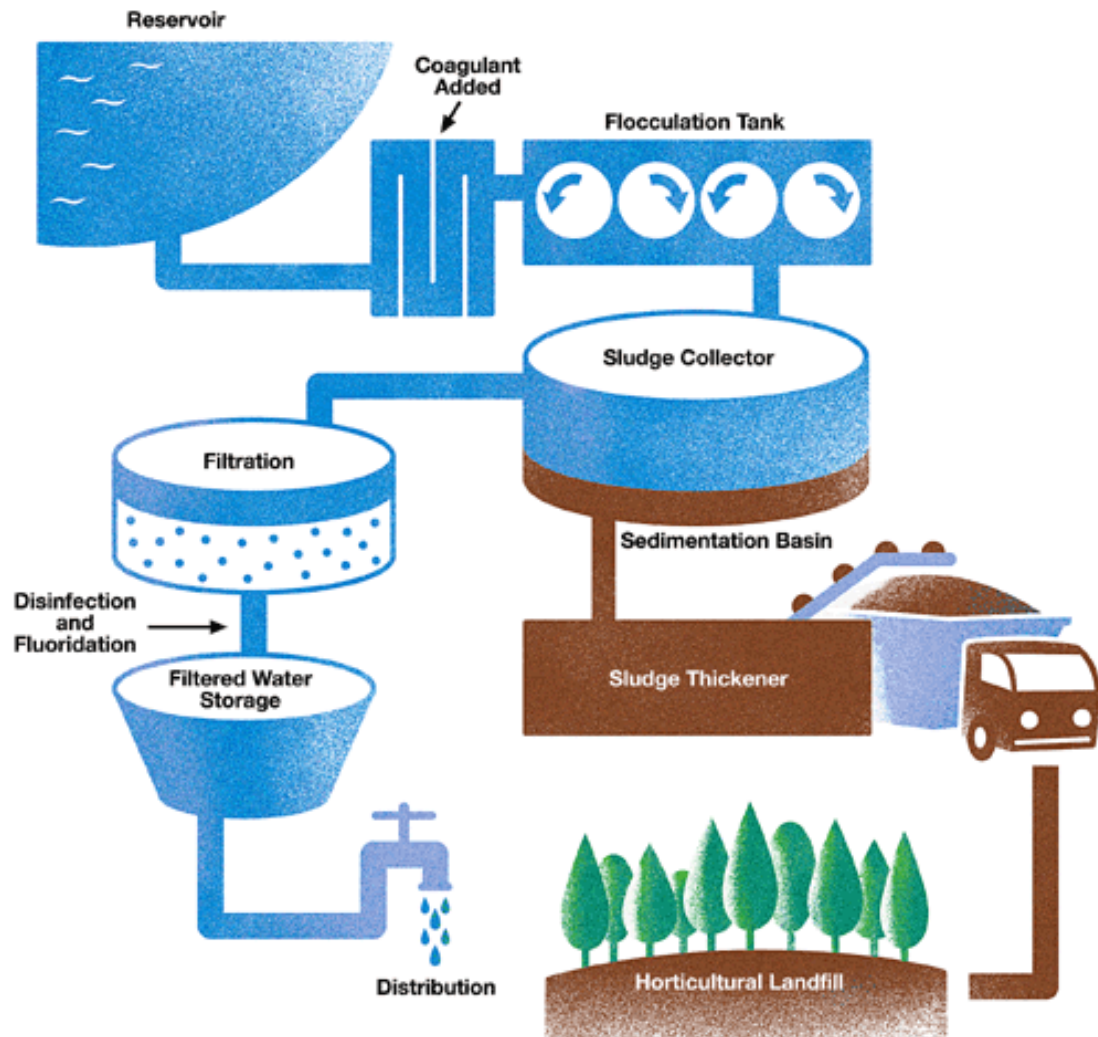
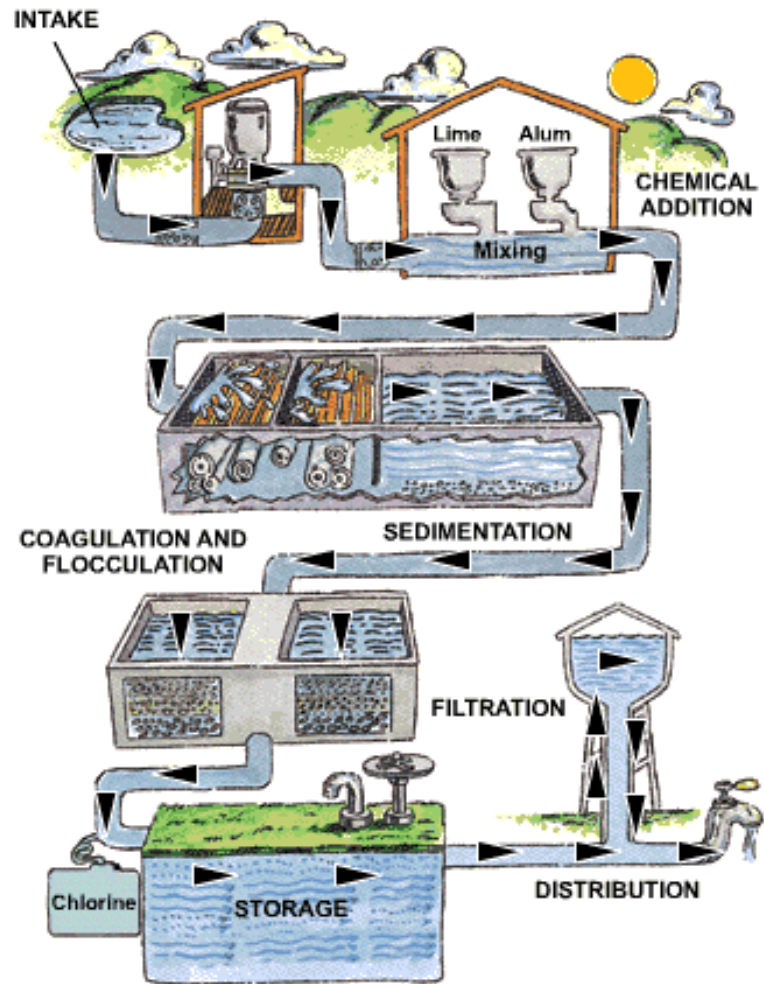
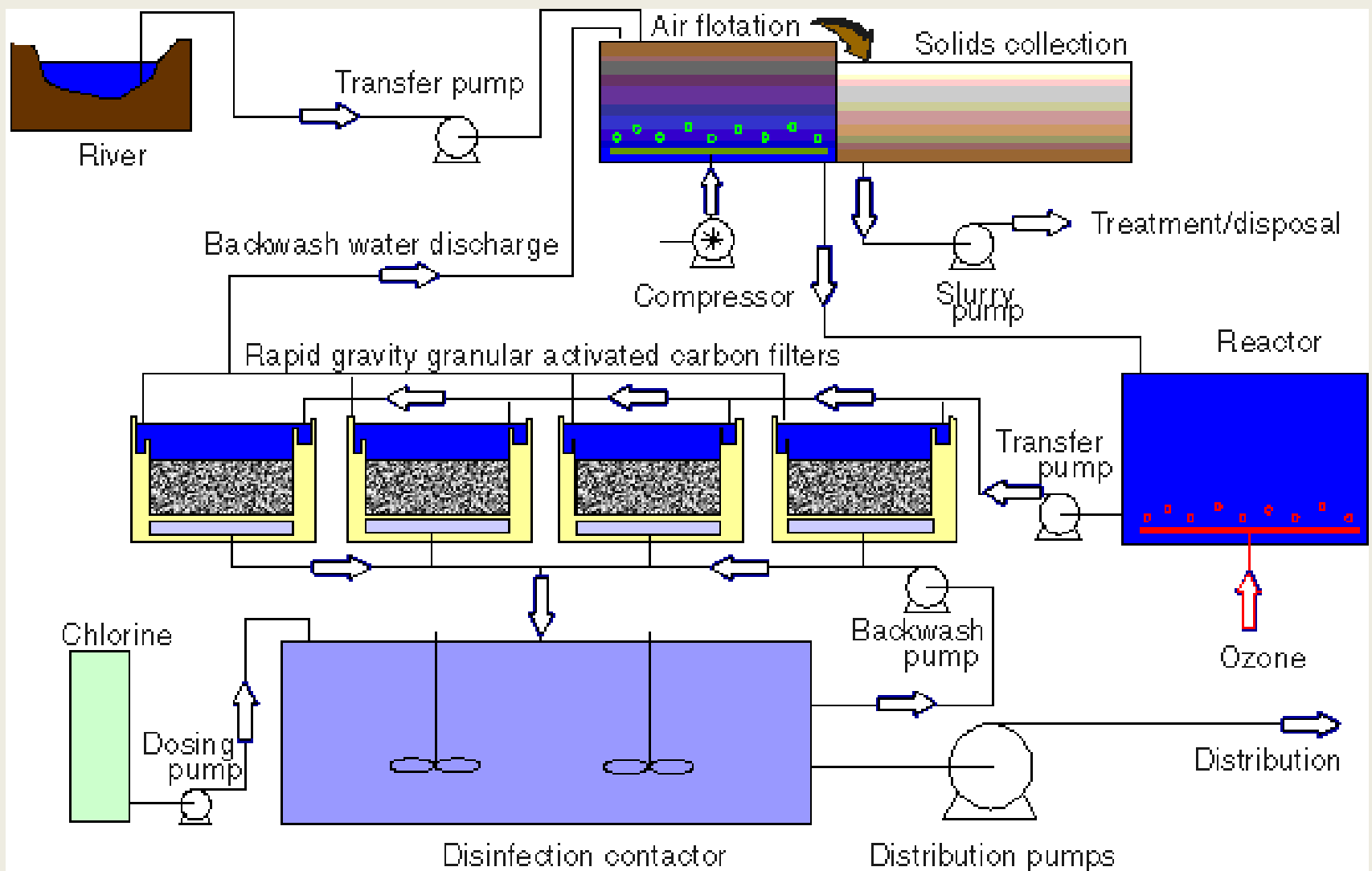


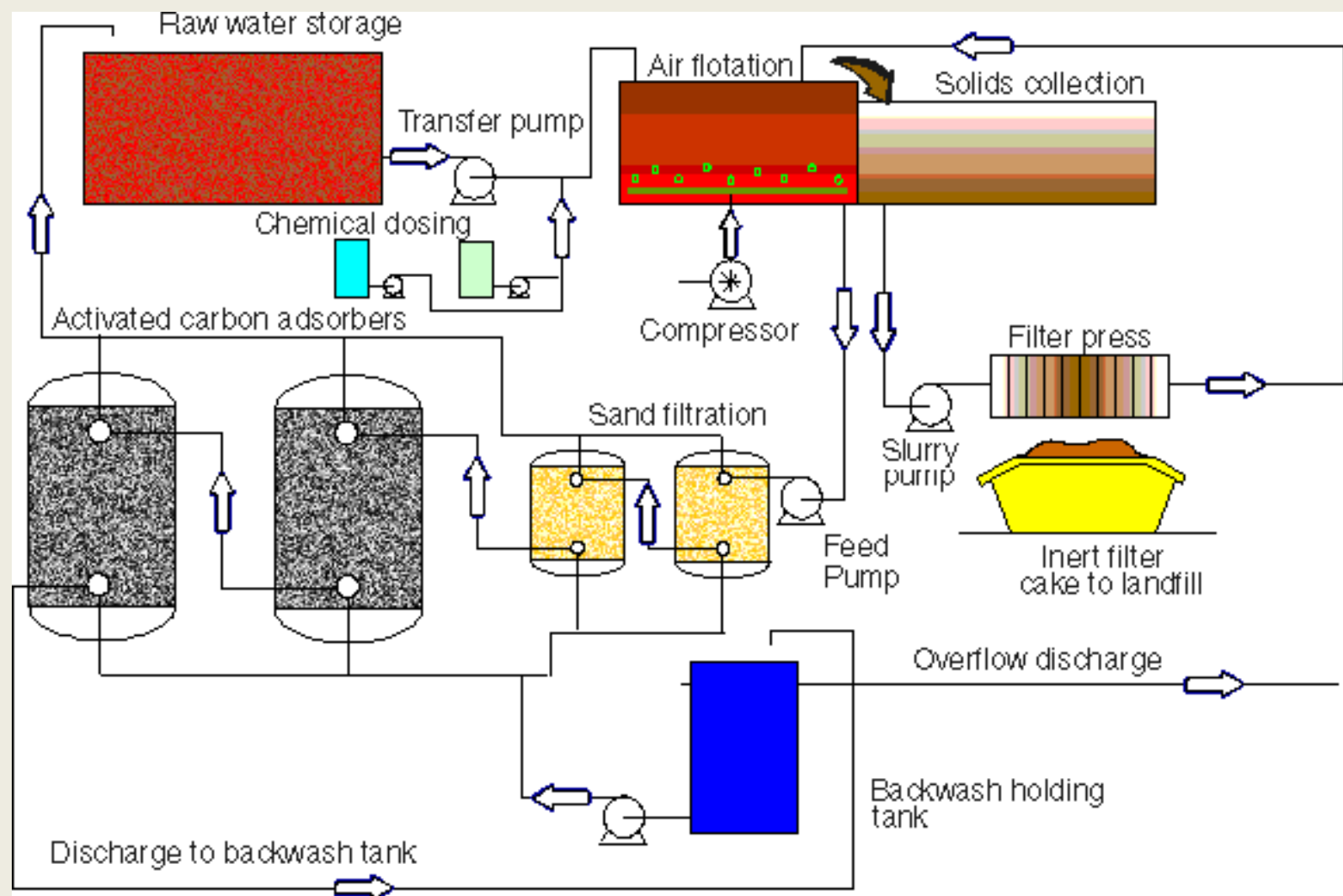
Water Treatment

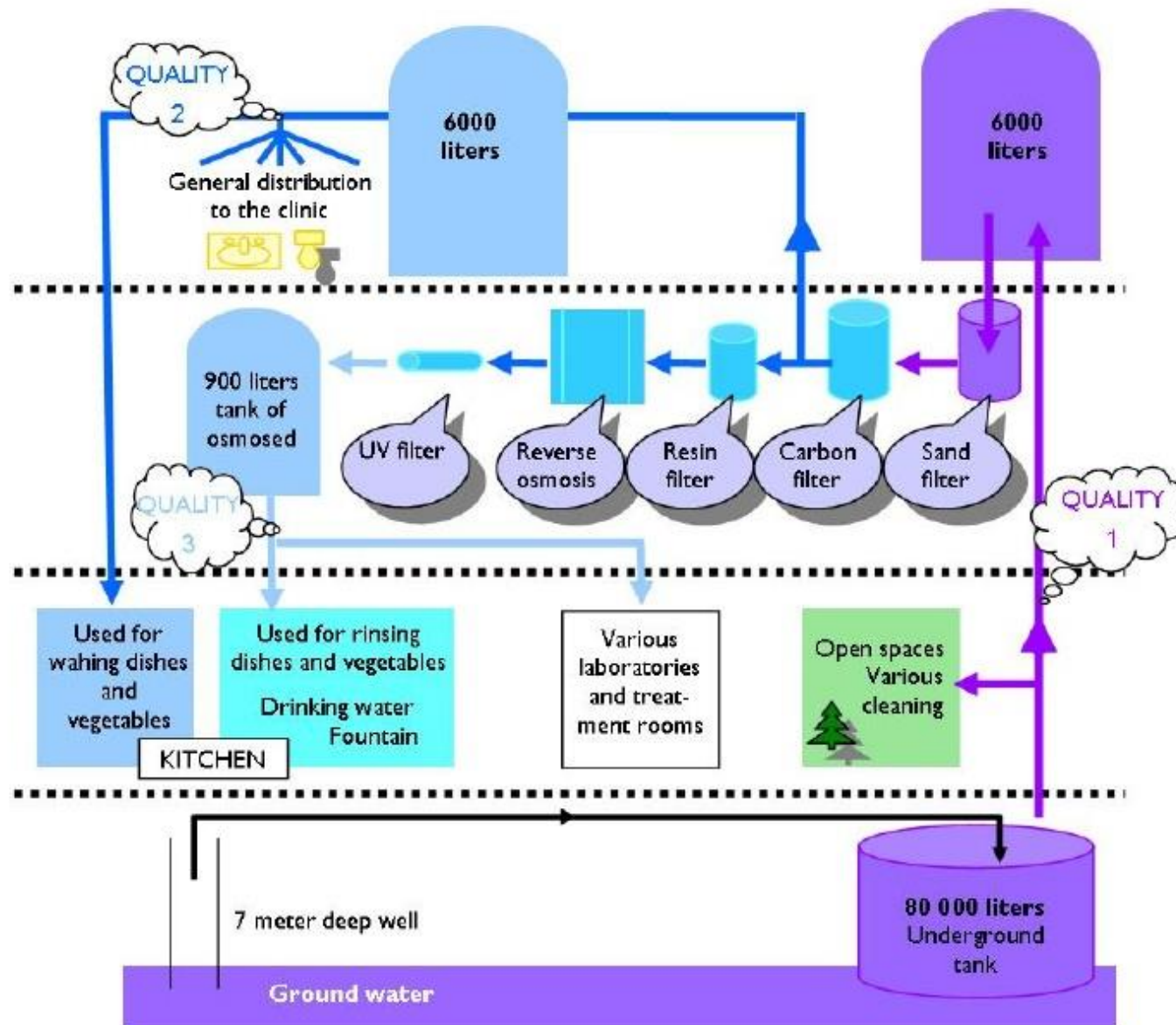
Houston, TX

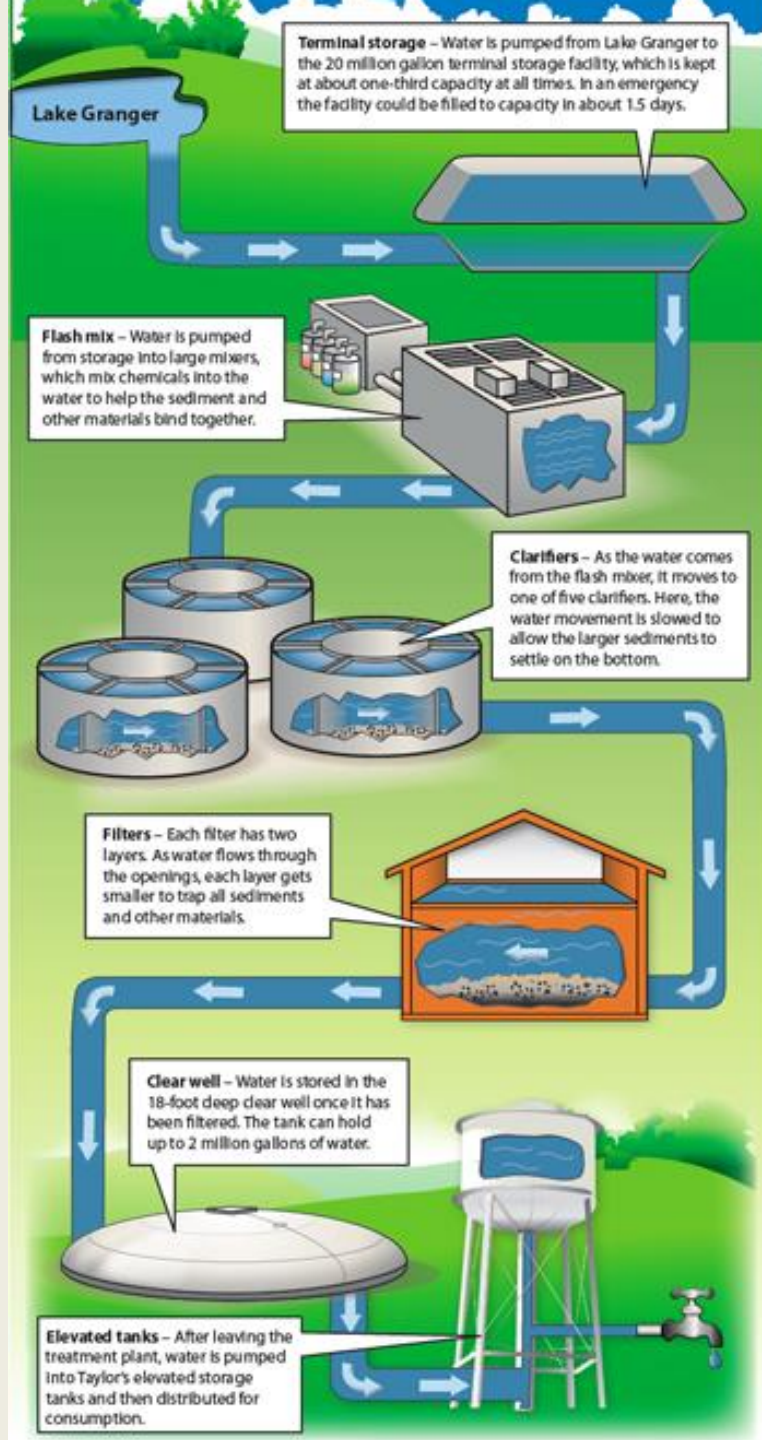
Tyler Gentry – Fall 09











Today the City of **Houston has plenty of water** and has won **awards for its water quality** accomplished through water treatment plants, according to city officials.

Jeff Taylor, Houston's Public Works director(2006), says the **emphasis is on water quality rather than water supply** in Houston because **the city receives about 50 inches of rainfall a year and has a 30 to 50 year supply**.

However, Jim Adams, general manager of the San Jacinto Water Authority and chair of Region H Water Planning Group (Region H includes Houston), says **by 2060, Houston will require three billion gallons of water a year**. "We are going to have to reuse water and we are going to have to conserve," says Adams. "Water is not as plentiful as it use to be."

- **Houston as a Model City: Meeting the challenges of an environmental crisis**
The Future of Water

by Vicki Wolf, April 2006

(Cont'd)

Rives Taylor, research scientist with Houston Advanced Research Center's Energy and Buildings Solutions Group and sustainability leader for Gensler Architecture, says these forecasts are optimistic as the population of Texas grows and droughts are more common.

He believes **in three years we will have concerns**. The water that Houston uses includes the Trinity River and the San Jacinto River, both downstream from areas with rapidly growing populations. Also, **Texas is experiencing the longest dry spell since the drought of record in the 1950s** with low precipitation levels forecast through this summer. **Global warming** may bring more droughts in the future.

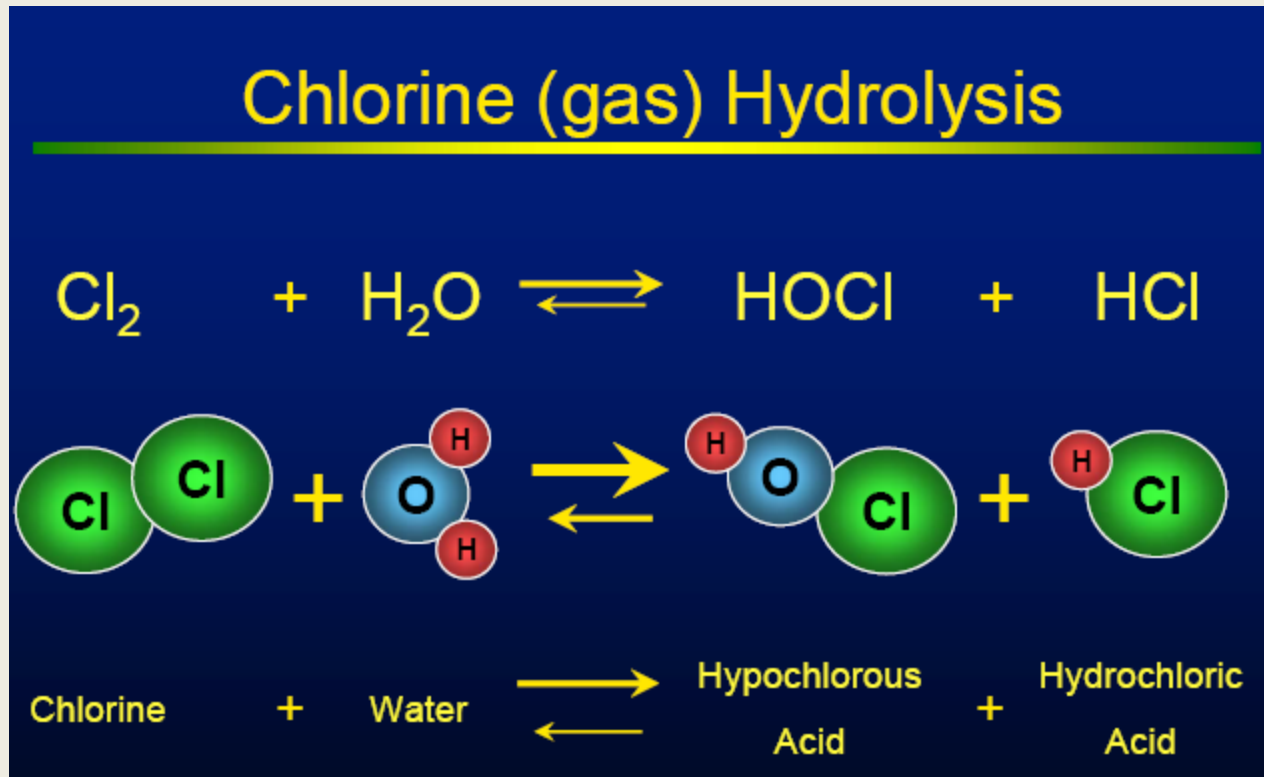
Also, use of ground water, **pumping water from aquifers** below the ground, is **causing the land to sink**. To prevent further subsidence, Houston is moving from ground water as the predominant source of water to surface water – lakes and reservoirs storing water that comes from rivers.

Capturing rainwater and storing it in cisterns is an effective way to **reduce runoff and conserve the public supply**. Rainwater without chemical treatment can be safely used for flushing toilets and washing clothes. It can be used for drinking when properly treated.

Considering that **up to 60 percent of city water is used for landscaping**, moving toward sustainability requires collecting and using rainwater for landscape and garden irrigation. Selecting native and adapted plants, and designing landscape and gardens to capture water and prevent runoff also help save water. Garden beds, shrubs and mulching are better conservation choices than growing grasses.

Planting vegetation similar to the diverse prairies and forests that covered Houston before it was paved over for development can be planted across the city, even on rooftops, to help cool the city and prevent runoff during heavy rains.

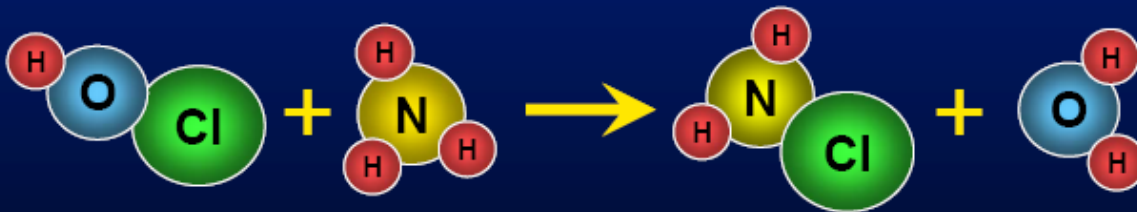
Understanding Chlorination Process



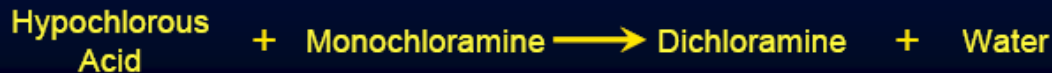
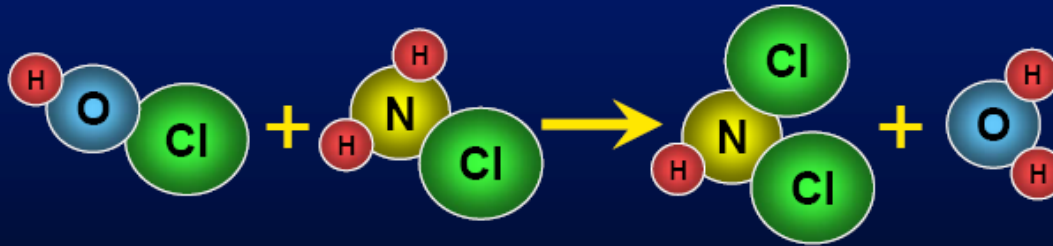
Dissociation of Hypochlorous Acid



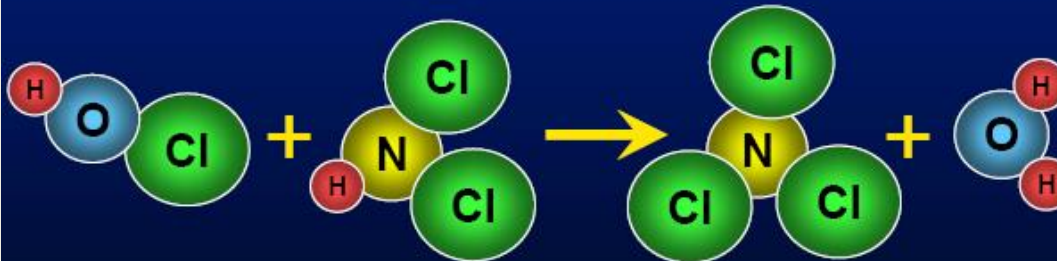
Monochloramine Formation



Dichloramine Formation



Trichloramine Formation



Weight-Based Ratios

(in the imaginary world)

$$\frac{\cancel{1 \text{ mol Cl}_2}}{\cancel{1 \text{ mol NH}_3}} \times \frac{71 \text{ lb Cl}_2}{\cancel{1 \text{ mol Cl}_2}} \times \frac{\cancel{1 \text{ mol NH}_3}}{17 \text{ lb NH}_3} = \frac{71 \text{ lb Cl}_2}{17 \text{ lb NH}_3}$$
$$= \frac{4.2 \text{ lb Cl}_2}{1 \text{ lb NH}_3}$$

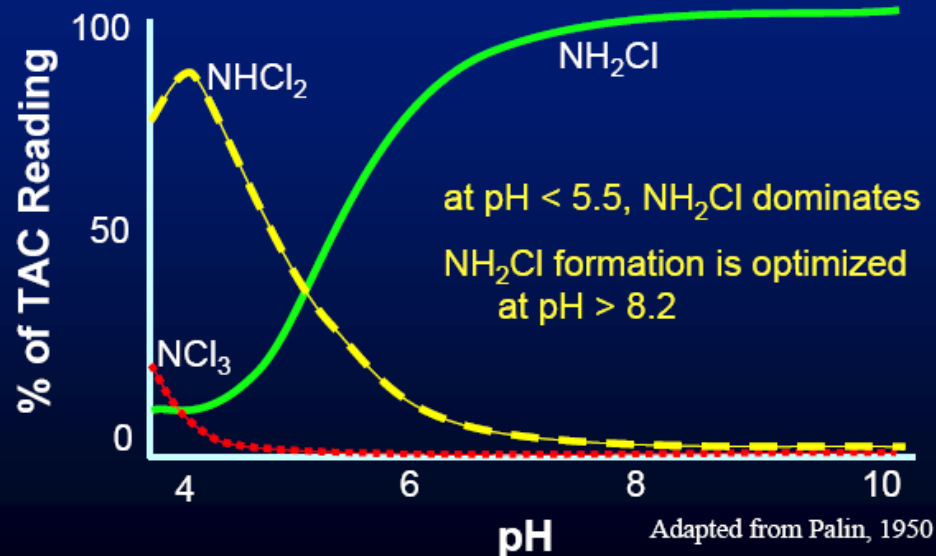
$$\frac{\cancel{1 \text{ mol Cl}_2}}{\cancel{1 \text{ mol NH}_3}} \times \frac{71 \text{ lb Cl}_2}{\cancel{1 \text{ mol Cl}_2}} \times \frac{\cancel{1 \text{ mol NH}_3}}{\cancel{1 \text{ mol N}}} \times \frac{\cancel{1 \text{ mol N}}}{14 \text{ lb N}} = \frac{71 \text{ lb Cl}_2}{14 \text{ lb N}}$$
$$= \frac{5.06 \text{ lb Cl}_2}{1 \text{ lb N}}$$

Reality Strikes

- ▶ In the real world, other conditions affect the optimum $\text{Cl}_2:\text{NH}_3$ ratio and the chloramination process

- pH
- Temperature
- Chlorine demand
- Competing reactions
- Reaction time
- Chloramine decay

Real World Impact of pH



Two Disinfection Scenarios

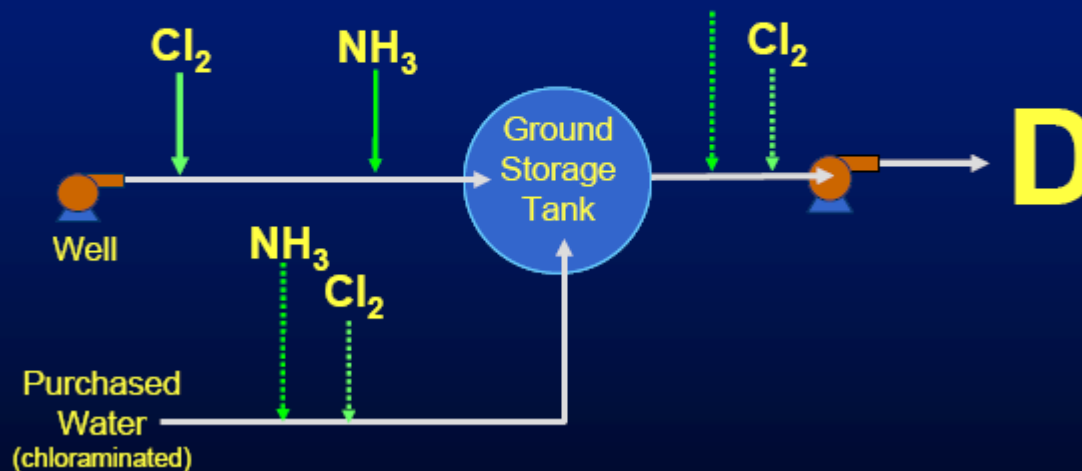
► Chlorine before Ammonia

- Primarily for initial disinfection
 - Provides safety factor for chloramine CT
 - Provides preoxidation

► Ammonia before chlorine

- Primarily for rechlorination
 - Reduces impact of competing reactions

Plant Schematic and Feed Points



Groundwater Reduction Plan (GRP)

- Dated May 28, 2003
- The NHCRWA will build its primary water transmission lines from the COH delivery points to its boundary in two construction phases.
- One transmission line will be constructed initially to satisfy the 2010 through 2019 conversion requirements.
- A second transmission line will be constructed to meet the requirements for 2020 through 2030. Other entities may pay a pro-rata share for capacity in the NHCRWA's transmission pipe.
- The Central Harris County Water Users Consortium and the West Harris County Regional Water Authority have been identified as possible participants at this time.
- The NHCRWA requested its primary water distribution system be sized and designed to provide all wholesale customers water at system pressure (55 to 65 pounds per square inch). Rates of water consumption vary widely throughout the year. Since the NEWPP will supply water at a comparatively constant rate, peaking requirements of wholesale customers will be provided from water sources within the NHCRWA Service Area.

NHCRWA

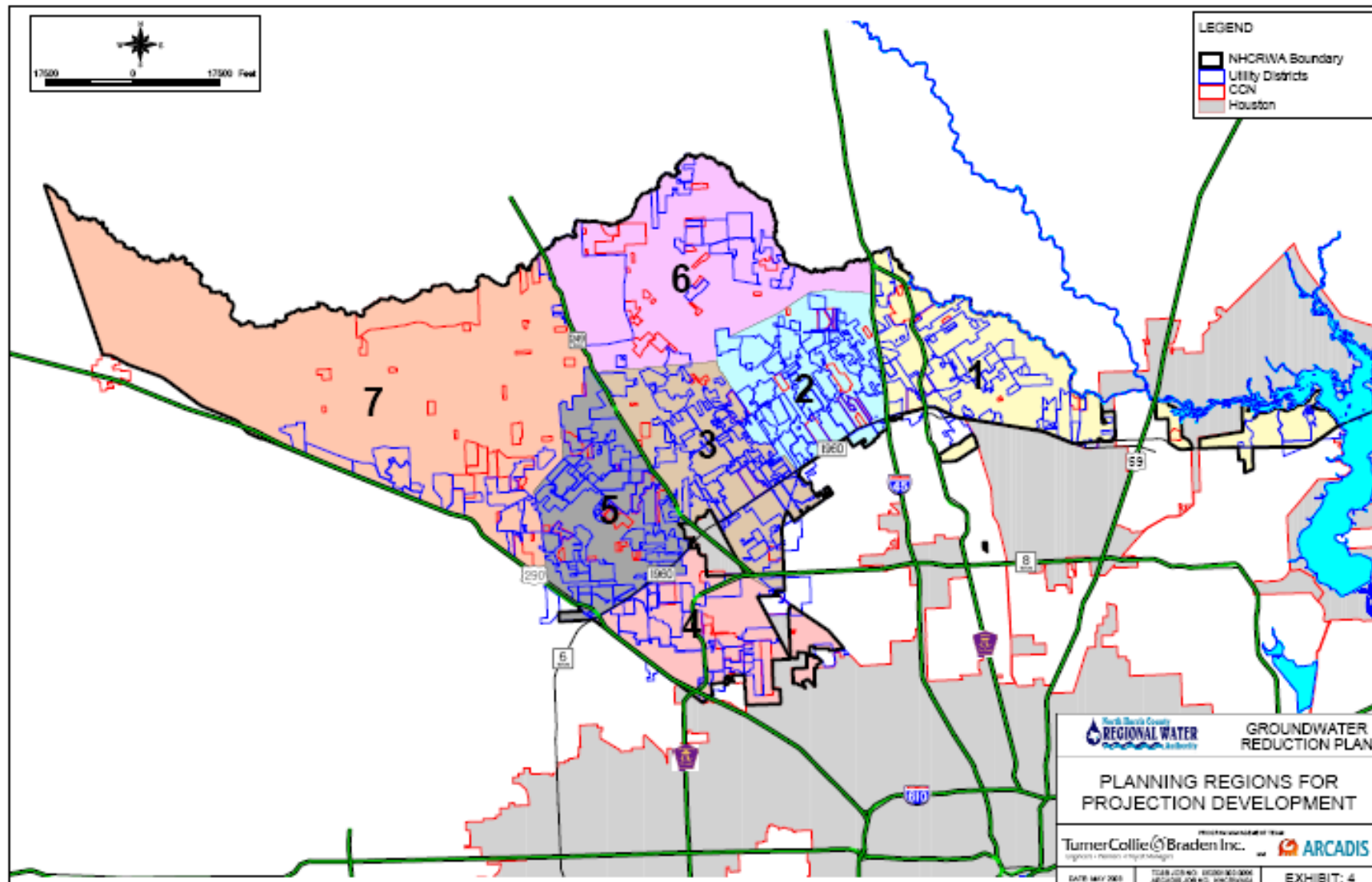
- The 2020 and 2030 conversion areas will spread outward from the initial area. The estimates of probable costs for 2020 and 2030 are \$402.1 million and \$29.1 million, respectively, and \$612.7 million total for all three decades, excluding interest, financing costs and water capacity purchase. The above estimates of probable costs were developed using Region H Water Planning Group 1999 unit values.
- The NHCRWA anticipates that water reuse and early/over conversion may generate credits against the total amount of surface water that must be used to achieve compliance. The NHCRWA reserves the right to submit for consideration an amended GRP in the future discussing these concepts along with a methodology of applying credits.

Entities Involved

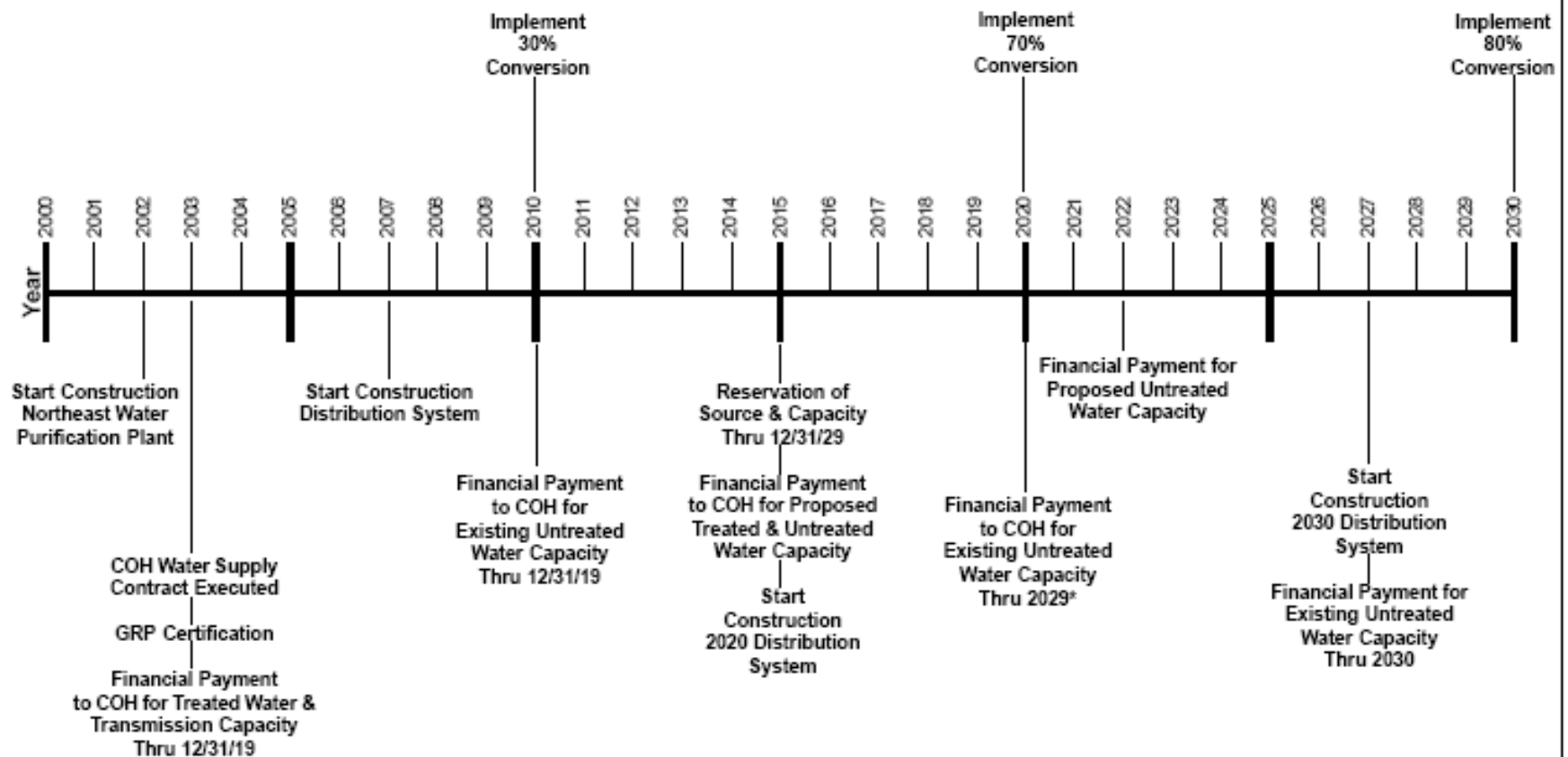
- Houston Area Water Corp.
- North Harris County Regional Water Authority (NHCRWA)
- Turner, Collie, and Braden
- Arcadis
- Harris-Galveston Coastal Subsidence District
- City of Houston (COH)
- Northeast Water Purification Plant (NEWPP)
- American Water Works Association (AWWA).
- Central Harris County Water Users Consortium
- West Harris County Regional Water Authority
- San Jacinto River Authority (SJRA).

NHCRWA

- The NHCRWA has 160 political subdivisions that include:
 - Cities
 - Municipal Utility District's (MUD),
 - Public Utility District's (PUD),
 - Water Control and Improvement District (WCID),
 - Utility District's (UD),
 - And more (collectively referred to as MUDs) as well as independent well owners that combined have a total of **1,612 groundwater wells** within the NHCRWA. The total year 2000 well pumpage within the NHCRWA as reported to HGCSO was over **25 billion gallons**.



North Harris County Regional Water Authority Project Timeline for Compliance With Harris-Galveston Coastal Subsidence District Regulatory Plan



* Assume COH is source for 2020 capacity.



Altivia Applications

Along with the products ALTIVIA manufactures and distributes, they offer a variety of site-specific service solutions to meet your water treatment and chemical management needs. Their chemists and engineers can analyze your requirements and design the most cost-effective solution possible. Services include:

- [Technical Evaluations](#)
- [FLEXTREAT™](#)
- [Regulatory Compliance](#)
- [Safety Training](#)
- [Inventory Management](#)

Northeast Water Purification Plant

- Grand Opening on June 23, 2004
- PBS&J provided owner's representative services for the design, construction, and operation of the Houston Area Water Corporation 40-mgd northeast water purification plant located on the west shore of Lake Houston in Harris County, Texas.
- This project is unique, in that it is the first of its kind in the Houston area to be constructed using the **design/build/operate** method of delivery.
- The plant uses a conventional treatment process of **coagulation, flocculation, sedimentation, filtration, and disinfection**.
- It has the potential for expansion to 80 mgd, and the plant site can accommodate a facility with a capacity of approximately 360 mgd.

NHCRWA Population and Water Demand Data

Year	Population	Water Demand (mgd)
2000	397,000	69.2 ²
2010	488,000	79.4
2020	608,000	98.0
2030	688,000	110.7

Waste Dumped into bayou

- In downtown Houston along Buffalo Bayou at Allen's Landing is where you see the sewage problem. Ever since the hurricane, a number of the city's waste water treatment plants went without power. As a result, the city was forced to actually dump raw sewage straight into the bayous.
- There are **39 wastewater treatment plants** in the city of Houston. So far, 31 are back up and running, and treating sewage. (This is after the hurricane)

Important Facts to Consider

- Up to 60% of Houston water use is for landscape irrigation.
- Pumping water is becoming less of an option for consideration.
- Reservoirs and Lakes are limited resources.
- Water must be stored for Houston use.

What do we do with the water?

- 50% of captured water shall be used for greywater, treated only as required for storage
- 50% of captured water shall be sent for treatment and then to end users.
- If tanks reach capacity and the tentacles end points are still under water, the float activator will still cause them to retract water to the tanks. The tanks will then need to overflow. This overflow must be in areas that are not prominent to flood, allowing that water to slowly reach the bayou system.

Resources

- http://www.cleanhouston.org/living/better_world/houston3.htm
- <http://houston.bizjournals.com/houston/stories/2003/10/13/story4.html?page=1>
- <http://abclocal.go.com/ktrk/story?section=weather/hurricane&id=6407411>
- http://altivia.com/company_who_we_are.aspx
- <http://www.impactnews.com/southwest-austin/recent-news/5652-city-panel-to-evaluate-water-treatment-plant-proposal>
- www.twdb.state.tx.us/publications/reports/RainHarv.pdf
- <http://www.naymz.com/institution/houston/area/water/corporation/1496>
- <http://www.nhcrwa.com/>
- <http://www.tceq.state.tx.us/assets/public/permitting/watersupply/ud/forms/jack.pdf>
- http://www.nhcrwa.com/grp/GRP_online_1-2005.pdf
- <http://www2.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STORY=/www/story/04-11-2006/0004338302&EDATE=>
- http://www.pbsj.com/Our_Businesses/Consulting/Services/Engineering/Drinking_Water/Pages/DBO_Services_Northeast_Water_Purification_Plant.aspx
- http://www.nhcrwa.com/maps/2010_system/2009/website2009-Oct.pdf
- <http://altivia.com/default.aspx>
- <http://abclocal.go.com/ktrk/story?section=weather/hurricane&id=6407411>
- <http://www.thewatertreatments.com/wp-content/uploads/2009/02/water-treatment-process.gif>
- <http://www.greeleygov.com/Water/WebImages/treatment.gif>
- <http://www.activated-carbon.com/images/oulu.gif>
- <http://washtech.files.wordpress.com/2009/02/shechen-water-treatment1.jpg>
- <http://www.activated-carbon.com/images/cg1.gif>
- <http://impactnews.com/images/stories/GHT/2008/08/19-water.jpg>