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Implications of Potential Y2K Problems for the Operation of Environmental Infrastructure Systems

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This article was adapted from a report prepared by the Regional Plan Association for its Regional Y2K Initiative.[1]

I. Introduction

This article provides an overview of the potential vulnerability to disruptions caused by the Year 2000 (Y2K) computer problem of the Tri-State Region's water supply, wastewater treatment and solid waste management infrastructure systems. The article is written from the perspective of a former environmental utility manager, not that of a computer expert.[2]

The article focuses on the following strategic questions: what are the social objectives of the infrastructure systems under review, how are they structured to achieve them, how do they use computer technology to aid their performance, how would computer failure affect that performance or cause operational failure, what are they doing to prevent computer failure, and what is the state of their contingency planning?

This article is not a comprehensive survey of every water, wastewater or solid waste system in the Region. There are thousands of these, ranging from the behemoth size of New York City's water, sewer and solid waste operations, to the hundreds of tiny local systems that may have as few as 25 customers. Rather, this article is an overall strategic assessment of the Y2K readiness of the Region's environmental infrastructure operations. Among those surveyed there is a wide commonality in action and conclusions, but the composite presented here should not be applied uncritically to any individual environmental infrastructure system, nor should any of its details be taken as definitive as to all industry practice.

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Y2K is often presented as some totally new space age problem with vague, menacing, unprecedented consequences. But, at least in environmental infrastructure systems, the disruptions Y2K problems could potentially cause are largely the kind of disruptions water, wastewater and solid waste systems have always had to address. Whether a sewage treatment plant breaks down because of a plant fire or a Y2K failure, the problem is the same: a disruption in the sewage treatment process and raw sewage discharging into a waterway. Remembering that modern society is robust and has faced the kinds of environmental infrastructure disruption that Y2K may produce, and that all should have a common camaraderie in the face of Y2K uncertainty and disruptions, should be a central part of any Y2K message to the public.

II. Intrinsic Vulnerability of Environmental Infrastructure Organizations to Y2K Disruptions

To assess the intrinsic vulnerability of environmental infrastructure utilities to disruption by Y2K problems, each of the three environmental infrastructure systems under review water supply, wastewater management and solid waste management shares three characteristics that determine the extent of the Y2K threat and how they have perceived and responded to it.

First, and most importantly, all three environmental infrastructure systems use complex, pre-computer era technologies that have delivered smooth and largely uninterrupted service for several generations. The use of computers and micro-processor controlled equipment is now widespread in environmental utilities. However, with minor exceptions, if a Y2K problem disrupted a computer equipment operation or a computerized control function, all that would happen is the system would switch over to manual operation.

Second, water supply, wastewater collection and treatment and solid waste management institutions play a critical role in the smooth functioning of society and in the protection of human health. For this reason, they have been organized to run without disruption. They are robust systems that have a considerable amount of redundancy built into them. A water main break, a malfunctioning sewage treatment plant, or a delay of a day in picking up garbage as scheduled, are immediately visible and notorious, and their consequences escalate directly with the length of failure. Three days of uncollected garbage is an incipient public health emergency. Consequently, the internal culture of environmental infrastructure agencies places a high emphasis on anticipating and heading off failure, or recognizing the need for disciplined response to emergencies, and on ongoing contingency planning.

That internal culture has predisposed the Tri-State Region's environmental infrastructure agencies to take Y2K seriously. Moreover, because of it they already possess a series of tested responses to the kinds of operational problems Y2K failures would likely produce. One health department regulator observed that if a water utility's purification process fails, the department will issue the usual boiled water notice and follow the usual procedure.

Many of the sources consulted for this article commented on what they regarded as widespread Y2K awareness by environmental infrastructure agencies. Few regarded the industry as particularly farsighted in anticipating the problem. But they also regarded environmental infrastructure agencies as now having a virtually universal understanding of the need to respond seriously to Y2K, and commented on the extent to which, in their experience, agencies were reaching out to the multiple sources of guidance on the problem that are available from industry associations, superior governmental agencies and regulators. With respect to hardware and software, all the operating agency representatives contacted reported that some version of what has become the standard Y2K procedure inventory, assess, remediate, test and certify is underway. Though none claimed to be fully completed, all expected to be by fall. All seemed to feel that environmental infrastructure agencies were generally being conscientious and workmanlike, though some also noted concerns about tardy hiring of consultants, budget delays, and internal indecision over priorities.

Where the institutional culture has served environmental infrastructure agencies particularly well is in the aspect of contingency plans. When asked about contingencies, virtually all parties interviewed could discuss particular specifics and what steps they were anticipating taking. Most of these, as discussed below, have focused on fears about loss of external resources such as electrical power. But in the details, there was a recurring tone of practical common sense. We are going to perform preventative maintenance on all our emergency generators as close to the first of the year as possible, said one wastewater executive, to minimize the chance of generator breakdowns. Another environmental agency official described how certain equipment performing low priority functions would be fueled up before January 1st, but not used until the reliability of fuel deliveries could be determined. If a problem emerges, fuel will be siphoned out of those vehicles for higher priority uses, adding another day to available fuel supplies.

Third, environmental infrastructure agencies are highly regulated entities. They are regulated by various federal, state, and local agencies. An environmental infrastructure agency that is not a public authority or privately owned is subject to the intergovernmental oversight of its parent municipal or county government, adding still another layer of supervision. And if it is privately owned or publicly owned but privately operated under an operations contract, that entity is often part of a larger enterprise (e.g., the United Water Company, which either owns or operates several water companies in northern New Jersey).

All of these sources of regulation and oversight have responded to Y2K. To overcome industry concerns about possible enforcement that could discourage testing for Y2K compliance, the U.S. Environmental Protection Agency (EPA) issued a ruling that it would not enforce against environmental violations that were inadvertently caused by good faith testing of the Y2K compliance of particular environmental facilities. This policy has been an extremely prudent measure, because it has worked to defuse environmental utility fears of regulatory oversight of Y2K efforts, and has helped make Y2K a cooperative effort between the regulated and regulators. Environmental and public health regulators have also worked to make available to environmental infrastructure agencies a large amount of technical information and have been using their influence to urge them to use the voluminous technical resources provided by professional associations.

Regulators consulted appear to regard environmental utility efforts to address Y2K as being conscientious if not necessarily enthusiastic. Regulatory agencies believe they are playing an important role in ensuring that all environmental utilities systematically address the Y2K issue. Most are working in coordination with their staff offices of emergency management. For example, the New York State Department of Health required that all county departments of health systematically survey all the water utilities in their county, prioritize the ones where they believe there are still Y2K concerns, and report back by the end of the summer. The New York State Department of Environmental Conservation has also completed a similar survey. Both agencies will forward the results to the Governor's Office, whose emergency management program is currently developing a critical facilities plan, as well as use them in their own Y2K activity.

In addition to regulatory oversight, a large number of environmental utilities also face inter-governmental oversight. For example, the New York City Departments of Environmental Protection and Sanitation are both carrying out their Y2K remedial activity under guidelines from the Mayor's Office of Emergency Management. Westchester County has an overall Y2K coordinator with program officers for various functions, including one for environmental infrastructure. Similar situations exist throughout the Region.

None of the many environmental infrastructure agency officials and industry experts consulted felt that this Region would experience large or significant disruptions in the provision of drinking water, sewage collection, or solid waste management from Y2K computer failures. Though they all expected some minor and unpredictable disruptions of individual equipment or facilities, they also expected that the impact of such disruptions would be limited and that environmental service delivery would continue essentially unimpaired. From the self-contained perspective of internal environmental infrastructure system operations, it is unlikely that this Region will experience large or significant disruptions in the provision of drinking water, sewage collection or solid waste management from Y2K-sparked computer system disruptions.

III. External Dependencies and Resulting Vulnerabilities for Environmental Infrastructure

One of the most important Y2K issues is the inter-dependent nature of modern society. Even if social systems such as environmental infrastructure are internally Y2K ready and well positioned to avoid any significant disruption, Y2K disruptions in one of the external systems that the environmental infrastructure systems depend upon could undermine the delivery of services.

In Y2K literature, the three external dependencies that receive most of the focus are electric power, transportation and telecommunications. Of these, electrical power was the one that came up almost universally in both the environmental infrastructure Y2K literature and personal consultations.

A. Electric Power

The impact from a loss of electric power most feared by those consulted was a loss of power for pumps, including hydraulic pumps for water and wastewater agencies, and fuel pumps to refuel vehicles used by solid waste agencies. Pumping is critical to all water management, whether in water supply or wastewater management utilities. All systems that use groundwater, such as those on Long Island, are absolutely dependent on pumping. Some surface water systems, such as New York City, are able to use gravity pressure on the water supply side to keep water moving through all or parts of their distribution system, but most surface water systems require at least some pumping as well.

On the wastewater side, pumps are an integral part of moving sewage into plants and through the collection system (though gravity flow is often used wherever feasible). Compared to water supply systems, sewage collection systems have more episodic flows, require larger pipes, are generally not under pressure, and are transported at deeper subsurface depths than drinking water so that, if there is a sewage leak, it will stay below everything else. Even the New York City sewage treatment system, which makes extensive use of gravity flow in its sewage transmission system, has no less than 77 pumping stations, most of which are not supported by emergency generators.

Solid waste agencies have a limited but vital pumping function to maintain. Many, particularly the large ones, fuel their own vehicles. Since solid waste management is completely vehicle dependent, and since the fuel capacity of the average solid waste vehicle has a relatively short duration (e.g., New York City garbage collectors must be refueled after every two or three days of collection), maintaining refueling capability is critical for solid waste management.

The environmental infrastructure systems representatives consulted generally reported that their systems have been reviewing their emergency generation capabilities. Contingency planning for power loss involves two elements: making sure the agency has enough generators for anticipated worst case operations, and making sure they will have adequate fuel to keep them running. The first problem is straightforward though not always easy to solve. As optimism over the reliability of the electric power supply grows, the pressures to avoid overspending on emergency generators that could turn out to be unneeded will also grow.

The fuel problem is more complicated. Facilities with permanent emergency generators often have limited amounts of fuel storage immediately available on-site, reflecting historic experience that refueling service would be readily available. Facilities that rely on portable generators generally have none. Thus, for environmental infrastructure utilities in the Region, fuel delivery has also become a critical contingency issue, *in the event there is a failure of electrical power service of sufficient duration to require ongoing use of emergency generation*. Determining the right amount of standby fuel and whether there is a need for central storage are planning problems that now appear to be the subject of much internal discussion in environmental infrastructure systems. One member of a local government wondered if they should be considering obtaining several large barge loads of fuel with the idea of anchoring them on the local waterfront as an emergency reserve.

Several of those consulted quoted recent reports that, at most, there would be nothing more than some rolling brownouts of electrical power. Since most environmental infrastructure agencies appear to have some fuel storage capacity, the question is less could they deal with a brownout, than how much risk is there of prolonged power disruption that could seriously strain fuel reserves for emergency power generation, and how should that risk be balanced against the expense, difficulty and possible adverse community impacts of adding more fuel storage?

B. Transportation

In general, transportation is not a critical external dependency issue for water and wastewater management systems. The delivery of chemicals for water treatment is a concern on Y2K checklists, but most water utilities consulted have at least some stockpiles and plan to add to them if necessary.

To the extent a Y2K-caused breakdown in transportation service could pose a threat to water and wastewater management systems, it would appear to lie in two areas. The first would be emergency response to breaks in water or sewer mains, backed up sewers, clogged catch basins, etc. To deal with those problems, emergency response teams must be able to get to those sites, with appropriate equipment and replacement parts. Fuel for emergency response vehicles can be stockpiled, if street access becomes difficult or reduced.

The other problem a Y2K transportation breakdown could create would be a potential disruption of the disposal of sewage sludge or drinking water filtration materials. These materials are generally transported by truck to landfill or other disposal sites. Sewage sludge disposal is probably the more serious concern. Many water systems do not have to filter, a change of filtration material is a relatively infrequent event, and the material itself is generally inoffensive and not difficult to store. But every sewage treatment plant produces sludge. It is odorous, liquid, difficult to handle and it accumulates quickly. A transportation problem extending more than a few days could put a major strain on sludge management. Should transportation access be prioritized, sludge disposal clearly needs to be considered.

As for solid waste management, transportation would appear to be its principal external vulnerability. All garbage collection is done by motor vehicles. If fuel distribution runs into serious Y2K problems, fuel availability for solid waste vehicles could quickly become a serious concern. One major sanitation department has estimated that, using every expedient it can muster, it could accumulate a seven day supply of fuel for its vehicles. That means that, if there are no fuel deliveries for ten days, three days of uncollected garbage would have accumulated with serious health and aesthetic consequences.

Even if fuel can be supplied, other transportation disruptions from Y2K could have significant impacts on solid waste management. When garbage is collected, it has to be taken somewhere, generally a landfill, for ultimate disposal. With the exhaustion of many local landfills in the last 15 years, and with the approaching closure of Fresh Kills, an increasing portion of the Region's garbage is trucked to distant landfills. Long Island sends hundreds of trucks a day of garbage off the Island to points west. New York City sends over 13,000 tons a day of non-residential waste to out of state landfills, and several thousands tons of residential garbage to distant landfills, as do many other regional municipalities, large and small.

Given the Tri-State Region's dependence on exporting much of its garbage to distant landfills, potential problems with the transportation system present a major potential Y2K vulnerability. This vulnerability should not be overstated, but should not be ignored. Moreover, should contingency planning for this problem be deemed necessary, it would be difficult because the logical contingency response, temporary local storage of garbage until transportation problems are resolved, cannot be planned for in detail without creating a long and difficult set of political problems that could be divisive and distracting from more immediate Y2K efforts.

C. Telecommunications

Phone service is so ubiquitous and such an assumed backdrop to the daily operation of almost anything that it would seem a priority that its disruption would have severe consequences for the management of environmental infrastructure. In fact, it appears that it would produce significant inconvenience, but no critical disruptions. Most of the operations of environmental infrastructure agencies are relatively continuing and do not require numerous and immediate communications to continually fine tune, or to exchange data. Most medium and larger environmental utilities have radio facilities as part of their field equipment. Several environmental agency representatives noted that, if there was a communications breakdown, they would rely on radio communication, and one even commented they planned to be sure that all radio batteries were fully charged and had backups. But in general, little of the sense of urgency that was communicated when discussing emergency generation, fuel supplies and water treatment chemicals seemed to be present when telecommunications were discussed.

One area where more attention may be needed in contingency planning is preserving the public access points of environmental infrastructure systems if there are telecommunications disruptions. Environmental infrastructure agencies generally have contact points for citizens to inform their service providers that something is wrong, e.g., sewage is backing up into a basement, water is coming through dirty and polluted, a street is flooded from a clogged catch basin, there has been no garbage pickup for five days, etc. It is not clear to what extent water utilities are responding to this problem, or if they are relying on citizens using 911 systems to relay such information to the relevant agency. This issue would seem to require more systematic attention as part of a more generic governmental strategy for informing citizens as to where they should direct their information and concerns in the first days of the new year.

D. Final Reflections on External Dependency Problems

Confidence appears to be growing that external systems, such as electric power, transportation, and fuel delivery, will perform without major breakdown. For environmental infrastructure agency personnel, the issue of contingency planning for external failures is therefore becoming more tricky. If they are to face major problems in service delivery, it would almost certainly be from prolonged external failures in electric power and fuel delivery. But, if such breakdowns are becoming less likely, Y2K will present those agencies with the classic dilemma of contingency planning: what is the appropriate level of preparation for an event that is very high impact but very low risk?

IV. Embedded Chips and Environmental Infrastructure Systems

Fixing Y2K requires solving two problems. The first is the problem of hardware and software with two digit annual calendars that will read 1/1/00 as January 1, 2000. The second is the problem of dedicated microprocessors embedded in operating equipment or automated command systems (hence the name embedded chips) and programmed to control certain specific functions according to pre-set programming. What distinguishes these two is what is involved in making them Y2K compliant.

Hardware and software, however complicated and enormous, presents a relatively straightforward reprogramming problem. It may be enormously expensive, tedious and time consuming, but what is conceptually involved in the reprogramming of two digit hardware and software is generally similar, regardless the organization or computer systems. Consequently, there is a standard process that is now recommended for all organizations to follow in making their hardware and softwareY2K compliant.

Embedded chips present a different problem. Of the 50 billion or so microprocessors that are currently in use worldwide, it is estimated that only between 1% and 5% of them present Y2K problems. Several information consultants and academic experts observed that almost none of the equipment and processes that embedded chips control in environmental infrastructure systems are used in date sensitive ways. So what problem do embedded chips pose for the environmental infrastructure industry?

The first problem is that it is not readily apparent if equipment or control processes that use embedded chips are calendar dependent or Y2K vulnerable. This is more than an issue of whether or not the process involved is date dependent. Many of the older embedded chips have calendar functions in them even when such functions are not needed. Opinions vary as to what will happen on January 1, 2000, with such older chips that have calendar functions that are not visible to the user or necessary for the work. The results will likely be individualized and highly unpredictable.

That would seem to make testing embedded chips for Y2K impacts imperative. But microprocessors often have firmware programming. "Firmware" is a term used to describe programming instructions that are designed not to be changed. Calendars on such chips often cannot be advanced to test how they will behave on January 1, 2000. Moreover, older embedded chips in particular are often tied together in a piece of equipment or on a motherboard in ways that makes it hard, if not impossible, to remove them for testing or replace them with new chips. That means that any testing may have to involve the actual equipment or process so that, if the test fails, it could produce immediate equipment failure.

Many of these problems can be resolved by asking the chip manufacturer or the equipment vendor for guidance. But support for older embedded chips is often no longer available from manufacturers or, worse, the manufacturers have gone out of business. And even when the programming codes for the chips are known, often there are no longer programmers who are able, or willing, to work in these obsolete codes.

What this means is that the process of testing and remediating embedded chips is fraught with considerably more uncertainty than remediating hardware and software. Moreover, as a number of the experts consulted also noted, agencies have legitimate fears that should they test and something go wrong, they would relieve the chip or equipment manufacturer of any legal liability they might have for Y2K malfunctions.

A consultant with a leading environmental engineering and information services firm that specializes in working with water supply and wastewater agencies summed up the matter as follows. The decision to test an older embedded chip is one that must be made case by case, and with care. There are definite risks that testing will backfire and immediately disable equipment. Moreover, he went on to add, the testing issue presents a particularly perverse tradeoff for the managers who must make the test decision. Some experts now expect the failure level of embedded chips to be very small, although the matter continues to be vigorously debated. The question thus becomes whether an environmental infrastructure Y2K manager should try to test embedded chips and risk immediate equipment failure with a significant possibility that the equipment will have to be replaced, when he or she has no certainty that the equipment is at any risk to fail.

Faced with this dilemma, many environmental agencies are attempting to obtain the embedded chip manufacturer's certification that the microprocessor is Y2K compliant or, if it is not, the manufacturer's guidance on how to fix it. This often involves obtaining an updated Y2K compliant chip and instructions on how to install it.

An engineering firm that operates a number of local sewage treatment and water supply facilities in rural areas of the Region gave this description of how they proceed. First, the firm went through each of its facilities with clipboards and noted all the systems and equipment that might be using embedded chips. Then it tracked down the chip and equipment manufacturers, wherever possible using their worldwide web sites. Then it requested the manufacturers to either certify the chips were Y2K compliant or to tell the firm what steps to take to replace them with Y2K compliant chips. Generally, the manufacturers did so, often supplying replacement chips for the obsolete ones. In all those instances where the firm obtained concrete compliance information, the chips were not tested.

If a manufacturer's certification could not be obtained, or if there was some other special reason or worry, then the firm would analyze case by case whether or not to test the chips. It did so when it could identify a safe testing procedure. For example, in one instance, it got some advice that showed how to hook up a particular chip to a PC and test it. As for those chips it decided it could not safely test, it left those chips in place. The firm did test its ability to run those particular pieces of equipment manually on short notice if the chip produced a failure. In every instance, the firm found that it could.

Two key implications of this discussion should be noted. First, it seems likely that not every embedded chip problem will get solved, or get solved correctly. This means some disruptions of particular processes may occur, though given the uncertainties about whether or not chips with calendar functions that are performing non-date sensitive functions will continue to function after January 1st even that suggestion must be carefully qualified. If such specific Y2K embedded chip disruptions do occur, it is critical to understand that the failures caused by embedded chips will be no different than if the same piece of equipment broke down from a completely Y2K-unrelated cause. If a sewage pump freezes up from an embedded chip failure, it will be no different than if the failure came from a defective piston breaking. Here the short-term answer will be the same as it is for all such problems that environmental infrastructure systems face: redundancy, flexibility and troubleshooting, until repair is completed.

Second, the Region's environmental infrastructure systems seem to be still evolving their approach to embedded chips. As the agencies consulted have gained confidence that their hardware and software remediation is, or will be, under control, they appear to be devoting a larger share of their attention to the embedded chip problem. Some of those consulted, perhaps influenced by their own emergency response culture and conscious of the small percentage of embedded chips that reportedly have calendar problems, seem comfortable with a "wait and see" policy. But the more general behavior pattern now seems to be to work with the manufacturers and then deal with the remaining set of equipment and chips whose status they cannot clarify, usually with some sort of priority to any functions that may not be able to be performed manually, and a sensitivity to the problem of testing risk.

V. Additional Discussion of Water Supply Systems

Clean and abundant water plays a fundamental role in the environmental health of the American household. Business and commercial activity depends on abundant pure water. Reliable municipal water is also critical for fire safety.

The main choke point for water systems comes at the water purification stage. However, water purification is generally a very simple process. Even New York City, which must chemically treat well over a billion gallons of water a day, does it with a system whose main mechanized feature is a simple pump, and whose only Y2K vulnerability has been addressed with backup power generation.

Otherwise, it is important to note, failure at one point in a water supply system does not necessarily mean failure at any others. Water systems are designed to function during trouble. It is the water supply systems that are too small to have the redundancy and flexibility of larger ones that are most at risk from problems like Y2K.

The Tri-State Region has no typical water system. Its water supply systems range in size from the City of New York, which serves over nine million people, to the several hundred water systems that serve from 25 to 1000 people. The small water systems are generally considered to be the ones most vulnerable to a disruption in water service due to Y2K problems. Gravity fed systems like New York City are considered to be virtually sure of uninterrupted water supply, and other middle and large sized systems should have enough backup storage to ensure water delivery in all but the most extreme circumstances.

There is a considerable amount of confidence in the water supply industry that they will successfully weather January 1, 2000 without significant problems, unless they have a major loss of external resources like electrical power. Most discussions of Y2K, and particularly of the embedded chip problem, caution that getting by January 1st does not mean the problem is solved. Experts caution that the embedded chip problem may take months to work through. Water agencies must remain alert.

Thus water supply systems can be expected and should be encouraged to pay attention to the following as Y2K approaches:

- Updating assessments of possible external disruptions and preparing for them.
- Ensuring the availability of an appropriate number of emergency generators, and ensuring that their maintenance is up-to-date and that adequate fuel will be available for them.
- Ensuring continuation of essential administrative services in the event of a power failure.
- Further refining their approaches to embedded chips, and intensifying contingency planning. The practice of testing the ability to run embedded chip equipment or processes in a manual mode has much to recommend it as a minimum standard for contingency preparation.
- Taking a more active role in public education and outreach, including educating the public as to the possibility of water main break level disruptions on an ongoing and unpredictable basis for several months after January 1, 2000.

VI. Additional Discussion of Wastewater Collection and Treatment Systems

Dealing with wastewater (or sewage) involves two separate functions: collection and treatment. Sometimes, as in New York City, they are combined in one organization. Often, they are performed by separate entities, as when a county government runs a sewage treatment plant or plants that serve a variety of local sewage treatment districts.

Wastewater collection and wastewater treatment have different functions and history. Wastewater collection, or sewage collection, is designed to get human body waste away from people. Wastewater collection systems rely on the pressure flush of toilets and the gravity flow of sinks, which depend on a supply of freshwater. As long as freshwater comes into homes and businesses, waste in the form of sewage can go out.

The system for collecting all those individual household flows operates exactly like a stream system. It gathers small flows into larger ones. These flows are ultimately directed to a body of water, the local river or ocean, which then carries the water away, completing the removal from human presence. Until the beginning of this century, that was the sum total of wastewater management collecting and transmitting it to where it could be deposited in a body of water that would carry the sewage away.

Modern sewage collection uses periodic pumping to help move the sewage along. Sewage collection and transmission is almost completely free of computer dependency. As long as the water comes into the homes and the electric power that the pumps need is uninterrupted, Y2K should not have a significant impact on sewage collection operations.

Sewage treatment has a more recent history. The goal of sewage collection was merely to get sewage to some ocean or river that would carry it away from urban populations. But as populations grew and sewage collection increased its scope and efficiency, those who lived downstream of the discharge point found that the pollution consequences were increasingly intolerable. Thus, the use of sewage treatment gradually spread until the 1972 Clean Water Act required comprehensive provision of sewage treatment.

Sewage treatment plants utilize a relatively complex technology. They are designed to mimic bacterial action in nature, by super-growing billions of bacteria to consume water polluting materials at a rate fast enough to match the inflow rate of the sewage influent. In this process there are five key variables: the rate of inflow of sewage (the food), the density of bacteria (how fast the food will be eaten), the amount of oxygen (to support bacterial life), the time everything is left together, and the production of sludge (the waste product of the process). Sewage plant operators manage and control the interaction of all these elements to maximize the efficiency of the sewage treatment process.

If a sewage treatment plant's operations were to suffer disruption, the most likely result would be that raw sewage or partially treated sewage would be diverted into the adjacent waterway. Though wastewater treatment agencies are concerned about the environmental consequences in such an event, it is not clear they can do anything to prevent them except minimize Y2K disruptions, although in-line storage of sewage may be possible in some systems for short periods of time.

Recent advances in computer software have made sewage treatment plants capable of being highly or even fully automated plant operation, backed up only by telemetry triggered emergency response teams. Engineering operations firms report that the penetration of such systems into the Region is in its early stages, and that the automation systems they are selling are Y2K compliant. But since such systems depend on embedded chips, with all the assessment and remediation problems discussed above, there are grounds for concern for any using embedded chips over a year old. Moreover some systems may have incorporated data and equipment modes from prior operators. And some have questioned as to whether or not such operations will have available suitable backup personnel if operations must switch to a manual mode.

Even when not in a fully automated mode, the use of embedded chips appears to be much more common in the sewage treatment process than in water supply systems. Particular sites would include pumps, meters, and process control systems. Given the uncertainties and judgement calls involved in Y2K remediation of embedded chips, some mistakes will be made. Those mistakes will probably cause some discharges of raw sewage into receiving waters. Nevertheless, the Region's wastewater collection and treatment systems regard themselves as in good shape to face Y2K, according to the regulators, experts, and wastewater agency representatives consulted.

VII. Additional Discussion of Solid Waste Management Systems

As in the water business, there is no prototypical Tri-State Region garbage collecting organization. Waste management organizations range from the New York City Department of Sanitation, which collects, recycles and landfills 13,000 tons of garbage a day, to small villages that have one truck to pick up garbage from a few collection stations. Many governments run their own solid waste agencies, but an increasing number are contracting with private waste firms to manage local garbage collection. Commercial garbage is predominantly collected by private waste management companies.

Private waste management companies such as Waste Management Inc., and Browning Ferris Inc., have been introducing increasingly sophisticated computer tools to assist in planning garbage routes, track collections and document environmental compliance. These are not embedded chip systems, but standard mainframe and desktop computers that have undergone Y2K remediation, testing and compliance verification. Waste Management Inc., for example, discloses its Y2K status (compliant) on its website. Private waste management company representatives consulted were confident that their operations will not be disrupted by Y2K problems. Embedded chips are not seen as a significant factor of concern in their operations.

Though government computer systems and practices are less sophisticated, representatives from public waste management institutions felt a similar confidence. One representative consulted could come up with no more pressing computer concern than the possibility of failure in the computer systems backing up the scales measuring garbage coming into transfer stations. This could result in the load records having to be produced by hand.

Garbage collection is completely vehicle dependent. It is picked up in cities by garbage trucks that travel the streets two or three times a week picking up loads of 8 to 16 tons of garbage or by specialized vehicles designed to support recycling programs. The material must then be consolidated in transfer stations and, with a few exceptions like the barging to Fresh Kills landfill, put into still larger trucks for the final trip to a landfill (or occasionally an incinerator). As local landfills have increasingly been shut down, these trips have become longer and more costly. For example, hundreds of semi-truck trailers a day leave Long Island fully loaded with garbage destined for Pennsylvania and Midwestern landfills.

This suggests that the chief contingencies to be concerned with in solid waste management are external ones, particularly disruption of fuel availability and more general transportation breakdowns. All the solid waste sources consulted were aware of the potential problem of fuel availability, and described contingency planning that was in various stages of completion.

The other issue with respect to external dependency is whether there would be some persistent gridlock of the transportation system that would block garbage getting to landfills and make it necessary to have contingency plans for backup sites to store collected garbage until the problem clears. The question really turns on whether there is any real likelihood that the use of the Hudson River crossings could be lost for a significant period of time.

Barring such extreme external transportation disruptions, the prospects for Y2K trouble free solid waste management in the Region are regarded as excellent, perhaps the best of the three environmental infrastructure systems discussed in this article.

VIII. Closing Comment

As noted in the outset of this article, Y2K has become a widespread, urgent social activity whose complexity, breadth and results can only be broadly sketched in a report like this. How then should the public be guided as to what to do about its own Y2K concerns?

What this author believes would best serve the public interest is a public-private partnership in shaping credible advice to the public on what contingency planning for Y2K members of the public should undertake. Environmental infrastructure agency representatives, emergency management coordinators, state and federal regulators should sit down this fall with a cross-section of citizen stakeholders and try to jointly develop some common conclusions about how prepared society is to deal with Y2K and what that means for individual members of the public. Should they stockpile food, store water, hoard currency, buy flashlights and candles, or take dozens of other steps that much of the current Y2K literature recommends? Is the public being told to get ready for a hurricane that is not coming? By the fall, most agencies will have reached conclusions about their Y2K readiness, either confirming their current optimism, or qualifying and drawing back from it. Either way, those conclusions needed to be participated in and reviewed by the public so that a working consensus can be created about them and what they mean for public conduct as Y2K draws near. Solving the technical issues of Y2K is one part of the challenge, but solving the social concerns that surround Y2K is equally important. As the information on Y2K readiness grows, it is time to consider how best to convey and interpret it for the public. And the best source to answer that question is the public itself.

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[2] This report was prepared using the following methodology. First, the author drew on his managerial experience with running the New York City water and wastewater system, and his knowledge of solid waste operations to focus on some initial areas for information gathering and analysis. Second, he used websites and informal discussions to update his knowledge of regional water industry use of computers, and to become current with respect to changes in environmental infrastructure computer usages in recent years. Then, using web sources supplemented by various official reports, he extensively researched the Y2K issue to gain a much more detailed understanding of it, both its technical details and its overall social context. He then analyzed that information to create a much more specific list of issues and concerns about computers, Y2K, and the Tri-State Region's environmental infrastructure systems. Then he consulted a large number of industry sources, regulators and experts, getting them in most instances to speak candidly, but not for direct attribution. In these discussions, particular attention was paid to the party's own intuitions and judgments, the assumptions behind them, and the path by which those consulted had come to their conclusions about Y2K. Though these discussions should not in any way be regarded as a systematic survey of three separate environmental systems across three separate states, they did show a considerable degree of unity in both their assessment of the problem, and in their general confidence in assessing Y2K's potential impacts on environmental infrastructure system operations.

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