

# Integration of Pre-positioning and Hardening Decisions for Disaster Preparedness

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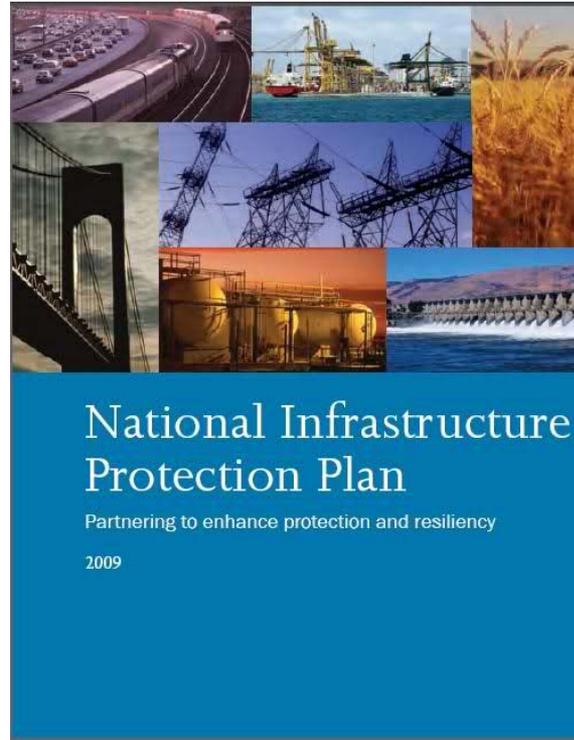
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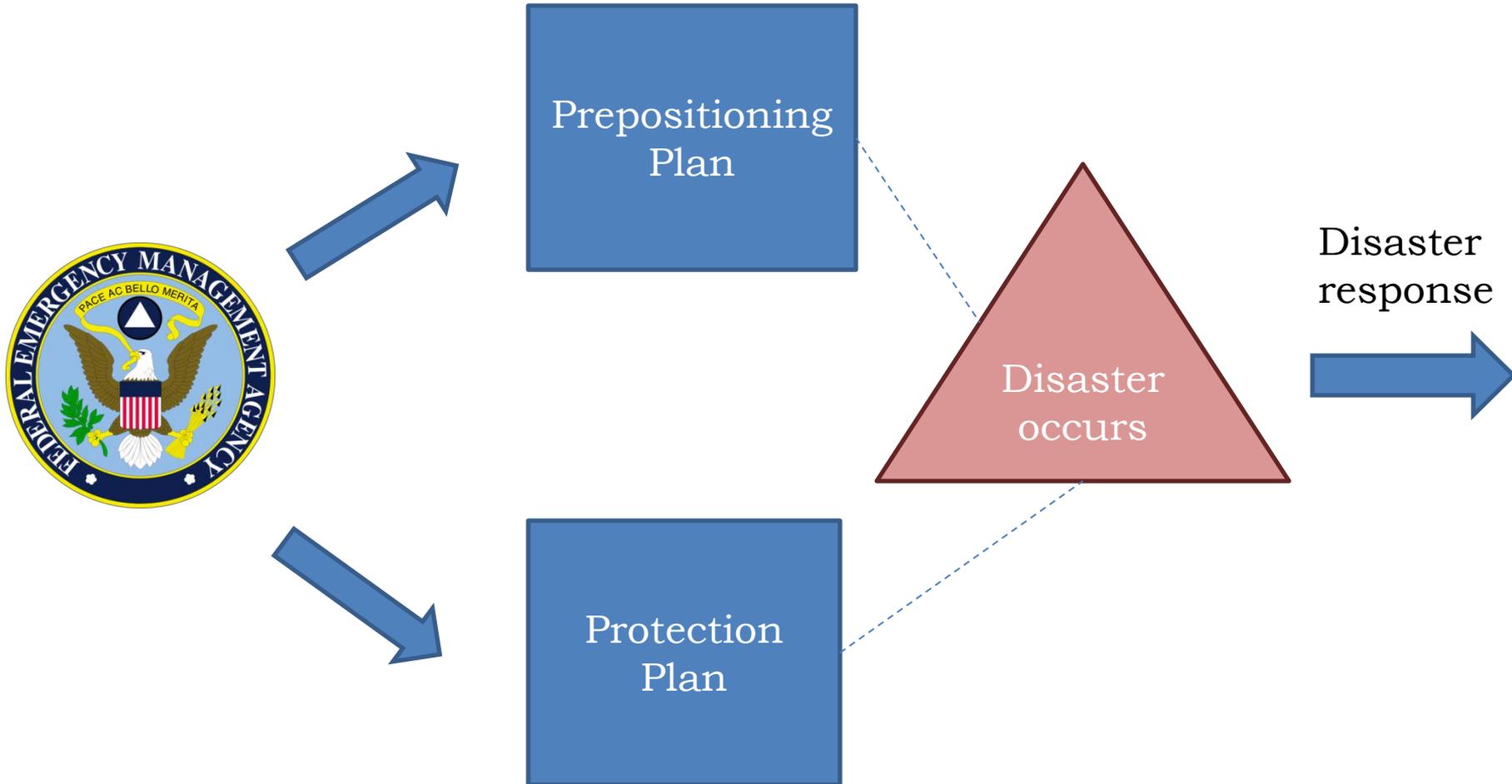


# Outline

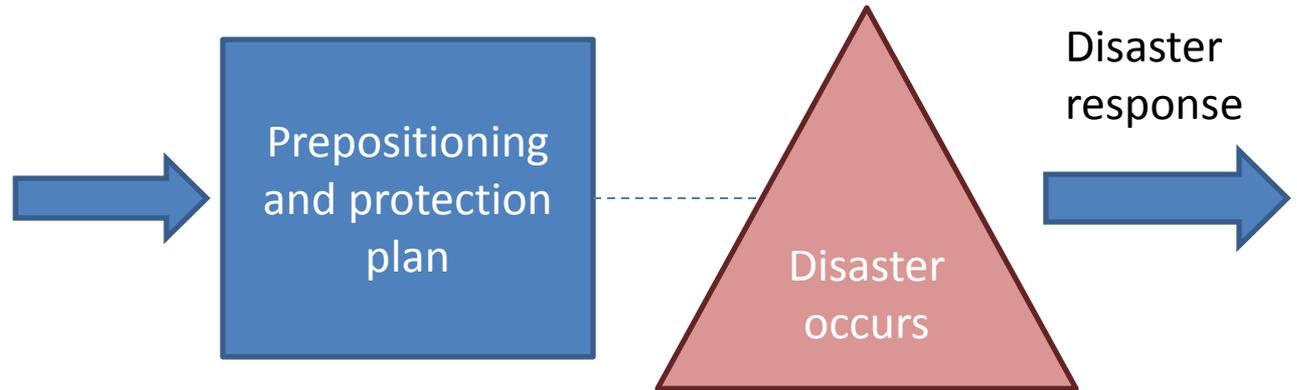
- This problem is relevant
- How we analyzed this problem
- Integration is beneficial

This problem is relevant.

# Parallel Approach



# Integrated Approach



How we analyzed this  
problem.

# Analysis

- Goal:
  - Estimate the benefit of integrating prepositioning and hardening decisions
- Method:
  - Mathematical model of the prepositioning and hardening resource allocation decisions
  - Compare non-integrated model with integrated model

# Two-Stage Model



## Decisions:

- Where and how many warehouses?
- Where and how much prepositioning?
- Where and how much hardening?

## Constraints:

- Budget for all activities

## Decisions:

- How to route supplies to disaster area?

## Constraints:

- Destroyed infrastructure and supplies cannot be used

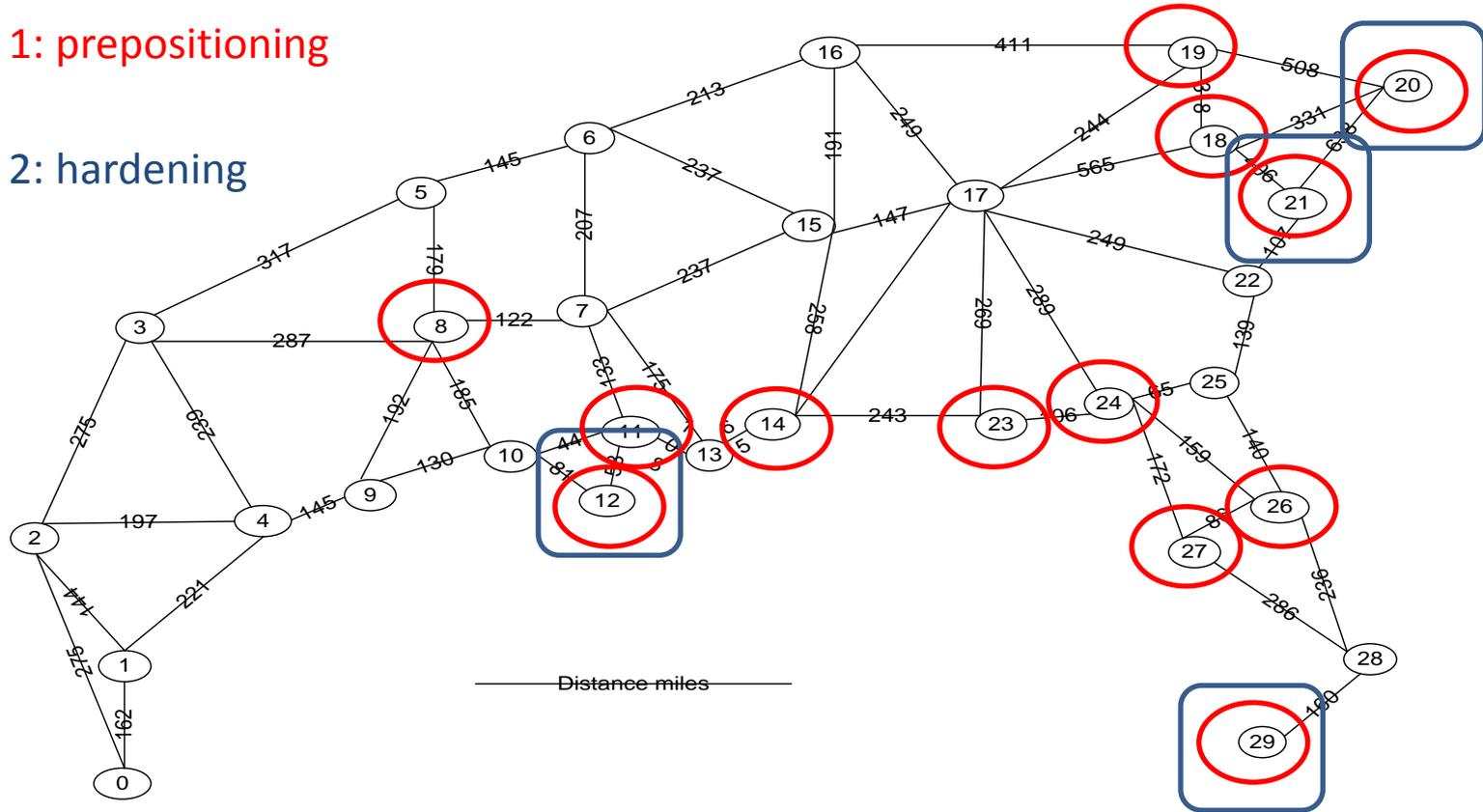
**Objective:** minimize average total travel time over all catastrophic event scenarios

Integration is beneficial.

# Sequential Approach

Phase 1: prepositioning  
(75%)

Phase 2: hardening  
(25%)



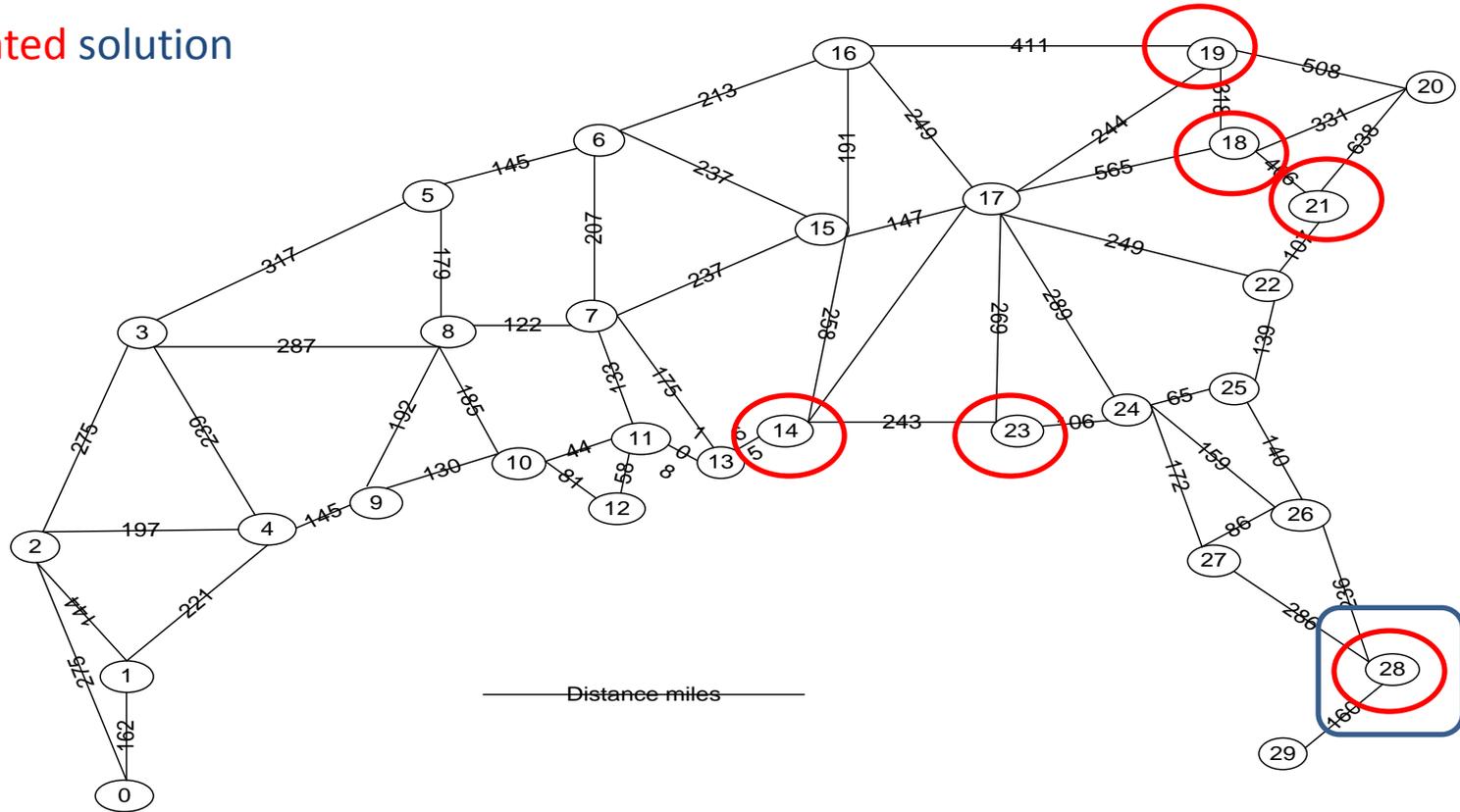
Pre-positioning  
cost:  
**\$21M**

Hardening cost:  
**\$2.4M**

Disaster response cost:  
**\$68M**

# Integrated Approach

Integrated solution



Pre-positioning  
cost:  
**\$29M**

Hardening cost:  
**\$600K**

Disaster response cost:  
**\$60M**

# Summary

- This problem is relevant
- How we analyzed this problem
- Integration is beneficial