

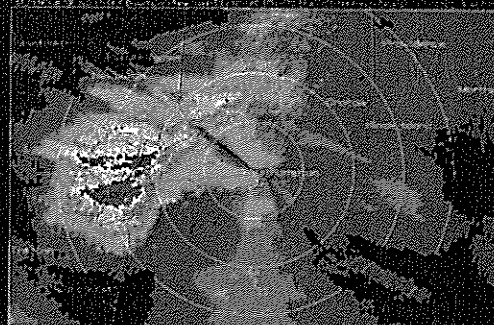
## City Council Transportation Committee Hearing

### Oversight: Flood Mitigation Initiatives

Cosima E. Crawford, P.E.  
SVP & Chief Engineer  
Capital Program Management

## August 8, 2007 Storm

Plymouth State Weather Center



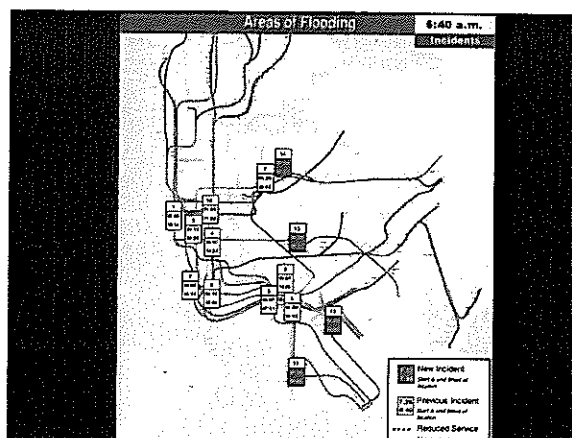
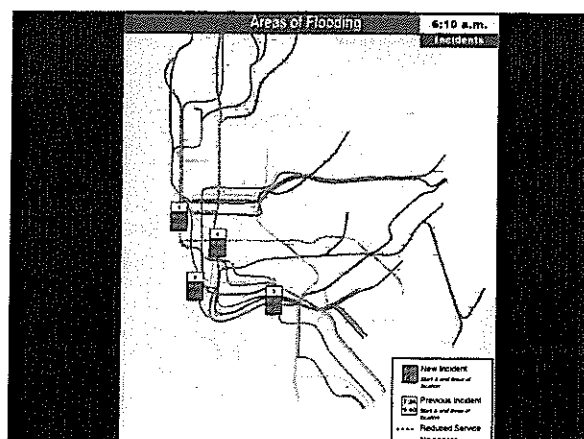
## Type of Storm

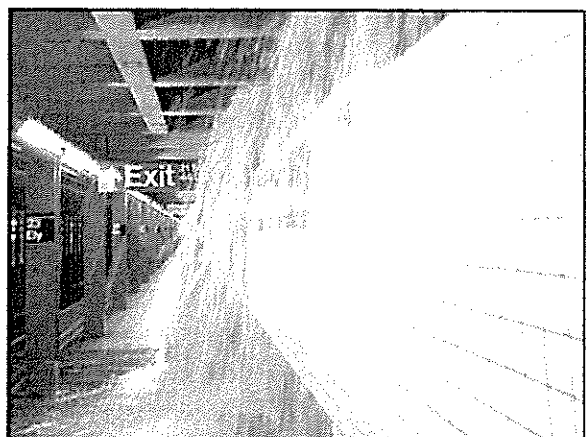
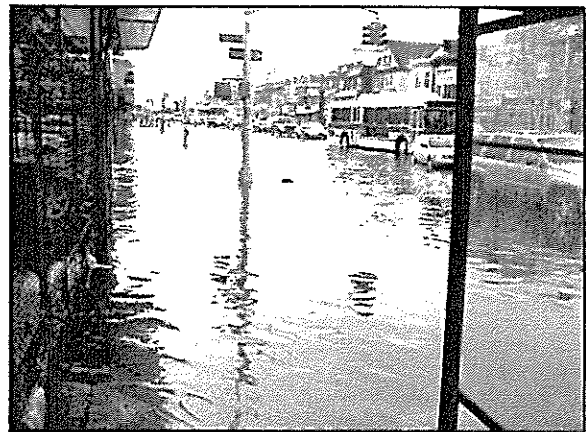
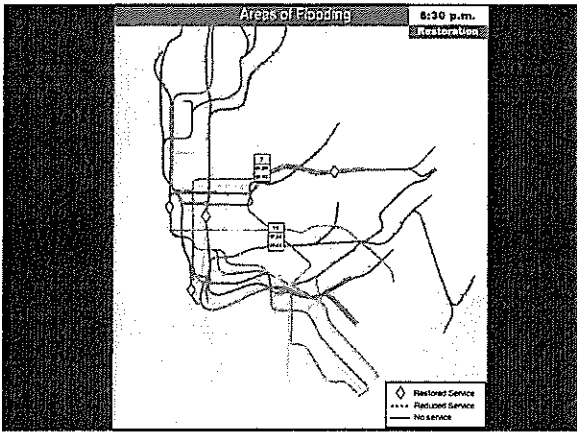
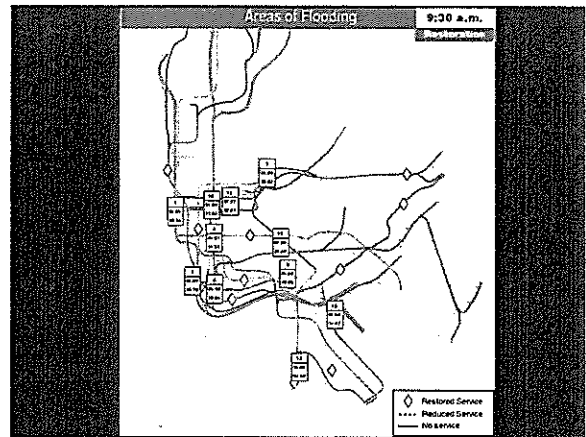
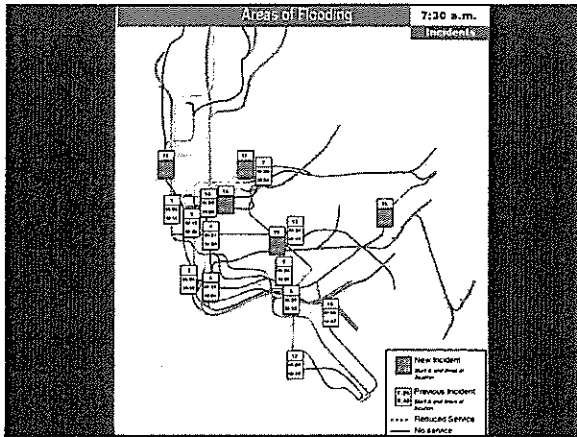
August 8, 2007

- Severe/largely unpredicted heavy rains and flooding.
- First tornado in 100 years in Brooklyn.
- Rainfall tallies ranged from 1.4 - 3.5 inches within 2 hour period during a.m. rush.
- Late August, President Bush declares Queens and Brooklyn as Federal disaster areas.

## Impacts to NYCT System

- 6:10 a.m. four locations in Brooklyn and Manhattan were flooded.
- By mid-morning, 19 major segments report flooding and are shut down.
- 2.5 M transit customers affected.
- Bus disruptions from flooded roads and highways.
- Displaced customers stressed with no alternative.







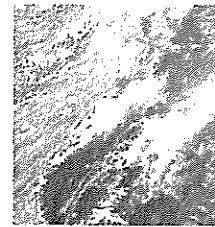
## Restore Subway Service

- Clear right of way
  - Remove water and 8 tons of debris, silt and mud
  - Remove trees and branches from Brighton and Sea Beach lines
- Clean and overhaul
  - 46 stops
  - 32 switches
  - 6 insulated joints

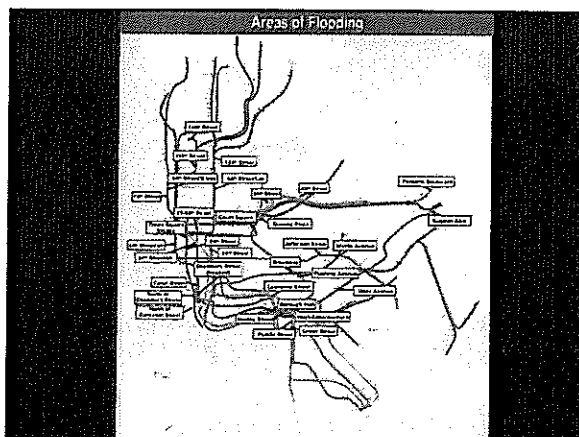
## Restore Subway Service (Cont'd)

- Test, validate, and repair signal and track equipment.
- Replace damaged components
  - 18 induction stop motors
  - 29 track relays
  - 53 resistors
  - 7 track transformers
  - 4 electric switch motors
- The cost for Track and Infrastructure personnel and equipment was approximately \$270,000.

## August 8, 2007 Storm Report



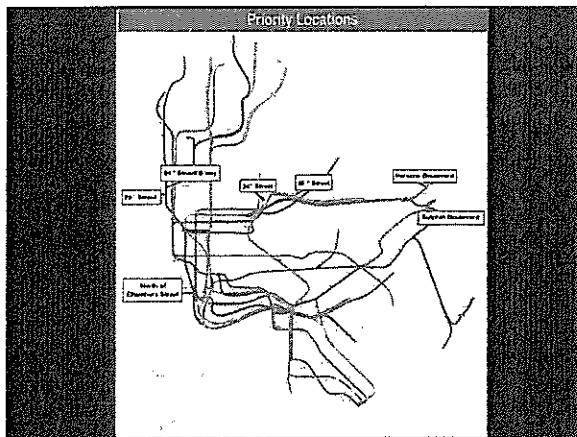
Metropolitan Transportation Authority



## Most frequently flooded locations

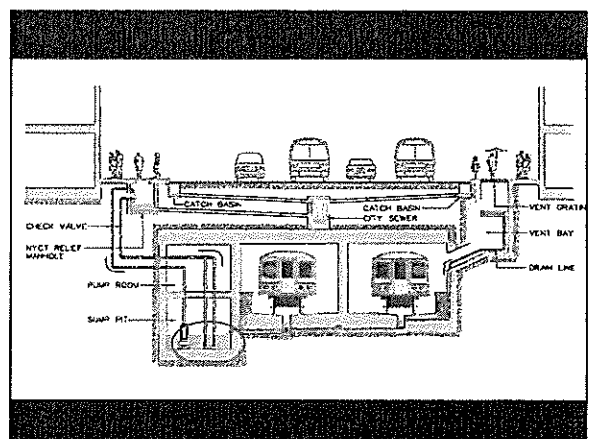
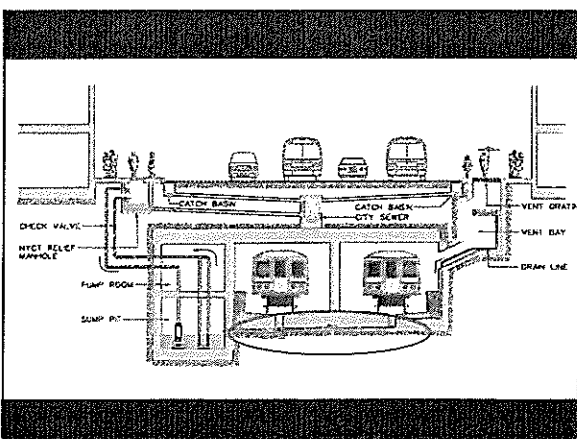
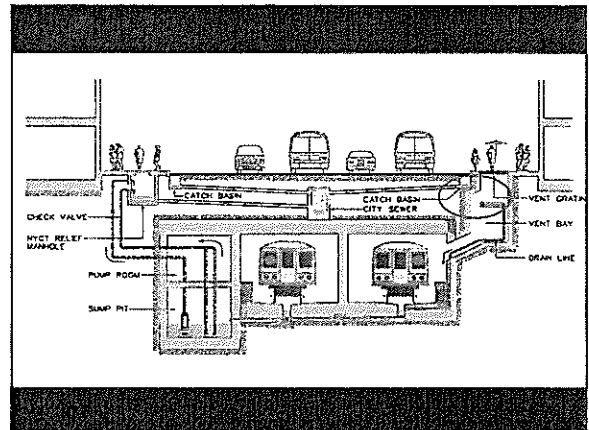
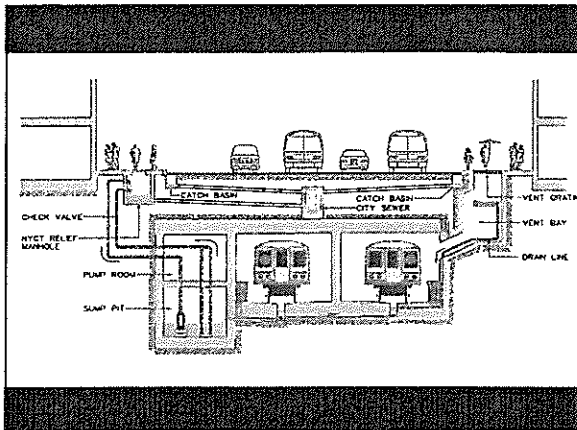
| Location                           | Frequency | Location                        | Frequency |
|------------------------------------|-----------|---------------------------------|-----------|
| Parsons - Hillside F               | 39        | Broadway - G                    | 5         |
| 65th St. Stn / Northern Blvd V/R/G | 28        | Union St. - R/V/N               | 5         |
| 79th St./Bwy - 1/2/3               | 27        | Navas St. - 2/3/4/5             | 5         |
| 30th St. & Stoinway St. Sine V/R/G | 21        | 110th St. / Lenox - 2/3         | 5         |
| Queens Plaza - E/G/R/V             | 19        | Hoyt - Schenckham Station A/C/G | 4         |
| Chambers St. (7th Ave.) - 1/2/3    | 19        | Jefferson St. - L               | 4         |
| Ulton Ave. - A                     | 18        | Sunphin Blvd. - J               | 4         |
| 86th St. 4/5/6                     | 16        | 148th St. - 3                   | 3         |
| Lawrence St. - R/V/N               | 15        | Corlandt St. - 1                | 3         |
| North of Pacific St. - D/M/N/R     | 14        | Court Square - G                | 3         |
| 34th St. / 8th Ave - A/C           | 13        | Chambers St. (Nassau) - M       | 3         |
| 125th St. 4/5/6                    | 12        | 26th St. & 7th Ave. - 1/2/3     | 2         |
| 23rd St. / Park Ave. - 4/5/6       | 8         | Myrtle Ave. - L                 | 2         |
| 86th St. & Broadway - 1/2/3        | 27        | * Borough Hall - 2/3            | 1         |
| 34th St. / Herald Sq. B/D/F/V      | 8         | * Flushing Ave. Station G       | 1         |
| 47th 50th Sts/Rock Center - B/D    | 8         | * Times Sq. Shuttle             | 1         |
| Canal St. - N/R                    | 5         |                                 |           |

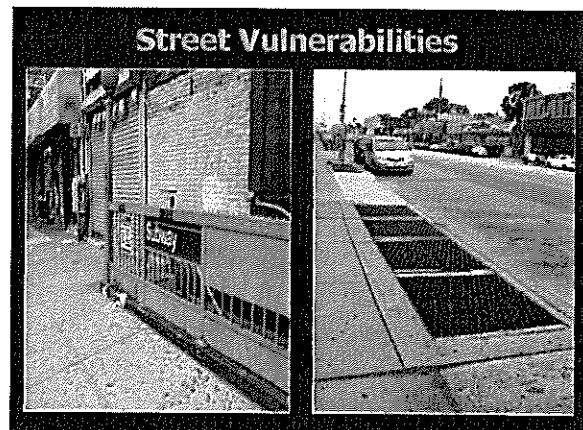
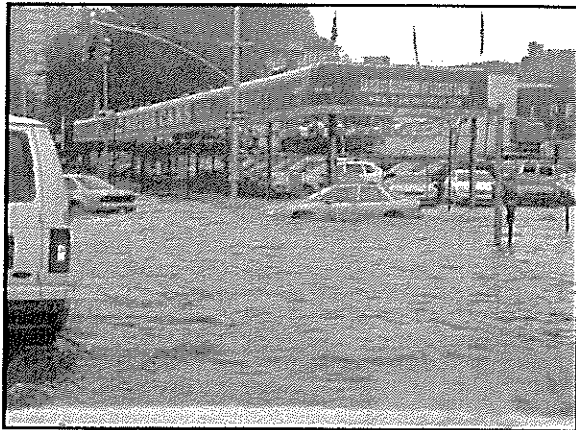
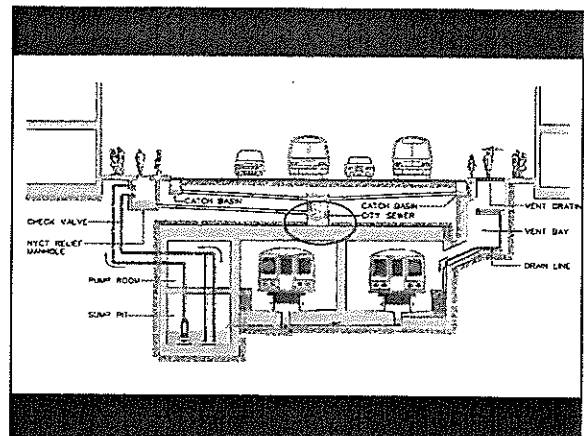
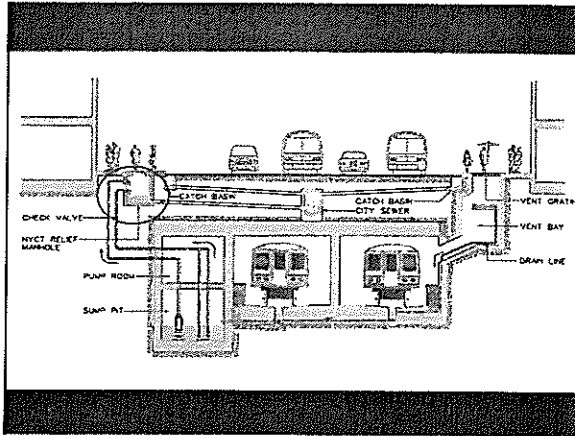
\* Flooded for the first time Aug. 8, 2007



## What Causes Subway Flooding?

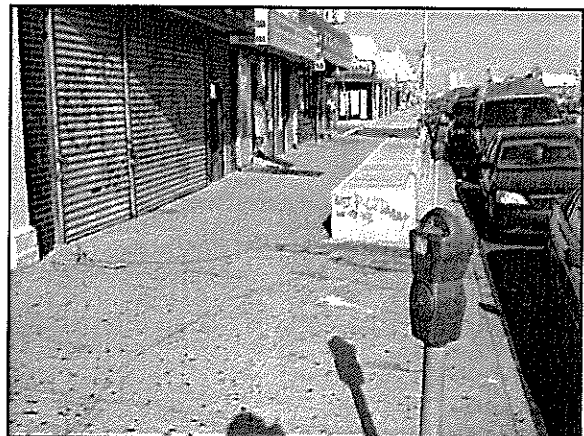
- Quick, heavy rainfall
- Water main breaks
- Poor roadway/sidewalk drainage
- Poor street drainage/sewer system
- Poor track drainage
- Sewer backflow at direct connection

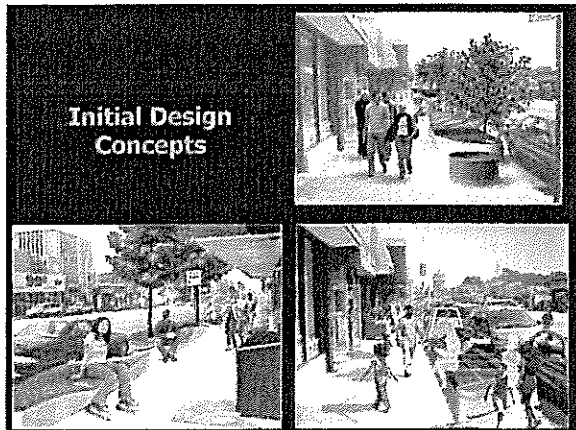




## Design Solutions

- Gratings
  - Raise
  - Close
  - Regrade sidewalk around them
- Modify entrance stairs
- Direct Sewer Connections – Add check valves

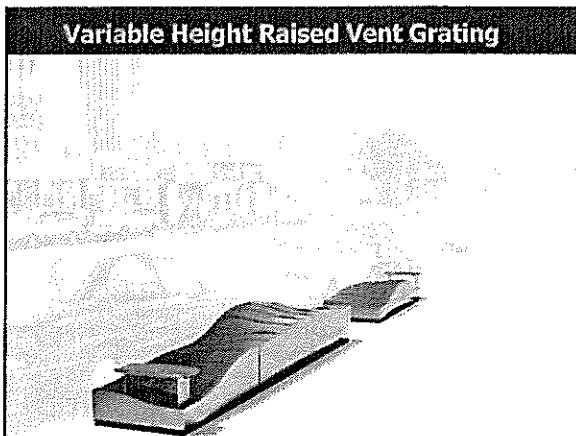




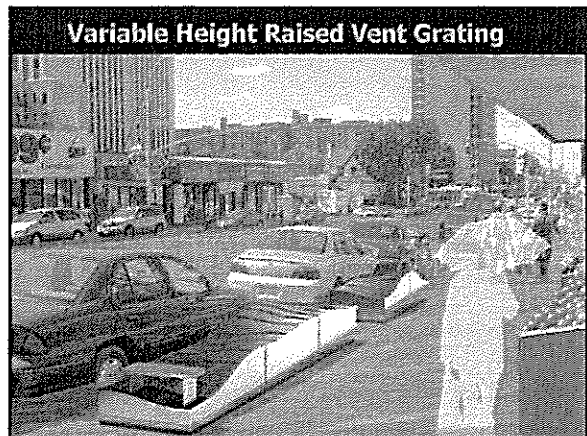
**Initial Design Concepts**

## **Raising/Closing of Vent Gratings**

- Steps involved in decision making
  - Topographic Surveys
  - Hydrology Analysis
  - Ventilation Analysis
    - Computational Fluid Dynamics (CFD)
    - Subway Environmental Simulation (SES)
  - Pedestrian Counts
  - Classify Vent Grates
    - Raising
    - Closing
    - No Action

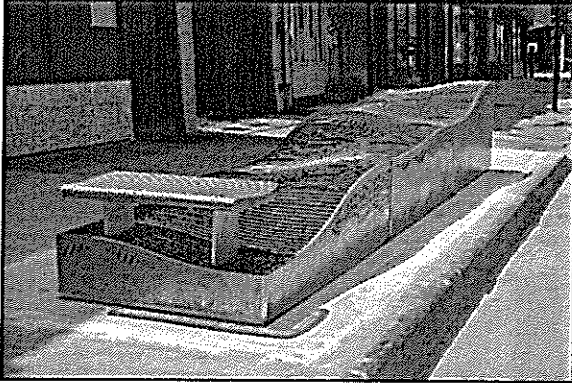


**Variable Height Raised Vent Grating**

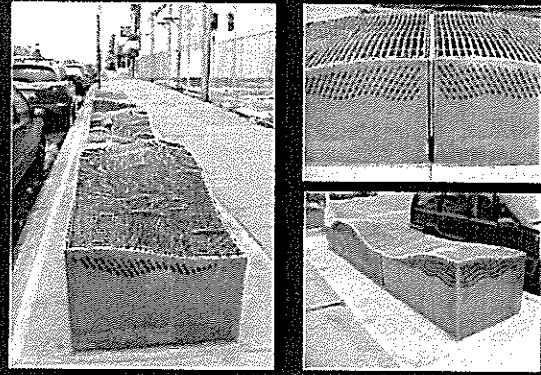


**Variable Height Raised Vent Grating**

**Variable Height Raised Vent Grating Prototype**



**Variable Height Raised Vent Grating**



**Variable Height Raised Vent Grating**



**Variable Height Raised Vent Grating**

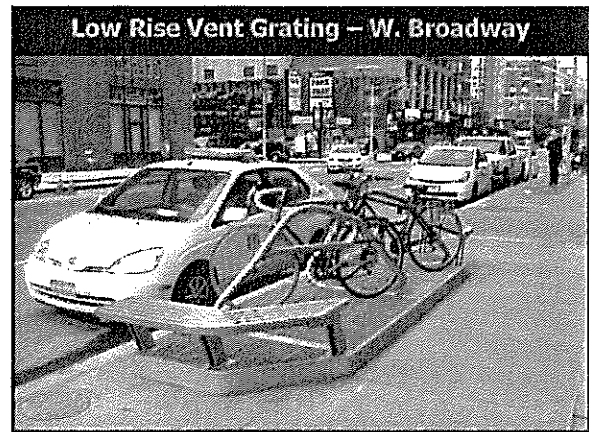
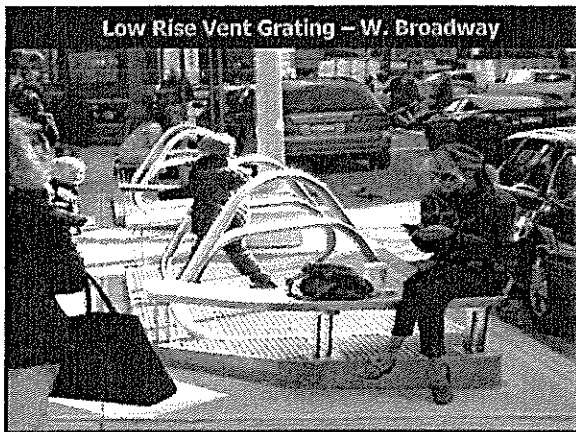
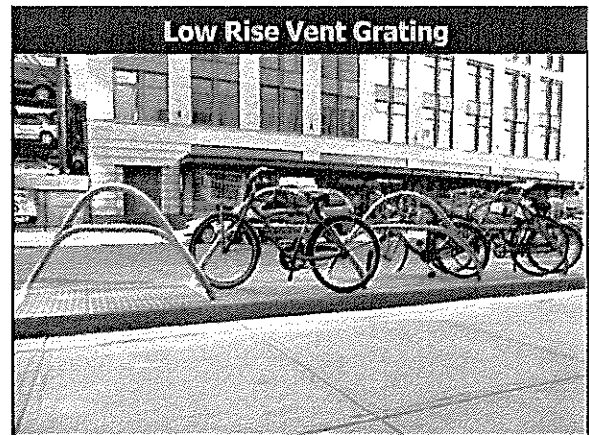


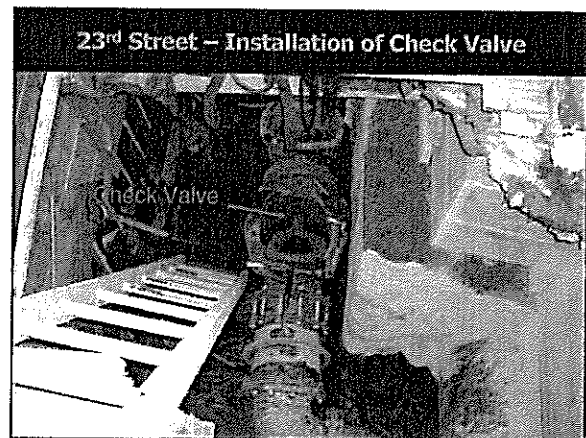
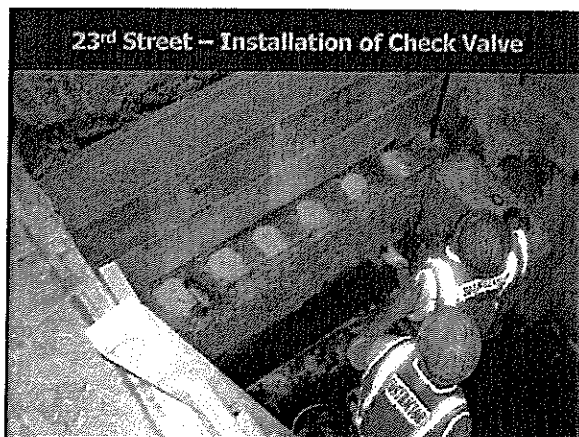
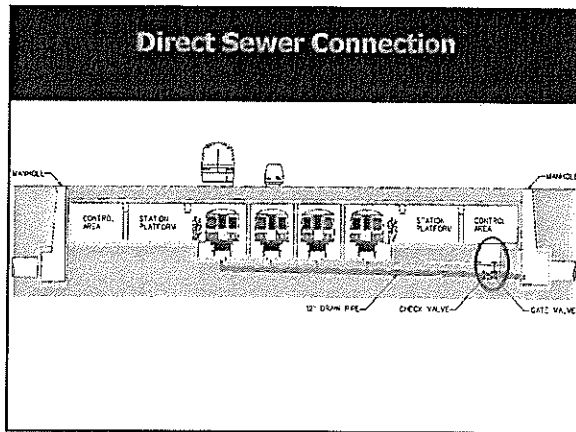
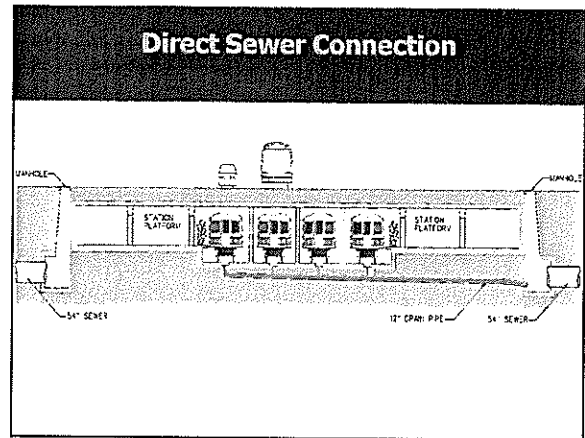
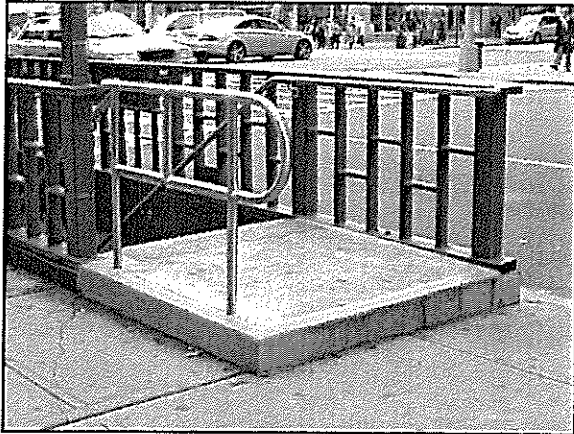
**Variable Height Raised Vent Grating**



**Low Rise Vent Grating**





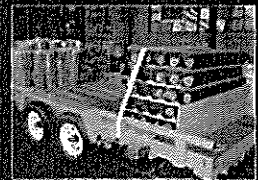
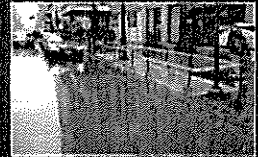


## Current Status

- **Vent Bays**
  - 7 priority locations completed
    - 864 raised
    - 805 closed
  - Designs completed for remaining 18 locations
- **Check Valves**
  - 7 completed
  - 14 in procurement
  - 9 in design

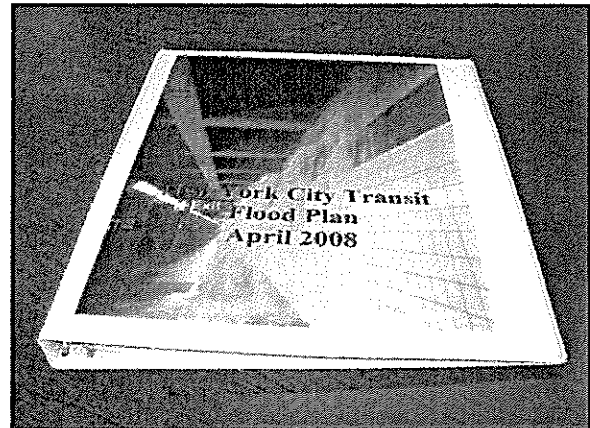
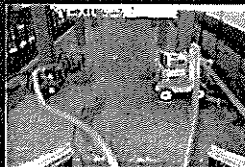
## Maintenance Improvements

- Increased frequency of cleaning in flood prone areas:
  - Vents
  - Track bed locations
  - Drains
- Operation Submarine
- Continuous monitoring and assessment



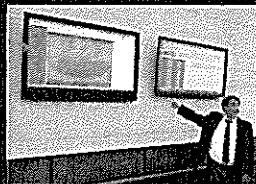
## Operational Preparedness

- Purchase and deployment of additional temporary pumps
- Drills for covering vents
- Positioning of pump train close to flood prone areas
- Staff on stand-by in event of a flood



## Communication Improvements

- Set up Communications Desk at RCC
- Installed Bus Command Desk at RCC
- Established clear emergency communication protocols
- Defined protocols between operation centers
- Improved communications with outside agencies
- Enhanced communications to the public via MTA website and media



## Improve Service Delivery During Flooding

- Developed Flood Contingency Service plans
- Developed a subway shutdown contingency plan with MTA Bus