



March 7<sup>th</sup>, 2014

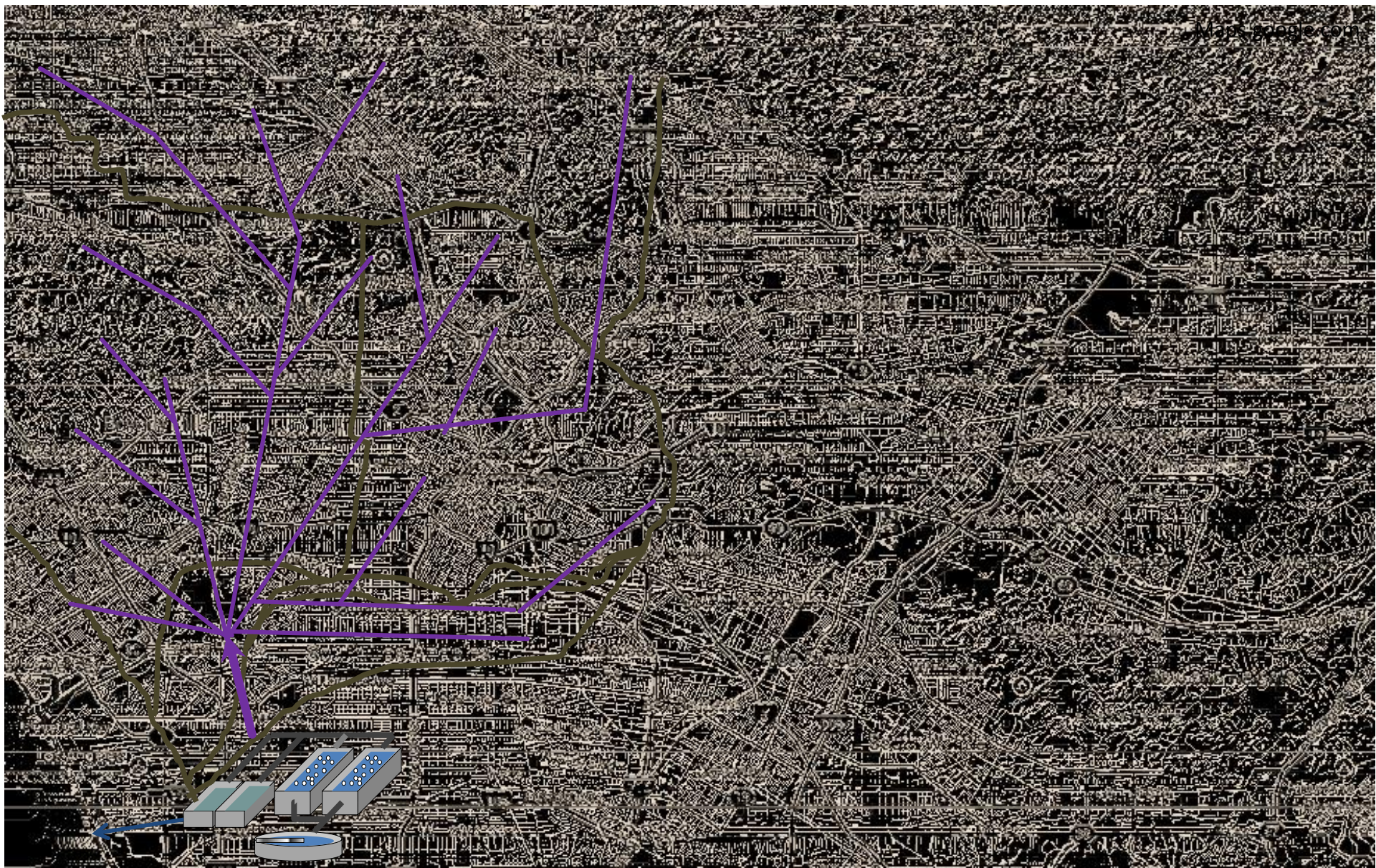
# Wastewater Reclamation in India: From Policy to Execution

Kartiki S. Naik Ph.D.

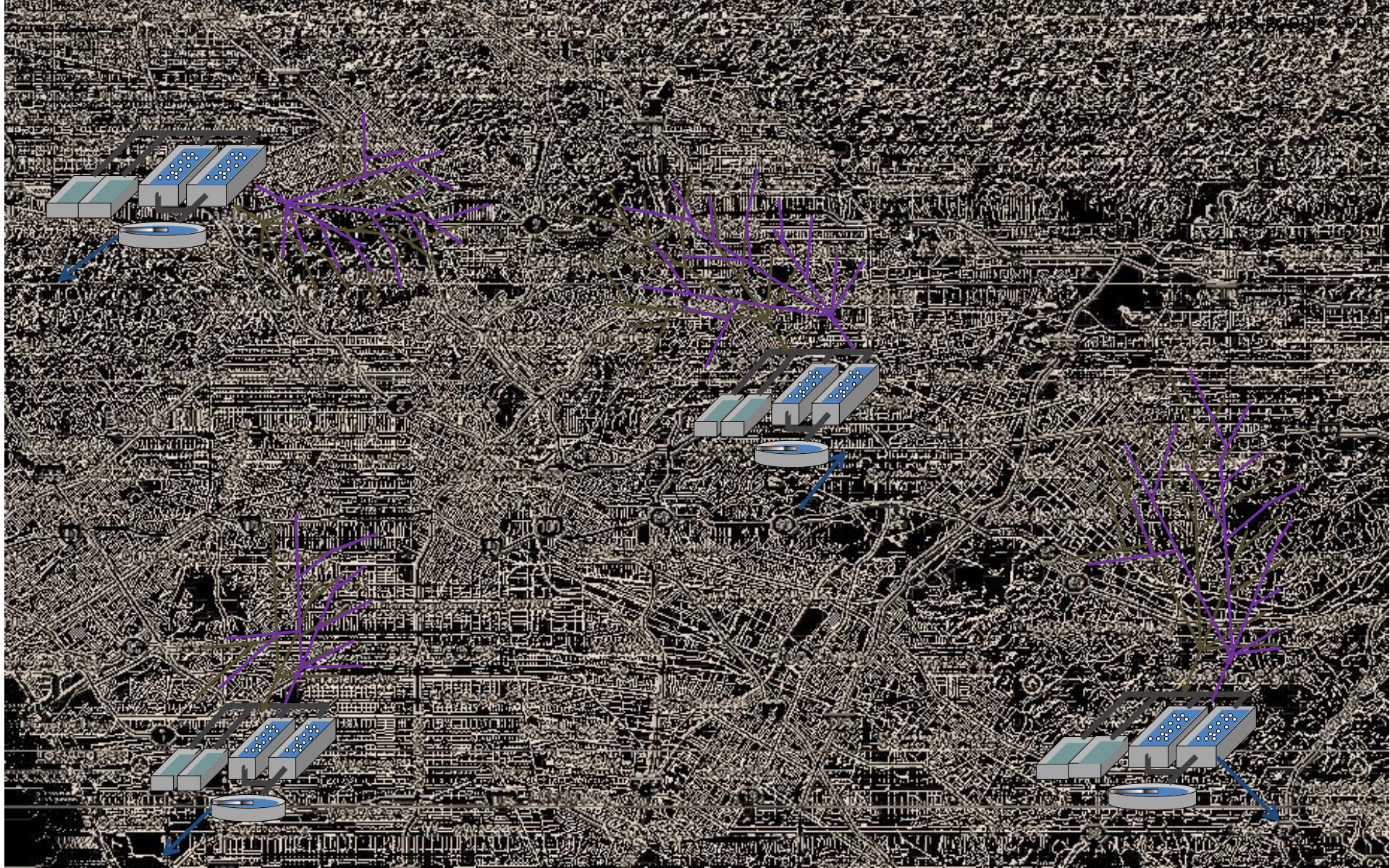
Michael K. Stenstrom, Ph.D., P.E., BCEE  
University of California, Los Angeles



# Centralized Treatment



# Decentralized Treatment



# Hollywood, CA

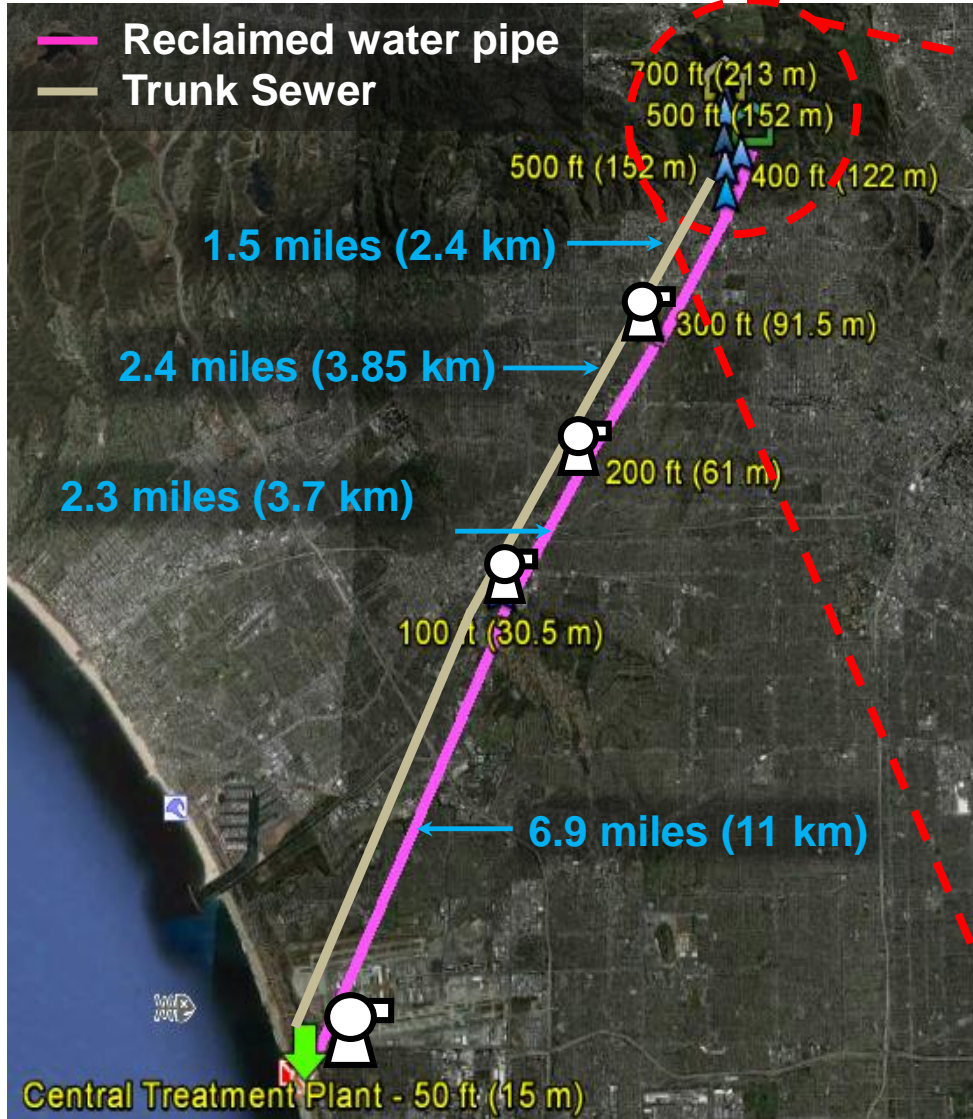
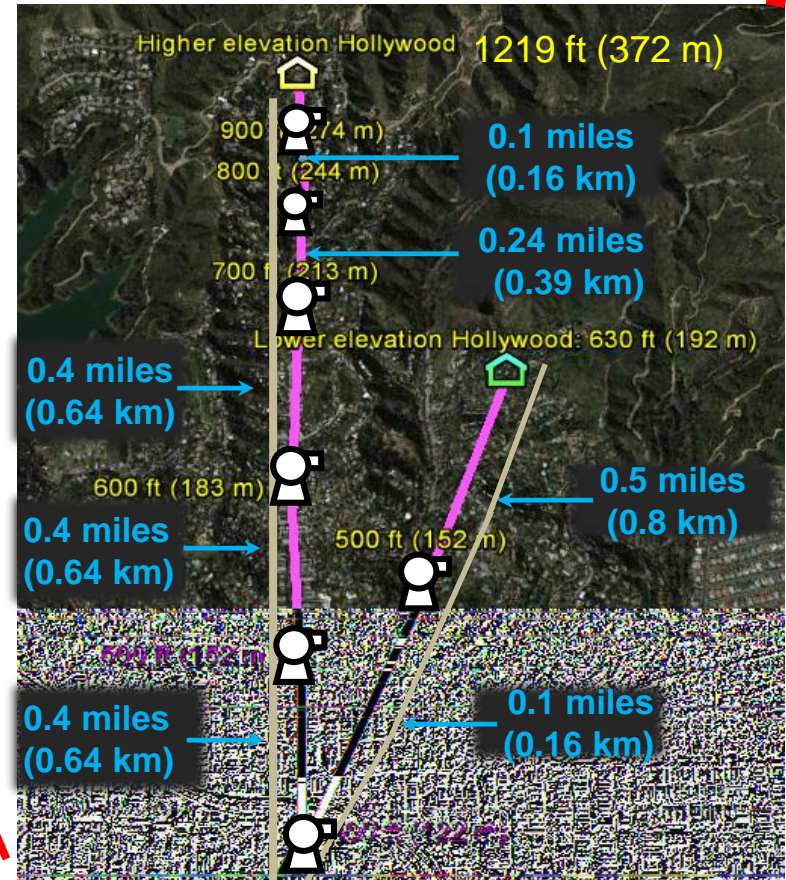


Image Landsat  
 Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
 Image IBCAO  
 Google earth



Lift station markers do not depict capacity

# Hypothetical Scenarios



# Cost and Energy Components

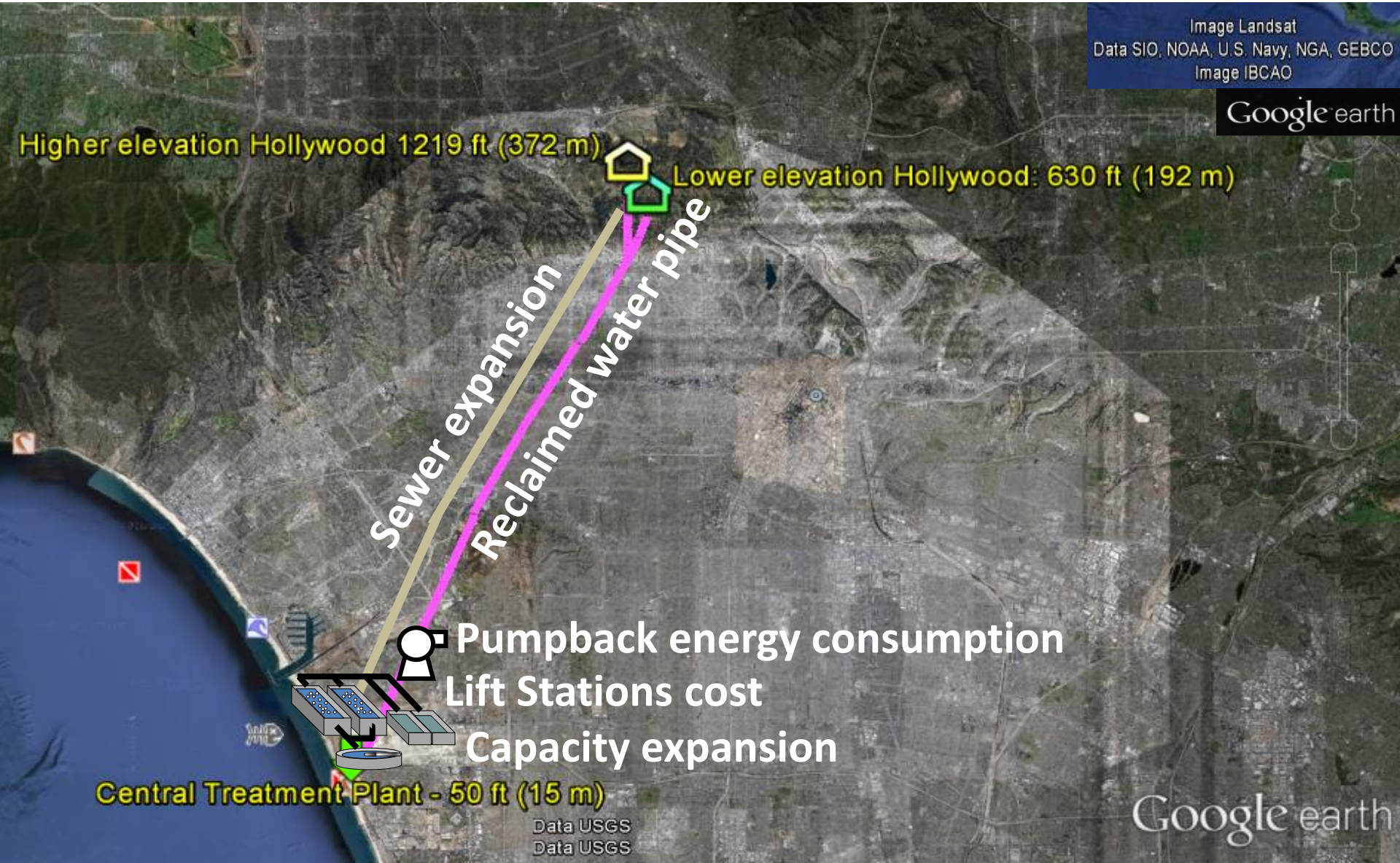


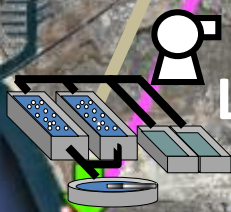
Image Landsat  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image IBCAO

Google earth

Higher elevation Hollywood 1219 ft (372 m)

Lower elevation Hollywood: 630 ft (192 m)

Sewer expansion  
Reclaimed water pipe



Pumpback energy consumption

Lift Stations cost

Capacity expansion

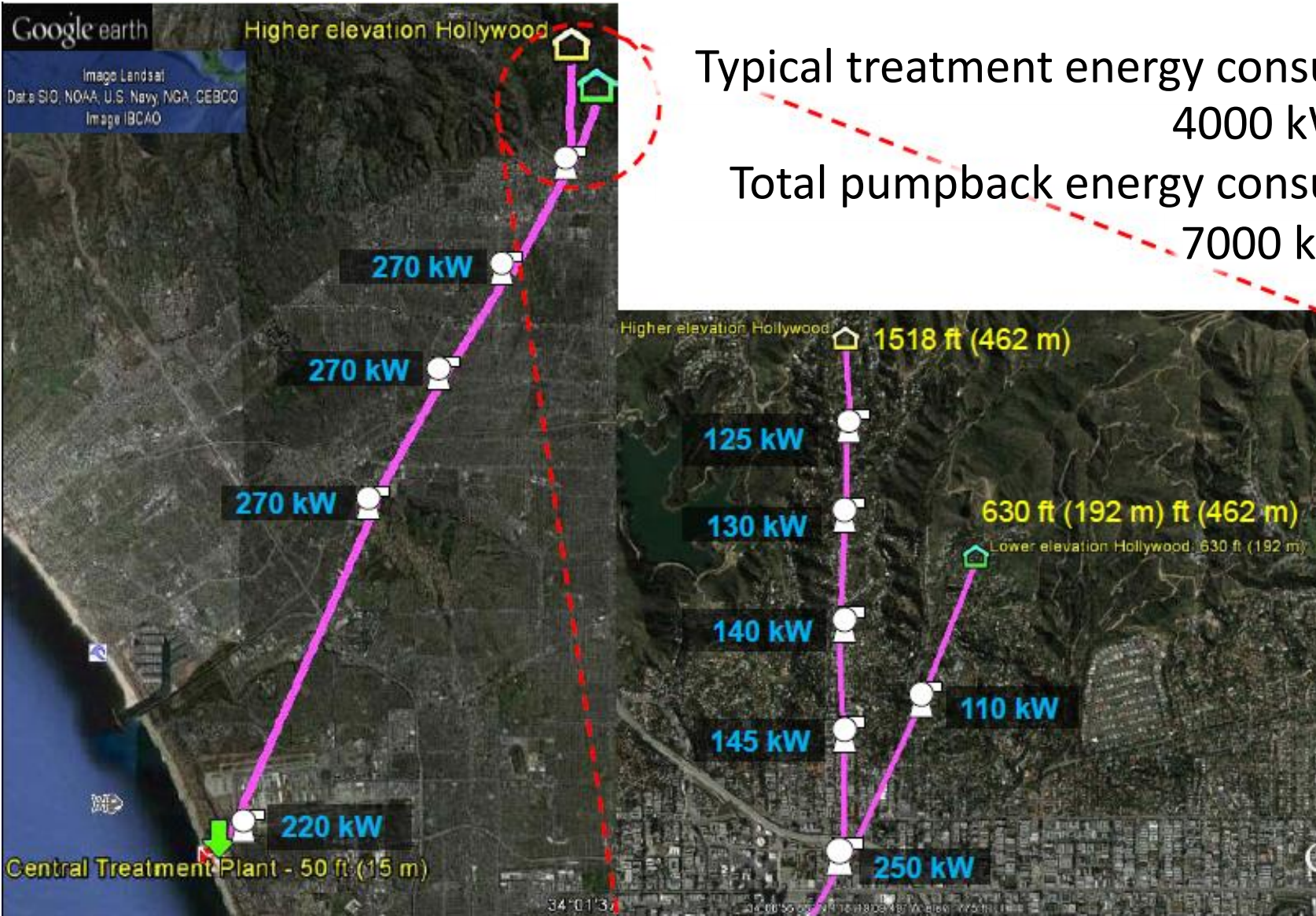
Central Treatment Plant - 50 ft (15 m)

Data USGS  
Data USGS

Google earth

# Pumpback Energy Consumption

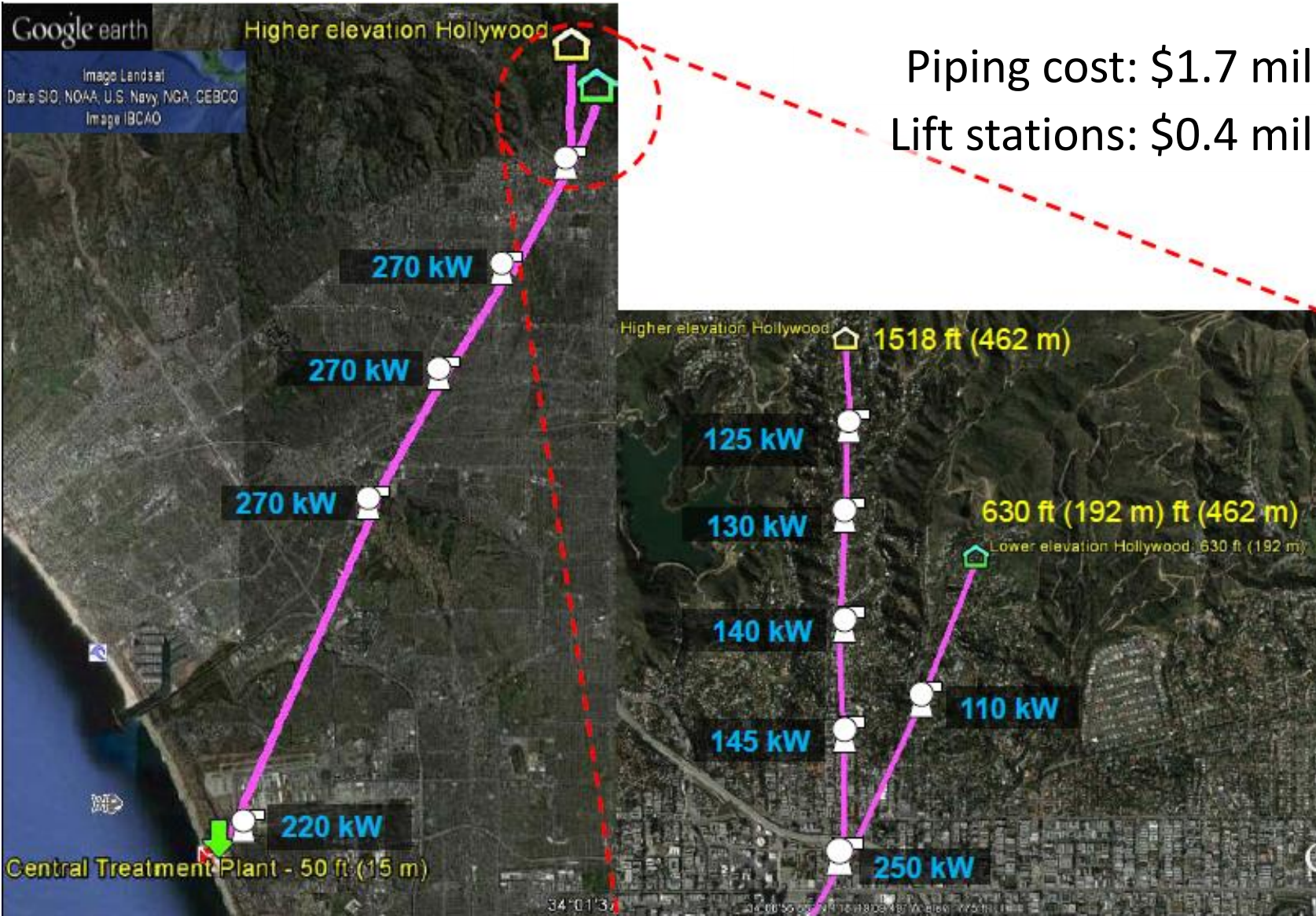
Typical treatment energy consumption  
4000 kWh/MG  
Total pumpback energy consumption  
7000 kWh/MG



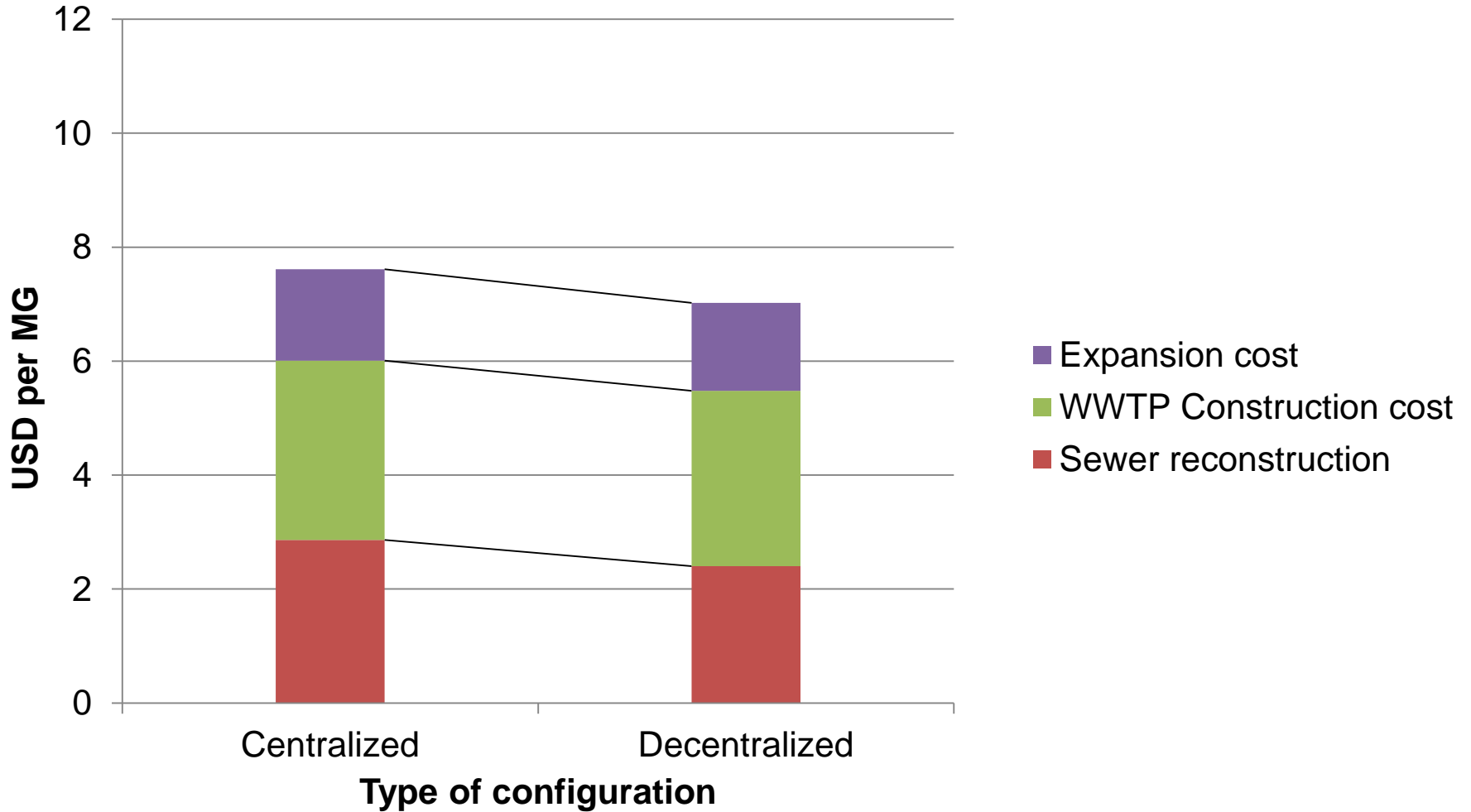


# Pumpback Energy Consumption

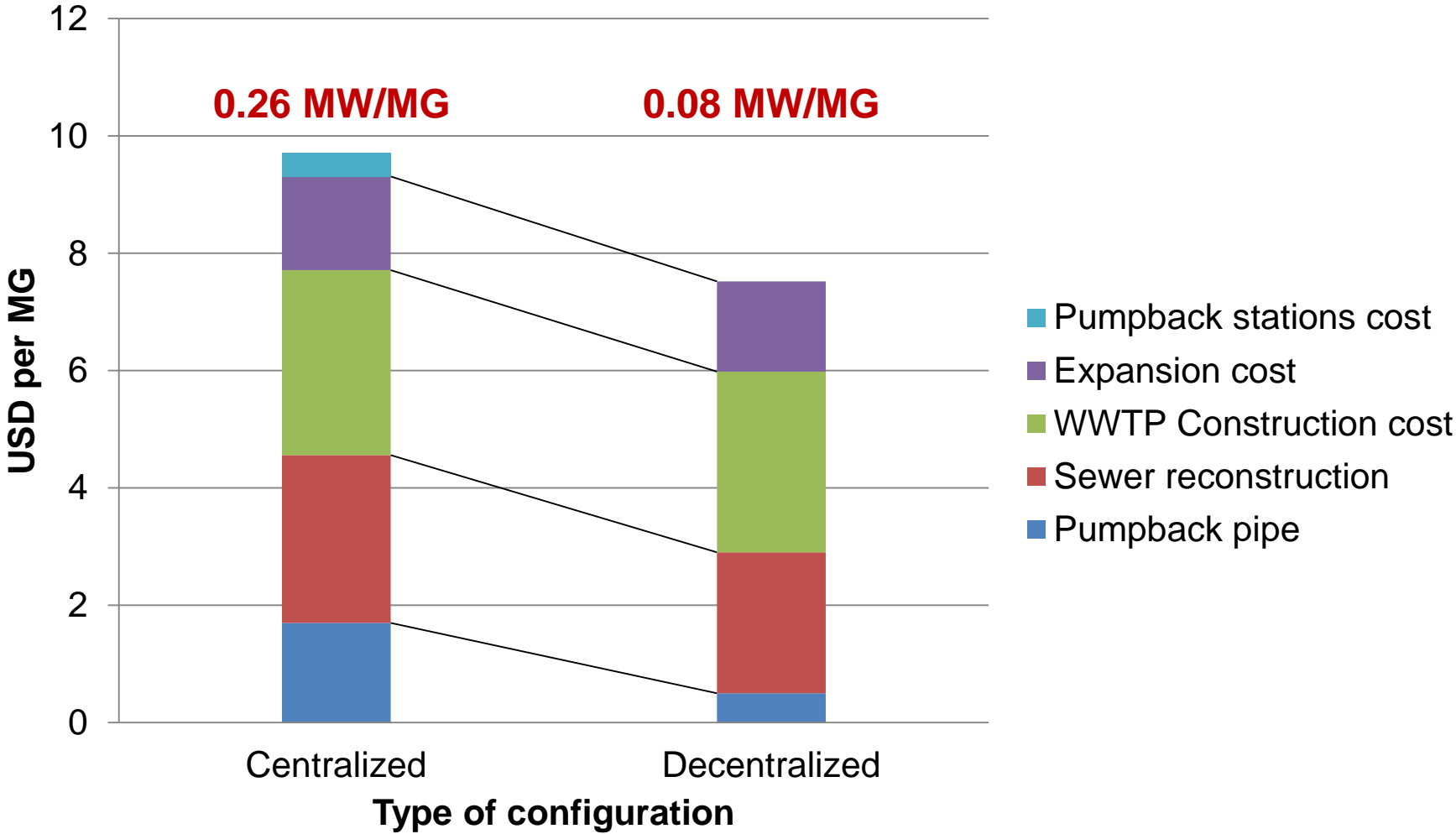
Piping cost: \$1.7 million/MG  
Lift stations: \$0.4 million/MG

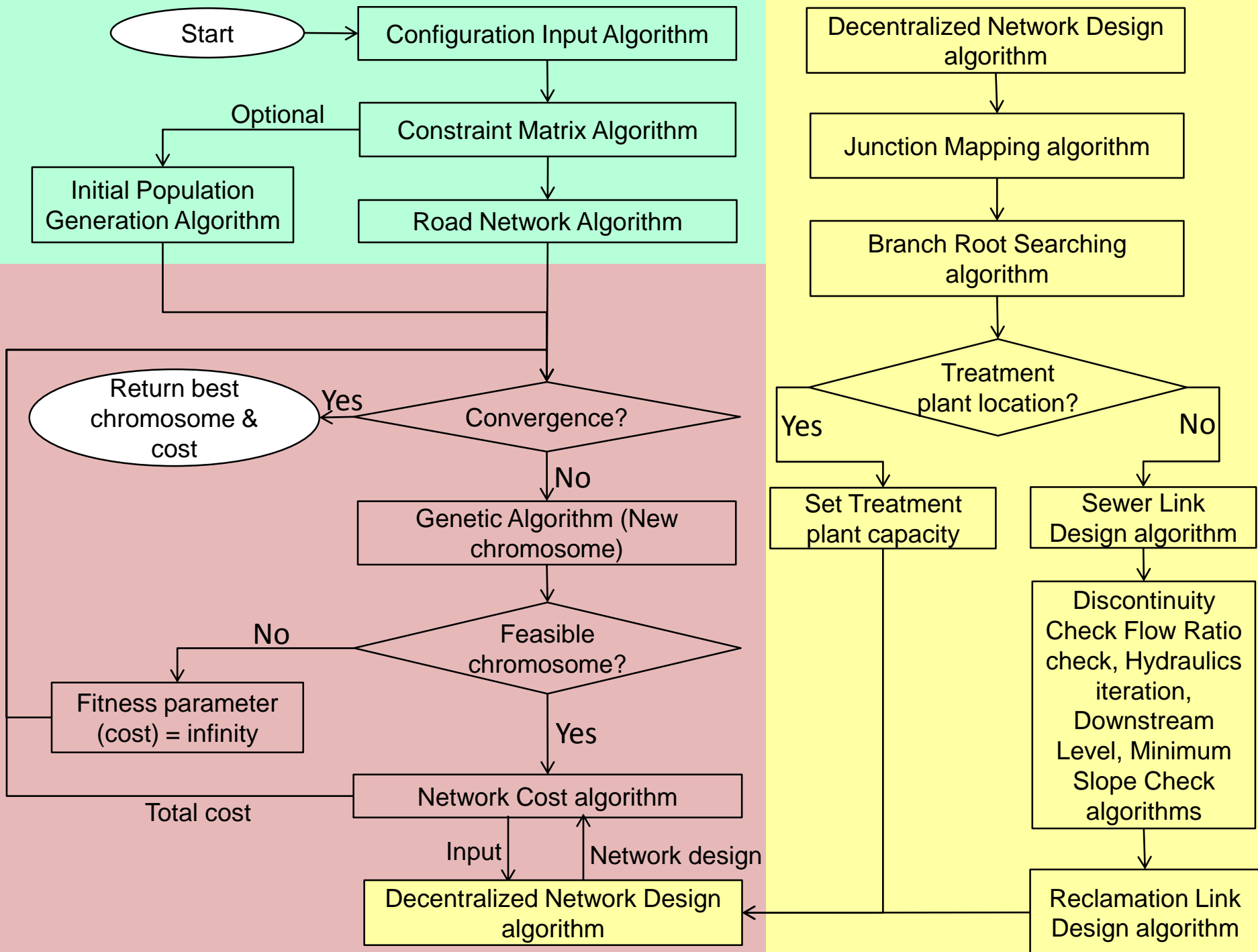


# Construction Cost



# Cost and Pumpback Energy Comparison





# Three Examples from India

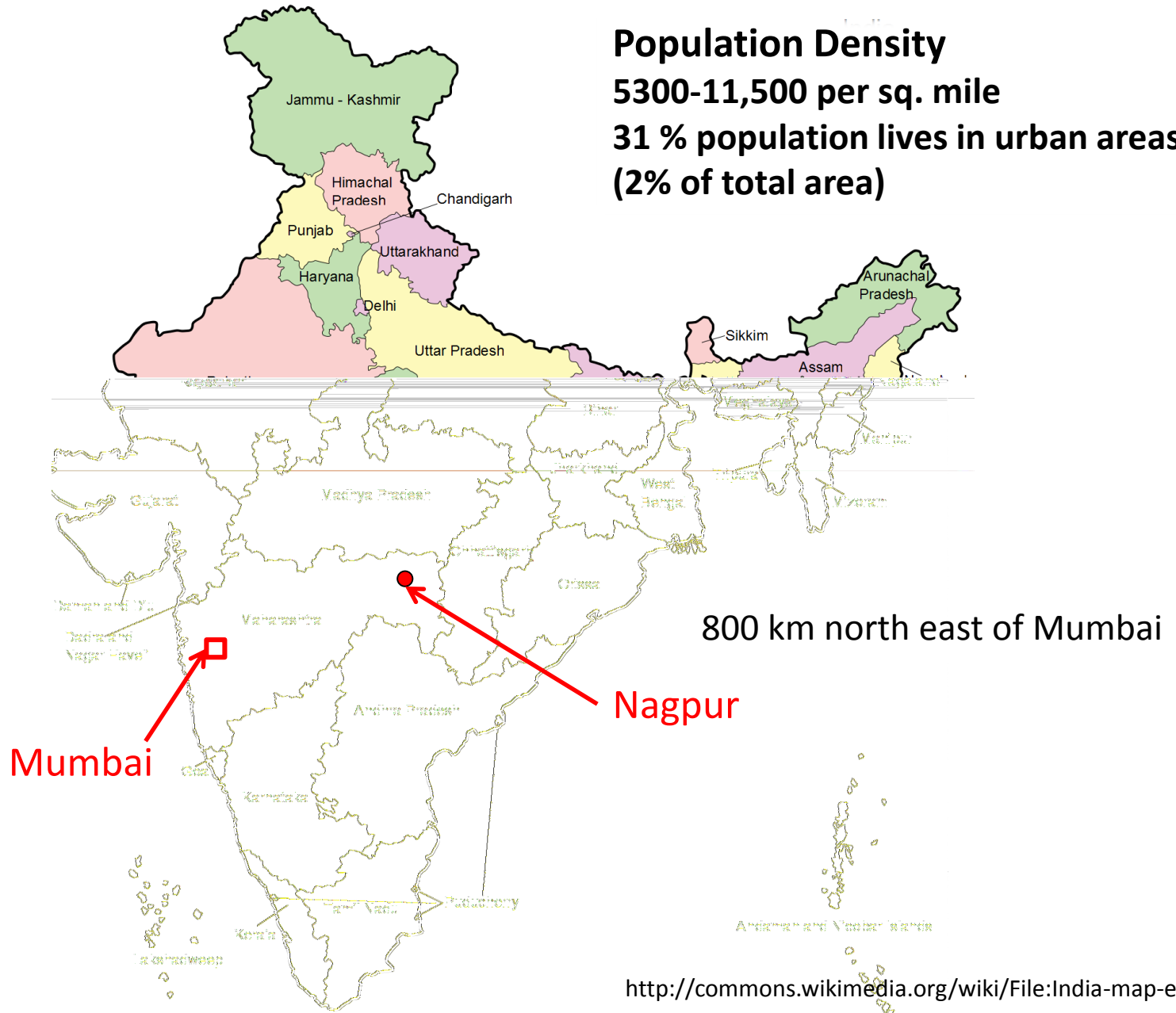
**Nagpur**     *Poor Source Water*

**Gurgaon**     *Lack of Capacity*

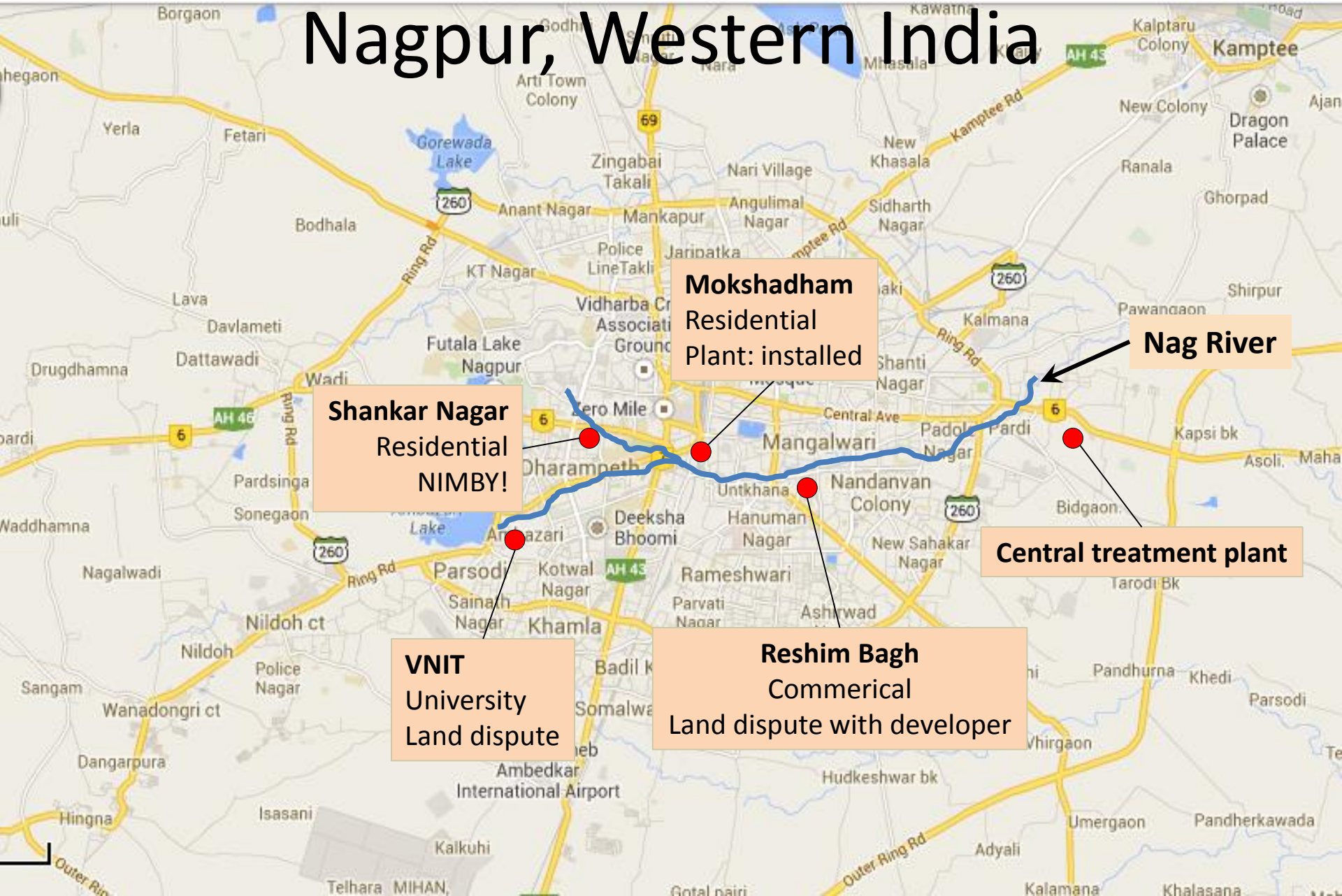
**Noida**     *Lack of Capacity*

# Nagpur, Central India

**Population Density**  
5300-11,500 per sq. mile  
31 % population lives in urban areas  
(2% of total area)



# Nagpur, Western India



**Mokshadham Residential Plant: installed**

**Shankar Nagar Residential NIMBY!**

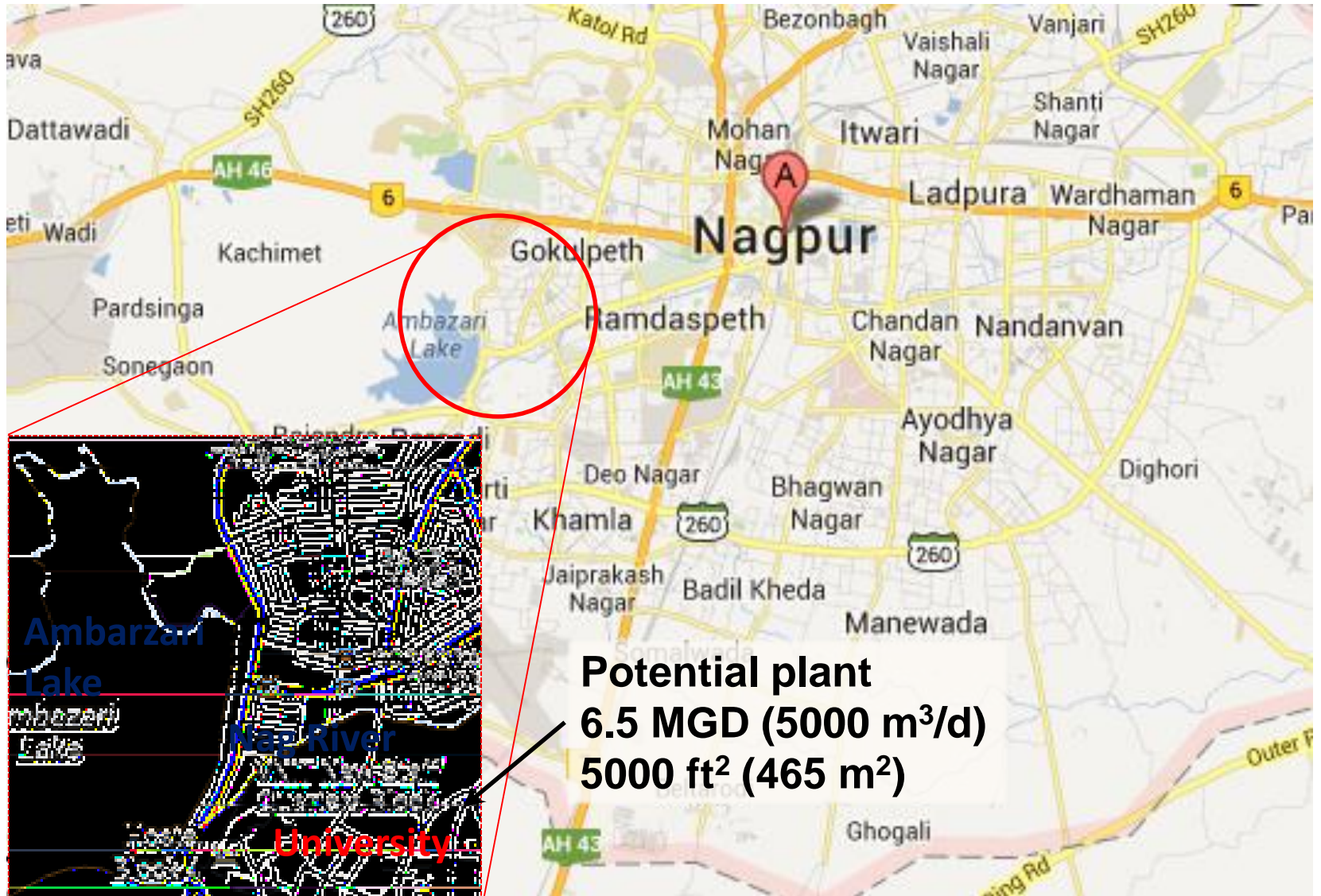
**VNIT University Land dispute**

**Reshim Bagh Commerical Land dispute with developer**

**Central treatment plant**

**Nag River**

# University and Treatment Plan

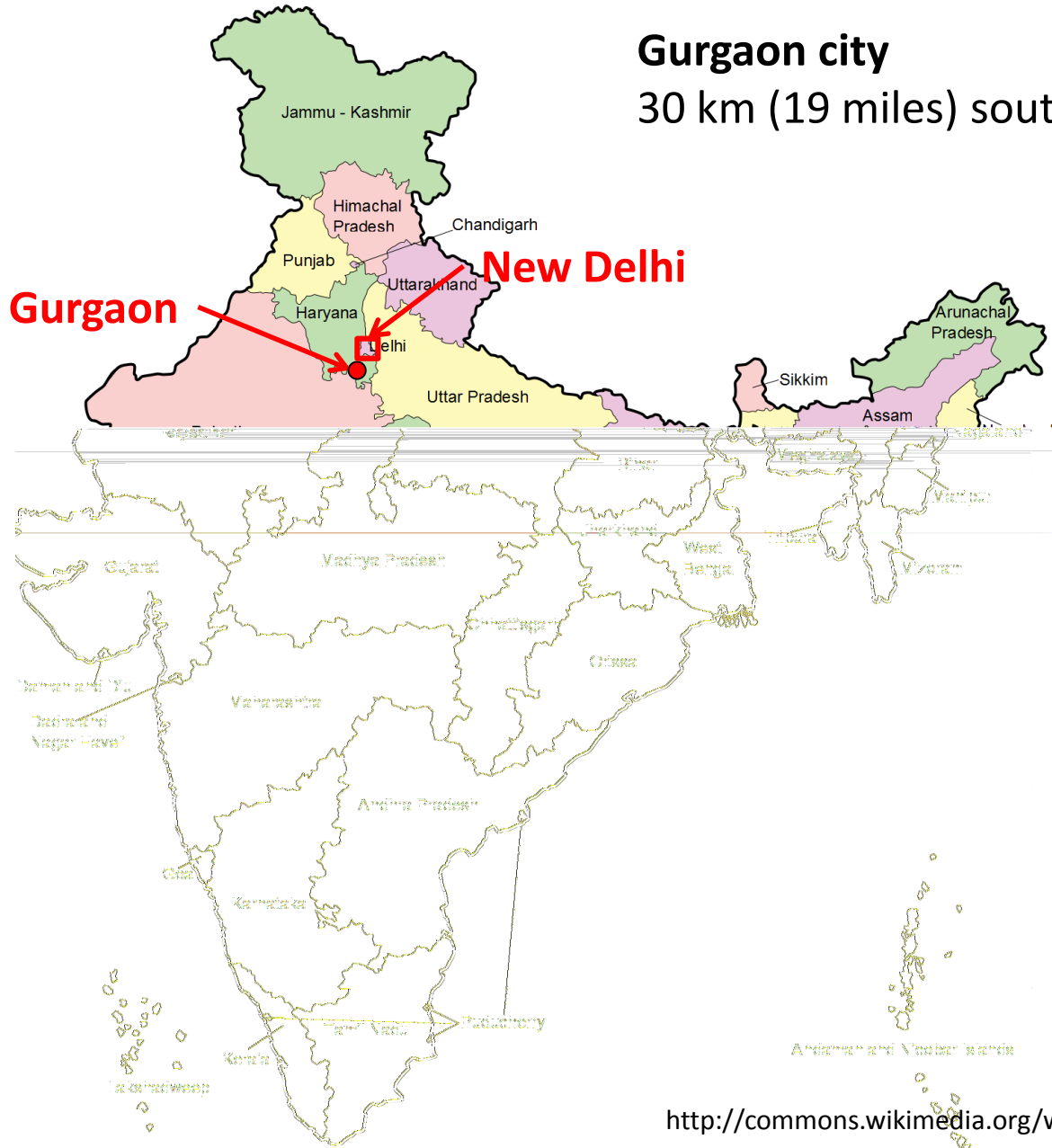




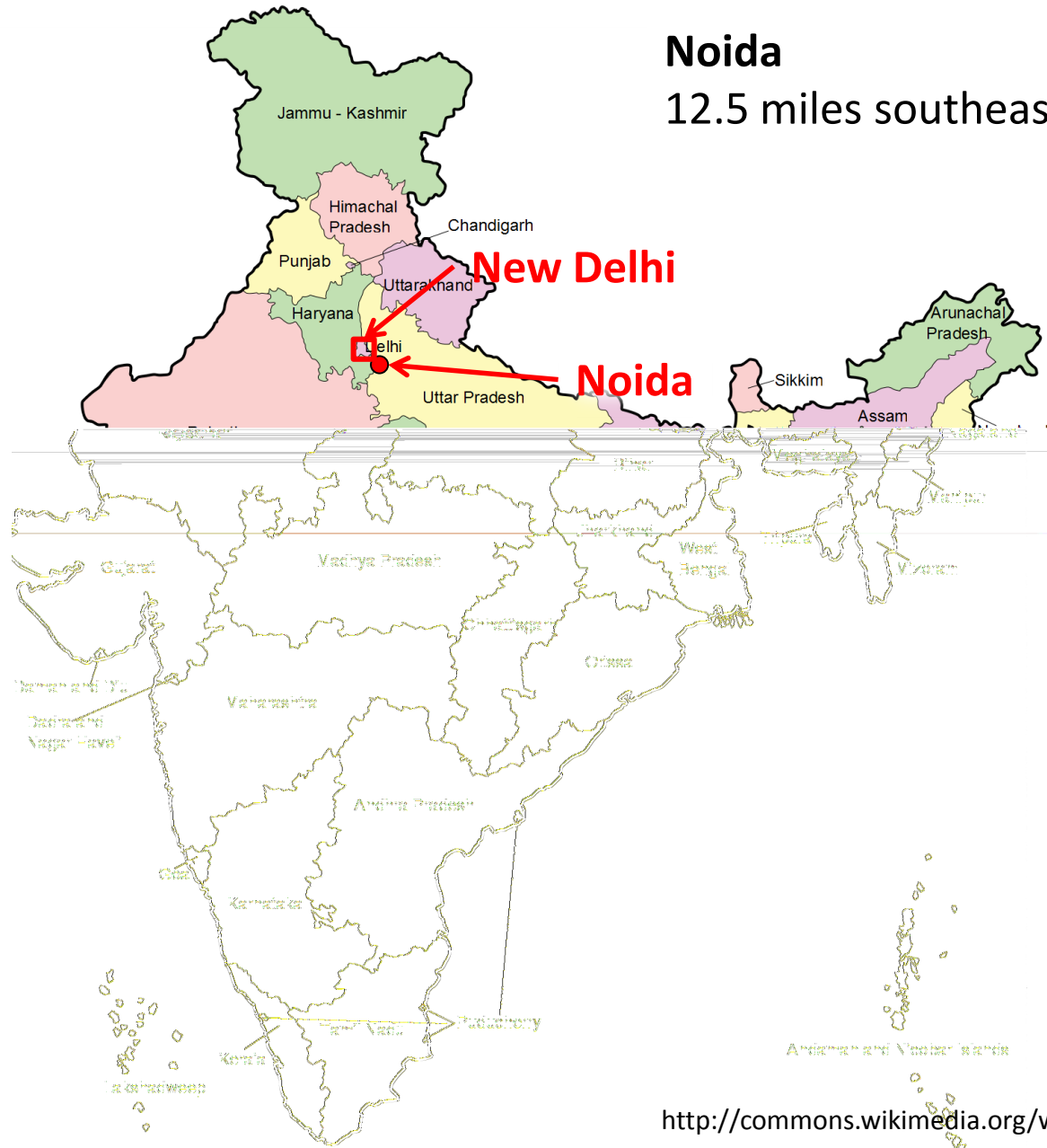
# Gurgaon and NOIDA, North India

**Gurgaon city**

30 km (19 miles) south of New Delhi



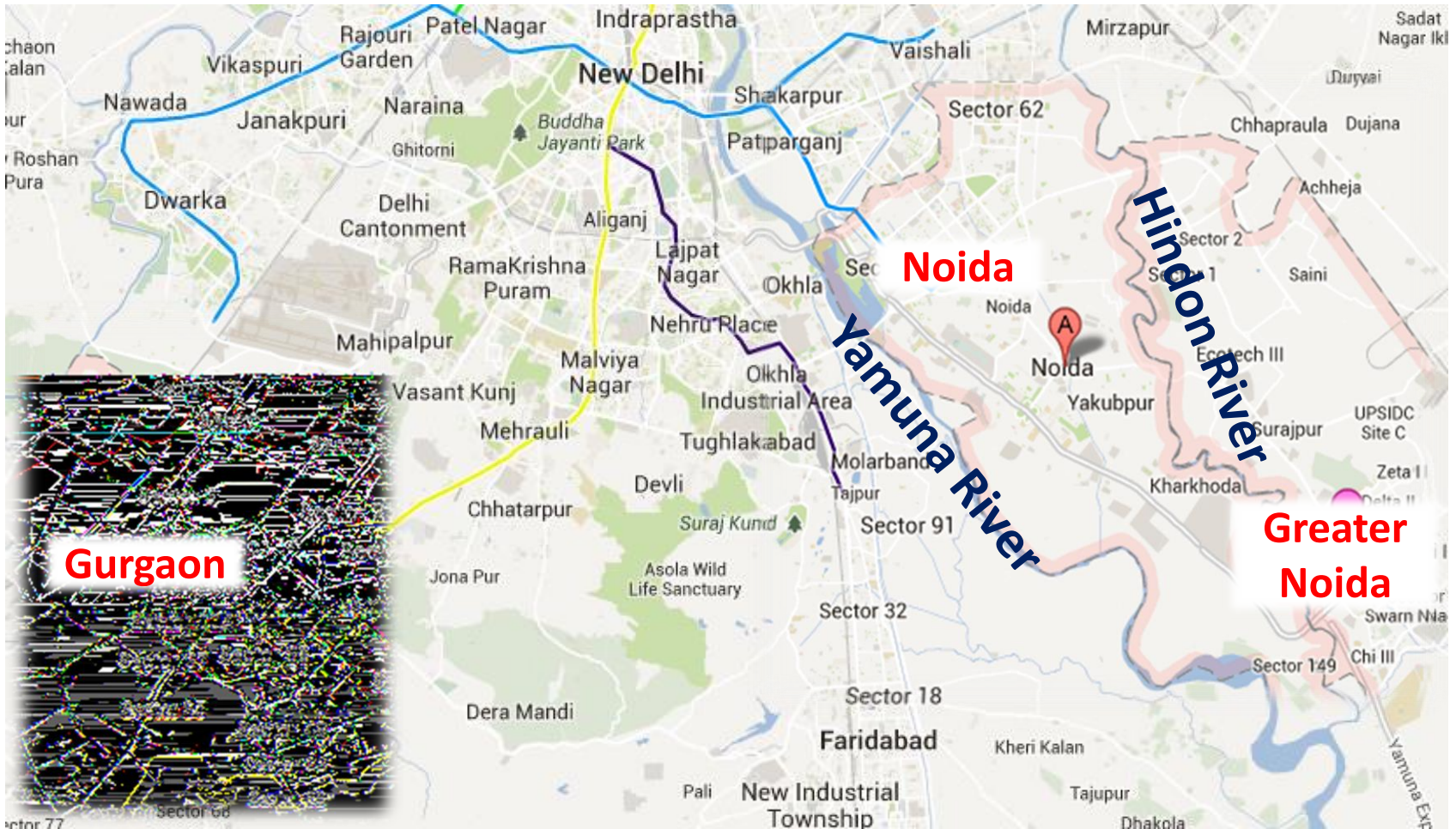
# Gurgaon and NOIDA, North India



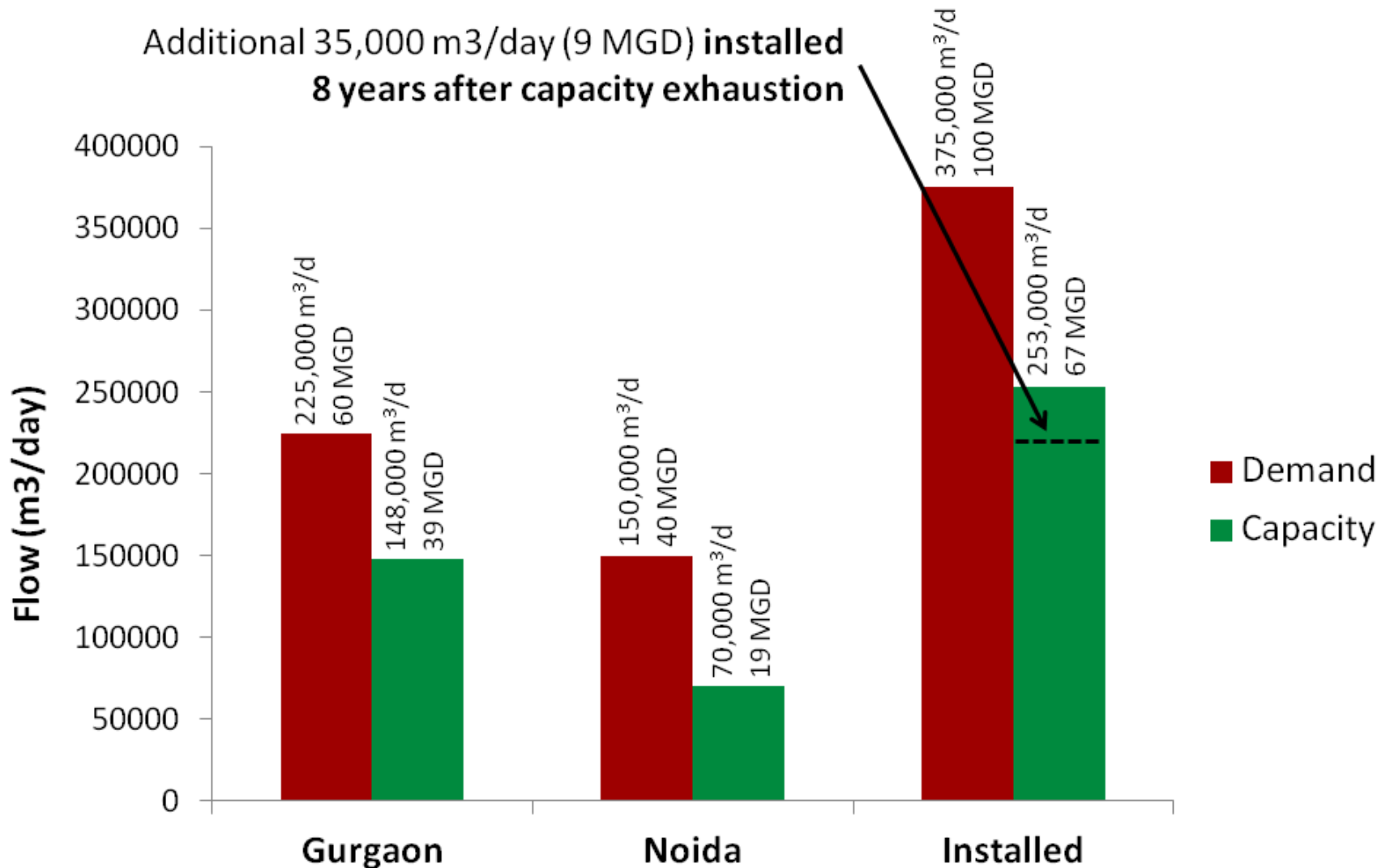
**Noida**

12.5 miles southeast of New Delhi

# Gurgaon-NOIDA, North India



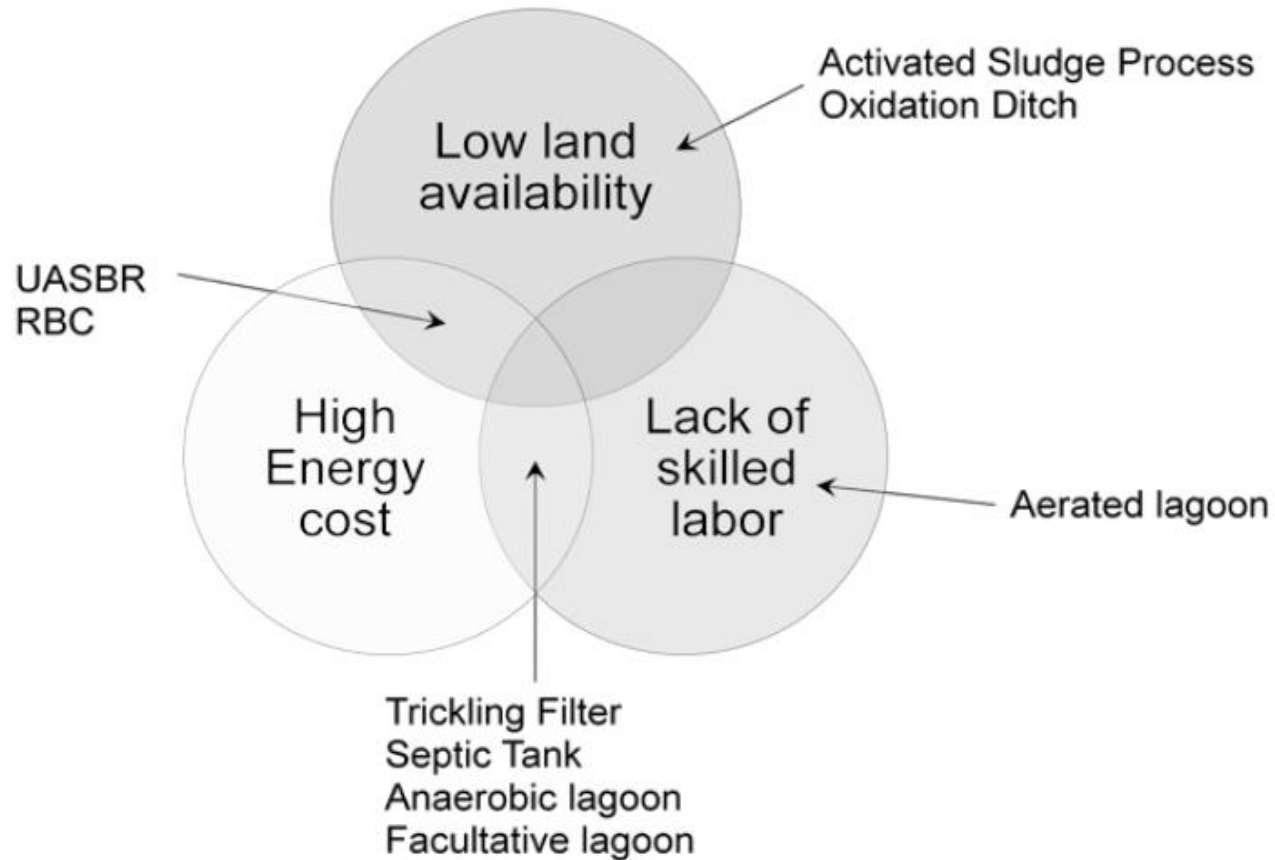
# Gurgaon-NOIDA, North India



# Decentralized Solutions

- Decentralized solutions exist for all three locations
- Problems exist due to land restrictions and “NIMBY”
- Water Reclamation needs exist and will drive decentralization
- Different priorities for different cultures

# Recommendations



- Smaller footprint
- Multiple plants –Flexibility
- Modularize capacity expansion
- Community participation