, using the vendor's own software, images of scanned ballots provided by the voting system. That is, the third party

vendor got ballot images provided by the voting system and counted them using its own software. It identified some problems that affected vote tallies, though these problems did not influence the election outcomes[4].

This procedure is not a satisfactory audit of the election outcome. Most importantly, though it is a third-party procedure, it is not independent. It relies on digital scans of the ballot provided by the very voting system being audited, and does not independently access the voter-verified paper ballots at all. Ballot scans are computer-generated and computer-manipulated data not verified by voters. Like all computer data, they are vulnerable to error, alteration, deletion, and fabrication. If the ballot images do not represent the paper ballots—whether due to intentional alteration or machine or human error—this procedure will not detect any resulting errors in voting system computation of the election outcome; beginning from the same flawed data, it would make the same errors.

In particular, the procedure would not detect a competent effort to change election outcome, and a finding of "no discrepancy" from this procedure is not meaningful.

The procedure is carried out by software, inside a computer and is not transparent to the public. In 2016, it was carried out on vendor premises in Boston, Massachusetts.

Finally, for votes cast by absentee voters and voters with disabilities, the procedure did not even access ballot scans of voter-verified information. Absentee votes were manually reproduced by election workers, and the ballots scans used were of the newly-made ballots, not of the mailed-in voter-verified ones. No ballot scans were provided to the vendor for votes cast by voters with disabilities using the ExpressVote system; instead, the vendor interpreted bar codes which were not voter-verified.

I wrote several letters to the State Board of Elections, many with other experts, communicating our concerns[5]. We recommended other types of audits[6] that would access the voter-verified ballots and provide robust evidence of election outcome correctness, and offered to help design and implement them at no charge to the state.

I will be happy to help Maryland design and implement audits in the future. Please do not hesitate to ask.

Respectfully,

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Note: my affiliation is included for identification only

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[4] For example, the third party found that ballot folds were being interpreted as marks, and hence over-votes, by the voting system.

[5] Some Observations re: Maryland's Election Procedures, 2016. http://www2.seas.gwu.edu/~poorvi/MarylandAudits/

[6] Mark Lindeman and P.B. Stark, "A Gentle Introduction to Risk-Limiting Audits", *IEEE Security & Privacy*, 10, 42–49. https://www.stat.berkeley.edu/~stark/Preprints/gentle12.pdf

Poorvi L. Vora is Professor of Computer Science at The George Washington University. Her research focus has been on end-to-end independently verifiable (E2E) voting systems which enable voters and observers to audit election outcomes without requiring them to rely on the trustworthiness of election technology or unobserved election processes. Prof. Vora was a member of the team that deployed polling-place, paper-ballot-based, E2E voting system Scantegrity II in the Takoma Park elections of 2009 and 2011, and of the team that developed remote voting E2E system Remotegrity and accessible voting variant Audiotegrity, used in 2011. She has worked with the National Institute of Standards and Technology (NIST) on definitions of desired properties of E2E systems, and on information-theoretic models and measures of voting system security properties. She obtained her Ph.D. from North Carolina State University.

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