

# Permitting Reality

## as a Geospatial Input to Grid Planning

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What geospatial permitting constraints mean for the sites and corridors grid models assume are buildable, and how structured regulatory-geospatial data can close the gap.

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# Grid models assume sites are buildable...permitting constraints prove otherwise

IRP and capacity expansion models optimize where to build generation and transmission.

They assume sites are permissible once land and interconnection constraints are cleared.

They're not. Permitting friction — zoning moratoriums, water rights, hazmat proximity — can add 1–3 years to timelines or kill sites entirely.

→ **Buildable area in the model is often a permitting minefield in the real world.**



# LLMs bridge the gap between regulatory text and geospatial data

Regulations describe geographic conditions in legal prose. Geospatial data is spatial geometry. Neither is natively queryable against the other.

## INPUTS

**Regulatory Text**

Municipal ordinances, state codes, federal rules — 4,000+ jurisdictions, unstructured legal prose

**Geospatial Datasets**

NWI wetlands, FEMA FIRM, USFWS critical habitat, state environmental layers — billions of spatial records across 46 states

## LLM PROCESSING

**1 Parse**

Extract permit trigger conditions from regulatory prose

**2 Structure**

Normalize triggers into typed, queryable schema

**3 Link**

Map each trigger to the relevant geospatial dataset layer

**4 Validate**

Human QA resolves ambiguity, superseded rules, conflicts

## OUTPUTS

**Site-Specific Permit Matrix**

Which permits apply and why, for any site boundary

**Permitting Timeline Estimates**

Based on regulatory structure and historical precedent

**Constraint Maps**

Geospatially-explicit permitting friction layers

# Purpose-built coverage spans 4,000+ jurisdictions and billions of spatial records

**4,000+**

## Jurisdictions

Hand-curated municipal ordinances, codes, and documents — normalized and structured

**46**

## States

Enriched geospatial datasets with full coverage across the continental U.S.

**Billions**

## Spatial Records

Individual records parsed, deduplicated, and indexed for regulatory query

**2,500+**

## Mapped Regs

Regulatory documents LLM-parsed and linked to specific geospatial dataset layers

### Hand-curation cannot be replaced by scraping

LLMs hallucinate on jurisdiction-specific edge cases. Human review is required to resolve conflicting sources, identify superseded ordinances, and validate that parsed triggers accurately reflect regulatory intent — especially when codes are ambiguous or cross-reference other statutes.

### Linking regulations to spatial layers requires domain expertise

Regulations describe geography in natural language: "within 500 feet of a wetland," "intersecting a sole source aquifer." Mapping those descriptions to specific spatial dataset columns requires understanding regulatory intent, dataset definitions, and jurisdictional scope — not just NLP.



# Water availability and discharge permitting add up to 12 months of unmodeled delay

*Data centers use millions of gallons/year for cooling. Water availability and discharge permitting rarely appear as siting constraints in grid models.*

## MIDWESTERN SITE — SOLE SOURCE AQUIFER

Site overlies an EPA-designated Sole Source Aquifer — the primary drinking water supply for the region. No withdrawal limits today, but active state legislation has targeted moratoriums on data center groundwater use from this aquifer.

A new well >100,000 gpd triggers county review; the district can recommend withdrawal restrictions to the state agriculture department.

Discharge pathway unresolved → Individual NPDES permit, public notice required → **~12 month timeline.**

## NORTHEASTERN SITE — HQ COLD WATER STREAMS

Site intersects 5+ miles of state-designated High Quality Cold Water Fishes (HQ-CWF) streams. Construction stormwater discharges to HQ/EV streams are ineligible for NPDES general permit coverage — requiring individual permits with site-specific antidegradation analysis.

Groundwater + surface withdrawals >10,000 gpd require state registration. Multiple named perennial streams cross the site — each a potential separate authorization.

Individual permit pathway → **~365 day timeline.**

# Local zoning changes faster than planning cycles and can block sites with no alternative pathway

*Local land use frameworks are evolving faster than planning cycles. A site that is legal today may be blocked tomorrow — and vice versa.*

## MIDWESTERN SITE — ACTIVE MORATORIUM

Data centers are not listed as a permitted use in the agricultural preservation district. In April 2026, the county adopted a zoning amendment prohibiting any use not explicitly listed — and **suspended data center permit applications** while drafting a new ordinance. No permitting pathway exists until the new ordinance is adopted and survives a ZBA public hearing.

Community opposition from a nearby cancelled project signals a contested public process ahead.

## NORTHEASTERN SITE — REGULATIONS IN FLUX

County has no zoning ordinance — development reviewed solely under a Subdivision and Land Development Ordinance (SALDO). As of June 2026, the county is actively drafting data center regulations.

A separate draft solar/BESS ordinance was tabled by commissioners pending public feedback — signaling that regulatory standards for energy-related development remain unsettled.

**Permitting pathway depends on which regulations are in effect at time of application — an unknown variable in any multi-year grid planning exercise.**

# Legacy industrial context cascades into multi-year investigative and permitting timelines

*"Greenfield" sites often sit adjacent to decades of industrial activity. Each legacy use triggers separate regulatory pathways.*

## Chemical Manufacturer

Specialty chemical plant (phenol-formaldehyde resins) on the site boundary — registered under an active NPDES record for a facility expansion. Given adjacent position and chemical manufacturing history, requires priority Phase I ESA evaluation. No formal RCRA corrective action on record, but subsurface risk profile is elevated.

## 45+ Legacy O&G Wells

Forty-five gas-type wells within the project boundary — active, plugged, abandoned, and DEP abandoned, operated by multiple entities. Pennsylvania requires 200–500 ft building setbacks from wells absent owner consent. Unknown wells require field confirmation before grading begins.

## Active MSW Landfill

Large-capacity municipal solid waste landfill 0.2 miles away with active NPDES permit for leachate discharge into tributaries flowing toward the site. Landfill gas migration and vapor intrusion pathways warrant Phase II subsurface investigation before construction permits can be issued.

**Phase I → Phase II ESA cascade: each adjacent facility potentially adds 6–18 months and significant investigation costs before any construction permit is issued.**

# Permitting friction should be treated as a first-class input to capacity expansion models

## Timeline uncertainty propagates upstream into IRP

A 6-month vs. 30-month permitting path changes capacity expansion assumptions dramatically. Current models apply uniform buildout assumptions that don't reflect this variance across site types or geographies.

## Transmission corridors face the same constraints

NWI crossings, critical habitat buffers, and industrial setbacks apply to rights-of-way just as they do to generation sites — corridor cost models should reflect this.

## Permitting friction layers should be applied before capacity expansion runs, not after

Pre-filter candidate sites through a geospatial permitting friction layer — water source constraints, regulatory status, hazmat proximity, zoning moratoriums — before running the optimization. The inputs exist. The datasets can be assembled. This is a workflow integration problem, not a data problem.