# St. Traffic Flow **Pollution Levels** with respect to the Light Rail Project

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## History of Yafo St.

- Main east-west artery of Jerusalem
  - Connected the Old City to Port of Yafo-Tel Aviv under the Ottoman rule
- Central Business District (CBS) of Jerusalem
  - Served as business & government center under British Mandate
  - Continues to be a booming commercial zone, for residents and tourists alike



# **Problems Arise**

Expansion of Jerusalem (post Six Day War)

- New neighborhoods such as Gilo & Ramot with their own shopping centers (especially Malcha Mall) draw Jerusalemites away from the downtown area
- Congestion / Lack of Capacity
  - Yafo St. is overflowing with buses, taxis, and private vehicles
  - Air & noise pollution levels rose significantly, decreasing quality of life

The Master Plan Solution In the 1990s, the Municipality developed an overarching transportation proposal

#### Goals

- Less vehicular traffic
- Less pollution

- New public transit options
  - Light Rail
  - Bus Rapid Transit
    - aka BRT

#### **Current Implementations of the Master Plan**

#### Derech Chevron BRT

- Old Train Station to Givat HaMatos (3 km)
- Completed in stages over the past decade
- Bus lines 71-74 run from Gilo & Har Homa to Ramot & Har Nof
- Additional bus lines utilize the route too

#### Yafo St. / Red Line Light Rail

- Har Herzel to Pisgat Ze'ev (over 13 km), via Yafo St.
- Planning & construction began in 2002
- Completion & testing in 2011
- Open to public in August 2011



#### **Yafo St. Light Rail >>** Traffic Flow Before, During, & After Construction

# Vehicular Access 2002-2011

- Before
  Construction
  (circa 2007)
  - Four lanes of vehicular traffic
  - Two-way flow
  - All vehicle types

 During Construction (2008–2010)

- Two to one lanes for vehicles
- At first, both ways
- In 2010, only east to west
- Only buses & taxis

Post-

Construction (2011 & on)

No vehicular access

- Pedestrian walkway
- Active light rail line

Extreme Congestion Lessening Congestion



### NOx Levels at Davidka Square Monitoring Station

- Reliable Indicators of Air Pollution:
  - Annual average levels (ppb)
    - Readings every half-hour
  - Number of times daily legal maximum exceeded
  - Number of times half-hour legal maximum exceeded
- By 2011, all indicators have shown significant reductions in air pollution levels
- However, during construction (2008–2010), the half-hour legal limit was exceeded more frequently, due to the heavy equipment used



#### Annual Average NOx Levels at Davidka Square

Decrease of 80%, from a high of 151 ppb in 2002 to a low of 32 ppb in 2011

## Note the drop to zero by 2011

#### Number of Times Half-hour Legal Max of NOx Exceeded





# CALRoads Model of Yafo St.

- CALRoads is a computer program that creates a model of air pollutant dispersion from vehicular traffic
- Inputs required:
  - Vehicle count per direction on street/intersection
  - Pollutant emission (gram per mile per vehicle)
  - Area of travel (of the vehicles)
- Output in a contour map of the area
  - Different color for each pollution levels
    - Allows for reading of general patterns, instead of only numbers from a few receptors

#### **Data Inputted & Variations**

- Four models in total were created, each with the same basic components, as noted previously
- The focus of the model was of the "rush hour", the hour of maximum traffic levels, of each intersection
- The four models were:
  - Pre Light Rail (traffic data ~ 2004)
  - Post Light Rail (traffic data ~ 2008-2010, with 2011 traffic flow directions)
  - Each time had two pollutant types:
    - Nitrous Oxide (NOx)
    - Particulate Matter [10 microns] (PM10)

## **Background Data**

- Wind conditions obtained from the Municipality monitoring station at the Kikar Safra
  - Most common speed & direction utilized
    - 3 m/s at 288 degrees
- GIS map obtained from the Municipality website
- Vehicle speed, for pollution dispersion purposes, was estimated at 20 km/hr
- All vehicle pathways running perpendicular/across Yafo St. radiate 50 meters outwards

Straus: Right onto Yafo[W]

and WT Right onto Hamelech George

Yafo[Vest] Straight) S-KG-3

Yato[E]: Right onto Straus

S-Water George: heft onto Yater

A Sample Intersection (King George–Straus)



NOx Levels (Pre Light Rail) Note the maximum concentrations above 65 ug/m3, near Rav Kook & Halani



NOx Levels (Post Light Rail) Note the severe drop – the maximum now is less than half, at approximately 30 ug/m3 & covers a much smaller area



#### PM10 Levels (Pre Light Rail)

Average contour zones ranging between .50-1.00 ug/m3



PM Levels (Post Light Rail) Simply dropped to zero nearly everywhere, besides the region between HaTurim & Sarei Yisroel, where the max is still less than 1 ug/m3

#### A Few Limitations & Assumptions

- Some of the traffic data was only from 2004 or before the current traffic flow was enacted (i.e. Kiach-Niviyim)
- Thus, for those intersections, only the relevant directions were included in the Post Light Rail model
- However, this is not entirely accurate, since traffic flow has changed significantly since then (i.e. buses rerouted from Yafo to Niviyim-Kiach)
  - Note the Davidka Square monitoring station's results still show that even with the rerouted traffic, the change was successful & air pollution has dropped significantly
- Additionally, some minor one-way streets did not have traffic data (ie Beit Ya'akov, HaGesher)

## **Changes for Future Studies**

- Model only utilized the worst-case scenario (hour of most heavy traffic by each intersection)
  - Future models can take a survey of every hour of the day & have a series of results
- More up-to-date traffic data

 Traffic data was only vehicle type & quantity
 Future models can integrate the real-time flow (via the timing of the traffic lights in each direction)

# THANK YOU FOR LISTENING!

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  - Interpretation of the data + technical issues
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