

# Why DREs Cause Long Lines, Why Paper Ballot-Optical Scan Can Eliminate Long Lines and Why DREs Would Cost Even More Than We Thought

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Additional details with references and calculations at <http://www.nyvv.org/voterlines.shtml> and <http://www.nyvv.org/doc/voterlines.pdf>

Early next year, New York counties will choose either direct recording electronic voting machines (DREs) or paper ballot-scanner systems (PBOS) to replace lever voting machines. How many new voting machines will be needed? The answer to this question is critical for ensuring that each county's voting will go smoothly and that costs will be within reason.

Long lines have occurred during elections with DRE use in California, Florida, Maryland, Mississippi, Ohio, Pennsylvania, Tennessee, Utah and other states and have caused some voters to give up and go home, effectively disenfranchising them. It is prohibitive to buy a large number of DREs because of their cost, which makes it likely that a substantial number of voters using DREs will end up in long lines. In contrast, PBOS uses inexpensive marking booths whose numbers can be increased to eliminate lines and long waits.

Recently the New York City Board of Elections published a report suggesting that one DRE could replace each lever machine and serve 277 voters who show up at the polls. Here is their reasoning. They posit that each voter using a DRE with voter verified paper trail takes 3.25 minutes. They then divide a 15 hour election day (900 minutes) by 3.25 minutes and get 277 voters.

If we accept their figure of 3.25 minutes to vote, is it really possible for 277 voters to finish in a 15 hour day? No, it is not. 277 voters at 3.25 minutes each would only work if everybody arrived at precise 3.25 minute intervals. On Election Day there are busy periods, such as early morning, lunch and dinner, when people come at a higher rate than average, and other slack periods. At all times, people come randomly. Sometimes many more than average will come, sometimes many less.

Here is what the NYC report said about this:

On Election Day, there are "peaks and valleys" of usage by voters depending upon the time of day, the weather, traffic and other variables outside of the control of election staff. Thus there will always be times when voters are waiting, but on the whole, there should be some insurance that waits will not be over long durations throughout the day and that on the whole, voting can be accomplished expeditiously. If we make the assumption that on the whole elections are conducted expeditiously by the survey jurisdictions, than [sic] a maximum that is at, or somewhat higher than, the average by type of technology should be a reasonable maximum for New York

Unfortunately, these statements are just unsupported assumptions that are contradicted by experience with DREs in real elections and the mathematics of queuing theory that governs the flow of voters. I have applied this mathematical approach to simulate elections in districts with 1, 2 or 4 DREs, allotting 1 DRE to each 277 voters as suggested by the NYC report. The result is that in more than 80% of these pollsites there will be people waiting over 1 hour to vote. There will be many polling places in which voters are kept waiting even longer.

This is not just mathematics—long lines with DREs have been endemic to that technology. This occurred in the 2004 general election in Florida and Mississippi. In Ohio long lines caused voters to give up and leave without voting. There were more long lines in the recent 2006 primary in Cuyahoga County, OH. There were long lines—along with other DRE issues—in the September 2006 problematic primary in Maryland. Insufficient DREs and DRE malfunctions caused more long lines and voter frustration in a number of places in this year’s general election on November 7.

Is there a cure for this problem? Yes, buy more machines—many more machines. But we can’t afford to do that.

The picture for paper ballot optical scan is very different. It is easy and inexpensive to buy marking booths for PBOS. Marking booths represent the same potential bottleneck for voter flow as do the DREs. The difference is that the marking booths cost about \$150 each, and the DREs cost \$8,000 each.

Let’s look at two PBOS examples. Lee, MA had 3200 voters in the 2004 general election served by a single scanner. They had 35 marking booths for a 13-hour day. In other words, 91 voters per marking booth. This is equivalent to 105 voters per booth for a 15 hour day.

The Lee town clerk Susan Scarpa said there were no lines to use the marking booths. They previously had 8 lever machines with, as described by Ms. Scarpa, “long, long lines.” So 8 lever machines were replaced by 35 marking booths, and the lines disappeared.

I spoke to the town clerk in Londonderry, NH. In the 2004 general election they had 12,000 voters served by two scanners for a 13-hour election day. They had 100 marking booths and no lines. So that is 120 voters per booth. This is equivalent to about 140 voters in a 15 hour day. The town clerk told me that some periods of the day have people in only a few booths, and busy times have 90% of the booths occupied.

So here we have two examples that work. They are equivalent to 105 and 140 voters/per marking booth in a 15 hour day. These figures are less than 1/3 the number of voters per DRE suggested by the NYC Board of Elections when a possible high voter turnout is taken into account. Lee, MA and Londonderry, NH do not have lines at their marking booths. Ohio and Maryland have had long lines at their DREs, big time. Many voters gave up trying to vote. This amounts to disenfranchisement.

I have not discussed the effects of DRE outages (roughly 10% in recent elections) or the effect of voters with special needs taking an average of 30 minutes each to use machines with disability aids, as indicated by recent tests conducted by the NY State Board of Elections. These factors will further exacerbate waiting times.

This brings us to cost. Are we prepared to buy 3 DREs for each lever machine we now own? As a taxpayer, I hope not. But that is what we would need to do to make the voting process run efficiently if we use DREs.

What I hope, instead, is that New York will opt to think of the voters first and get what works for us.

In summary, DREs and marking booths for paper ballots represent the same bottleneck for voting. With paper ballots, buying more marking booths is effective and inexpensive. We will not be able to buy enough DREs to reduce lines at all polling places because of DRE cost.