

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BROOKLYN-QUEENS AQUIFER FEASIBILITY STUDY

CITIZENS ADVISORY COMMITTEE MEETING: January 8, 2004

MINUTES

The 17th meeting of the Brooklyn-Queens Aquifer (BQA) Feasibility Study Citizens Advisory Committee (CAC) was held on Thursday, January 8, 2004 at the Hillside Manor Comprehensive Care Center. (See Attachment A for Attendance List.)

Helen Neuhaus, Helen Neuhaus & Associates (HNA), opened the meeting by wishing members a happy New Year and by introducing Adam Zeller, HNA, filling in for Denise Woodin. Following adoption of the Minutes of the December 4, 2003 meeting without changes, Ms. Neuhaus facilitated a discussion of follow-up items. These included:

- Deputy Commissioner Doug Greeley, New York City Department of Environmental Protection (DEP), provided additional information regarding reimbursement for remediation of the West Side Corporation (WSC) site. He informed the CAC that DEP's Legal Department is pursuing a proportional recoupment strategy, whereby agencies will receive reimbursement from the site's owner(s) based upon the amount of money invested for clean-up.
- Ms. Neuhaus stated that presentations on the project's progress will be given to Community Board #12 and Community Board #13 later this month. Both Ms. Neuhaus and Nicole Brown, Malcolm Pirnie, Inc., will bring the Community Boards up-to-date on the progress made since the last Community Board briefings. The "Partners" video will be shown at both presentations.
- Ms. Neuhaus pointed out that a glossary of terms to accompany the "Partners" video was available at the sign-in table for use when the video is shown to local organizations.
- Ms. Brown reported on a meeting she attended earlier in the day with I.S. 59 representatives regarding the development of educational programs, including establishment of a water quality laboratory in the school. Ms. Brown estimated the cost of the project at up to \$150,000 and indicated that the initiative will require funding from outside sources. Manuel Caughman, who also attended the meeting, added that the Hudson River Foundation provides grants up to \$50,000. Ms. Brown and Mr. Caughman have tentatively scheduled a meeting with I.S. 59's assistant principal on Thursday, January 16th to continue discussing development and funding of the lab.
- Commissioner Greeley noted that because of interest generated by the October 22nd Public Meeting, York College has requested that monitoring wells be installed on its campus. The United States Geological Survey (USGS) has agreed to drill and install the wells and will assist with monitoring and data collection. The exact number and location of wells to be installed need to be confirmed. Ms. Brown commented that these wells could become an important educational tool for students at the Queens High School for the Sciences, which is located on the York College campus. Don Cohen, Malcolm Pirnie, Inc., added that, because of their location, the wells could also provide useful information for the Station 6 project.

Project Update

Permitting

Mr. Cohen began his presentation (see Attachment B) by noting that the permitting approval process for Stations 24 and 6 is proceeding slower and with more difficulty than expected. He remarked that while the facilities will bring great benefits to the community, they remain subject to stringent permitting regulations and approval processes. Before reviewing the status of work at each site, Mr. Cohen provided an overview of the required permits and approvals:

- State Pollution Discharge Elimination System (SPDES) Permit – issued by the New York State Department of Environmental Conservation (DEC), this permit regulates pollutants in wastewater discharge and protects the quality of surface water (in this case, Jamaica Bay).
- Uniform Land Use Review Procedure (ULURP) – administered by the New York City Department of City Planning (DCP), this review process ensures compliance with City codes.
- Building Permits – issued by the New York City Department of Buildings (DOB), these permits allow building construction in New York City. The Board of Standards and Appeals (BSA) becomes involved in a project when a permit is rejected by DOB.
- City Environmental Quality Review (CEQR) – overseen by DEP’s Office of Environmental Planning and Assessment, this review process ensures that city agencies have considered the environmental implications of issuing permits.
- System Works Approval – issued by the New York State Department of Health to ensure the safe operation of the water supply system.
- architectural review and approval of proposed buildings by the New York City Art Commission. A building permit cannot be issued without Art Commission approval, which is contingent upon review by the affected Community Board (in this case, Queens Community Board #12).

Station 24

Mr. Cohen began by discussing permitting issues at Station 24. He explained that because DEC is a partner with DEP on this project, an application was submitted for a SPDES “equivalent” permit, rather than the full SPDES permit. In response, DEC proposed preliminary discharge limits close to those levels requested by the project team. However, final limits for three parameters [pH, Perchloroethylene (PCE) and metals] are still being negotiated. Mr. Cohen explained that although Station 24 would meet the PCE limit proposed by DEC during normal operations, there would be short periods of time (i.e., during backwashing) when the limit would be exceeded. He added that the U.S. Environmental Protection Agency (EPA) has indicated that such discharges would not be harmful to aquatic life on a limited basis.

With regard to land use and zoning reviews, Mr. Cohen noted that half of the affected land is zoned residential (R-4), while the other half is zoned for manufacturing (M-1). He explained that DCP has recommended that the entire area be zoned M-1, adding that construction at Station 24 could possibly begin with BSA approval, followed by a formal zoning change at a later date. Mr. Cohen also noted that several mapped streets run through the property and indicated that, in the interest of expediency, the project team could apply for a BSA waiver to allow for construction in the footprint of the mapped streets. The formal street demapping process could be conducted at a later date. Referring to a map of the area, Mr. Cohen noted that recent construction on 107th Avenue and 178th Street, which are dead end streets, has limited access for

deliveries and emergency vehicles. He stressed that as part of the formal demapping of streets at the Station 24 property, the project team would coordinate with emergency services and other appropriate parties to ensure satisfactory access.

Station 6

Mr. Cohen reported that the SPDES permitting process for Station 6 is moving much more slowly than for Station 24, because DEC has set a prohibitively strict limit of 4 mg/L for total nitrogen in the discharge. Although the reverse osmosis process at Station 6 will produce reject water with extremely high concentrations, the nitrogen limit set by DEC is significantly more stringent than that set for local wastewater treatment plants. The proposed limits reflect DEC's "no new source" policy for nitrogen, which is designed to protect surface water quality.

Mr. Cohen also explained that it will be difficult to meet the 1 part per billion (ppb) limit for PCE set by DEC, especially during backwashing operations, where PCE levels could reach 20 ppb. The stringent limits could lead to the need for secondary treatment operations or alternatively the discharge of water to the Jamaica Bay Water Pollution Control Plant via the sanitary sewer. Although the treatment plant has the capacity to accept the flow, this option would involve construction of a new force main and sewer connections in Brinkerhoff Avenue.

Referencing a zoning map of the area, Mr. Cohen noted that the Station 6 facility is located in a residential (R-4) area, adding that DCP and BSA are engaged in a jurisdictional dispute concerning permitting at this site. He also explained that DCP is reluctant to change the zoning designation from residential to manufacturing in this predominantly residential area but could grant a waiver for the project. DEP's Legal Department is looking into which city agency has jurisdiction over the matter. Mr. Cohen added that although zoning categories exist for water pumping and distribution, there is no category for water treatment facilities. This is likely to result in a long and complicated process to obtain a zoning amendment for water treatment. Therefore other options, including a mayoral override, are being considered.

Questions and comments raised during the presentation are summarized below:

- In response to a question from Mark Lanaghan, DEP, Mr. Cohen clarified that the Station 6 plant is considered a new source of nitrogen because it would discharge water containing concentrated nitrogen into the storm sewer system, which leads directly to Jamaica Bay.
- Several questions and concerns were raised regarding the new sewer lines that would be required for the Station 6 facility. Commissioner Greeley explained that funding is available and that the new connection would be a dedicated pipe to bypass the flow to larger sewers downstream of existing flooding problems. The new lines could be installed in conjunction with other sewer improvement projects, thereby minimizing construction impacts on the community. Mr. Cohen confirmed that the existing sanitary sewer infrastructure could handle the additional flow from Station 6.
- Tracey Bowes stated that the residential community would be likely to oppose any effort to introduce additional manufacturing zones. She emphasized that the community is not opposed to the work but is concerned about a zoning designation that would allow for future industrial uses. Mr. Lanaghan pointed out that a zoning change could be accompanied by certain restrictions that would prevent use of the land for anything except water treatment. Ms. Bowes also voiced support for the ULURP process, as it

involves the participation of the Community Board. Bill Yulinsky, DEP, responded by explaining that the ULURP process can take more than a year and that working through the BSA process instead could expedite clean-up of the WSC.

- In response to a question from Mr. Caughman, Mr. Cohen said that surveying for street demapping is underway at Station 24. Irving Hicks reiterated his support for demapping of the streets.

Aquifer Storage and Recovery

Mr. Cohen provided an overview of Aquifer Storage and Recovery (ASR), another component of the City's continuing efforts to ensure dependability of the water supply system. (See Attachment C.) He explained that ASR, also known as "water banking," is a way to store water during years of normal precipitation for use during a drought or other event. Commissioner Greeley observed that in rainy weather, the City releases approximately 3 billion gallons of water a day and that residents in Delaware County are currently experiencing flooding because of the heavy rains in recent months. He described it as "obscene" to waste that much water when it could be stored and used later. ASR could, in fact, put an end to the effects of mini-droughts that affect the City approximately every five years, while at the same time recharging the aquifer.

Mr. Cohen explained that the location of the Lloyd Aquifer makes southeast Queens a prime candidate for ASR. He described Long Island (of which Queens is a part) as being made up of layers of sand and gravel, starting near the Long Island Expressway and moving southward. This geology is not found to the same extent in the other boroughs. Mr. Cohen showed a drawing of the three aquifers beneath Long Island, of which the Lloyd is the deepest (ranging from 700 to 1,000 feet deep). He pointed out that the Lloyd lies between layers of clay and bedrock, which would both contain the spread of water injected as part of ASR and keep any surface contaminants out.

Commissioner Greeley reported that proposals to significantly increase the City's water capacity are being developed in light of the discovery of a 30 million gallon per day (mgd) leak in the Delaware Aqueduct, which carries half of the City's daily water supply. In order to fix the leak, the aqueduct must be temporarily closed and drained. DEP expects to begin work on the aqueduct in 2012. However, an alternate water supply must be in place prior to that time. Commissioner Greeley noted that DEP reviewed alternative sources of water for use during the repair period at a workshop last summer. These included ASR; demand reduction measures (rebates, use of individual water meters in apartment buildings); desalination projects and interconnections with other water companies.

ASR was found to be a feasible alternative and a pilot program was authorized. Mr. Cohen indicated that although ASR is not a new concept (38 states currently have active systems), it has not been used in New York, which is why pilot testing will be conducted prior to any decision on implementation of a full system. The pilot test, which would take place on Guy R. Brewer Boulevard, between 132nd and 134th Avenues, across from Rochdale Village, is not expected to begin for almost a year, following approval from DEC. This approval process is complicated by a State-imposed moratorium that currently prevents drilling in the Lloyd Aquifer. The ban was originally designed to protect Long Island beach communities that utilize the aquifer for their water supply. The pilot test would be conducted to determine the feasibility of a large-scale ASR project, as well as to verify computer model projections. If the ASR pilot test is successful,

up to fifty wells might be drilled in southeast Queens. These could pump enough water into the aquifer to create a supply of 200 mgd for two to three years.

Mr. Cohen explained that the ASR recharge cycle involves pumping water from upstate reservoirs into the aquifer. The pressure of the stored water creates a bubble in the aquifer, largely preventing it from mixing with water in the aquifer. He described how this bubble should be strong enough to prevent saltwater intrusion from the Atlantic Ocean. During the recovery cycle, the stored water is pumped out and put into the distribution system. The City has pledged to withdraw only 90% of the water it pumps into the aquifer, allowing the remainder to recharge the aquifer. He added that the biggest technical issue regarding the use of ASR relates to the chemistry of mixing upstate surface water with aquifer water. Mr. Cohen reported that the USGS is working with the project team on ASR-related issues (microbiological, chemical, etc.).

Comments and questions raised during the presentation are summarized below:

- In response to questions about construction impacts, Mr. Cohen said that little new construction would be needed for initial ASR efforts. Citing the Station 24 test wells as an example, he pointed out that well drilling is minimally invasive for the community and that DEP would use existing equipment and property whenever possible. Commissioner Greeley reiterated that the recharge phase will require little new construction and that major construction-related disruptions are not anticipated.
- Responding to several questions from Michael Turner concerning the aquifer and ASR system, Mr. Cohen explained that the Lloyd Aquifer has been thoroughly mapped (up to thirty miles offshore to the continental shelf) and that its length, depth and slope are well known. The holding capacity of the aquifer has been determined through computer modeling. Mr. Cohen added that several states bordering the ocean, including Florida, New Jersey, California, Delaware and Virginia, have active ASR systems. In response to a related question, Mr. Cohen indicated that an ASR pilot project would not be conducted on Staten Island because of the Borough's inadequate water distribution network, as well as its location over a far smaller section of the Lloyd Aquifer.
- In response to concerns that Queens residents would be put on well water upon completion of the ASR system, Commissioner Greeley stated that the costs associated with ASR make it economical to pump stored water only in times of drought or other outages. He also emphasized that it would be inappropriate to use ASR for everyday applications, since the aquifer would have a large, but finite, water supply.
- Ms. Bowes observed that introduction of the ASR project so soon after the October public meeting and DEP's receipt of community consensus on the Station 6 and 24 projects might be perceived as a way for the City to compel residents to accept ASR in southeast Queens. Commissioner Greeley responded that ASR, which was originally discussed at the March 2003 CAC meeting, was being re-introduced tonight both as an informational item and as a means of maintaining CAC momentum during a lull in progress on the Station 6 and 24 projects. He emphasized that the project team has always viewed the CAC as being on the 'front lines' of a transparent process and that this presentation was consistent with that approach. Commissioner Greeley also noted that ASR will be a separate project with its own citywide education and outreach effort.
- In response to Ms. Bowes' question about the relationship between the ASR project and the BQA Study, Mr. Yulinsky responded that, although not directly connected, ASR fits

under the umbrella of the BQA study, which was designed to help the City meet its water supply needs during periods of drought. He reminded the group that other spin-offs of the study, including clean-up of the WSC site (which has received substantial community support) were not part of the original scope of work. Mr. Cohen reiterated that ASR is one of many potential projects throughout the five boroughs, upstate counties, and New Jersey that DEP is considering to increase the City's water supply.

- Mr. Caughman said that the CAC has done an excellent job on outreach for Station 6 and that he feels confident that the same could happen with ASR. He expressed interest in forming another CAC to address ASR issues.
- In response to a question by Linda Caleb Hazel, Mr. Cohen explained that it is unlikely that Well 6C (a Lloyd Aquifer well that was previously operated by the Jamaica Water Supply Company) would be used for ASR, since it is located too far north and in a shallower portion of the aquifer.
- Mr. Cohen described the current water distribution system, emphasizing that southeast Queens is located at the end of the City's water system pipeline. He explained that it would therefore be the first community affected in the event of a water shortage. Locating an ASR system in the community would place it at the head of the pipeline.

New Business

The CAC discussed adding new members to the Committee, as well as removing members for non-attendance. Mr. Caughman stated that he had brought a visitor, Robert Bowens, President, Federation of Civic Associations and a retired detective, to be considered as a possible candidate for the CAC. Given the lateness of the hour and the decreasing number of CAC members present, Ms. Neuhaus suggested that the membership issue be further discussed at the next CAC meeting. She reminded the group that its Operational Guidelines cover membership issues and that the CAC had previously asked interested candidates to present their credentials, either orally or in writing. Mr. Bowens then asked for a moment to speak, during which he indicated that he was not likely to formally request consideration for CAC membership.

Other comments relating to membership issues included the following:

- Richard Hellenbrecht suggested that consideration be given to expansion of membership if the CAC decides to address ASR issues.
- Responding to a question concerning the anticipated size of the CAC, Ms. Neuhaus stated that the CAC should decide what, if any, number should be considered the cap. [The Operational Guidelines currently indicate "approximately 25-30 members."]
- Ms. Bowes suggested corresponding with CAC members who have not been attending regularly to determine their interest in continuing to serve and dropping those who remain inactive.
- Ms. Hazel suggested that the CAC clarify its focus before accepting new members or expanding the SRP. In response, Ms. Neuhaus noted that one SRP member has already expressed interest in ASR issues.

Ms. Neuhaus then introduced an issue raised by SRP member Dr. Alan Rabideau concerning the appropriateness of his possible conduct of groundwater modeling research with his students at SUNY-Buffalo. Specifically, Dr. Rabideau indicated that he is likely to have opportunities to apply for National Science Foundation grants this year that dovetail with BQA issues and that might provide some basis for an academic partnership with the BQA Study. He asked whether

DEP and/or the CAC perceive this as presenting a conflict of interest with his role on the SRP or in any way compromising his role as the CAC's independent advisor. Ms. Neuhaus added that Dr. Rabideau emphasized that he would forego the research, if necessary, because his first priority is to continue serving on the SRP. Initial reaction from DEP and the CAC was positive, but the issue will be discussed further at the next CAC meeting.

At the conclusion of the meeting, Commissioner Greeley suggested that CAC members tour DEP's water storage and distribution facilities in the coming months, in order to get a first-hand view of how the City manages its surface water supply. He recommended trips to Hillview Reservoir in Yonkers and the Van Cortlandt Valve Chamber in the Bronx. These field visits will be scheduled for the Spring.

Follow-Up Items

1. Present analyses regarding current and long-term capacity of sewers that would receive discharge from Station 6, when available. Responsibility: DEP, Malcolm Pirnie.
2. Distribute copies of Station 6 and Station 24 Permitting Requirements PowerPoint presentation to CAC members. Responsibility: HNA.
3. Schedule visit to Hillview Reservoir and Van Cortlandt Valve Chamber to illustrate operation of City's surface water system. Responsibility: DEP, Malcolm Pirnie, HNA.
4. Determine number of members who have dropped off CAC/prepare CAC attendance chart. Responsibility: HNA.
5. Prepare draft letter to CAC non-attendees to determine their interest in remaining on the Committee. (Issue to be discussed further at February 5th CAC meeting.) Responsibility: HNA.
6. Coordinate with emergency services and other agencies, as appropriate, regarding demapping of streets within the boundaries of Stations 6 and 24. Responsibility: DEP, Malcolm Pirnie.

The next CAC meeting is scheduled for **Thursday, February 5th at 7 p.m.** at the Hillside Manor Comprehensive Care Center, 188-11 Hillside Avenue, Jamaica Estates.

Brooklyn-Queens Aquifer Feasibility Study
Citizens Advisory Committee
Thursday, January 8, 2004

Attendance List

CAC Members/Alternates

Tracey Bowes
Community Board #12

Linda Caleb Hazel
A Better Day Inc./St. Benedict The Moor/
St. Bonaventure

Manuel Caughman
Community Board #12/Brinkerhoff Action
Association

Kenneth Gill
Addisleigh Park Civic Association

Richard Hellenbrecht
Community Board #13

Irving Hicks
Brinkerhoff Action Association

Earl Roberts
113th Precinct Council

Mark Scott
Office of Borough President Helen Marshall

Gurpal Singh
Office of State Senator Malcolm A. Smith

Michael Turner
Resident/Addisleigh Park Civic Association

Guests

Robert Bowens
Federation of Civic Associations

Sarah Hicks
Resident

Maurice E. Muir
Community Board #12

Project Team

Nicole Brown
Malcolm Pirnie, Inc.

Don Cohen
Malcolm Pirnie, Inc.

Stacy Cyrus
New York City Department of
Environmental Protection

Lillie Farrell
New York City Department of
Environmental Protection

Doug Greeley
New York City Department of
Environmental Protection

Mark Lanaghan
New York City Department of
Environmental Protection

Helen Neuhaus
Helen Neuhaus & Associates Inc.

Anita Wright
Helen Neuhaus & Associates Inc.

Bill Yulinsky
New York City Department of
Environmental Protection

Adam Zeller
Helen Neuhaus & Associates Inc.

Brooklyn/Queens Aquifer Studies
Station 6 / Station 24
Permit Status

CAC Presentation
 January 8, 2004



CITY OF NEW YORK
 DEPARTMENT OF ENVIRONMENTAL CONSERVATION
 DIVISION OF WATER AND ENERGY SERVICES




PERMITS

- SPDES State Pollution Discharge Elimination System
- ULURP Uniform Land Use Review Procedure
- Building Department
- CEQR City Environmental Quality Review
- NYSDOH New York State Department of Health
- NYC Art Commission

SPDES Permits - NYSDEC

- Station 24 / Westside
 - ◆ SPDES Equivalent Application Submitted
 - ◆ NYSDEC Issued Preliminary Discharge Limits
- Basically OK
 - ◆ Submitted FS/TS for 3 Parameters

SPDES Station 24 / Westside

	DEC Limit	Requested Limit
pH	6.5 - 8.5	6.0 - 8.5
PCE	1 ppb	20/5/1 ppb*
Metals		
•Copper	5.6	Monitor
•Nickel	7.9	Only

* Intermittent Max Discharge at 20, Average O&M Discharge 5 ppb, Normal Discharge < 1 ppb

SPDES Permits - NYSDEC

- Station 6
 - ◆ SPDES Equivalent Application Submitted
 - ◆ NYSDEC Issued Preliminary Discharge Limits
 - ◆ Limits are Prohibitively Strict
 - ◆ RO Reject is Main Issue
 - ◆ RO Removes Na, Ca, Nitrates
 - ◆ Disposal of the Reject Stream is a Challenge

SPDES Station 6

	RO Reject	Blended Discharge	DEC Limit
Nitrogen	50 mg/l	10 - 50 mg/l	4 mg/l
pH	7.0 - 8.0	6.0 - 8.0	7.5 - 8.9
PCE	5 ug/l	5 ug/l	1 ug/l

DEC Willing to Negotiate pH and PCE

DEC Not Willing to Discuss Nitrogen

• "No New Source" Policy

Station 6 RO Reject Disposal Alternatives

- Construct a Nitrogen Removal Plant
- Discharge RO Reject to Sanitary Sewer
 - ◆ Treatment at Jamaica WPCP
 - ◆ New Force Main Needed
 - ◆ In 110th Ave with New Water Main
 - ◆ New Connection to Large Sewer Main Needed

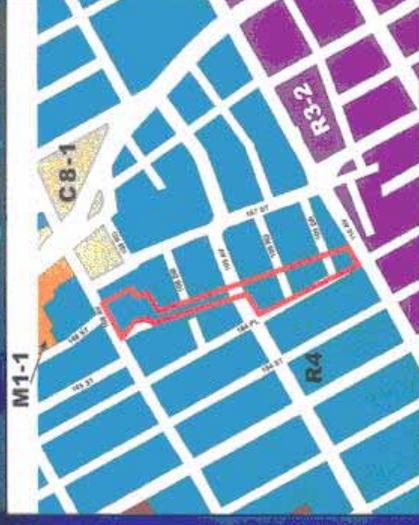
Land Use Permits

- ULURP
 - ◆ Uniform Land Use Review Procedure
 - ◆ Dept of City Planning
- BSA
 - ◆ Bureau of Standards and Appeals
 - ◆ Dept of Buildings - Queens and NYC

Land Use Permits

- Station 6 is Zoned R-4 Residential

Station 6 Zoning Map



Station 6 Aerial Photo



Zoning

- Station 6 is Zoned R-4 Residential
- DCP
 - ◆ Zoning Waiver With Special Permit (May not apply)
 - ◆ Won't Change Zoning
- BSA
 - ◆ Claims Jurisdiction
 - ◆ DOB Rejection Triggers BSA Review
 - ◆ Says No Need for DCP

Zoning

- Station 24
- ◆ Half R-4 Residential
- ◆ Half M-1 Commercial/Industrial

Station 24 Zoning Map



Station 24 Aerial Photo



Zoning

- Station 24
- ◆ Half R-4 Residential
- ◆ Half M-1 Commercial/Industrial
- DCP Recommends Zoning Change
- ◆ ULURP Action
- BSA
- ◆ DOB Precedent
- ◆ Recently Permitted GAC on Existing Sites

Zoning Issue

- No Current Zone for Water Treatment
 - ◆ Water or Sewer Pumping – yes
 - ◆ Treatment – no
- May Require Zoning Amendment
 - ◆ Very Lengthy Process
- Could Be Done with Mayoral Over Ride
- Currently Under DEP Legal Review

Street De-Mapping

- Station 24 Survey Underway
 - ◆ via ULURP / DCP
- Station 6 Not Yet Started
 - ◆ Either DCP or BSA
 - ◆ BSA Issues Waiver to Build in Mapped Street
 - ◆ Not a Permanent De-Mapping

ULURP / BSA Permits

Best Case

- BSA Approval via DOB Rejection
 - ◆ More Timely Process
- ULURP Process Could Follow
 - ◆ To Make Permanent Changes

Other Permits

- CEQR
 - ◆ City Environmental Quality Review
- DOH
 - ◆ NYS Dept of Health, System Works Approval
- NYC Art Commission
 - ◆ For Building Permits
- Local Community Board
 - ◆ For Art Commission and ULURP

Underground Water Storage and Water Supply

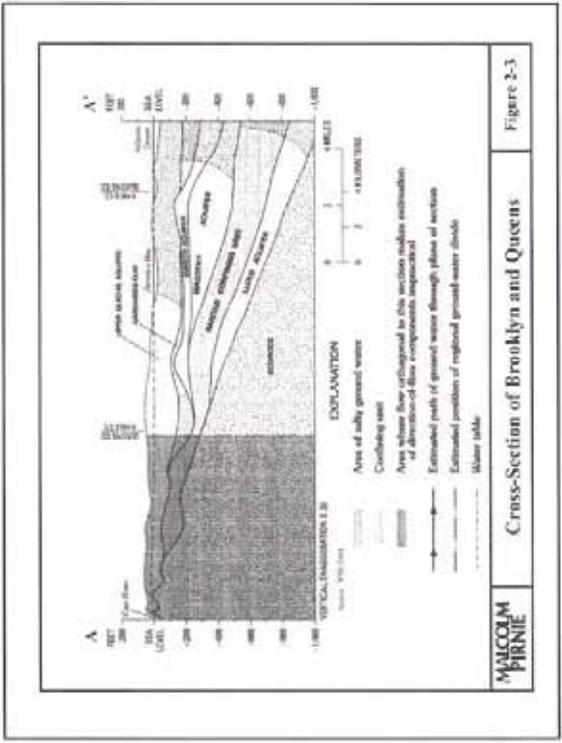
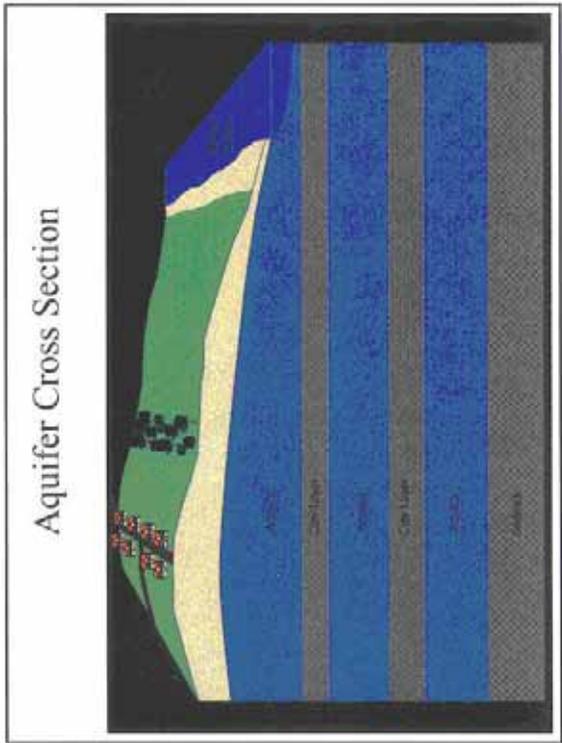
Brooklyn Queens Aquifer Feasibility Study

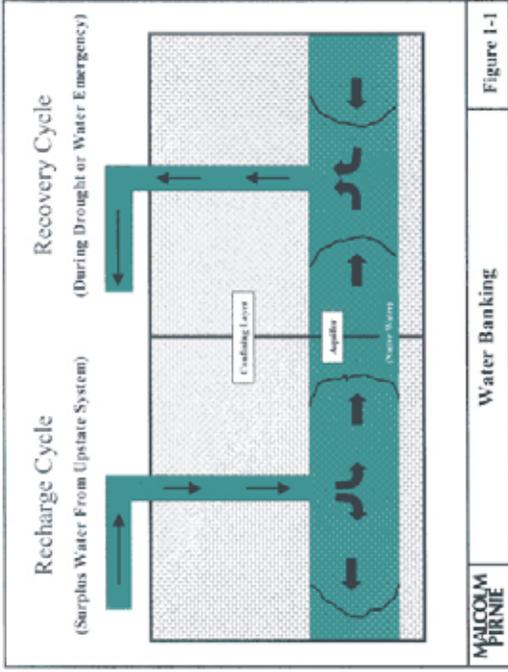
Prepared for:
New York City Department
of Environmental Protection

January 2004

Aquifer Storage and Recovery

- Uses Excess Upstate Water
- Injected Into Deepest Aquifer (Lloyd)
- Creates A Storage “Bubble”
- Pumped Out When Needed





MALCOLM
PIRNIE

Water Banking

Figure 1-1

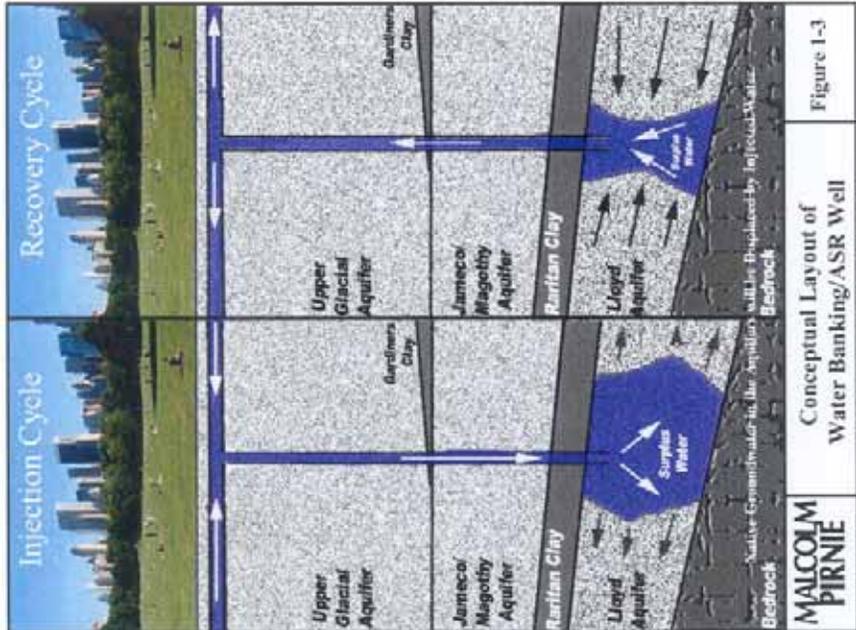
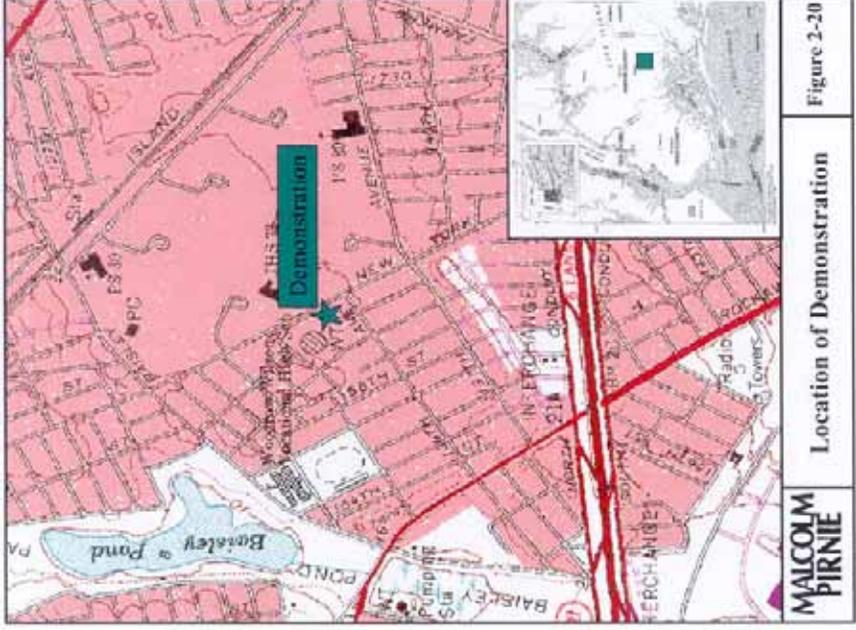


Figure 1-3

Conceptual Layout of Water Banking/ASR Well

MALCOLM PIRNIE



Location of Demonstration

Figure 2-20