



Queen Anne's County Health Department
State of Maryland

206 N. Commerce Street, Centreville, MD 21617-1049
Tel: 410-758-2281 • Fax: 410-758-6602

February 12, 2004

ENVIRONMENTAL HEALTH SERVICES

To: Mr. D. Steven Walls, Director of Public Works

From: John E. Nickerson, Director of Environmental Health

JEN

Re: Kent Island Environmental Health Department Concerns Regarding Failing and Inadequate Septic Systems in "Older Subdivisions"

Attached are a compilation of various letters, documents and comments regarding the above referenced subject by our office. In addition, the following comments are offered:

1. The need for public sewer to Kent Island Estates - Romancoke on the Bay remains as strong or stronger than as stated in previous discussions.
2. Other smaller "older-type subdivisions" such as Matapeake Estates, Sunny Isle of Kent, Chesapeake Estates, Kentmorr, Queen Anne Colony, Marling Farms, Dominion area and to a lesser extent Tower Gardens are all in need of public sewer to address their inadequate on-site waste disposal. These needs are similar to Kent Island Estates & Romancoke on the Bay except for the magnitude of the number of failures. House percentage failure rates are comparable.
3. Isolated individual homes in the Batts Neck-Normans cluster area should be served by public sewer, as this area also has seasonal septic system failures.
4. Once a decision is finalized to provide public sewer, the timing of serving each community can be implemented by the most cost effective method for staging of construction.
5. The Health Department's position is that public sewer is the only practical and permanent solution to provide adequate domestic waste disposal to these "older subdivisions". In addition, public health nuisances, groundwater contamination concerns and the negative impact to nearby shellfish growing waters would all be eliminated with public sewer service to these areas.

CC: Dr. Devadason, Health Officer
The Honorable Queen Anne's County Commissioners

- Enclosures:
- 12/17/98 Letter to Steve Walls
 - 4/29/97 Letter to Steve Walls
 - Wastewater and Health Article
 - The History of Plumbing Article
 - Septic Systems Handbook
 - 5/25/90 Letter to J.L. Hearn





ENVIRONMENTAL HEALTH SERVICES
QUEEN ANNE'S COUNTY
HEALTH DEPARTMENT

206 N. COMMERCE STREET
CENTREVILLE, MARYLAND 21617
PHONE: 410-758-2281

TO: Mr. D. Steven Walls, Director of Public Works

FROM: John Nickerson, Director of Environmental Health

DATE: December 17, 1998

RE: Southern Kent Island Environmental Health Department Issues

The following information and comments are offered regarding certain public health concerns which you may wish to incorporate or reference in your executive summary to the County Commissioners.

General Comments:

1. As "Approving Authority" for individual on-site waste disposal systems and water supplies for Queen Anne's County the "older small lot subdivisions" on Kent Island represent the greatest challenge for our office in assuring adequacy of water and sewer. In most instances lot size constraints represent the most significant limiting factor to continue providing adequate on-site waste disposal. Repairing, replacing or adding on to existing septic systems becomes increasingly difficult and more expensive. Homeowners are limited as to expanding their living space or allowing accessory uses such as swimming pools or garages when these proposals adversely affect their sewage system replacement areas. Our office has not formally tracked building and use permit denials or alterations. My staff indicates the majority of these denials or changes to the original requests occur via phone or via office visits prior to actual building permit applications. Public sewer to the "older small lot subdivisions would be of intrinsic benefit to property owners as it would allow them to maximize their uses according to zoning restraints.
2. Kent Island Estates-Romancoke on the Bay continue to "stand out" as the designated number one priority area for public sewer from an Environmental Health viewpoint. If one were to review and consider all areas of Queen Anne's County currently served by septic systems this area has the greatest priority for the following reasons:
 - a. Small lot sizes
 - b. Number of existing houses clustered on a limited acreage
 - c. A seasonal high water table (Feb-April) which causes the septic system discharges not to be properly attenuated before entering the State's groundwater. This condition constitutes a septic system failure by traditional public health definition. A homeowner's definition of failure would be when wastewater backs up in the house

plumbing or significantly overflows on the ground surface.

3. The 1989 Health Department Study currently in Queen Anne's County Master Water and Sewer Plan was conducted by E. Wayne Asplen, Regional Consultant for the Maryland Department of Environment and myself. It must be emphasized that this study assigned higher risk weight to sewage directly penetrating groundwater and that the uncorrectable failures relates to failures because of groundwater penetration. This study does not correlate to the failure that homeowner's recognize which is sewage backing up in their plumbing or overflowing on the ground.

4. There are over 750 homes in Kent Island Estates-Romancoke on the Bay. Seasonal high water tables observed in piezometers and auger holes indicate at least 80% of these houses discharge septic wastes directly to the groundwater during the wet season (March, April). All the well casings for these homes go through the shallow groundwater where sewage wastes discharge in order to reach the Aquia Aquifer which is a "confined aquifer" utilized for their water source. There is no known bacterial contamination or nitrate-nitrogen contamination of the Aquia Aquifer at this location. However, there is a risk associated with this existing situation. Pitted or cracked well casings or inadequate grouting around the casings is a risk factor which could cause contamination to the drinking water. The health risks because of the density of housing and the direct penetration of the groundwater with sewage wastes is significantly higher than areas of the County where there is less density and no direct penetration of the groundwater with sewage wastes:

5. Documented health disease outbreaks because of sewage wastes occurs most often when people drink water contaminated with sewage. (See attached plumbing history, septic systems handbook, and wastewater and health literature) There are risks with sewage discharging on top of the ground if children, animals, or adults physically come in contact with the wastes. Health journals indicate flies, cock roaches and other pests may cause indirect contamination of food sources. There have been several outbreaks of disease associated with shellfish (oysters, clams) contaminated from sewage wastes running off into shellfish growing areas.
Again, Kent Island Estates-Romancoke on the Bay rate the first priority for public sewer in Queen Anne's County because of the potential for a water related sickness caused directly or indirectly by sewage contamination. Health officials have particular concerns about what they refer to as infective doses or concentrations. The high density of homes in this area causes a greater concentration of sewage wastes in the shallow groundwater.

6. There have been two physical surveys of Kent Island Estates-Romancoke on the Bay to document sewage wastes ponding in the grass or running into nearby ditches. (See attached 1990 and 1995 surveys and discussion in letter of 5-25-90 to J.L. Hearn and letter of 4-29-97 to Steve Walls.) Conducting any further studies of this type for this area, I believe, would serve no particular value as there appears to be no significant difference in the pattern of "homeowner type failures." Weather conditions, change of ownership, changes in wastewater volume, and an average of approximately (7) seven repairs of septic systems per year in this area provide a continual change year to year. My staff has

not formally tracked complaints, but are of the opinion there is no significant noticeable increase in the level of complaint activity from Kent Island Estates-Romancoke on the Bay. They estimate an average of 10-12 citizen complaints per year from this area regarding septic system failures. This represents the highest number of complaints when compared to any other area (subdivision) in the County.

7. As you are aware, Planning and Zoning have segmented Southern Kent Island into four (4) segments (A,B,C,D) for purposes of evaluating certain scenarios if public sewer served these segments. It is obvious by their map where the greatest density of small lots clustered together occurs. Subdivisions such as Sunny Isle of Kent, Chesapeake Estates, Kentmorr and Kent Point are similar in lot sizes as Kent Island Estates-Romancoke on the Bay. As a generalized statement these subdivisions have comparable Environmental Health concerns as Kent Island Estates and Romancoke on the Bay. The per cent of homes with their sewage wastes directly penetrating groundwater during the wet season is approximately 75 per cent and a physical sanitary survey would probably show similar "homeowner failure per cent rates. The difference is in the number of lots, the number of existing homes, and citizens being affected.
8. Public water would not be required by our Environmental Health office should any or all of these areas be served with public sewer. However, public water is considered as a better method of providing water rather than each lot having its own well. In addition, there will occur demand for a significant number of new wells to serve vacant lots which would become buildable with public sewer. This increased usage may cause the potential for increased salt-water intrusion into the Aquia Aquifer along the western edge of Kent Island. Our office would strongly recommend that if public water were provided that all existing wells be required to be abandoned and sealed. Existing wells left in Cloverfields and Bay City have become an enforcement "nightmare" to determine if they are routinely in use. Wells not routinely used pose the specific hazard of the homeowner not recognizing any changes in the water such as "dirty water" from an eroded casing. This in turn causes unnecessary risks for contamination of the Aquia Aquifer.

Summary Comments:

1. The critical question becomes when should public sewer be provided for these "older small lot subdivisions," in particular Kent Island Estates-Romancoke on the Bay. If one considers a septic system failure as one with direct groundwater penetration then the answer is immediately. As a practical matter the homeowner definition of failure should be weighed more heavily, because ultimately the people within the communities must acknowledge and recognize they have a significant problem that public sewer would rectify. In addition, I am of the opinion that most vacant lot owners would vote for public sewer immediately. The cost to each homeowner for public sewer will become the overriding decision factor.

2. There are other County Commissioner concerns besides the health Department issues, such as vacant lot build out overcrowding schools, increased road traffic, private versus public roads, stormwater management, solid wastes increase, and last but not least, debt load.
3. Our office will continue to strive to serve the citizens with on-site repairs. I do not believe "pump and haul" methods are practical because of excessive costs.
4. Currently, I am reviewing (as time permits), each record of the older subdivisions on Southern Kent Island that our office has on file. I am compiling a list of the dates of septic system installations, the type of system installed, and the corresponding Lot, Block, Section Number. This information will prove useful for tracking new type of installations such as low pressure dosing, sewage effluent pumped systems, sand lined trenches, septic tank replacements. In addition, I am tracking some seasonal water table readings from utilizing the piezometer or auger hole reading method.

CC: Dr. Devadason, Health Officer

Enclosures: 5-25-90 Letter to J.L. Hearn
4-29-97 Letter to Steve Walls
Wastewater and Health Article
The History of Plumbing Article
Septic Systems Handbook

ENVIRONMENTAL HEALTH SERVICES
QUEEN ANNE'S COUNTY
HEALTH DEPARTMENT

206 N. COMMERCE STREET
CENTREVILLE, MARYLAND 21617
PHONE: 410-758-2281



April 29, 1997

Mr. D. Steven Walls, Director
Queen Anne's Co. Dept. Of Public Works
P.O. Box 56
Centreville, Maryland 21617

RE: Romancoke on the Bay
Kent Island Estates
Sanitary Survey in the Spring of 1995

Dear Steve,

As a follow-up to our office's sanitary survey conducted in 1990 of the above referenced subdivisions another survey was completed in the Spring of 1995. It should be noted that the weather pattern was one of extreme drought and caution should be exercised as to whether this survey is comparable to a normal wet season. However, this survey's information is valuable in providing additional data for future sewer need evaluations in the Kent Island Estates and Romancoke on the Bay area.

The following comments and results are offered:

I. Background Information

1. A physical survey of this type is only a representation of what was observed or documented on the given survey day.
2. Some of the septic systems showing septic wastes, laundry wastes or kitchen wastes on the ground surface or weeping into nearby ditches, may be exhibiting these conditions only during the seasonal high water table period.
3. Conversely, other systems not shown as failing in this matter during the survey time, may be failing now due to age, lack of maintenance, or increased usage.
4. Other systems observed may be failing intermittently during peak usage even though the survey found no evidence.
5. Of particular importance, is the fact that septic systems are by nature an interim means of waste disposal and will eventually clog to the point they cannot handle the given house's wastewater flow. When this occurs they will "back-up" into the house's plumbing or weep-out to ground level. They then have to be replaced, repaired, or added on to, if there remains a suitable replacement or "recovery area"; state regulations for old lots of record required only one replacement area.

II. Recent and Current Health Department Activities

1. Our office starting in 1989-1990 began implementing more stringent and in general more costly methodologies when repairing or replacing a septic system.
2. Drainfield systems were required in many instances to be elevated and a method of low pressure dosing was utilized to evenly spread the wastewater over the entire drainfield. This requires pump chambers, alarms, pumps, electrical wiring and in general a more complex maintenance procedure. It is our experience (as a generalized statement), the average homeowner lacks the experience or aptitude to assure routine maintenance of his or her septic system. They usually respond when it "doesn't work." (I.e. "The car is

- completely broke down")
3. When a homeowner has their septic system repaired by elevating their waste disposal area, they often impact negatively upon surrounding properties. Typically, the run-off water now diverts more intensely to a lower surrounding lot. Hence, some of these repair jobs bring complaints from neighbors about the effects upon their property.
 4. Most repairs are now utilizing sand-lined trenches. Use of this technology hopefully will cause the "clogging mat" to form more closely to the land surface. If this "clogging mat" forms close enough to the surface we may be able to physically dig out failed clogged trenches and replace with fresh sand in an attempt to rejuvenate existing drainfields.

III. Results of the 1995 Sanitary Survey are as follows: (Please see 5-25-1990 attached letter to J. L. Hearn for comparison to 1990 Sanitary Survey)

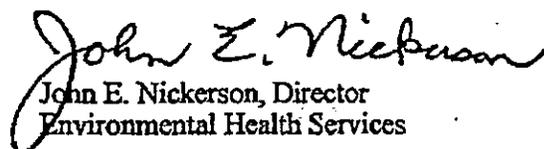
1. Romancoke on the Bay
 - a. 160 Homes were surveyed
 - b. 31 Homes had septic wastes, laundry wastes or kitchen wastes ponding in the grass or discharging into nearby ditches.
 - c. Of the occupants at home, 15 were in favor of public sewer and 10 were opposed.
2. Kent Island Estates (Section I, II, III)
 - a. 592 Homes were surveyed
 - b. 86 Homes had septic wastes, laundry wastes or kitchen wastes ponding in the grass or discharging into nearby ditches.
 - c. Of the occupants at home 98 were in favor of public sewer and 74 were opposed.

IV. Other Comments:

1. Seasonal high water table readings observed in piezometers and auger holes indicate that approximately 80% of the houses discharge septic wastes directly to the groundwater during the wet season.
2. There are no known shallow wells in either subdivision and both subdivisions are served by individual deep wells screened in the Aquia Aquifer.
3. The well casings must pass through the shallow unconfined aquifer in which septic wastes are being discharged. This poses some health risks if the well casings pit or crack or if the grout is inadequate.

In summary, our Environmental Health Division considers public sewer as the long term vision for providing adequate waste disposal for the Kent Island Estates-Romancoke on the Bay subdivisions. If you have any questions please call me at 758-2281.

Sincerely,


John E. Nickerson, Director
Environmental Health Services

CC: The Honorable Queen Anne's County Commissioners
Dr. Devadason, Q.A. County Health Officer
Mr. LaMonte Cook, Acting County Administrator
Mr. Steven Kai-Zeigler, Planning Director

Enclosures: 5-25-90 Letter to J.L. Hearn
11-7-94 Letter to Steve Walls
Regarding Master Water and Sewer Plan Update Issues.

How Are Diseases Spread from Wastewater?

Humans "catch" diseases from wastewater in a variety of ways. Pathogens in wastewater may be transmitted by direct contact with sewage, by eating food or drinking water contaminated with sewage, or through contact with human, animal, or insect carriers.

For example, direct contact might accidentally occur as a result of walking in fields fertilized with untreated wastes, playing or walking in a yard with a failed septic system, touching raw sewage disposed of in open areas, swimming or bathing in contaminated water, or working with or coming into contact with animals or wastewater and not following proper hygiene.

Houseflies can be used to illustrate the dangers posed by disease carriers. Flies, which have tastebuds on their feet, always land directly on the food they eat—and on any given day, that could mean raw sewage (a fly favorite) followed by picnic food. The hairs on a housefly's body can carry millions of pathogens, which then brush off on anything the fly touches.

By making sure that wastewater is treated and disposed of properly, communities can control the spread of disease by flies and other disease carriers, such as rats, lice, cockroaches, and mosquitoes.

By controlling the population of these animals and insects, communities also help to control the other, nonwastewater-related diseases they may carry.

But by far the most common way that people contract diseases from wastewater is through the fecal-oral route, or in other words, by eating food or drinking water contaminated by sewage or by not washing hands after contact with sewage.

In communities where wastewater treatment is inadequate or nonexistent, the opportunities for people to become infected seem endless. For example, people have become ill by doing the following:

-  drinking contaminated water, juices made with water, or other beverages made with contaminated water or ice;

-  eating food improperly handled by infected people or carriers (often workers in restaurants or food processing facilities);

-  eating vegetables and fruits contaminated by irrigation with polluted water or fertilized with untreated sewage or sewage sludge;

-  eating meat or drinking milk from animals that grazed on contaminated pasture or drank contaminated water;

-  eating fish or shellfish grown, caught, or harvested in contaminated water; and

-  eating food exposed to flies or vermin that feed on or come into contact with sewage.

Diseases contracted by drinking contaminated water or eating contaminated food are often referred to as waterborne and foodborne diseases. ♣

What Diseases Are Commonly Caused By Wastewater?

Bacteria, viruses, and parasites (including worms and protozoans), are the types of pathogens in wastewater that are hazardous to humans. Fungi that can cause skin, eye, and respiratory infections also grow in sewage and sewage sludge. Scientists believe there may be hundreds of disease-causing organisms present in sewage and wastewater that have yet to be identified.

Diseases Caused by Bacteria

Bacteria are microscopic organisms that are responsible for several wastewater-related diseases, including typhoid, paratyphoid, bacillary dysentery, gastroenteritis, and cholera.

Many of these illnesses have similar symptoms, which vary in severity. Most infect the stomach and intestinal tract and can cause symptoms like headache, diarrhea (sometimes with blood), abdominal cramps, fever, nausea, and vomiting. Depending on the bacteria involved, symptoms can begin hours to several days after ingestion.

Often, infected people will experience only mild symptoms or no symptoms at all. However, anyone experiencing frequent diarrhea and vomiting should seek medical attention immediately. Severe dehydration and death can result in serious cases, sometimes within a day.

Typhoid

Early in this century, typhoid fever was major cause of death from outbreaks of waterborne disease in this country. Today water and wastewater treatment has almost eliminated this highly infectious disease in developed countries, but it continues to be a problem in many areas of the world.

Paratyphoid fever, which is like typhoid fever, is also a waterborne disease. In 1991, 910 suspected cases of paratyphoid fever were reported in the United States. The disease was linked to sewage contaminating the water reservoirs after a sewage pipe had been damaged during construction work.

Cholera

Cholera is another waterborne bacterial disease that used to be responsible for recurring outbreaks in the U.S. It is again a threat in much of the world.

Cholera spreads quickly, especially in areas where people live in crowded conditions without toilets or clean water. Outbreaks also result from people eating contaminated seafood.

Since 1961, there has been a devastating global epidemic of cholera, which spread to this part of the world in 1991. A Chinese freighter that dumped its wastewater into the harbor at Lima, Peru, is suspected of having brought the disease to Latin America for the first time in more than 100 years. The epidemic quickly spread to Ecuador, Colombia, Chile, and north to Mexico. At least 10,000 deaths and 1 million cases have been reported to the Pan American Health Organization from Latin America alone.

Continued on page 4

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Because cholera can be controlled with water treatment and boil-water advisories, a massive outbreak is unlikely in the U.S. However, smaller, isolated outbreaks have occurred.

Oyster beds contaminated with cholera bacteria were found in Mobile, Alabama, in 1991 and were closed by health officials. Other small outbreaks in the U.S. originated from travelers eating contaminated seafood or seafood brought home in suitcases.

Diseases Caused By Viruses

Viruses are microscopic parasitic organisms. They are smaller than bacteria and can be seen only with an electron microscope. Some can infect people through wastewater.

Viruses can't multiply outside their hosts, and wastewater is a hostile environment for them. But enough viruses can survive in water to make people sick.

Hepatitis A, polio, and viral gastroenteritis are a few of the diseases that can be contracted from viruses in wastewater. Viral gastroenteritis is thought to be one of the leading causes of illness in the U.S.

There may be as many as 100 different virus types present in raw sewage, but they are difficult to identify. Much is still not known about the viruses and other pathogens in wastewater or their exact behavior and effect on humans.

According to the U.S. Environmental Protection Agency, tests using DNA to help detect and identify viruses are being developed.

Parasites In Wastewater

Until recently, most Americans haven't been concerned about parasites in their drinking water. But in the past few years, well-publicized outbreaks of giardiasis (caused by the protozoan *Giardia lamblia*), and cryptosporidiosis (caused by the protozoan *Cryptosporidium*) have brought attention to these organisms.

The types of parasites found in wastewater include protozoans and helminths (parasitic worms).

When people drink water contaminated with protozoans, they can multiply inside the body and cause mild to severe diarrhea.

Another protozoan, *Entamoeba histolytica*, is the cause of amebiosis, also known as

amebic dysentery. Amebiosis used to be a major cause of illness in the U.S. before the days of widespread water and wastewater treatment. Bloody diarrhea is a major symptom.

Infected people become carriers of protozoans and shed them in feces. The protozoans can form a protective covering (called cysts) and become inactive when in hostile environments, like water and wastewater. In this stage, they are often resistant to disinfection and water treatment methods.

While outbreaks can be controlled by boiling water, the best strategy is to prevent pollution by limiting the amount of untreated wastes released to water sources.

Parasitic worms can also dwell in untreated sewage. Tapeworms and roundworms are the most common types found in the U.S. Their eggs are found in untreated wastewater and can be ingested.

Hookworms are still present in the southeastern U.S. They usually enter through the skin or bare feet.

Symptoms from parasitic worms vary, but can include abdominal pain, weight loss, anemia, and fatigue.

HIV Not a Threat in Wastewater

Because HIV (Human Immunodeficiency Virus) the virus that causes AIDS (Acquired Immune Deficiency Syndrome) is transmitted through blood and body secretions and is not a waterborne disease, it is not among the risks associated with wastewater.

Although HIV organisms have survived several hours in wastewater in controlled laboratory tests, in reality, wastewater is a hostile environment for HIV. Also, HIV is not shed in the feces like most other pathogens in wastewater, and it cannot multiply outside the human body.

In fact, the only ways that HIV can enter wastewater is through blood, semen, saliva, or tears, and it can only infect people through direct contact with their blood. For these reasons, it is not likely to be present in high enough concentrations in wastewater to pose a risk.

Who is most at risk?

Whether or not someone will get sick after being exposed to untreated wastewater is hard to predict. There are enough disease-causing organisms in wastewater, however, to make contact with it always very risky.

Many people who are infected with pathogens or pollutants in water never even develop symptoms. How healthy you are to begin with, whether or not you have built up a resistance to a specific disease, how the organism or substance enters your body, how potent or toxic it is, and the size of the dose all contribute to how severely you will be affected.

People who have suppressed immune systems because of HIV/AIDS, chronic disease, chemotherapy, or other conditions are especially at risk from wastewater-related diseases. Children, the elderly, and the urban and rural poor are also significantly more at risk than the general population.

Other Wastewater-related Health Concerns

Because of inadequate wastewater treatment, excessive amounts of the nutrients nitrogen and phosphorus sometimes invade water sources causing algae blooms.

Algae blooms are dangerous to fish because they use a lot of the oxygen in the water. They can also have a strong, objectionable smell and can affect the taste of water.

Too much nitrogen in water can also be dangerous for humans. It is the cause of methemoglobinemia, or blue baby syndrome—a condition that prevents the normal uptake of oxygen in the blood of young babies. It is also suspected of causing miscarriages.

Excess nutrients in coastal waters may also be related to certain "red tides," which kill fish and other aquatic life and can cause shellfish poisonings and certain respiratory illnesses in humans.

Metals, such as cadmium, copper, lead, nickel, and zinc, can also be found in wastewater. Some of these metals are needed in trace amounts by our bodies, but can be harmful in larger doses. Acute poisoning from heavy metals in water is rare in the U.S., but whether ingesting small amounts over an extended period of time has any accumulative effects is unknown.

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Other potentially toxic substances can enter wastewater from various sources, such as local business, industry, or storm water runoff. These substances can include pesticides and chemicals like chlorinated hydrocarbons, phenol, PCBs (polychlorinated biphenyls), and benzene.

Preventing potentially harmful substances from polluting water in the first place is always the best strategy for protecting health and the environment and preserving valuable water resources for community use and recreation.

Communities can help through programs that ensure local businesses and industries properly pretreat and dispose of the wastewater they generate. Communities can also educate and encourage homeowners to properly dispose of hazardous household chemicals, such as paints, varnishes, photographic solutions, pesticides, and motor oil. Some communities set up special dates and locations for collecting these substances. ▲

How Wastewater Treatment Helps Prevent Disease

Wastewater treatment consists of a combination of processes used in steps to remove, kill, or "inactivate" a large portion of the pollutants and disease-causing organisms in wastewater.

Most treatment methods include a preliminary step in which the solid materials are filtered out or allowed to settle and separate from the rest of the wastewater. Helpful bacteria grow naturally in the solids or "sludge," which provide some initial treatment for the sludge and the wastewater that comes in contact with it.

The wastewater receives further treatment often through a combination of filtration and biological and chemical processes. Liquids are often stored for a period of time to allow further settling and bacterial treatment.

The sludge is then treated further by applying lime or chemicals, air drying, heat drying, or composting. For final disposal, it is burned, buried in landfills, used as commercial fertilizer, spread on forested

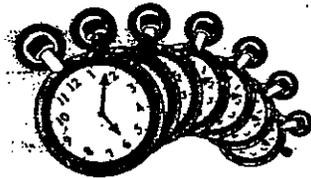
land, or disposed of in the ocean.

Soil can also be used to help treat wastewater. If conditions are right, liquid wastes can be applied to soil, and most of the pollutants are either removed, inactivated by bacteria, adhere to certain materials in the soil, or filtered out before reaching the groundwater. Sand or other media can be used in place of soil in areas where the natural soil or geographical conditions are not suited for this purpose.

Disinfection is normally the final treatment step for wastewater being discharged near or directly into surface water or for groundwater recharge. Chlorine, ozone, ultraviolet light, or other chemical agents inactivate many pathogens that manage to survive previous treatment processes.

However, while wastewater treatment is essential for protecting water quality, it is only one barrier against disease. Additional treatment is usually needed to ensure that water is safe to drink. ▲

Waterborne Disease



1700BC Ahead of his time by a few thousand years, King Minos of Crete had running water in his bathrooms in his palace at Knossos. Although there is evidence of plumbing and sewerage systems at several ancient sites, including the cloaca maxima (or great sewer) of ancient Rome, their use did not become widespread until modern times.

1817 A major epidemic of cholera hit Calcutta, India, after a national festival. There is no record of exactly how many people were affected, but there were 10,000 fatalities among British troops there alone. The epidemic then spread to other countries and to the U.S. and Canada in 1832. The governor of New York quarantined the Canadian border in a vain attempt to stop the epidemic. When cholera reached New York City, people were so frightened they either fled or stayed inside, leaving city streets deserted.

1854 A London physician, Dr. John Snow, demonstrated that cholera deaths in an area of the city could all be traced to a common public drinking water pump that was contaminated with sewage from a nearby house. Although he couldn't identify the exact cause, he did convince authorities to close the pump.

1859 The British Parliament was suspended during the summer because of the stench coming from the Thames. As was the case in many cities at this time, storm sewers carried a combination of sewage, street debris and other wastes, and storm water to the nearest body of water. According to one account, the river began to "seethe and ferment under a burning sun."

1892 The comma-shaped bacteria that causes cholera was identified by German scientist Robert Koch during an epidemic in Hamburg. His discovery proved the relationship between contaminated water and the disease.

1939 Sixty people died in an outbreak of typhoid fever at Manteno State Hospital in Illinois. The cause was traced to a sewer line passing too close to the hospital's water supply.

1940 A valve accidentally opened caused polluted water from the Genessee River to be pumped into the Rochester, New York, public water supply system. Approximately 35,000 cases of gastroenteritis and six cases of typhoid fever were reported.

1955 Water containing a large amount of sewage was blamed for overwhelming a water treatment plant and causing an epidemic of hepatitis in Delhi, India. An estimated 1 million people were infected.

1961 A worldwide epidemic of cholera began in Indonesia and spread to eastern Asia and India by 1964; Russia, Iran, and Iraq by 1966; Africa by 1970; and Latin America by 1991.

1968 A four-year epidemic of dysentery began in Central America resulting in more than 500,000 cases and at least 20,000 deaths. Epidemic dysentery is currently a problem in many African nations.

1993 An outbreak of cryptosporidiosis in Milwaukee, Wisconsin, claimed 104 lives and infected more than 400,000 people, making it the largest recorded outbreak of waterborne disease in the U.S.

Sources: Plumbing and Mechanical Magazine; Environmental Engineering and Sanitation, 4th ed., by J. Salvato; and Water and Wastewater Engineering, vol. 1, by Fair, Geyer, and Okun. ▲

Why Public Health Agencies Control the Disposal of Domestic Sewage

I used to believe that everyone knew that sewage poses a health hazard. After all, hygiene is taught at home and in prep school. Epidemiology itself was born as a science in the 1600s, when Snow related cholera epidemics to sewage contamination of groundwater. At the UCLA School of Public Health, I learned from Professor C. Senn that, until pit privies were introduced, millions of people in the South were parasitized by hookworms and, too weak to work, were considered to be "lazy." World Health Organization bulletins from Senn's bookshelves spoke of elevated morbidity and mortality due to improperly disposed sewage; one of them described an occasion when introduction of piped-in, clean potable water to a developing-country village increased morbidity and infant mortality because no measures were taken to dispose of the water after it was used.

So, I was quite surprised and shocked when I heard an "expert" testify in front of a local planning commission that sewage was not a health hazard. Later on, I met more than a few such "experts."

Therefore, it seems proper to start this book by giving solid reasons why the disposal of wastewater or sewage must be controlled by public health agencies. For our purposes, sewage is any domestic wastewater, be it "blackwater," which drains down the toilet, or "greywater," which drains from all other plumbing fixtures (handbasin, kitchen sink, tub, shower, etc.).

1.1 CONSEQUENCES OF IMPROPER DISPOSAL OF SEWAGE

Ponded sewage near inhabited areas may afflict residents in various ways. As a nuisance, it may generate offensive odors, it may attract rodent pests, and it may serve as a breeding ground for mosquitoes and flies. Obviously, such conditions do not help the neighborhood's property values. As a health hazard, sewage may contain parasitic worms, eggs and larvae, and also microbial pathogens and parasites. Some of these may attack man directly through the skin, or after transmission by a vector (usually rodent or insect), or after man ingests sewage-contaminated food or water. Of the "top five" human parasitic diseases, each with about half a million to a million cases per year worldwide (ascariasis, hookworm, malaria, trichuriasis, and amoebiasis), only one (malaria) is not directly spread in sewage. A wealth of pertinent, detailed, and authoritative information can be found elsewhere.³⁴ A brief mention of diseases propagated through direct or indirect contact with sewage and of their causative agents follows. (See Appendix A for summary.)

1.2 CATEGORIES OF CAUSATIVE AGENTS AND SPECIFIC DISEASES

Various Types of Tapeworms, Roundworms, and Flatworms

Ancylostomiasis. The hookworm larvae penetrate the skin of the feet and travel to the gut.

Ascariasis. The roundworm eggs stay in the sewage-contaminated soil; after they are ingested (dirty hands, contaminated food), they develop in the gut. The adults may attack lungs, liver, and other organs.

Dracontiniasis. These unusual roundworm larvae are shed from the skin with the washwater (greywater), and are ingested by a tiny aquatic "bug" (Cyclops); the roundworm infects people who drink (the bug in) the water.

Enterobiasis. The adult female roundworm, "pinworm," injects its eggs near the anus of the victim. The eggs are easily spread in sewage-contaminated irrigation waters, and contaminate leafy vegetables.

Strongyloidiasis. The roundworm larvae in contaminated soil penetrate the skin of the feet and move to the lungs and gut.

Somatic cysticercosis. The eggs of the tapeworm are ingested with contaminated water, hatch in the gut, and then the larvae may attack various organs: eye, brain, heart.

Schistosomiasis. The eggs of the flatworms are discharged in the urine or feces; the larvae grow inside aquatic snails, are discharged by them, swim to and penetrate the skin of people who might be wading nearby, and grow to adulthood in the veins of the victims.

Trichuriasis. Eggs of the roundworm develop into embryos in contaminated soil; after the embryos are ingested (dirty food, hands), they grow in the gut.

Yeast

Candidiasis. The yeast is transmitted by contact with feces or secretions from infected people. Although it causes usually mild infections, occasionally it may cause ulcers in the intestinal tract, or lesions in the kidneys, brain, or other organs.

SEPTIC SYSTEMS HANDBOOK

Protozoa

Amoebiasis, balantidiasis, and giardiasis. The protozoa or their cysts are transmitted through contaminated water, contaminated raw vegetables, and flies; they attack the gut and cause mild to severe diarrhea.

Bacteria

Cholera, salmonellosis, shigellosis, and typhoid fever. The bacterial agents may be ingested in food or water contaminated by sewage: ~~contaminated water or food.~~

Viruses

Epidemic and sporadic viral gastroenteritis, hepatitis A, and polio. The viral agents are transmitted in sewage-contaminated water or food.

Others

Allegedly, there are infectious agents even smaller than viruses which are called prions, and which are suspected of causing some uncommon degenerative diseases. Someday, one or another kind of prion or an unknown type of life form might be found to be spread through contaminated food or water. We should keep our minds open to such possibilities.

The History of Plumbing

By: Ronald L. George, CIPE • SHG Architects Engineers Inc.

150 W. Jefferson Ave. Ste #100 Detroit, MI 48226

Phone: 313-983-3809 - E-mail: rgeorge@smithgroup.com • Website: www.smithgroup.com

Of all the ancient peoples, the Romans carried sanitation to the highest and broadest degree of development. From their language, Latin, have come such words as sanitation and plumber, the latter being derived from artifex plumbarius, meaning a worker in lead.

Learning From Past Experiences

We all learn from our mistakes and there have been plenty of events to learn from over the course of the history of plumbing systems. History provides us with knowledge and informative records of past plumbing performance and adverse experiences. Recognition of our past mistakes and learning from them provides us with the knowledge to move on and develop plumbing systems that will prevent illnesses and protect the health of the public. Society tends to react to plagues and epidemics by first asking why did this happen and what could have been done to prevent it from occurring again. The American Society of Sanitary Engineering carries this thought forward in their motto. "Prevention Rather Than Cure". We can learn from the past and prevent outbreaks and illnesses rather than cure the ill effects experienced by persons exposed to unsanitary or outdated plumbing systems.

Ancient Plumbing

4000-3000 BC:

Indus River Valley, India

Plumbing has been around for a long time. The first known evidence of ancient plumbing was when Archaeologists unearthed copper water pipes in the Palace Ruins in the Indus River Valley. The water pipe was estimated to be 5,500 years old. The Palace site was excavated and found to have individual apartments. Each bedroom

apparently had been provided with a bathroom with elaborate plumbing systems for the time. This establishes the earliest known plumbing systems almost 6,000 years ago.

2400-2150 BC: Babylon Between Tigris and Euphrates Rivers

Greek writers wrote of ancient Babylonia where the science of Hydraulic Engineering seemed to have had its beginning. A network of canals all skillfully planned and regulated covered the area. They had large brick drainage sewers with access holes similar to today's manholes.

The First Building Code

The first reported building code came from Babylonia. It was called the Hammurabi Code, written by King Shulgi of the Ur Dynasty. This compilation of laws included special provisions for construction and maintenance of the canals that were very important to that desert region. One of the clauses in this code deals with construction of a building. The clause struck terror in the heart of unethical contractors. The Clause said "Woe to the builder whose house falls and kills someone. That builder shall be sentenced to death".

1000 BC: The Island of Crete

On the island of Crete, the remains of a plumbing system at least 3000 years old were unearthed in excavations on the site of

an ancient palace of Knossos. Evidence was found of plumbing fixtures, a water supply system, a sanitary drainage system, and a heating system. One of the fixtures was a bathtub made of hard pottery and 5 feet in length. It was a floor-standing model with an integral base, resembling in shape the cast-iron bathtub-on-base widely installed in America in the latter part of the nineteenth century. Another fixture was a water closet, also of hard pottery. It showed evidence of having been equipped with a water closet seat and a flushing device. Found intact were long sections of clay drain pipe of the bell-and-spigot type. Pipe lengths were short, and branch fittings were provided with T and Y connections adjacent to the bells or hubs.

500 BC - 455 AD:

"The Roman Empire"

Of all the ancient peoples, the Romans carried sanitation to the highest and broadest degree of development. From their language, Latin, have come such words as sanitation and plumber, the latter being derived from artifex plumbarius, meaning a worker in lead. Roman aqueducts still grace the Italian countryside and rank among the world's engineering triumphs. Extensive large underground sewer systems, public and private baths, lead and bronze water piping systems, and marble fixtures with gold and silver fittings have come to be symbolic of the civilization of Ancient Rome. An especially significant feature of progress may be cited as the fact that much of the underground public water supply system was constructed of standardized cast lead sections. It is interesting to note that the lead pipes that were so convenient to work with at the time, made vast improvements in sanitary conditions. Today we are moving away from lead in piping systems for health reasons. One more lesson learned from our experiences.

500 BC - 455 AD: "The Roman Baths"

Public bathing colonies dotted the Roman Empire. One of them, the baths of Diocletian, reportedly accommodated 3200 bathers. Baths and bathing pools were lined with ceramic glazed tile. In residences, bathtubs often occupied an entire room and were supplied with both hot and cold water. Hot water was provided means of lead or bronze piping which conveyed water across open fires. Bathtubs often were carved from solid marble or lined with ceramic glazed tile and equipped with gold or silver fittings.

455 AD - 1200 AD: The "Dark Ages"

After almost a thousand years of world rule, the empire of Ancient Rome crumbled. In the fifth century, it was subjected to successive invasions by Goths and Vandals, barbaric tribes from the north of Europe. In 455, Vandals swept south through Rome, sacked it of all things of value including any metals that could be removed, and destroyed its public works. With the destruction of Rome, its civilization rapidly decayed, and sanitary standards regressed almost to the vanishing point. Surprisingly several major urban areas today are going through similar experiences on a smaller scale.

The following 10 centuries have been historically termed the Dark Ages. For many centuries, people in general paid little attention to personal cleanliness and other domestic sanitary needs involving the use of water. Bathing was frowned upon by persons of influence and not taken seriously even by members of the ruling class, many of whom preferred to use perfume. Plumbing fixtures fell into disuse, including water closets which had been developed and widely used during the fourth and fifth centuries in Rome. They were not used again until about the twelfth century, and even then their use was extremely limited.

1300 - 1400 AD:

The "Plagues and Epidemics"

During the fourteenth century, Europe was ravaged by disease. Bubonic plague swept the continent and England reportedly killed 25 million people. To improve sanitary conditions in Paris in 1395, the authorities ordered a stop to the practice of throwing sewage out of building windows and dumping sewage waste pots onto the streets below. But this was a common practice that continued unabated in other cities.

As late as the early part of the eighteenth century, European cities had not been equipped

with sanitary sewage disposal facilities. The mortality rate in many cities exceeded the birth rate. When building owners were ordered to install domestic sewage vaults, considerable opposition was raised. It was not until the latter part of the eighteenth and early part of the nineteenth centuries that European cities started to provide public sewer systems beneath city streets. Slowly people began to use the convenient pub-

lic sewer facilities for the disposal of sewage from buildings and to develop progressively higher sanitary standards.

Early American Sanitation Standards

1600: Early Settlements

Although America has become a symbol of high standards in plumbing
(continued on page 8)

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History ...

(continued from page 7)

and sanitation, these evolved from very primitive and rude beginnings. Along the Atlantic Coast, firmly established settlements developed local industries and conducted trade with Europe. Among the numerous early settlements were several which later became major port cities, such as Boston, New York, Philadelphia, and Baltimore. Each faced the same general sanitation problems and progressed in developing sanitary standards almost simultaneously. The following is an account of the historical records of early American plumbing history.

1626: New York Port Area Living Conditions

Available reports of the progressive development of sanitary standards in New York may be cited as typical. Following settlement of the port area in 1626, houses were built. None had within them any water supply or sewage disposal facilities.

Drinking water was used sparingly as it had to be carried from springs or wells, or purchased by the bucket from water peddlers who traveled through the streets selling water from wooden barrels on horse drawn trucks. Outdoor earth-pit privies were used as toilet facilities. Wastes from dishwashing, clothes washing, and bathing were disposed of outdoors by dumping them onto the ground adjacent to buildings. Rainwater from roofs also was disposed of onto the ground. As the population of the settlement increased with the arrival of new immigrants, conditions deteriorated. Shallow wells became polluted by seepage from earth-pit privies, areas around homes became excessively fouled from sewage and refuse dumped onto the ground, and streets were quagmires of mud long after rainstorms ended.

1675: New York Appoints The First Health Official in America

Health conditions became intolerable in time and forced organization of a Common Council in 1675. The council ap-

pointed a health officer in charge of sewage and refuse disposal and other health matters. Water tight privy vaults began to be installed instead of earth-pit privies as toilet facilities. Scavenging regulations governing the disposal of privy-vault wastes were put into effect in 1676. The Scavengers lifted the wastes with buckets and hauled it away in barrels on carts pulled by horses or oxen. Scavengers were the predecessors to today's modern septic tank pumping services.

1677: New York Builds the First Public Water Wells

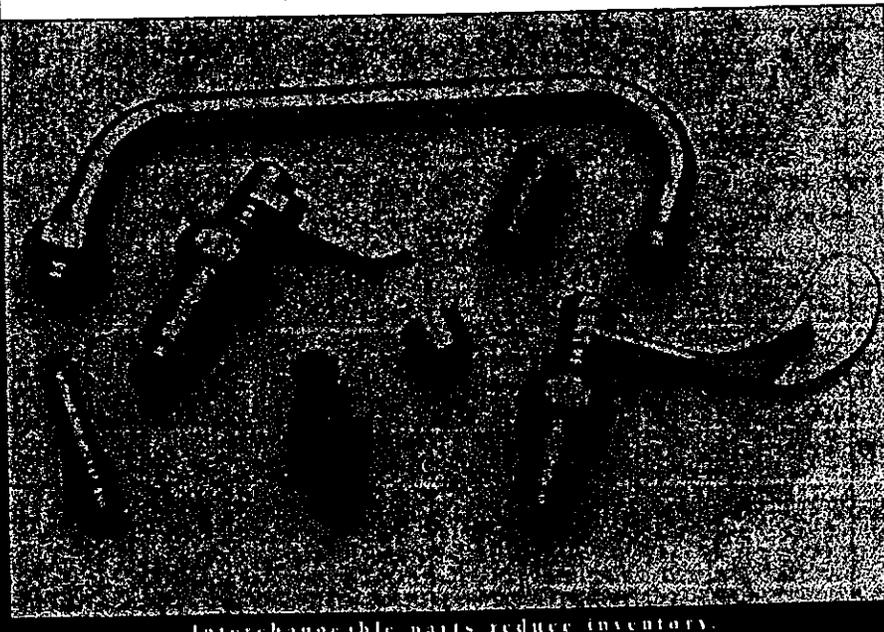
The cities first public water wells were projected in 1677 and completed in 1686. People could draw water from these wells that were located in the populated areas. Later horse drawn carts would deliver water to the doorstep for a small fee.

1687: Muddy Streets Called for Gutters in New York City

Streets were paved and gutters were installed in built-up areas in 1687, and

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homeowners were ordered to pave sidewalks. This was all the result of storm water runoff causing muddy streets and sidewalks. Once again we learn from the past.

1700: New York Adopts a Sanitary Waste Ordinance

In 1700, a sanitary ordinance was adopted prohibiting the dumping of scavengers' barrels of vault wastes into the street gutters. They were required to go far beyond the city to dump their smelly cargo.

1703: New York Builds Sewage Canals

An open-ditch public sewer or sewage canal was constructed, and city surveyors were appointed to establish street and sewer grades.

1717: Open Sewers Drain Into New York Bay

Complaints arose about the unsanitary conditions created by the open-ditch public sewer, and in 1717 the sewer was extended to empty into New York Bay.

1728: New York Installs the First Underground Sewer

The public began to complain about the smell of the open sewers and the health officials responded by installing the first sewer under the streets of New York.

1776: The First Water Reservoir Constructed for New York

The first water supply reservoir was constructed in 1776. It collected water from wells and ponds and distributed water through a supply system consisting of hollow wooden logs laid under principal streets.

1794 - 1797: Epidemics Caused Formation of More Health Boards

Epidemics of waterborne diseases occurred in New York, Philadelphia, Baltimore, and other population centers along the Atlantic Coast. Public pressure developed as complaints to authorities mounted regarding the unsanitary disposal of sewage and the lack of an adequate, available supply of safe drinking water. To improve

conditions, boards of health were established in Philadelphia in 1794, and Boston in 1797. At this time they were not chlorinating the water to kill bacteria. Later we learned this simple process would save millions of lives from bacteria in the water.

1800s: The First Catch-Basins

As a health protection measure, communities began to install all public sewers underground and to extend them to buildings, although many people considered the sewers merely as a means of eliminating unsightly conditions. These early underground sewers were constructed with flat stone tops and bottoms and brick masonry sidewalls. They were intended to serve just for storm water drainage from streets and buildings. But they soon became foul and odorous from sewage and garbage dumped into street gutters. In 1831, catch-basin traps were installed in street gutters to intercept solids conveyed by storm water draining into the public sewer. Later they would learn round or egg shaped sewers would carry away solids much more efficiently.

1830: First Water Mains Installed Under New York Streets

In 1830, after numerous fires had demonstrated the need for an adequate, available supply of water for fire fighting, New York City installed its first public waterworks. This consisted of a large above ground water storage tank into which water was pumped from shallow wells, and from which water was supplied through two 12 inch cast iron water mains to fire hydrants installed along several of the main streets where business buildings were located. But this system proved to be totally inadequate when a severe fire broke out on December 16, 1835. A total of 530 buildings were destroyed overnight.

1835: The New York Fire

The disastrous fire of 1835 in New York City stirred the people into action and led to developments of great significance and benefit. People became aware of the necessity for having an adequate pressurized water supply system readily and constantly available for fire fighting in built-up areas. They also realized there was a great need, both as a sanitary measure and as a labor saving convenience, for having an

adequate pressurized water supply system from which safe drinking water could be piped directly to buildings. Soon after the fire, plans were projected for providing a large public water supply system which would satisfy both of these needs. The 1835 New York City Fire taught us a lesson about sizing water mains that civil engineers still refer to today.

1842: New Yorks Aqueduct Placed in Service

In 1842 the original Croton Aqueduct System was placed in operation. In this system, water from the Croton River was collected in Croton Reservoir, 40 miles north of the city, and supplied from there through an underground piping system to two reservoirs in the city, one at 42nd Street and another in central park. From these reservoirs, water was distributed through a system of cast-iron water mains installed underground in city streets, and fire hydrants were installed in sidewalks at appropriate locations along the curb. Building owners were permitted to have water service connections made to the public main, and water service piping extended from the main to supply faucets or hydrants in building cellars or yards. At that time the population of the city of New York was about 300,000.

Plumbing Systems Inside Buildings in America - "Indoor Plumbing"

1842: New York City Installs Water Piping to Buildings

Upon completion of the Croton Aqueduct System and pressurized water services into building cellars and yards in New York City in 1842, a radical change in building construction took place - the installation of plumbing systems in buildings. Pressurized water supply systems made it possible to satisfy, at the turn of a faucet, the needs of building occupants for a safe and abundant supply of water for all domestic purposes and to eliminate the drudgery, labor and inconvenience of having to carry water from the source. No plumbing fixtures had been installed in buildings prior

(continued on page 10)

History ...

(continued from page 9)

to this time, except for a few crude sink installations reportedly installed in kitchens that were provided with water supply by means of an adjacent hand pump that drew water from a shallow well.

1845 - 1850: Drainage Piping Installed in Buildings

As late as 1845, records indicate that buildings were not provided with interior drainage piping systems. Most buildings were equipped with exterior leaders which conveyed storm water from roofs to pavements and sidewalks from which the water ran into the street gutters. In some cases where branches had been installed from the public sewer to buildings, the exterior leaders discharged directly into such branches or building sewers. Before fixtures could be installed with water supply and drainage piping systems, building sewers had to be installed first so as to convey sewage away from the buildings to a suitable disposal terminal, such as a public sewer system. In 1845 New York City permitted sanitary building sewers to be connected to the existing public sewer system which had originally been provided for just storm water disposal. These building sewers, and the main drains installed underground in buildings at the time were constructed with flat stone tops and brick masonry bottoms and brick masonry sidewalls. They still had flat bottomed sewers. And when they allowed the connection of sanitary sewers to the storm sewers many solids started to settle out in the bottoms of the sewers.

1845 - 1850: Plumbing Fixtures Installed in NYC Buildings

By 1850, plumbing fixtures had been installed in a number of New York City homes. These were principally private residences owned by wealthy people who could afford to alter their buildings to accommodate such facilities. Provision had to be made to protect the fixtures and piping against frost damage by means of heating equipment, insulation or both. Earliest installations consisted of wooden and sheet-metal sinks in kitchens, wooden washtubs in kitchens, cellars or basement

laundry rooms, and sheet-metal bathtubs in special bathrooms or closets.

For these early installations, water supply and drainage piping were attached to building walls and either left exposed in rooms or concealed in box work. A hand-made trap was installed in the drain of each individual fixture to prevent escape of obnoxious odors and sewer gases from fixture waste outlets. However, these traps often lost their water seals because of siphonage and back-pressure conditions in the drainage system, and this caused fouling of the atmosphere of rooms in which fixtures were placed. Check valves and many specially designed traps were installed in efforts to prevent loss of trap seal, but such devices were found to be totally ineffective. At that time, the principle of venting fixture drains to protect trap seals was unknown.

1845 - 1850: Development of the Toilet Room in America

Nevertheless, progress was made in the installation of plumbing systems in buildings. Fixtures were placed in locations where they would not be too objectionable. Sinks and washtubs were put in kitchens and basements. Lavatories and bathtubs were located on various floors and connected to separate stacks. Long hopper water closets, so named because of their funnel or long hopper shape, were installed in toilet rooms or compartments accessible only from outdoors, because it was considered hazardous to health for rooms which housed such odorous fixtures to be directly accessible from the interior of buildings. The hopper type water closet was installed so as to be relatively frost-proof by placing the trap and water supply valve below the floor level. There was little or no consideration for backflow or cross connections in the early installations.

In the late 1850s, people became more and more aware of the need for improving sanitary standards in and adjacent to buildings. Recognition was given to the fact that plumbing systems in buildings could provide adequate safe water for drinking, cooking, bathing, and for flushing fixtures and also could safely and efficiently dispose of sewage and other wastes from buildings. Extensions were built on many homes specifically to provide bathrooms at the

upper stories of existing buildings. Lavatories, bathtubs, and water closets were installed in these extension bathrooms, many of which were also provided with heating equipment. Double doors were placed in passageways between extension bathrooms and the main building in order to prevent bathroom odors and sewer gases from entering the living quarters.

1860s: The First Multi-Family Housing Built in East Coast Cities

Directly following the Civil War, immigration swelled the populations of industrial cities in the eastern part of the country. In many cities, rows of attached three and four tenement houses were built to take care of the additional population. These buildings were provided just with yard hydrants for drinking water supply, while toilet facilities consisted of rows of privies built above watertight privy vaults located in the backyards of the buildings. Extremely objectionable, unsanitary conditions soon developed under such circumstances. Health authorities had to take stringent action to halt the spread of disease. To protect the health of building occupants, the public was alerted to the necessity of equipping buildings with adequate means for supplying safe drinking water for domestic purposes and with adequate facilities for sanitary disposal of sewage. Health authorities advocated the installation of plumbing systems in buildings, and as a result this became a subject of regulation in sanitary codes.

1870s: The First Water Heaters

In the early 1870s, water-supplied kitchen sinks came into general use in private homes and other small buildings. Fireboxes of coal-fired kitchen ranges were equipped with water jacketed backs and water jacketed fronts, and circulation piping was installed between these water-heating units and hot water storage tanks so as to make pressurized hot water available in volume at fixtures. The use of outdoor privies and privy vaults for private homes was discontinued gradually as indoor water closets, directly connected to building drains, were installed in toilet rooms accessible from backyards.

1874: The Venting Theory Was Proven

A major stymie to more rapid introduction of plumbing systems in buildings was the fact that, as late as 1874, no method was known for preventing fixture trap seals from being lost because of siphonage and back pressure conditions in the drainage system. Where fixture trap seals were lost, objectionable odors and sewer gases escaped from the system at fixture outlets and fouled the atmosphere of rooms in buildings. A significant instance of this occurred when a plumbing system was installed in a large new private dwelling in New York City in 1874. Soon after occupying the building, the owner complained to the plumbing contractor that the stench of sewer gas from fixtures in the building was unbearable. After receiving this complaint, the plumbing contractor discussed it at a conference with other New York City master and journeymen plumbers.

At this conference in 1874, the theory was that air pressure in the drain at the outlet of a fixture trap had to be in relatively exact balance with the atmospheric pressure at the inlet of the trap, and this balance could be maintained by means of a vent pipe connected to the drain at the trap outlet and extended to atmospheric pressure outdoors so that air could flow freely into or out of the drain in response to pressure variations in the drain. This theory was tested by contractors and journeymen in the field on numerous installations, and it was proved to be correct. However, numerous details of vent-piping installation and sizing had to be determined by further testing and field experience before continuous, satisfactory performance of vent piping was assured. Nevertheless, the principle of venting sanitary drainage systems by means of attendant vent pipes, to protect fixture trap seals against loss by siphonage and back pressure, was estab-

lished. The way had been found to prevent objectionable odors and sewer gases from escaping at fixture waste outlets and fouling the atmosphere in buildings. To me this is one of the most important advances in modern plumbing history. Now, there could be "indoor plumbing".

The Venting Principle is Publicized

News of the development of the principle of venting sanitary drainage systems spread rapidly to all parts of the country. Detailed information on vent-piping installation, test reports, and experience with systems in service were carried in trade publications, association reports, and newspapers at the time. A major breakthrough had been achieved in knowledge of the design of plumbing systems in buildings which made it possible to locate plumbing

(continued on page 12)

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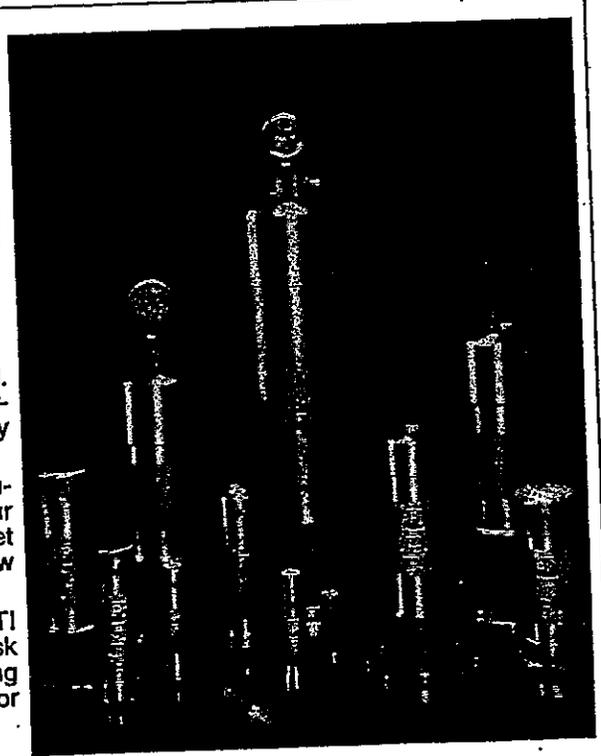
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History ...

(continued from page 11)

fixtures inside without fouling the atmosphere. Objections to installing plumbing systems in buildings rapidly vanished, and plumbing installation proceeded at a greatly accelerated rate.

Within a few years, kitchen sinks were installed in each dwelling unit in tenement houses. Owners of private homes began to have kitchen sinks put in, followed soon after by laundry trays, then bathtubs, and later lavatories placed in appropriate locations for convenient use. About 1880, the use of privies and privy vaults in the backyards of tenement houses was discontinued. In their place batteries of hopper-type water closets, directly connected to building drains, were installed in either backyards or cellars. Similarly, at schools privies and privy vaults were removed. They were replaced by installation of trough-type water closets, known as school sinks, directly connected to building drains. These fixtures were provided in separate schoolyard toilet buildings.

1881: Building Sewers Improve Living Conditions

By 1881, the health protection benefits of sanitary plumbing systems in buildings were clearly recognized by health officials in cities. Prior to this time, in New York City, 90 percent of all human wastes had to be disposed of by removing such wastes from privy vaults and transporting them through buildings, along city streets to docks, and then out to sea where they were dumped. This method of sewage disposal was a severe health hazard and had to be eliminated for this reason. Sanitary plumbing systems in buildings were the answer. People in cities knew this from hard experience. They began to rely upon plumbing facilities for improved sanitary conditions, and to reduce their daily work and increase their enjoyment of living. For economy in installations, sinks and laundry trays were grouped together in kitchens; and water closets, bathtubs, and lavatories were grouped together in bathrooms. This was possible to do in cities with public water supply and sewage disposal systems. But in rural areas, having no such public systems available for building

connection, homes had no plumbing facilities. The only sanitary provisions for building occupants in such areas were an outdoor earth-pit privy as a well. Portable washtubs and bathtubs were used either indoors or under an outdoor shed in most areas.

1890s: The First Washdown Water Closet and Cast-Iron Bathtub

In the 1890s, two important fixture developments, combined with newly available gas and electric public utility systems laid under city streets, aided in further expanding the use of plumbing systems in buildings. The first water closet design considered to be really sanitary was introduced about 1890 with the development of the Washdown water closet. Almost simultaneously, the free-standing, white-enameled cast iron bathtub appeared. They were hailed as important new sanitary advances, as they were reasonable prices, mass-produced fixtures which homeowners desired. The smooth surfaces of these fixtures did not harbor bacteria and were easy to clean. These new smooth finishes on these fixtures helped to reduce odors, spread of diseases and they improved sanitary conditions.

1890: The Manning Formula

In 1890, Robert Manning proposed a formula to calculate the flow in sloping drains. The "Manning Formula" is now the popular formula for determining flow in sloping drains.

1890s: New Gas Mains Allowed Installation of Gas Fired Water Heaters

Doctors and health authorities advocated the expanded use of hot water as a sanitary measure and proclaimed the health benefits of bathing. The ready availability of public utility gas supply systems, which had been newly laid under city streets, aided in expanding the use of hot water supply systems in buildings and the installation of gas-fired water heaters. The availability of public utility systems for supplying electricity for light and power in buildings made possible the installation of efficient electric pumps for pumping

water to plumbing fixtures at any height. It was at this time that skyscraper-type office buildings were first erected in New York City, Chicago, Philadelphia and other major cities. These buildings were equipped with plumbing systems that performed satisfactorily and unobjectionable, and suitable kinds and numbers of fixtures were provided in convenient locations for building occupants.

1900s: Minimum Requirements for Number of Fixtures

At the start of the twentieth century, laws had already been enacted in many areas of the country requiring the installation of plumbing systems in buildings and the provision of suitable kinds and numbers of fixtures in convenient locations for the use of building occupants. In general, such areas were large municipalities where public water supply and public sewer systems were available for building connections. In areas beyond the limits of public systems, it was deemed unreasonable to require installations of plumbing systems and fixtures. Nevertheless, people desired sanitary plumbing facilities and sought to equip their buildings with appropriate systems.

1900s: Key Developments in Water Heating

Hot water supply was especially desired as manufacturers publicized their new developments in water heater equipment. Coal and gas-fired sidearm water heaters appeared on the scene. Automatic controls to eliminate the dangers associated with manual operation of water heaters, and range boiler manufacturers introduced tanks made of several different materials with greater durability.

1900's: Unsanitary Conditions Caused Building Codes to be Updated

Many new tenements were erected in large industrial cities to house the swelling populations. These buildings had sinks and laundry trays in each dwelling unit, but water closets were provided in toilet compartments accessible from the public hallways on each floor. In many cases, more than one family used the toilet faci-

(continued on page 14)

History ...

(continued from page 12)

ties. It was soon apparent that such arrangements were inadequate and objectionable and fostered unsanitary conditions. Health authorities put new regulations into effect requiring that water closets be installed in toilet rooms or bathrooms in each dwelling unit, and strenuous efforts were made to bring existing buildings up to existing standards.

1906: American Society of Sanitary Engineering Organized

The American Society of Sanitary Engineering grew out of a meeting held in Washington D.C., January 29-31, 1906. Henry B. Davis, chief Plumbing Inspector for the District of Columbia, believed it was vital that the plumbing practice in the United States be standardized. Mr. Davis invited 25 inspectors from other American cities to organize an association of plumbing inspectors and sanitary engineers. The Fundamental Principle they decided to follow was "Prevention Rather Than Cure". This principle still guides the society today. ASSE's activities and programs were designed to educate the industry and the public on the importance of safe and correct plumbing installations.

1920s: Post WW I Building Boom

Following World War I and continuing through the early 1920s, the large industrial cities expanded tremendously. New housing developments were built on the fringes of cities, and public water supply, sewer, and utility systems were extended to serve the new buildings. All these were equipped with the most modern plumbing systems and fixtures of the day. Complete bathroom installations, consisting of a water closet, lavatory, and bathtub with an overhead shower were provided in each dwelling unit along with modern kitchen sinks and laundry trays. The growing importance of sanitary plumbing systems in buildings was shown by large-scale plumbing installations in hotels, office buildings, factories, food processing plants, and dairy buildings. Most buildings were provided with more plumbing equipment than was required by law. Multi-story residential

buildings in great numbers were erected in the central parts of cities where land values were very high. They too were fully equipped with complete bathroom, kitchen, and laundry fixtures of modern and sanitary design. Many were equipped with colored plumbing fixtures which were introduced in the middle 1920s. But this tremendous new building construction wave reached its peak in 1929 and came to a sudden halt in 1930 when the severe business depression occurred.

1926: IAPMO Began as the Plumbing Inspectors Association of Southern California.

In 1926 forty-two plumbing inspectors banded together to bring about an improvement in the application of common-sense codification and application of ordinances based on scientific knowledge. In 1932 they published the Standard Plumbing Code. The organization still writes codes, they publish the Uniform Plumbing Code and the Uniform Mechanical Code. Today they are known as the International Association of Plumbing and Mechanical Officials.

1930s: The Depression - Inadequate Systems Corrected

During the 1930s relatively few new buildings were erected until the latter part of the decade. This period was devoted principally to the correction and modernization of plumbing systems and equipment in existing buildings. Important corrections were made to the potable water supply systems of buildings to eliminate all water supply piping connections and fixture supply piping connections which were recognized as potential sources of contamination. This drive for correction of systems was led by health officials, water supply officials, and building officials to avoid the repetition of the amoebic dysentery epidemic which occurred in the city of Chicago during its world fair in 1933. Other important improvements were made in the hot water supply systems in existing buildings. Many were equipped with modern automatically controlled hot water heaters designed for use with gas, oil, or electricity as a source of heat.

1932: Report on Plumbing Drainage Flow in Stacks Released

In 1932, Dr. Ray B. Hunter describes in a report of the Subcommittee on Plumbing of the Building Code Committee, U.S. Department of Commerce, Bureau of Standards, BH 13, (1932).

1935 - 1940: Electricity Extended to Rural Areas.

During this period, the public utility systems around the country extended their electric supply lines into a great portion of the rural area. This provided a source of power for pumping water from wells and for supplying plumbing systems with all the water needed to maintain the sanitary standards that were enjoyed in the cities. Private sewage disposal systems were provided by means of underground septic tank and leaching field installations in appropriate locations. In this way, modern sanitary plumbing systems and fixtures became available even in the remote regions of the country.

1940's: ASSE and the Plumbing Industry Search for Cause of Polio

In the 1940's the American Society of Sanitary Engineering (ASSE) and the plumbing industry took on an extensive effort to prove that Polio was a water borne disease. ASSE and the plumbing industry contended the viral disease was spread through polluted potable water. The theory was many cases were caused by faulty plumbing practices such as cross connections which led to back siphonage and backflow. The ASSE campaign was of major importance in developing a greater consciousness of proper plumbing practices. Since that time the American Society of Sanitary Engineering has developed many Standards for Products that are components of plumbing systems. The standards have a heavy emphasis on backflow prevention and are being adopted by model codes throughout the country.

1944: The National Sanitation Foundation was Formed

The National Sanitation Foundation was formed by Walter Snyder, Henry Vaughan and Nathan Sinai. The Agency was devoted to scientific research in Sani-

tation. They kept in contact with national, state and local governments for the purposes of promoting sound improvements in sanitation. NSF International develops standards for food & beverage equipment, components used in drinking water systems and plastic pipe and fittings.

1946 - 1970s: Post WW II Building Boom

In the latter 1940s, following World War II, and continuing through the 1950s, 1960s, and into the 1970s, there was a tremendous expansion of housing developments and industrial plant construction outside the central areas of cities in the United States. New buildings were erected along new principle highways, and public water, sewer, gas, and electric systems were provided for building service needs in most areas. Private systems were utilized in many areas where public systems were not available. All of the buildings built during these years were equipped with modern plumbing systems conforming to sanitary standards elevated to a higher level than ever before. In the central areas of cities many old buildings were removed and in their places large skyscraper office buildings and apartment buildings were erected. They too were equipped with modern plumbing systems designed in accordance with the highest sanitary standards in history in order to serve the greatest occupancy loads of all time.

1950s: N.B.S. Published Report on Estimating Loads

In the 1950s, the National Bureau of Standards published report BMS 65, "Methods of Estimating Loads in Plumbing Systems," prepared by Dr. Roy B. Hunter. The report gave tables of load producing characteristics (fixture unit weights) of commonly used fixtures, along with probability curves which made it easy to apply to actual design problems. The curves are known as "Hunter's Curves."

1950s - 1960s: Skyscraper Construction Brings Changes in Design

Tower building construction accelerated in the late 1950s and early 1960s, and necessitated changes in design to meet changing conditions. Increased building

heights and increased water usage, including water for air conditioning, required water supply tanks so large that they caused significant space problems and were uneconomical. To meet the changing conditions, design was changed to provide tankless, automatic constant-pressure booster-pump systems which required a minimum of valuable building space and which also provided a sealed-in supply of potable water from the source of supply to the plumbing fixture outlet.

1966: The Development of Plastic Piping

In 1966, a critical shortage of copper occurred in the United States because of stoppage of shipments from foreign sources of supply. Inventories of copper drainage waste and vent (DWV) tube and fittings were rapidly exhausted. Large developments of single family residences were halted for most of 1966 because of the unavailability of copper DWV piping which originally had been planned to be installed. This urgent need was soon filled by non-metallic, plastic DWV pipe and fittings, which were then introduced into use for building plumbing systems under carefully prescribed installation conditions.

1961 - 1992: Development of Plumbing for the Disabled

A most significant change in the design of buildings used by the public began in 1961. The object of the change was to make all buildings and facilities, including plumbing, used by the public accessible to, and

functional for, the physically handicapped, without loss of function, space, or facility where the general public is concerned. The changes were originally set forth in the American National Standards Institute (ANSI) standard, Specification for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People, originally issued as A117.1-1961. Updates were made in 1971 and 1980 and in 1992 Government regulations went into affect Known as the Americans with Disabilities Act (ADA) These regulations were enacted and mandated the necessary building design changes including many related to plumbing systems in buildings.

1974: Energy Efficiency in Plumbing Design

In 1974, when the supply of foreign oil to the United States was interrupted and oil prices rose sharply, ways to conserve energy have been a constant concern. Some important conservation measures

(continued on page 24)

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ASSE Standards Update

ASSE Standard #1001

A new Working Group for ASSE Standard #1001, *Pipe Applied Atmospheric Type Vacuum Breakers*, is being formed resolve comments from the Product Standards Committee ballot.

ASSE Standard #1019

The resolution of comments on the revised draft of Standard #1019, *Vacuum Breaker Wall Hydrants, Frost Resistant Automatic Draining Type*, is being reviewed by the Product Standards Committee. The draft will be forwarded to the ASSE Board of Directors upon the approval of the Committee.

ASSE Standard #1020

ASSE Standard #1020, *Pressure Vacuum Breaker Assembly*, has been approved by the ASSE Board of Directors. A Canvass List is being formed to review the document for submittal to the American National Standards Institute (ANSI). If you are interested in being a member of the Canvass List, please contact ASSE Central Office.

ASSE Standard #1023

ASSE Standard #1023, *Hot Water Dispensers Household Storage Type Electrical*, is in the revision process. Anyone interested in participating in the revision process, please contact ASSE Central Office.

ASSE Standards #1045 & #1046

The ASSE Board of Directors has approved delisting ASSE Standards #1045, *Aluminum Drain, Waste and Vent Pipe with End Cap Components*, and #1046, *Thermal Expansion Relief Valve*.

ASSE Standard #1062

The ASSE Board of Directors has approved ASSE Standard #1062, *Temperature Actuated, Flow Reduction (TAFR) Valves for Individual Fixture Fittings*. A Canvass List has been formed and is currently reviewing the standard prior to being submitted to the American National Standards Institute (ANSI). ○

ASSE Central Office
Phone: (216) 835-3040 - Fax: (216) 835-3488
E-Mail: ASSE@IX.netcom.com.

History ...

(continued from page 15)

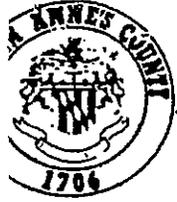
related to plumbing were: Elimination of water waste, limitation of water use to a reasonable minimum, limitation of hot water supply temperature and rate of flow reductions for hot water faucets, insulation of water heater tanks and piping, and use of heat reclaiming systems and solar heating systems. These are just some of the conservation methods that have been applied to plumbing systems. Today water saving faucets and fixtures are becoming mandated by many municipalities from coast to coast due to water shortages in many water districts around the country.

1994 - 1996: New Legislation to Further Restrict Water Usage

Legislation was adopted as part of the Energy Efficiency Act in the 1980's to restrict the water flow rates in various plumbing fixtures. Later it was amended with the Energy Policy Act of 1992 to further reduce water usage in plumbing fixtures. As part of the Energy Policy Act of 1992 legislators determined 1.6 gallons per minute would be the maximum consumption allowed for water closets without any testing or research. Manufactures have spent millions of dollars to redesign fixtures to flush with the lower flow rates and the jury is still out on this one. Can we learn a lesson from this? I think we have. Before legislation of this type is introduced in the future, there should be research done by an independent organization to conclude that the fixtures will work properly at a given flow rate.

As you can see there are a lot of significant events recorded in the history of plumbing. Each time something did not work properly, or someone became ill there was an investigation of some scale to determine the cause of the failure or occurrence. We need to respect the things we have learned from history and continue teaching them to the young engineers and apprentices. The code book may tell you not to do something but history tells you why you should not do something. ○

References: 1. Internet; search for "History of Plumbing"; 2. *Standard Plumbing Engineering Design* - Louis Nielson; 3. *Engineered Plumbing Design* - Steele



QUEEN ANNE'S COUNTY HEALTH DEPARTMENT

206 N. COMMERCE STREET
CENTREVILLE, MARYLAND 21617
301 758-2281

May 25, 1990

Mr. J. L. Hearn, Director
Water Management Administration
Department of Environment
Baltimore, Maryland 21201

Re: Romancoke on the Bay
Kent Island Estates
Sanitary Survey

Dear Mr. Hearn:

The Sanitary Survey for the above referenced subdivisions in Queen Anne's County has been completed with the following results:

I. Romancoke-on-the-Bay

- (a) Number of total homes is 155.
- (b) 132 homes were surveyed.
- (c) 19 homes had septic wastes or laundry wastes ponding on the ground surface or discharging into nearby ditches.
- (d) 6 people indicated their septic systems were sluggish during wet weather.
- (e) Several auger holes (piezometers) were drilled in Romancoke on the Bay. Based upon the seasonal high water table readings in the auger holes, I estimate at least 90% of the homes have septic wastes which directly discharge into the groundwater during the wet season.

II. Kent Island Estates (Sections I, II, III)

- (a) Total number of homes is 572.
- (b) 513 homes were surveyed.
- (c) 92 homes had septic wastes or laundry wastes ponding on the ground surface or discharging into nearby ditches.
- (d) 16 people indicated their septic systems were sluggish during wet weather.

(e) Seasonal high water table readings were observed in several auger holes and piezometers. Based upon these observations I would estimate 70-75% of the homes have septic wastes which directly discharge into the groundwater during the wet season.

There are no known shallow wells in either subdivision. Both communities are served by individual deep wells.

In conclusion, I hope this information is useful in assessing Queen Anne's County's Public Sewer needs. If you or Charlotte have any questions please call me at 758-2281.

Respectively yours,


John E. Nickerson, Director
Environmental Health Services

CC: Honorable Queen Anne's County Commissioners
Dr. John Ryan
Dr. Larry Durante
Mr. Robert Sallitt
Mr. Steve Walls
Mr. Wayne Asplen