Update on Erosion Modeling Issues

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West Valley Citizen Task Force meeting
September 27, 2017

Erosion Modeling Issues that Need Attention and Sensitivity Analyses – as presented June 28, 2017

1. **Principal causes of erosion, and erosion's central importance to risk, are being pushed aside or severely diluted by other "bells and whistles" in the modeling work**

2. **Channelized flow in Erdman Brook watershed has been (and is still being?) modeled incorrectly**

3. **Using Franks Creek watershed (rather than Buttermilk Creek watershed) as the modeled area will apparently reduce the robustness of the model and its results**

4. **Ten-year time steps for the model runs are much too long unless many identical model runs are conducted**

5. **Modeling runs are apparently using incorrect rainfall intensity-frequency (RIF) distributions**

Erosion Modeling Issues that Need Attention and Sensitivity Analyses – as updated Sept. 27, 2017

1. Principal causes of erosion, and erosion's central importance to risk, are being pushed aside or diluted by other "bells and whistles" in the modeling work – mostly a Probabilistic Performance Assessment issue
2. Channelized flow in Erdman Brook watershed has been modeled incorrectly – apparently corrected now
3. Using Franks Creek watershed (rather than Buttermilk Creek watershed) as the modeled area will apparently reduce the robustness of the model and its results – ?
4. Ten-year time steps for the model runs are much too long unless many identical model runs are conducted – still an issue, and interrelated with issue #5
5. Modeling runs are apparently using incorrect rainfall intensity-frequency (RIF) distributions – n.b. correction

Erosion Modeling Issues that Need Attention and Sensitivity Analyses – as updated Sept. 27, 2017

6. New questions sent to Greg Tucker:

- Can you provide a list of all the modeling input variables that are being calibrated by the post-glacial model runs?
- Are any or all of these capable of being directly measured in the field?
- Or are some or all of them surrogates for field-testable variables, but not directly testable?
- If the latter, how can we look at and understand the surrogate relationships?

Greg acknowledges these are good/important questions; asks me to pose these questions through DOE & NYSERDA; says his EWG report (to be completed end of December?) "will have all of this information and more"

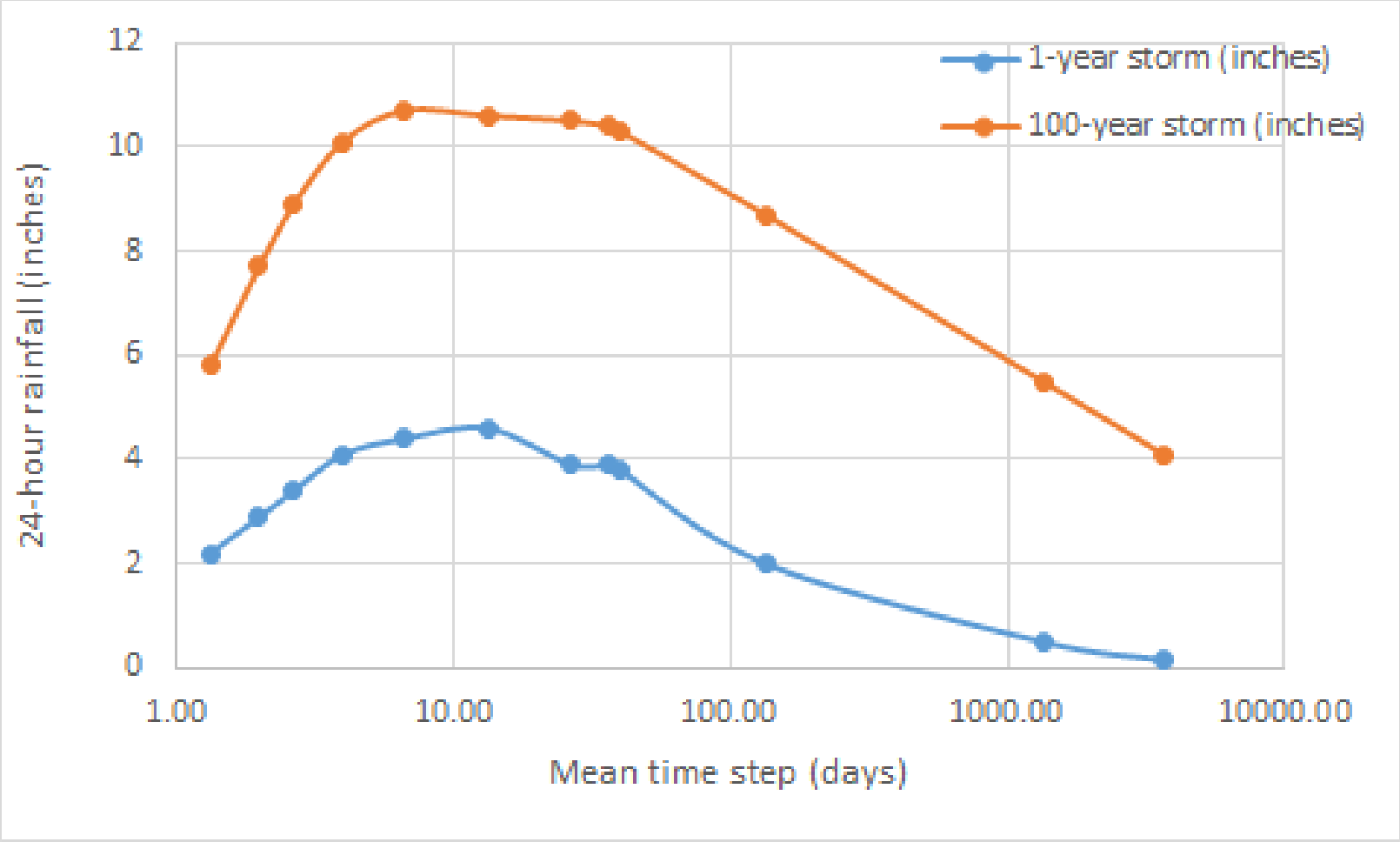
Modeling runs are apparently using incorrect rainfall intensity-frequency (RIF) distributions – as presented June 28, 2017

- **It appears from my own calculations (using Excel and Fortran) that the RIFs used by Tucker, Price, and Doty for the CHILD modeling runs that supported the 2010 EIS are *wrong* (rainfall intensity *substantially low*)**
- **Tucker uses 0.15 inch mean depth of rainfall during storms (or 0.3 inch for "wet scenario"), and multiplies this value by the negative natural log of a random number to generate individual storm rainfall depths**
- **Tucker uses 2.57 hr mean duration of storms and multiplies this value by the negative natural log of a random number for individual storm durations**
- **Tucker uses 0.08 as the fraction of time during which storms occur**

Modeling runs are apparently using incorrect rainfall intensity-frequency (RIF) distributions – as updated September 27, 2017

- My own calculations (using Excel and Fortran) indicate that the RIFs used by Tucker, Doty (and Price) for the current modeling runs and earlier CHILD modeling runs depend jointly (and unexpectedly) on the model's time step and its stochastic-rainfall-generator inputs
- Tucker uses 0.06 in/hr mean intensity (not depth) of rainfall during storms, and multiplies this value by the negative natural log of a random number to generate individual storm rainfall intensities
- Tucker uses 2.57 hr mean duration of storms and multiplies this value by the negative natural log of a random number for individual storm durations
- Tucker uses 0.08 as the fraction of time during which storms occur

Unexpected/unacknowledged effect of model time step on the model's rainfall intensity-frequency (RIF) distribution



Source: Calculations by RV, using Excel and Fortran, based on 0.06 in/hr mean rainfall intensity, 2.57 hr mean storm duration, and 0.08 fraction of time during which storms occur, and assuming that all storms start at beginning of day. "1-year storm" and "100-year storm" mean storms with greatest 24-hr rainfall in 1-yr and 100-yr return intervals, respectively.

The point of all this…

- **If erosion modeling supports the 2020 DOE-NYSERDA decision on removing buried wastes or stabilizing them in place, *it's critically important to understand how the models work***
- **For example, the models use input variables that are calibrated by post-glacial model runs. *These input variables should be capable of being directly measured in the field.***
- **If these model inputs aren't directly measurable but are relatively abstract values that act as "surrogates" for field-testable variables, it's crucially important to understand the surrogate relationships**

Questions?

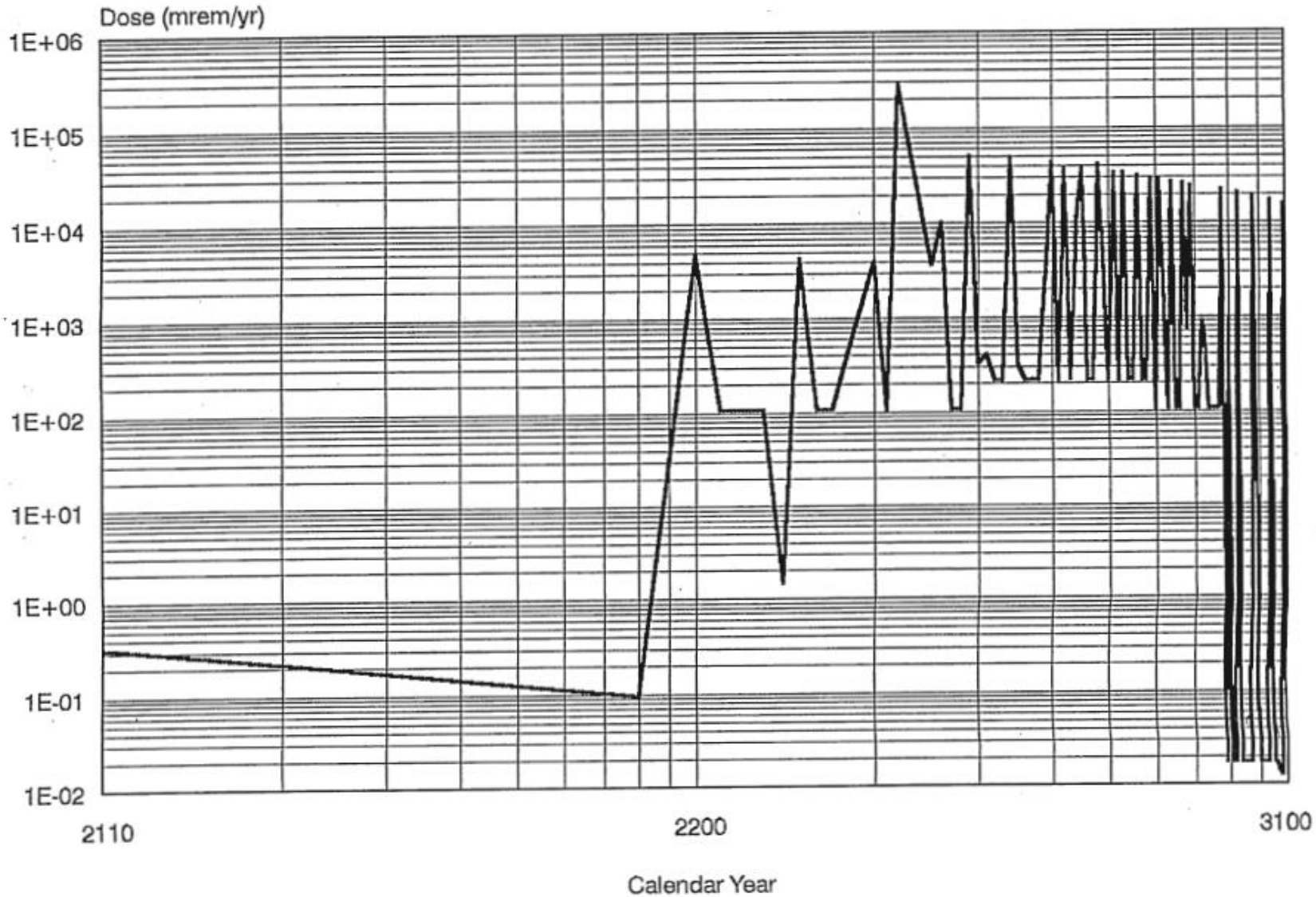
Erosion's central importance to risk is being pushed aside or severely diluted by other "bells and whistles" in the modeling work

- **We know from comparing 1996 DEIS to 2010 EIS that different erosion modeling assumptions can change receptor dose by as much as a factor of 75,000**

- **Factor of 75,000 = 300,000 mrem/yr / 4 mrem/yr**

- **…where 300,000 mrem/yr was peak dose in 1996 DEIS, and 4 mrem/yr is peak dose in 2010 EIS (Table 2-4) for Cattaraugus Creek and SNI receptors for the *close-in-place alternative*, assuming unmitigated erosion**

- **Compare also *the serious breaching of burial grounds in 1996 DEIS* to absence of such breaching in 2010 EIS**



D-41

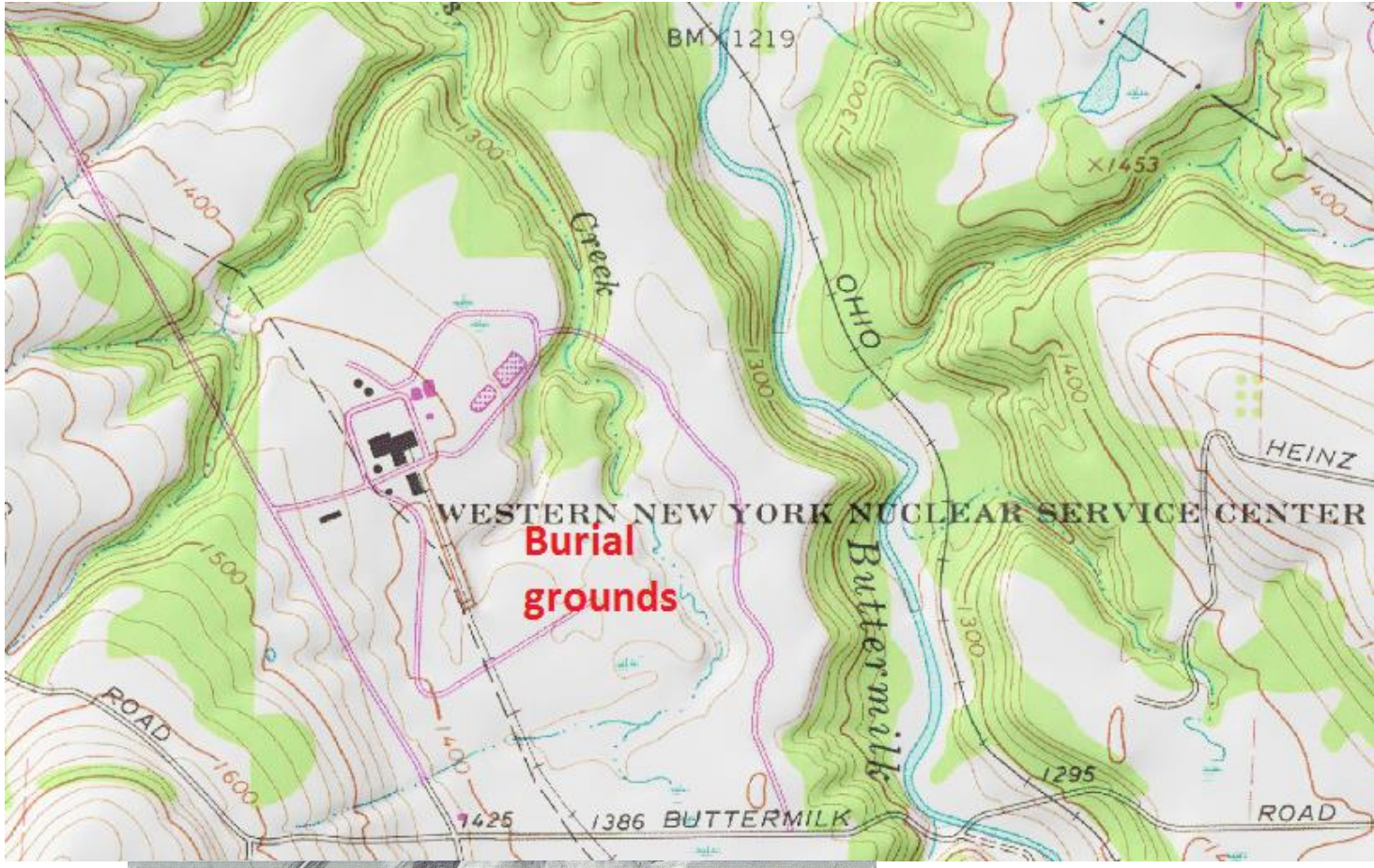
Figure D-8. Alternative III Assumed Loss of Institutional Control Case, Local Erosion Control Strategy: Erosion Collapse Scenario, Cumulative Impacts for a Buttermilk Creek Resident

Source: DOE 1996 West Valley DEIS, DOE/EIS-0226D, Appendix D, page D-41

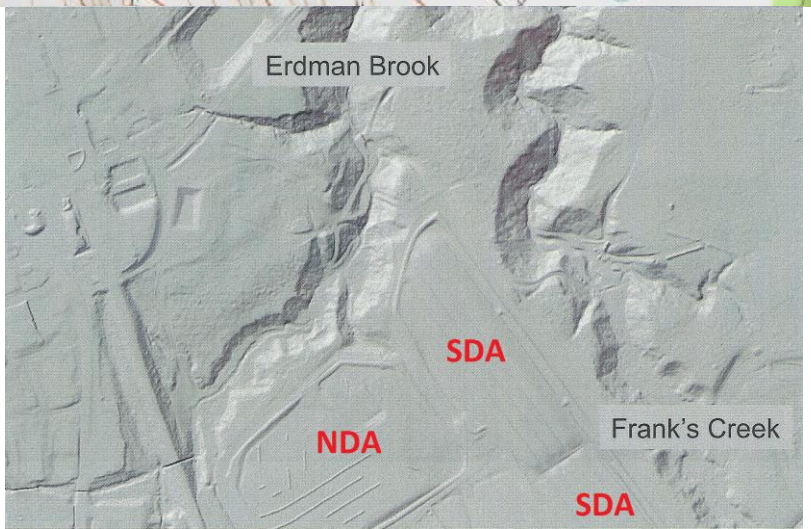
Channelized flow in Erdman Brook watershed has been (and is still being?) modeled incorrectly

- **Headwaters of Erdman Brook descend hillside west of Rock Springs Road, partly as channelized flow (see esp. 1963? topo map) which formerly continued directly into Erdman Brook channel between North & South plateaus**
- **Culverts carry this flow under road & rail embankments**
- **Modeling done for 2010 EIS *apparently didn't recognize culverts* and effectively treated embankment(s) as check dam(s) – a well-known way to reduce erosion**
- **Current modeling apparently simulates culverts as thin slots in embankment(s), which is better – and note that thin slots will tend to widen due to erosion**
- **A consistent, realistic approach is needed!**

1963(?) topographic map



NYSERDA 2015 LiDAR



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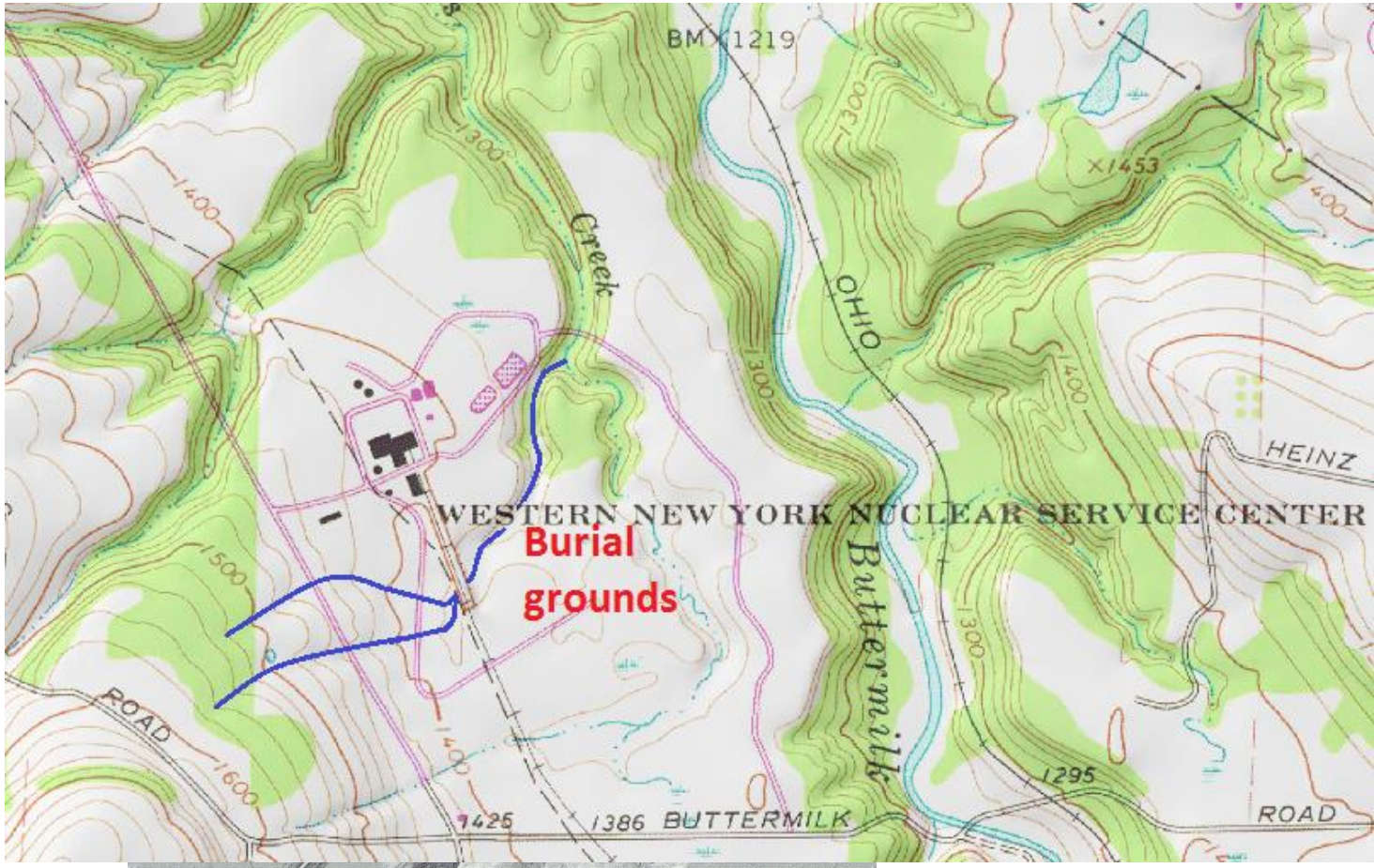
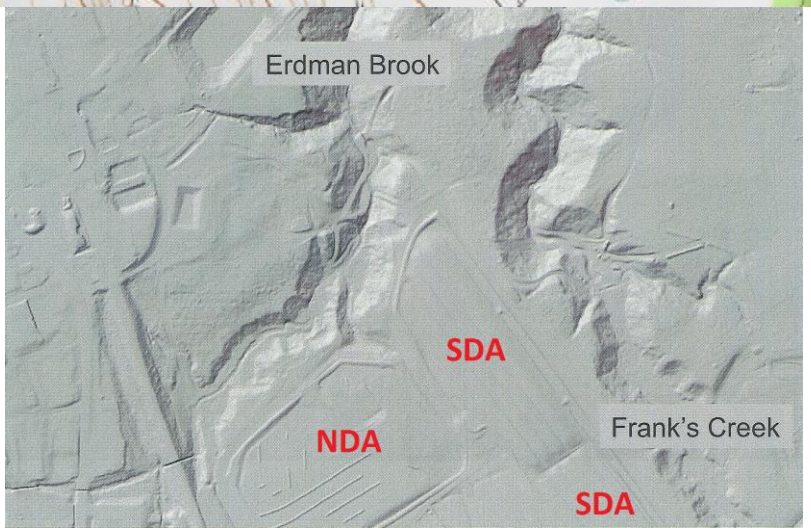


NYSERDA 2015 LiDAR



Ten-year time steps for the model runs are much too long unless many identical model runs are conducted

- **Long global time steps are *not statistically equivalent to shorter steps* in their effect on the rainfall intensity-frequency (RIF) distribution**

- **Tucker's own guidance apparently contradicts his plan to use global time steps (Tg) as long as 10 years:**

  "The model is relatively insensitive to Tg as long as its value is sufficiently small.... [Test r]esults showed that values of Tg of approximately 1 year or smaller produce very similar results... A value of 0.1 years was used in calibration and forward runs." **(2010 EIS, Appendix F, page F-29)**

- **Note that *these are separate points!***