Small Modular Reactor (SMR) Siting in the State of Maine

**What is SMR?**
Small modular reactors (SMRs) are advanced reactor designs that have been miniaturized to enhance flexibility in applications, financing, transportability, and standardized factory production. The reduced physical size of the units allows the entire power plant to be manufactured in a factory setting, then shipped to their installation sites via rail car, barge, or by truck. SMRs have a minimal environmental footprint in terms of pollution, water use, and life-cycle greenhouse gas emissions. These factors combined mean that SMR should have more siting options than large nuclear power plants.

**Why Maine?**
Maine represents a prime example of where SMR might exploit niche markets. Maine has a small population but a huge land area, so the state experiences low electricity demand growth and a diminished fossil fuel plant retirement. Additional retired, clean electricity generation will be required to replace it. Additional-electricity generation in Maine against the siting criteria. Criteria were divided into individual layers as follows:

- **SMR Design Requirements**: The SMR is assumed to be a Babcock & Wilcox Generation mPower unit, which is rated for 180 MWe and 530 MWth.
- **Population Density**: Areas >500 persons per square mile were excluded. Cities with population >25,000 must have 4 mile exclusion zone, >100,000 must have 10 miles.
- **Cooling Water**: Combination of ocean, streams/rivers, and lakes. Source must be within 20 miles per regulations, and proximity to the source is accounted for in the scoring system. Siting closer is preferred for costs of piping/pumping water.
- **100 Year Flood**: Land within 100 year flood zone as declared by FEMA is excluded.
- **Parks, Wildlife Refuges, Wetlands**: Land is excluded from consideration.
- **Landslides**: Area with a Moderate or High Susceptibility is excluded. Slope is a major factor.
- **Earthquakes**: Land near faults are excluded. Land with a safe shutdown earthquake (SSE) peak ground acceleration >2% chance in 50 years greater than 0.5g is excluded.
- **Hazardous Facilities**: Major airports have 10 mile exclusion zones. Proximity to dams considered.
- **Transportation Infrastructure**: Areas within 10 miles of railroads and major roads are preferred.

**SMR Siting Criteria**
Individual layers were created based on the regulatory standards of SMR siting, each converted to a raster data set, then calculated together to create a digitized map that would rank areas in Maine against the siting criteria. Criteria were divided into individual layers as follows:

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**Results & Limitations**
The results showed Maine's remarkable capacity to site multiple SMR units. Since Maine is a large and rural state, only four areas had sufficient populations to achieve "Exclusion Zone" status. Sufficient water was available state-wide. Natural hazards like landslides, slope, and floods were largely limited to affecting the western quarter of the state only. Earthquake concerns were a non-factor, as no threatening fault lines lie within or near Maine's borders. Only a handful of airports were of concern, most of which were already located in areas of high population densities. High-volume dams were prevalent, but were not exclusionary factors. The most restrictive factor was that of Conserved Lands layer. The assessment of threats from dams could be further analyzed to include the emergency flood zone, water flows, and probability of dam failure. Additionally, population density could be re-analyzed using a grid analysis rather than by calculating density by census subdivision.

**References**
Class: DHP-P207 GIS for International Applications
Project Coordinates: NAD_1983 UTM_ZONE_19N
Cartography: Evan M. Paradis

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**Scoring System**
Each layer had a maximum value of 5 points, and with 10 layers this meant a 'perfect' score of 50 points was possible for areas that met every regulatory requirement. However, any layer that had an absolute criteria (i.e. no nuclear power plants within 10 miles of a major airport) had a penalty of -50 points for the affected land area. This meant that even if a site had an otherwise perfect score, a single absolute criteria would take the score to below zero, signifying that the space was unsuitable for SMR. The lowest possible suitable score was 30 points, putting the range of acceptable point totals from 30 to 50 points.