CITY OF PHILOMATH
Wastewater System Facilities Plan,
Philomath, Oregon

Section 6

Collection System Evaluation and Recommendations

SECTION 6
COLLECTION SYSTEM EVALUATION AND RECOMMENDATIONS

6.1. General

This section includes an analysis of the collection system. The first subsection focusses on operation, maintenance, and rehab of the collection system. This is followed by the development and evaluation of alternatives for potential improvements to the wastewater collection system, including gravity mains, pump stations, and force mains.

This section addresses the following key questions:

- What are the current collection system operation and maintenance practices and how can they be improved?
- What are the existing collection system deficiencies?
- What collection system components are likely to become deficient during the planning period or prior to complete buildout of the system?
- How shall the existing and projected deficiencies be corrected?

The existing and projected collection system deficiencies are presented along with a set of alternatives, or tools, for addressing each of the deficiencies. Each of the alternatives are evaluated against each of the collection system deficiencies to determine the most cost-effective, long-term solution for the City's collection system. The recommended collection system improvements are divided into individual projects and cost estimates are presented.

6.2. Collection System Operation, Maintenance & Rehabilitation

This section discusses the need for sanitary sewer system maintenance and provides recommendations for the basic elements necessary for a maintenance program. The need for system-wide preventive maintenance is addressed first, then the general recommended approaches to collection system maintenance are outlined.

6.2.1 Need for System-Wide Preventive Maintenance

Maintenance of sewerage systems is necessary to insure the proper operation of the facilities and to obtain the full useful life of those facilities. Sanitary sewer systems represent significant investment of public capital. If a sewer system is allowed to fall into disrepair because of the lack of maintenance, it will not operate efficiently or as designed. Health problems and property damage may result from sanitary sewer backups, surcharging and/or overflows. Without proper maintenance, a system's capacity can be reduced by debris clogging, root intrusion growth, structural damage, infiltration and inflow (I/I), and other factors that eventually lead to failures throughout the system. Repair of failed sections of a sanitary sewer system are costly, quite often exceeding the original cost of construction. In spite of this, many jurisdictions do not adequately fund the level of maintenance necessary to protect their investment in the sewerage system. Collection system maintenance can be separated into two types: preventive and corrective.

Preventive maintenance involves scheduled inspection of the system and data gathering to identify problem areas and analysis of this data so that scheduled maintenance can be targeted at specific problems. As a general rule, as preventative maintenance increases, the amount of corrective maintenance required decreases.

Corrective maintenance, often referred to as emergency maintenance, is typically performed when the sewer system fails to convey sewage. Causes for initiating corrective maintenance may include blockages, solids buildup, excessive I/I, flooding and sewer breaks. Corrective maintenance requires immediate action, and the jurisdiction will typically pay a premium to have this work performed.

6.2.2 Present Maintenance Practices

The City has a relatively active collection system maintenance program. The City currently cleans and inspects every line in the collection system on an annual basis. The City also owns a vactor truck and cleaning equipment. In addition, the City allocates funds for TV inspection work. Where possible, minor emergency repairs are performed by City crews with City owned equipment. However, the City does not own the equipment to perform major repairs on most sewer mainlines. Therefore, these services must be contracted out.

6.2.3 Preventative Maintenance Program Recommendations

The following paragraphs outline some recommendations for implementing preventive and corrective maintenance throughout the City's sanitary sewer collection system. These include the following:

- Continue the systematic sewer cleaning and inspection program.
- Establish a sewer rehabilitation and replacement program for removal of excessive I/I and replacement or repair of aging sewers.
- Develop a routine maintenance program for the WWTP & pump stations.

6.2.3.1 Sewer Cleaning Program

It is important that the systematic program for the cleaning of gravity sewers be continued. Regular cleaning is necessary to prevent blockages, grease accumulation and sediment buildup in sewer lines. Normally, sanitary sewers laid at steep grades require less frequent cleaning than those laid at flat grades. Sewers at flat grades can experience sedimentation and grease buildup problems and will require more frequent cleaning and maintenance. During our recent inspection work many of sewers were observed to be in need of cleaning.

As part of the cleaning program, it is important that the City continue to keep records, including conditions encountered such as pipe failures, grease and solids buildup, and other problems. These records are useful in scheduling corrective work and to establish a long term cleaning frequency schedule for different sewers. As the database is established, a schedule for subsequent cleaning can be tailored to the physical character of each line, the area served, and its performance history. Specific problem areas requiring more frequent cleaning can be incorporated into this program.

6.2.3.2 Sewer Inspection Program

The City should continue its current sewer inspection program. The inspection program should include both above ground and internal inspection of the sewer system.

Above ground inspection is performed by inspecting right-of-ways and easements and noting evidence of structural failure, flooding, manholes covers above or below the present level of streets, or other problems.

The two common methods of internal inspection are TV inspection performed in conjunction with the cleaning activities, and smoke testing. TV inspection of a sewer system utilizes a specially designed television camera and equipment to view the interior of the piping system. A video tape and written record of the inspection is generated and retained by the City. Leaking sewer service connections, debris or root buildup, structural failures, leaking joints and other problems can be easily identified and documented. TV inspection of sewers requires that the sewers be cleaned immediately prior to the inspection.

Due to the high cost of purchasing TV inspection equipment, as well as operator training requirements, it can be more economical to contract out to private firms for TV inspection services rather than owning and operating the equipment. These private firms provide all personnel and equipment necessary to clean the sewer and perform the inspections. TV inspection of sewers is typically performed during the winter months so that sources of I/I can more easily be noted and identified. As the City continues to grow, it may become more economical for the City to own and operate TV inspection equipment. Regardless if the work is done "in house" or contracted out, the City should continue its current TV inspection practices.

Smoke testing is conducted by blowing harmless nontoxic smoke into the sewer system and observing the points at which it escapes. Smoke testing is typically performed during the summer months so that groundwater does not interfere with the smoke. Smoke testing can be used to identify potential leaks into the system caused by broken pipes, bad joints, manhole failures, and similar deficiencies. Smoke testing is also very effective for locating storm sewer cross connections and illegal connections, such as roof and foundation drains. The equipment necessary to perform smoke testing is relatively inexpensive and can be purchased by the City.

6.2.3.3 Sewer Rehabilitation & Replacement Program

A sewer rehabilitation and replacement program should include mainline, manhole and service lateral rehabilitation or replacement. This type of sewer rehabilitation program is typically referred to as an I/I reduction program. The details of this program are discussed below (see **Section 6.5.1**).

6.3. Identification of Collection System Deficiencies

The purpose of this section is to determine the components of the existing collection system that are or will become deficient. This includes components that lack capacity to convey existing peak flows or will lack capacity as flows increase due to growth. A number of existing collection system deficiencies were identified in **Section 4**. This section is intended to supplement those discussions. Together with the deficiencies listed in **Section 4**, the intent of this section is to present an overall list of deficiencies that must be addressed by the City.

The existing sewage collection system was analyzed under projected peak flow conditions at the end of the planning period and at buildout. In addition to the capacity of the gravity mains, the existing pump stations and force mains were analyzed for projected 20-year peak flows. Discussions relating to each of these system components follow.

6.3.1 Gravity Main Capacity Analysis

The peak design flows developed in **Section 5** were used as the basis for a basin-by-basin evaluation of the existing sanitary sewer trunk lines. Pipe sizes, lengths, slopes, and locations were determined from construction drawings provided by the City. The evaluation was limited to the main trunk lines conveying sewage through the basins. This approach was taken since most of the pipes within a basin will actually encounter only a fraction of the total basin flow. The projected flows for the trunk lines were assumed to be the entire flows contributed by that basin.

The peak wet weather I/I was determined by distributing the I/I contribution to the existing PHF determined in **Section 5** to each of the presently served basins by the proportions observed during the flow mapping effort. For example, if basin A1 was observed to contribute 10% of the total observed I/I during the flow mapping effort, then 10% of the I/I contribution to the PHF was assumed to be contributed by basin A1.

The capacity of the gravity mains were calculated assuming non-pressure flow (i.e., no surcharging) and utilized Manning's equation. The pipe roughness coefficient used in the Manning's equation varies according to the material used and the age of the pipe material. For this planning effort, an "n" value of 0.013 was be used in Manning's formula regardless of pipe material. In theory, new PVC sewers have manufacturer's "n" value of as low as 0.009. However, sand and grit as well as slime buildup on the pipe walls over time tend to render a true "n" value of 0.013. The resultant pipe capacity was compared against the portion of the projected flow that was routed through that basin.

Surcharging of a sewer occurs when the pipe is flowing under some pressure. This condition is evidenced when the water surface at the manholes is above the pipe crown. Under severe surcharge conditions, sewage overflow at manholes or backflow and flooding of buildings connected to the sewer system may occur. Occasionally, minor surcharging may occur in portions of a gravity sewer system. This condition may be tolerated for short periods to the extent that no potential for overflow or damage exists. The ability of the sewer pipe to flow under minor surcharge conditions without flooding may be thought of as the safety factor built into the system to compensate for partial obstructions in the sewer lines or short term flows slightly higher than design. Since even minor surcharging on a regular basis indicates that there is no longer any safety factor left in the hydraulic design of the pipe, it will only be a matter of time before the system experiences a major surcharge and overflow. Once a surcharging condition is noted, the cause should be determined and corrected as soon as possible, either by cleaning the system to remove blockages, by flow reduction measures and/or system improvements.

Each of the major trunk sewers within each basin were analyzed with respect to three classes of deficiencies. These are; 1) sewers that lack capacity to convey existing peak flows, 2) sewers that are likely to lack the capacity to convey peak flows associated with growth during the planning period, and 3) sewers that are likely to lack the capacity to convey peak flows at buildout conditions. Philomath's gravity collection system includes sewers that fall into all three categories. These are discussed in greater detail later in this section. At a minimum the City will have to address sewers that fall into categories one and two during the planning period. Should any of the existing sewer lines that fall into the third category need to be replaced as part of I/I reduction efforts or other maintenance reasons, they should be sized to accommodate flows at buildout.

6.3.2 Infiltration and Inflow Analysis

As is typical in Western Oregon, Philomath experiences increased wastewater flows resulting from I/I. The level of I/I experienced is correlated with both the groundwater levels and precipitation from major winter storms.

Base infiltration that results from higher groundwater levels during the winter months and that continuously enters the collection system through cracks and faults in pipes, laterals and manholes is relatively significant. A review of the DMRs over the past five years shows that the ratio between the AWWF and ADWF is approximately 2.4. The corresponding ratio between the PDAF at the WWTP to the AWWF during the past five years is approximately 3.7. For the period examined (i.e., 1996–2002), there have been several storms with a return frequency equal to or greater than 5 years. Additionally, 1997 was the wettest year on record in most of Western Oregon. Therefore, the DMR data evaluated is believed to enable an accurate assessment of the I/I problem.

Based on field observations, the collection system is subject to routine surcharging, particularly in the lower portions of the pump station A collection system. This indicates that portions of the gravity collection system as well as pump station A are not capable of conveying the peak flows. No known overflows have occurred to date. However, as previously mentioned, even minor surcharging is generally a sign that overflows may be imminent. The Newton Creek pump station is capable of conveying the peak flows to the WWTP. Although nearing its design capacity, the WWTP is not yet in violation of the discharge permit limitations. Though significant, the existing I/I problem in Philomath is not excessive when compared to similarly sized communities in the Willamette Valley. However, much of the core collection system is more than 50 years old and will approach, or reach, the end of its useful life during the planning period. As collection piping ages, the I/I problem will increase. Without improvements, the worsening I/I problem will likely result in overflows and bypasses during the planning period. Another problem with I/I is the added pumping costs required to transport larger volumes of wastewater to the treatment plant. As the volume of I/I progressively increases, the pumping costs will increase at a rate faster than expected when compared to the City's growth rate. As such, the I/I problem associated with the aging pipelines is a problem that the City should address during the planning period.

6.3.3 Pump Station Capacity Analysis

The three major pump stations within the City were analyzed for 20 year projected peak flows for each basin as developed in **Section 5**, as well as anticipated flows at buildout. Existing pump capacities, as well as other pump station information (i.e., force main dimensions, pump data and capacities), were previously summarized in **Section 4**.

The existing pump station capacities were compared to the existing and projected 20-year peak hour flows. All pumps were analyzed for pump capacity with the single largest pump out of service. Since the Timber Estates Pump Station is a duplex station (i.e., two pumps), it was analyzed for pump capacity assuming only a single pump in operation (i.e., 100% redundancy) per DEQ guidelines. The results of this analysis indicated that Pump Station A does not have the capacity to convey existing peak flows. This conclusion is confirmed by the regular surcharging observed upstream of Pump Station A. The Newton Creek pump station has the capacity to convey the existing peak hour flows, but not the projected 2027 peak hour flows. The

Timber Estates Pump Station has the capacity to convey existing and projected peak flows.

TABLE 6-1
Summary Of Pump Station Pumping Capacity Analysis

(Description)	Existing Capacity (gpm)	Existing Peak Flows (gpm)	Required 2027 Capacity (gpm) (1)	Required Buildout Capacity (gpm) (1)	Recommended Upgrades (see discussions later in this section)
Pump Station A	± 1550	± 2110	± 3230	± 3460	-Replace Entire Station
Newton Creek Pump Station	± 2110	± 2090	± 4220	± 6580	-Upgrade control system -Remove underground storage tank -Upgrade pumping capacity as required by growth.
Timber Estates Pump Station	± 108	± 60	± 66	± 70	- Upgrade control system

(1) Flow projections based on the assumption that flows from Basin N8A are transferred from basin A2 to basin N6A.

As noted in this table, Pump Station A must be replaced and the underground fuel storage tank for the auxiliary power unit at the Newton Creek Pump Station must be removed. Other improvements required during the planning period include control systems upgrades for the Newton Creek and Timber Estates pump stations. The analysis suggests that the pumping capacity of the Newton Creek Pump Station will have to be increased during the planning period. At the very least this will include additional pumps, discharge piping modifications, a larger auxiliary power unit and modifications to the control system. The existing wet well is sized to accommodate a peak flow of 7.05 MGD (4900 GPM). Therefore, the wet well should not need to be replaced during the planning period.

6.3.4 Force Main Capacity Analysis

Key design criteria for sewer force mains include maximum velocity, minimum intermittent velocity and detention time. If the velocity in a force main exceeds 5-6 feet per second the friction losses in the pipe can become excessive leading to high pumping costs. High pipe velocities also increase the effects of pressure transients, which increase the wear and tear on the piping and can ultimately lead to premature failures. When pumping raw sewage a minimum velocity of 2 to 2.5 feet per second must be maintained at least on an intermittent basis to prevent solids accumulation in the piping. In sewage force mains, excessive detention time can lead to corrosion problems caused by low pH values both in the pipeline and at the discharge point. Low pH values can also cause problems with treatment processes. To minimize these problems a maximum detention time of 16 hours is preferred.

The existing force mains were evaluated against these criteria for existing and projected peak hourly flows. All force main segments are adequate to convey the existing peak flows. The 14-inch segment from Pump Station A to the Newton Creek Pump Station has the capacity to convey peak flows at buildout. However, the force main may need to be replaced before buildout is achieved due to age. Nonetheless, the 14-inch segment from Pump Station A to the Newton Creek Pump Station will likely not require improvements during the planning period. The 18-inch segment from the Newton Creek Pump Station to the treatment plant lacks capacity to convey the projected peak flows at the end of the planning period (2027). Therefore, as part of the Newton Creek pump Station capacity increase, a new force main parallel to the existing force main should be constructed. The timing and costs of this improvement are discussed later in this section.

6.3.5 Collection System Improvements to Serve Currently Undeveloped Areas

There are a number of areas within the City that are currently undeveloped and lack gravity sewer service. New gravity mainlines will need to be installed to serve these areas as they develop. Current City ordinances require that mainlines and pump stations required to serve these areas be installed at the expense of the developer. These lines should be sized as required to serve all upstream areas.

6.3.6 Summary of Collection System Deficiencies

The known deficiencies described in **Section 4** have been combined with the deficiencies described above to develop a complete list of collection system deficiencies. These deficiencies are listed in **Table 6-2**.

TABLE 6-2 Summary of Collection System Deficiencies	
Location	Description of Deficiency
Gravity Collection Piping	
16th Street (Pump Station A to MH 26)	Lacks capacity to convey existing peak flows.
Cedar Street (MH 26 to MH 29)	Lacks capacity to convey existing peak flows.
13th Street (MH 29 to MH31)	Lacks capacity to convey existing peak flows.
Applegate Street (MH 31 to MH 35)	Lacks capacity to convey existing peak flows.
12th Street (MH 32 to MH 71)	Lacks capacity to convey existing peak flows.
10th Street (MH 34 to MH 45)	Lacks capacity to convey existing peak flows.
Main Street (MH 45 to MH 46)	Lacks capacity to convey existing peak flows.
Applegate Street (MH 202A to MH 2)	Lacks capacity to convey existing peak flows.
20th Street (MH 2 to MH 339)	Lacks capacity to convey existing peak flows.
College Street (MH 6 to MH 290)	Lacks capacity to convey existing peak flows.
Basin A4A, A4B, A6	Excessive I/I.
Basin N3AA, N3AB, N3B	Excessive I/I
All 1952 Mortar Joint Concrete Pipe	Approaching the end of useful life.
Manholes Throughout the Collection System	Excessive I/I.
College Street (MH 290 to MH 288)	May lack capacity to convey peak flows before end of planning period.
Industrial Park Sewer (MH 288 to MH 134)	May lack capacity to convey peak flows before end of planning period.
Main Street (MH 46 to MH 52)	May lack capacity to convey peak flows before end of planning period.
9th Street (MH 35 to MH 36)	May lack capacity to convey peak flows before end of planning period.
Alley ½ Block South of Main (MH 36 to MH 38)	May lack capacity to convey peak flows before end of planning period.
7th Street (MH 38 to MH 39)	May lack capacity to convey peak flows at buildout.
Main Street (MH 39 to MH 184)	May lack capacity to convey peak flows at buildout.
Pump Stations	
Pump Station A	Lacks capacity to convey existing peak flows.
Newton Creek Pump Station Control System	May become antiquated before end of planning period.
Newton Creek Pump Station Buried Fuel Tank	Will reach end of useful life early in the planning period.
Newton Creek Pump Station	May lack capacity to convey peak flows before end of planning period.
Timber Estates Pump Station Control System	May become antiquated before end of planning period.
Force mains	
14" FM From PS A to NCPS	May lack capacity to convey peak flows at buildout.
18" FM From NCPS to WWTP	May lack capacity to convey peak flows before end of planning period
Undeveloped Areas	
All undeveloped Areas	No sewer service

6.4. Identification of Collection System Alternatives

Facilities planning requires the examination of a broad range of alternatives for each portion of the wastewater system. This section examines the alternatives for collecting wastewater within the study area and conveying it to the point of treatment. This section develops and screens wastewater collection alternatives using criteria such as land requirements, topographic constraints, reliability, operational flexibility, construction and long-term O&M costs, and regulatory restrictions. The alternatives listed in this section represent the tools used in the facilities planning effort to address the previously listed deficiencies in order to provide a comprehensive long-term solution for the City's collection system.

6.4.1 No Action

The no action approach implies that no improvements will be made to the existing collection system (excluding maintenance or repairs). Obviously, this approach is recommended for those areas of the system which have sufficient capacity to convey the design flows and are in acceptable condition. Although this approach may be justified in isolated areas within the system on a case-by-case basis where there is insufficient capacity to convey peak design flows (i.e., minor surcharging for short periods of time), this approach is effectively eliminated by DEQ guidelines and regulations.

Although it is always an option to not improve the system, the result will be health risks, damages, and inconveniences where sewage collection and pumping facilities are inadequate. Furthermore, delaying required improvements almost inevitably leads to a greater future problem. However, to ensure that system improvements are justified, it is necessary to consider the costs and advantages of proposed improvements against the risks entailed by the no action alternative. It should be noted that since resources are limited and the sewer system cannot be upgraded all at one time, the phasing plan adopted by the City for the improvements will in effect require that the no action alternative be adopted on a temporary basis for all but the first phase improvements.

It should be noted that since the detailed hydraulic analysis of the system was limited to the trunk sewer collection system, the recommendations do not encompass the minor or local portions of the sewer collection system unless there may be problems due to blockages, pipe failures or maintenance problems.

6.4.2 Reroute Sewage (Basin Transfer)

Under this scenario, sewage would be diverted or rerouted from one sewer basin or system to another. This approach is practical in cases where an existing sewer and pump station has capacity in excess of that needed to convey design flows from that basin, and where flow diversion is practical from a construction and topographic standpoint.

6.4.3 Upgrade Existing Collection System, Pump Stations, & Force Mains

This approach involves constructing replacement pipes and/or upgrading pump stations and force mains to provide adequate capacity for the design flows. This is the most obvious alternative since it provides assurance that the sewage collection system can convey the design flows through town and that overflows will be kept to a minimum, which in turn limits the City's liability.

6.4.4 Infiltration/Inflow Reduction

As stated previously, the collection system collects large amounts of I/I during the winter months. While reduction of the existing I/I flows and minimization of future

I/I flows is important, experience in western Oregon has shown that the goal of complete elimination of I/I is unreasonable and largely unattainable. An understanding of I/I hydraulics is necessary to understand why this is so, and to illustrate the place that I/I reduction has in the overall management and improvement program.

Infiltration is groundwater that enters the collection system through faults in manhole barrels or bases, mainline pipes or service laterals. Inflow, on the other hand, is surface water or storm runoff that enters the collection system directly from sources such as manhole lids, open cleanout covers, roof drain connections or sump pump connections. Such inflow connections are illegal under the City's current ordinances. Unless there are illegal drainage connections, typically very little water entering the sewer system is direct inflow.

Inflow sources can most easily be identified by smoke testing the existing sewer system. When smoke is blown into the mainlines, it tends to exit through any connections open to the atmosphere, including roof drains and cleanout covers. If done during dry weather, the smoke testing can also reveal faulty sewer laterals. The water seal in the traps for sinks, bathtubs and toilets keeps the smoke from entering houses.

Most soils in the Willamette Valley and in the study area have relatively low permeability and are poorly drained during the winter months. Ground water levels remain relatively close to the surface during much of the winter. Even in areas where ground water levels are high during the dry weather months, little dry weather infiltration occurs because the groundwater permeates very slowly into the sewer trenches.

Many of the trenches dug when the sanitary sewers were installed are backfilled with granular materials. Even in areas with native backfill, the trench excavation destroyed the relatively tight soil structure and the replaced materials pass water much more readily than did the original soil. As the sewer trenches are generally deeper than any other utilities, stormwater tends to collect in the old trenches as soon as there is enough precipitation to cause surface runoff.

The factors limiting the amount of infiltration entering the sewer system include:

- The amount of water available to enter.
- The number and size of faults allowing the water to enter.
- The available hydrostatic head.

In the older portions of the sewer system, there are generally more than enough breaks, leaks and faults in the sewer system to allow virtually all water collecting in the sewer trenches to enter the sewer piping. Inadequate downstream capacities (pipe capacities and/or pump station capacities) cause surcharges that inhibit the rate at which water enters the sewer system.

After a period of precipitation, the sewer system effectively drains the collected waters from the sewer trenches. Because the soils drain poorly, the sewer trenches tend to be recharged from surface runoff for several days after a period of precipitation, thereby maintaining high I/I flows for several days after the precipitation ceases. As the trenches are gradually drained, the I/I flows decrease.

As the sewers are repaired, the number of system faults in each area are reduced until the size and number of faults start to inhibit the flow of I/I into the sewers. When that happens, groundwater levels in the sewer trenches rises. Peak I/I flows are smaller, but as long as some faults remain at elevations generally below trench-water levels, the I/I flows several days after a precipitation period remain high. The relationship between ground water levels, precipitation and I/I is complex and transient. Ground water levels in the sewer trenches often are unrelated to nearby groundwater levels in undisturbed soils.

Although complete elimination of infiltration from the sewer system is not a viable alternative, work can be done to reduce or maintain the amount of I/I. The goal of an I/I reduction program is to repair leaks and eliminate direct inflow and infiltration sources into the gravity mainlines, manholes and services. Over the years, experience has shown that the best approach is to focus on a particular area until significant I/I reduction is achieved before moving on to other areas of the collection system. The most logical locations to start work are those areas with the most significant I/I problems.

As previously described, smoke testing can be used to identify direct inflow sources. Once identified, spot repairs can be made. The City's sewer ordinance requires property owners to disconnect inflow sources on private property upon receiving a thirty (30) day notice from the City. All inflow sources on public property will likely remain the City's responsibility.

Several options are available for reducing infiltration and inflow into the collection system. These include complete replacement of mainlines manholes and services, in place rehabilitation (i.e., pipe bursting, cured in place pipe, slip lining, grouting, etc.), and spot repairs. Selection of the proper technology must be done on a project by project basis to determine the most cost-effective approach. Examples of factors that must be considered include pipe size, depth, level of deterioration, backfill, soil condition, alignment, surface restoration and number of services.

6.4.5 New Trunk Sewers, Pump Stations, & Force Mains

The construction of new collection system components including trunk sewers, lift stations, and force mains is the only method considered herein for providing service to undeveloped areas. This method basically involves extending the conventional gravity collection system into the undeveloped areas and installing new pump station where topographical limitations require. Septic tank effluent pumping (STEP) or

Septic tank effluent gravity (STEG) collection systems were not considered practical given the City's reliance on a conventional gravity system and the potential deterioration of concrete components in the existing system from hydrogen sulfide present in STEP and STEG effluents.

6.5. Evaluation of Alternatives and Development of Complete Collection System Recommendation

Each of the alternatives listed previously were evaluated against each of the collection system deficiencies to determine the most cost-effective, long-term solution for the City's collection system. This section presents the results of this evaluation and summarizes the overall collection system recommendation. The City's goal is to develop a sewage collection system that not only meets existing needs, but also accommodates future development.

Based on the anticipated sewage flows previously discussed, it is recommend that the City establish a formal Capital Improvement Program to replace and/or upgrade the major components in the existing collection system to provide capacity to convey the design flows under fully developed conditions. Further it is recommend the City implement a program of phased construction of these improvements as funding becomes available.

A conceptual design was developed for each major improvement project to determine the approximate size and features needed to convey the design flows. As part of this process, alternatives such as alignment, feasibility of reusing existing portions of the system were identified and evaluated. This involved evaluation of topographic opportunities, available vacant lands, and natural resource constraints with field reconnaissance to confirm the conceptual level feasibility of each alternative.

6.5.1 Existing Gravity Sewer Collection System

6.5.1.1 I/I Reduction Program

As described, the I/I problem is significant. As an alternative to addressing I/I, the City could chose to collect, treat, and dispose of all existing and anticipated I/I. This would amount to the "do nothing" option with respect to the I/I problem. Without continued I/I reduction efforts, the amount of I/I in the existing system will continue to increase as the collection system continues to age. This increase in flow will exceed the capacity of sections of piping in addition to those currently at capacity. As a result, additional sections of collection piping would have to be upsized and pump stations and force mains would have to be oversized to handle the anticipated increase in I/I. Once collected and conveyed to the treatment plant, the I/I must be treated and disposed of. In order to treat the anticipated increase in I/I, the hydraulic capacity of the treatment plant would have to be oversized. All of these improvements would be in addition to the improvements listed in the recommended plan. As such, the "do nothing" alternative with respect to the I/I problem is not the least cost alternative. Even if this fact is ignored, the real problem with the "do nothing" approach is in relation to disposal at the WWTP. As the City continues to grow during and beyond the planning period, wintertime disposal will become a controlling factor with regard to the treatment facilities. This is due to the fact that the Marys River has been listed as water quality limited by the DEQ. The end result of this listing is that the DEQ will likely not approve an increase in the existing mass loads to the Marys River. This limits the amount of pollutants the City can discharge. Since wastewater flows will grow as the City grows, the only way to maintain the pollutant loads to the river is to provide a higher level of treatment. As wastewater flows increase, eventually the City will be forced to produce a higher quality effluent than it currently does. If the I/I problem is not addressed, the City may be forced to make the modifications required to produce a higher quality effluent during the planning period. Given this fact, and the fact that the "do nothing" alternative with respect to the I/I problem is not the most cost effective solution, it will be dropped from further consideration.

The majority of the problems associated with the existing gravity collection system are the result of the age of the original 1952 gravity piping and the materials and construction methods used to install the system. The system is now more than 50 years old and is showing significant signs of deterioration. This deterioration results in a significant amount of infiltration into the collection piping and appurtenances. This infiltration is the major reason for many of the capacity issues in the existing gravity collection piping. If all of the infiltration and inflow sources could be removed, the existing gravity piping would most likely have the required capacity to convey existing and projected peak flows. Though, complete elimination of infiltration and inflow is not possible, it can be significantly reduced. Reducing the amount of I/I into the collection system has a number of benefits. Some of these are listed as follow.

- **Reduction in wintertime disposal requirements.** All of the infiltration and inflow that enters the collection system must be treated and disposed of as if it were wastewater. During the winter, the only disposal method available to the City is to discharge treated wastewater to the Marys River. The DEQ limits the amount of wastewater that can be discharged by setting mass load limits. As discussed in **Section 7**, the existing mass load limits are sufficient to provide for wintertime discharge of lagoon effluent during the planning period. However, as one looks beyond the planning period, finding wintertime disposal methods is going to become a significant concern for the City. Efforts to reduce I/I will result in a decrease in the amount of additional wintertime disposal that must be provided in the future.

- **Reduces pumping costs.** In Philomath all wastewater that is collected from the users is pumped to the treatment plant. As such, reducing the amount of I/I will decrease pumping costs.

- **Extends the life of the pumping and treatment facilities.** I/I utilizes capacity that could be used for wastewater. If the amount of I/I can be reduced, the time until the pumping and treatment facilities reach capacity can be extended.

The only way to reduce I/I is to replace or repair the faulty collection piping and manholes. When designing an I/I reduction program, the key question that needs to be answered is how much of the collection system should be addressed on an annual basis. Since much of the original 1952 collection system is nearing the end of its useful life, the City should embark on an I/I reduction strategy that results in replacing or repairing the entire 1952 collection system over the next ± 30 years. By the end of this time period, the 1952 collection system still remaining in service will be 80 years old and require extensive and ongoing maintenance at considerable cost. Based on the flow mapping data (see **Section 4**), much of the collection piping located in basin N3B that was constructed in 1961 shows signs of an I/I problem. Therefore, this piping is included in the I/I reduction plan.

The total length of gravity mainline that should be included in the I/I reduction plan is approximately 35,000 feet. In order to replace or repair this entire length over a 30-year period, 1,150 feet must be done on an annual basis. The annual cost of this work is based on the assumption that all mainline manholes and all public portions of the services are replaced. This assumption is conservative. It may be more cost effective to repair the existing mainline using in-place methods for certain portions of the collection system. If so, the cost savings can simply be used to replace a longer section of the system or to replace the private portions of the services. It is also likely that unforeseeable (at the facilities planning stage) difficulties will result in certain projects costing more than estimated herein. As such, it is likely that individual cost savings and overruns will balance out over the 30-year term of the effort. If not, the overall duration of the project may be extended or decreased. The intent of the effort is to repair the aging collection system. It makes little difference if it requires, 25, 30, or 35 years. Furthermore, at the end of the 30-year period, it is highly likely that other portions of the collection system will need to be replaced or repaired due to age and deterioration. As such, the I/I reduction effort should be extended indefinitely.

The City currently has and ongoing I/I reduction plan that is funded at approximately $65,000 per year. The recommendation is to increase the funding dedicated to the plan by the amount necessary to replace approximately 1,150 feet of sewer mainline annually. The estimated costs for this work are summarized in **Table 6-3**. As shown in **Table 6-3**, the annual project cost for the proposed I/I reduction plan is approximately $222,000.

TABLE 6-3
Annual I/I Reduction Plan Cost Estimate

Item	Unit	Quantity	Unit Cost	Total Cost
TV Inspection	L.F.	1,150	$2.00 (2)	$2,300
12" Mainline (1)	L.F.	1,150	$84.00	$96,600
Manholes	Each	4 (3)	$3,500	$14,000
Services	Each	23 (4)	$2,000	$46,000
Subtotal Construction Cost				$158,900
Construction Contingency @ 10%				$15,890
Engineering Costs @ 20%				$31,780
Administrative Costs @ 10%				$15,890
Total Project Costs				$222,460

(1) 12" mainline assumed to be average size over entire project area.
(2) Assumed unit price based on TV work done at ± 5,000 foot increments.
(3) Based on average manhole spacing of 300 feet.
(4) Based on average service spacing of 50 feet.

Experience has shown that successful I/I correction requires a carefully planned iterative approach. The first step involves fieldwork and data collection within the proposed work area. Each line should be cleaned and inspected with television monitoring equipment. With the exception of smoke testing, all fieldwork should be done during wet periods when reliable I/I flows are high. The data must be carefully analyzed to refine the locations of the problem areas and to determine if the line should be replaced entirely or if an in-place repair technology is more appropriate. After the improvements are constructed, more fieldwork and inspections should be performed to determine the success of the I/I correction. For example, if high I/I flows are observed from a particular section of sewer main that has been replaced including the manholes and the public portion of the services, a logical source would be the private portion of the services. This would indicate that to be successful, the entire system must be replaced/rehabilitated from the mainline to each structure.

Replacing the private portions of the services can be politically challenging. The City's current sewer ordinance requires users to repair the private portions of the services within sixty (60) days notice from the City that the service is causing excessive infiltration. At $1,000 to $2,000 per service, this can be a difficult cost for homeowners to bear. The political ramifications of implementing this policy must be carefully considered. In some successful I/I control programs grant funding to correct service laterals for low income users has been available and makes the I/I correction work less of a financial burden.

Most I/I correction programs have not been as successful as intended because the nature of sewer system I/I was not fully understood. In the past, many I/I reduction programs were based on the theory that to significantly reduce I/I, only the major leaks need to be identified and repaired. There are many reasons why this approach has failed. Two significant reasons are summarized as follows.

- The effects of "hydraulic transfer" have not been well understood. Water in the sewer trenches easily runs along the outside of the sewer pipes. After the mainline pipes that collect I/I are grouted or otherwise repaired, nearby pipes and adjacent service laterals begin collecting large I/I quantities and total system flows remain substantially unchanged. This is hydraulic transfer. Plugging some leaks causes the trench groundwater level to rise slightly. The trench backfill material is relatively permeable, allowing water to run along the pipeline and enter other faults at slightly higher elevations, or through smaller leaks that now have more pressure on them (greater hydraulic head).

- Service laterals have not been effectively addressed. In most systems, service lateral piping represents half of the total system. In many systems, very little is done to locate and stop service lateral leakage. Some have concluded that because service laterals are relatively shallow, they will not contribute much I/I. Frequently, however, service laterals contribute a major part of total I/I and significant I/I reductions cannot be achieved without repairing faulty service laterals. The connection of service laterals to the sewer main is particularly critical. Typically, a significant percentage of these connections in older systems are faulty and leaking profusely.

Some of the lessons from successful I/I correction programs of the past are as follows.

- Do I/I correction on a basin-by-basin basis. Significant I/I reductions are only reliably achieved by eliminating all or nearly all I/I contributing faults in a sewer basin. To repair much less tends to shift the entry of I/I from one fault to the next.

- Measure wet weather I/I flows from the selected basins before repair work starts.

- Initially determine what, in general, must be done to repair the faults contributing significant I/I. Locate as many such faults as reasonable, but realize that it is impossible to find them all. Some will not be discovered until some repairs are made.

- Establish a repair plan and budget for all known repairs. Make allowances for repair of faults not initially discovered. The repair plan must include repairs to mains, manholes and service laterals if each contributes significant I/I.

- Make the initial repairs and then re-measure wet weather I/I. Unless the I/I reductions are acceptable, find the remaining I/I sources and repair them. Repeat this process until acceptable I/I reductions are achieved. Experience has demonstrated that the ratio of I/I reduction per dollar spent will be much higher for the last repairs than the first.

I/I correction is a complex process. A process that is part art and part science, since there are often multiple methods for correcting the system faults. In general, the repairs must be long lasting, and the least expensive method of achieving a long-term repair should be utilized.

Several methods are available for rehabilitating pipelines to eliminate I/I. These methods include the following:

- Sewer replacement
- Chemical grouting of joints and lateral connections
- Slip lining (HDPE)
- Cured-in-place Pipe (Insituform or equivalent inversion lining)
- Folded & formed pipe (Nupipe, U-liner or equivalent)
- Pipe Bursting

Factors such as cost, structural conditions, safety, and potential for I/I migration will influence the selection of the proper technique and must be considered when selecting a rehabilitation method on any specific pipeline section.

Manholes are usually rehabilitated to correct structural deficiencies and to eliminate the entrance of ground and surface water. Each manhole should be evaluated to determine the type of problems occurring and the optimum method of rehabilitation and repairs including frame, cover, side wall, and base rehabilitation. Chemical grouting is usually very effective for correcting sources of infiltration in manholes.

6.5.1.2 Construct Basin A2 Overflow Structure

Flow from Basin A2 is currently routed through basin N3AA to the Newton Creek pump station. The trunk sewers on the downstream end of basin N3AA as well as those downstream of basin N3AA lack capacity to convey existing and projected peak wastewater flows. As described later in this section, the recommended plan includes upsizing sections of these trunk sewers. To limit the magnitude and extent of the piping that must be upsized, the recommended plan includes the construction of an overflow structure that prevents surcharging in basin N3AA by splitting flows from basin A2 between basin N3AA and basin A4A. During low and normal flow conditions, all of the flow from basin A2 should be directed into basin N3AA. As flows increase in response to wet weather conditions, any wastewater that cannot flow into basin N3AA without surcharging will overflow into basin A4A and flow by gravity to Pump Station A. The overflow structure should be constructed by modifying manhole #288 at 15th and College Street. Manhole #288 currently has two outlets. The outlet to the south drains to basin A4A. The outlet to the east drains into basin N3AA. The east outlet is at a slightly lower invert elevation than the southern outlet. A hand formed concrete ledge and slide gate prevents flow from entering the southern outlet. To provide the desired function, the concrete ledge and slide gate will need to be modified. The modifications should be designed to direct any flow deeper than 2/3 of the diameter of the eastern outlet into the southern outlet. This can be accomplished by chipping away the existing concrete ledge and installing an adjustable set of stop logs or other similar device. The total costs for this project should be less than $7,500).

This modification has number of benefits. Since the Newton Creek Pump Station is closer to the treatment plant than Pump Station A, it is less expensive to pump wastewater from the Newton Creek Pump Station than from Pump Station A. Therefore, as much flow as possible should be directed toward the Newton Creek Pump Station. The construction of the overflow structure results in only the highest flows being diverted to Pump Station A. The majority of the flow will be directed toward the Newton Creek Pump Station. The recommended plan includes maintaining this configuration indefinitely. Therefore, the majority of flow from Basin A2 will be diverted to the Newton Creek Pump Station.

6.5.1.3 Basin N8A Basin Transfer

Sewer service has been extended into basin N8A from basin A2 rather than from basin N6A as planned in the original 1985 Facilities Plan. As a consequence, flows from basin N8A are contributing to the capacity problems downstream of basin A2. The overflow structure previously described partially alleviates the capacity problem. However, as a long-term solution, flows from basin N8A must be intercepted by the trunk sewer system that is described later in this section.

There is a significant amount of undeveloped land within and upstream of basin N8A (i.e., basins N8B and N8C). Without this basin transfer, the entire trunk sewer from manhole #27 to manhole #134 will have to be upsized prior to buildout since it lacks capacity to convey the projected flows. This would reroute a substantial amount of flow away from the Newton Creek Pump Station and into Pump Station A. Since pump station A is further from the treatment plant than the Newton Creek Pump Station, rerouting basins N8A, N8B, and N8C to Pump Station A will significantly increase pumping costs over the long run. These pumping costs together with costs required to increase the trunk sewer size are excessive when compared to the costs of routing flows from basin N8A into basin N6A.

The drawback to this option is that a substantial amount of time may be required before the trunk sewer is extended to the point where flows from basin N8A can be rerouted. Currently, there is very little room for growth in basins A2, N8A, N8B, and N8C due to the downstream capacity problems. The recommended plan in effect may discourage growth in these areas until the trunk sewer system has been extended to the point where flows from basin N8C can be intercepted before discharging into basin A2.

6.5.1.4 Replace Under-Capacity Sewer Lines

As described in **Section 4** and demonstrated in **Section 6.3,** large portions of the collection system lack capacity to convey present peak hourly flows. As such, major upgrades are required at this time. Many additional sections of the gravity collection piping lack capacity to convey projected flows at the end of the planning period and at buildout. As such, many additional sections of the gravity collection piping will likely require replacement during the planning period. The recommended improvements and project costs are listed in **Table 6-4**. A detailed breakdown of the construction costs, contingency, design and administration/financing costs are included in **Appendix I**. The sewer replacement projects include complete replacement of the main, all manholes, and services within five feet of structures. The lines are assumed to be constructed in the same horizontal alignment and at the same slope as the existing lines. The recommended sizes are noted in **Table 6-4**.

Technically, the projects listed in **Table 6-4** can be considered as part of the I/I reduction plan. Therefore, if the City desires, the funds earmarked for the I/I reduction plan can be used for the projects listed in **Table 6-4**. However, it should be noted that most of the projects listed in **Table 6-4** include an oversize component to accommodate upstream growth. Therefore, a portion of these projects is eligible for funding by the collection of SDC's. The oversize component of the overall project budget is included in **Table 6-4**.

As the projects listed in **Table 6-4** are completed, the flows should be evaluated to quantify any reductions in the amount of I/I. If during the implementation of the above improvements or the implementation of the I/I reduction program, significant reduction in the amount of I/I into the collection system is observed, the City may wish to reevaluate the pipe diameter recommendations listed in **Table 6-4**.

6.5.2 Pump Stations and Force mains

As demonstrated in **Section 6.3** the pump stations and force mains include a number of deficiencies. Key amongst these is that existing capacity problems with Pump Station A.

As described in **Section 4** pump station A was constructed as part of the original 1952 sewer system and subsequently renovated in 1985. Therefore, several of the main components of the pump station are more than 50 years old. In addition to its age, the pump station lacks capacity to convey peak flows. The size of the wet well must be increased to provide additional capacity. As such, the recommended plan includes complete replacement of Pump Station A. The estimated project cost for replacing Pump Station A is included in **Table 6-4.**

The other major pump station improvement project is the Newton Creek Pump Station capacity increase. This project consists of installing additional pumps with new control systems, renovating the discharge piping, installing a new auxiliary power unit, and installing a parallel force main from the Newton Creek Pump Station to the WWTP. At this time, it is difficult to determine if this improvement will be required during the planning period. The flow projections indicate that this upgrade may be necessary sometime late in the planning period. However, these projections are based on the assumption that growth will occur at an equal rate in each basin. As the projects required to increase the capacity of the pump station A collection system are made, this basin will become more suited for growth than the Newton Creek Pump Station basin. As such, a higher percentage of growth is likely to occur in the Pump Station A basin rather than the Newton Creek basin. Furthermore, the possibility exists that the I/I reduction program will decrease the amount of I/I, and subsequently decrease flows to both pump stations. Based on these arguments, it is possible that the Newton Creek Pump Station capacity increase may be delayed beyond the current planning period. As such, we recommend that the City evaluate growth patterns and the success of the I/I reduction plan at 5-year intervals during the planning period and amend the Facilities Plan as required.

Other minor improvements to the existing pump stations are the removal of the underground storage tank at the Newton Creek Pump Station, and the control system upgrade at the Timber Estates Pump Station. Total Estimated project costs are included in **Table 6-4**. A detailed breakdown of the costs is included in **Appendix I**.

6.5.3 Collection System Improvements to Serve Currently Undeveloped Area

With a few minor modifications, the gravity trunk sewer system recommended in the 1985 Facilities Plan should remain as the City's long term plan. The existing system of pump stations and force mains are designed around the long term collection system proposed in the 1985 Facilities Plan. Many of the trunk sewer improvements to date have followed the recommendations of the 1985 plan. For these and other reasons, departing from the 1985 plan at this time would require major system overhauls that are not necessary and not cost effective. As part of this facilities planning effort, the collection system improvements proposed in the 1985 Facilities Plan were reevaluated both from a capacity and layout standpoint. As a result, some minor modifications and additions to the 1985 plan are presently proposed. The conceptual layout of the proposed trunk sewer improvements is shown in **Figure 6-1**. In addition to the trunk sewer system, two additional pump station are proposed to serve basins P1B and P2B. These are called the 13th Street Pump Station and the Applegate Street Pump Station respectively.

The collection system improvements to serve currently undeveloped areas have been partitioned into the individual projects listed in the recommended improvements to allow for inclusion in the CIP at the discretion of the City Council. The total project estimates are listed in **Table 6-4**. Detailed project estimates are included in **Appendix I**. Even if these projects are included in the CIP, it is assumed that developers will construct them. The final locations of the new pump stations and detailed alignment of the trunk sewers and force mains have not yet been determined, and will be based on the proposed development pattern of the land being served by the facility. The locations shown later in this section represent the general location required for the facilities in order to serve the tributary drainage basins. Alternate locations proposed by developers should be considered only if they are capable of providing service to the entire basin.

6.5.4 Summary of Recommended Collection System Improvements

The improvements outlined in **Table 6-4** of this report are shown on **Figure 6-1.** A schematic depiction of the long-term collection system routing is included in **Figure 6-2**. These improvements will result in a sewage collection system with the capacity needed to convey flows from within the planning area assuming development to zoning densities shown. The proposed improvements are intended to minimize the amount of new piping which must be installed, as well as to minimize the unnecessary replacement of existing sewer mainlines. The proposed trunk sewer system improvements largely follow existing street right-of-ways through the community along existing sewer alignments. As such, the alternative alignments are limited. Construction of the recommended new sewers to address capacity issues will also result in a decrease in the I/I contributions as the existing concrete sewers are replaced with new sewers of PVC pipe material.

The improvements are based on the complete development of the land within the UGB. Therefore, many will not be required during the planning period. The improvements address existing deficiencies, as well as potential deficiencies at the end of the planning period and at buildout. Only the improvements that address the existing deficiencies are required at this time. The remaining deficiencies are growth dependent. Of these, some may be required before the end of the planning and some may not. Nonetheless, should any of the sewer mainlines be replaced as part of the I/I correction work, they should be sized in accordance with the recommendations listed in **Table 6-4** regardless of whether or not the mainline lacks capacity at the time of construction. The improvements are prioritized in **Section 8** if this report.

The alignment of future lines through the undeveloped portions of town has not yet been determined. The final alignment of sewer lines in these areas should be determined as property develops. Sewer lines should be placed within right-of-ways whenever possible. If the City Limits or UGB are to be expanded in the future, the sewer system should be re-examined to determine where additions are needed and if alternate alignments are justified.

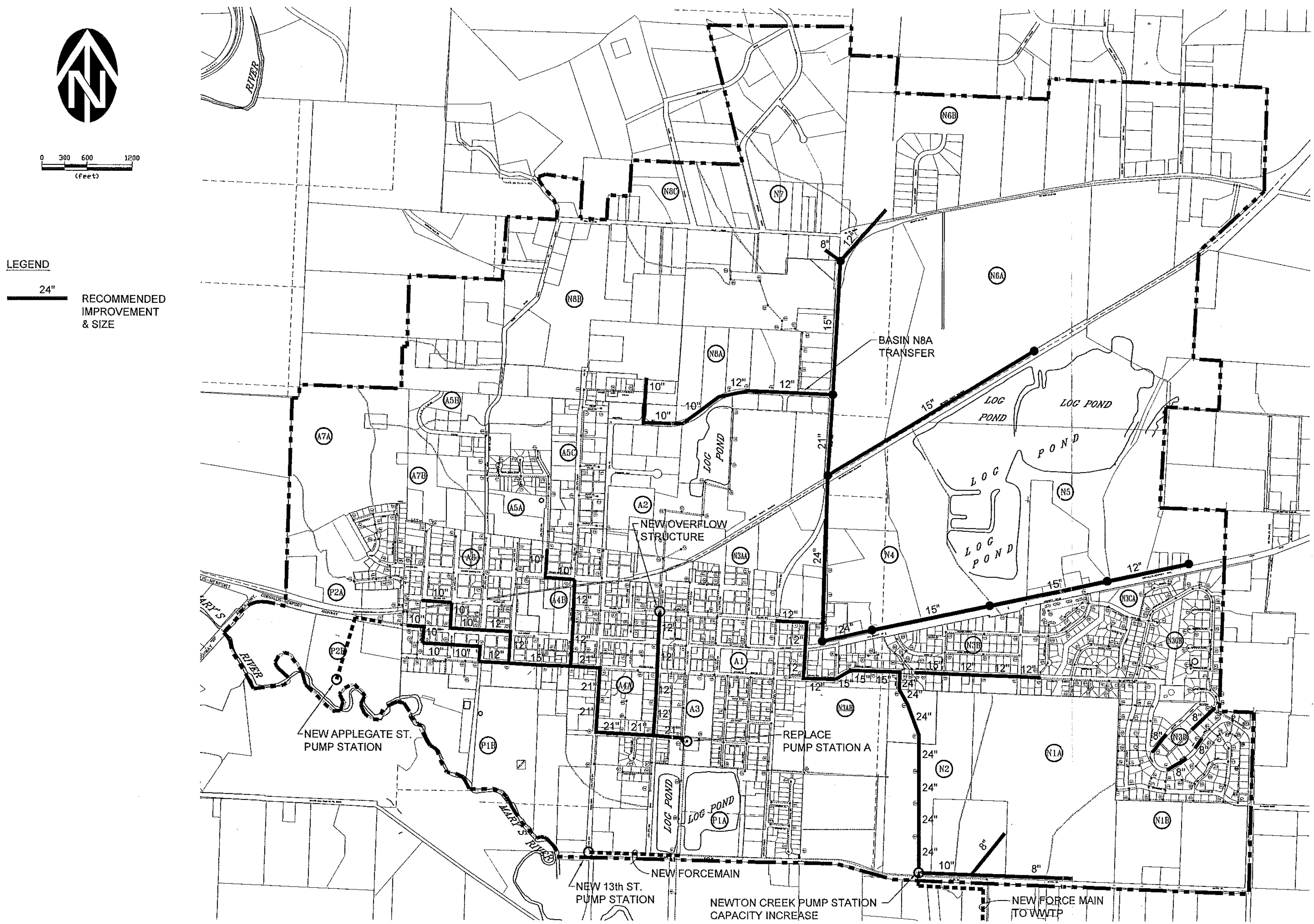
The capacity problems in the collection system are well documented. Any additional development upstream of the identified bottlenecks prior to the implementation of the recommended improvements will exacerbate the capacity the problem and will result in additional surcharging of sewers and possible overflow or flooding of homes or businesses.

TABLE 6-4
Recommended Collection System Improvements

Project Location(s)	Existing Size/Capacity	Length (ft)	Recommended Size/Capacity	Total Estimated Project Cost	Oversize Cost Required for Future Growth
I/I Reduction Plan (Original 1952 Collection System)		1150 ft/yr	As listed	$222,000/yr [(1)]	$0
Pump Station A (16th & Cedar)	±1550 gpm	-	±3460 gpm	$1,125,000	$468,000
Overflow Structure (15th & College)				$11,000	$6,000
Buried Fuel Tank at Newton Creek Pump Station				$14,000	$2,500
Pump Station A Trunk Sewer Improvements					
Cedar Street (MH 200 to MH 29)	12"	1200	21"	$278,000	$32,000
13th Street (MH 29 to MH 31)	12"	840	21"	$215,000	$22,000
Applegate Street (MH 31 to MH 32)	12"	390	21"	$93,000	$10,000
Basin N3A Trunk Sewer Improvements					
Applegate Street (MH 1 to MH 2)	8"	430	12"	$77,000	$0
20th Street (MH 2 to MH 6)	8"	740	12"	$128,000	$0
College Street (MH 6 to MH 9)	8"	400	12"	$71,000	$0
12th Street Trunk Sewer Improvements					
12th Street (MH 32 to MH 71)	8"	1150	12"	$188,000	$22,000
Basin A6 Trunk Sewer Imps. Phase I					
Applegate Street (MH 32 to MH 34)	10"	820	15"	$164,000	$24,000
Applegate Street (MH 34 to MH 35)	10"	400	12"	$63,000	$8,000
10th Street (MH 34 to MH 45)	10"	420	12"	$80,000	$8,000
Main Street (MH 45 to MH 46)	10"	400	12"	$77,000	$8,000
Basin N3B Trunk Sewer Improvements					
Applegate Street (MH 203 to MH 205)	10"	390	15"	$90,000	$15,000
Applegate Street (MH 205 to MH 208)	10"	1280	12"	$227,000	$12,000
Basin A6 Trunk Sewer Imps. Phase II					
9th Street (MH 35 to MH 36)	8"	200	10"	$32,000	$4,000
Alley (MH 36 to MH 38)	8"	770	10"	$124,000	$17,000
Main Street (MH 46 to MH 52)	8"	400	10"	$74,000	$9,000
8th Street (MH 52 to MH 53)	8"	330	10"	$55,000	$7,000
Timber Estates Pump Station Imps				$113,000	$0
Newton Creek Pump Station Capacity Imps					
New Force main to WWTP				$832,000	$832,000
Pump Station Improvements				$300,000	$300,000
Basin A6 Trunk Sewer Imps. Phase III					
7th Street (MH 38 to MH 39)	8"	220	10"	$37,000	$5,000
Main Street (MH 39 to MH 40)	8"	230	10"	$46,000	$5,000
College Street (MH 53 to MH 56)	8"	400	10"	$62,000	$8,000

(1) Funds generated as part of the I/I reduction plan may be used to complete the trunk sewer replacement projects listed in this table.

TABLE 6-4 (Continued) Recommended Collection System Improvements					
Project Location(s)	Existing Size/Capacity	Length (ft)	Recommended Size/Capacity	Total Estimated Project Cost	Oversize Cost Required for Future Growth
Basin A4B Trunk Sewer Imps. Phase II					
Pioneer Street (MH 71 to MH 73)	8"	400	10"	$71,000	$9,000
11th Street (MH 73 to MH 74)	8"	375	10"	$62,000	$8,000
15th Street Trunk Sewer Improvements					
15th Street (MH 27 to MH 288)	8"	1630	12"	$296,000	$50,000
Basin N3AA Trunk Sewer Improvements					
Applegate Street (MH 202A to MH 1)	12"	875	15"	$197,000	$197,000
Newton Creek Trunk Sewer Improvements					
Newton Creek (MH 202A to NCPS)	21"	2660	24"	$593,000	$593,000
Benton View Drive Sewer Improvements		1150	8"	$167,000	$167,000
East Highway 20 Trunk Sewer					
From 24" Stub to Basin N4/N5 Boundary		1650	15"	$250,000	$250,000
From Basin N4/N5 Boundary to End 15"		1600	15"	$244,000	$244,000
From End 15" to End of Trunk Sewer		1050	12"	$139,000	$139,000
20th Place Trunk Sewer					
From 24" Stub to 20th Pl./Hwy 20 Intersection		680	24"	$167,000	$167,000
From 20th Pl./Hwy 20 Intersection to SPRR		2100	24"	$489,000	$489,000
Railroad Bore		100	24"	$52,000	$52,000
Railroad Trunk Sewer		1600	15"	$318,000	$318,000
Green Road Trunk Sewer Phase I					
From SPRR to Industrial Way		1100	21"	$228,000	$228,000
Green Road Trunk Sewer Phase II					
From Industrial Way to West Hills Rd.		1700	15"	$286,000	$286,000
From West Hills Rd. to End		900	12"	$132,000	$132,000
Industrial Way Trunk Sewer					
From Green Rd. to MH 134		1300	12"	$195,000	$195,000
From MH 134 to End		2000	10"	$270,000	$270,000
Applegate Street Pump Station					
Pump Station			±185 gpm	$525,000	$525,000
Force Main				$67,000	$67,000
13th Street Pump Station					
Pump Station			±400 gpm	$578,000	$578,000
Force main				$97,000	$97,000
Totals				$10,174,000	$6,978,000



CITY OF PHILOMATH

2003 SANITARY SEWER FACILITIES PLAN

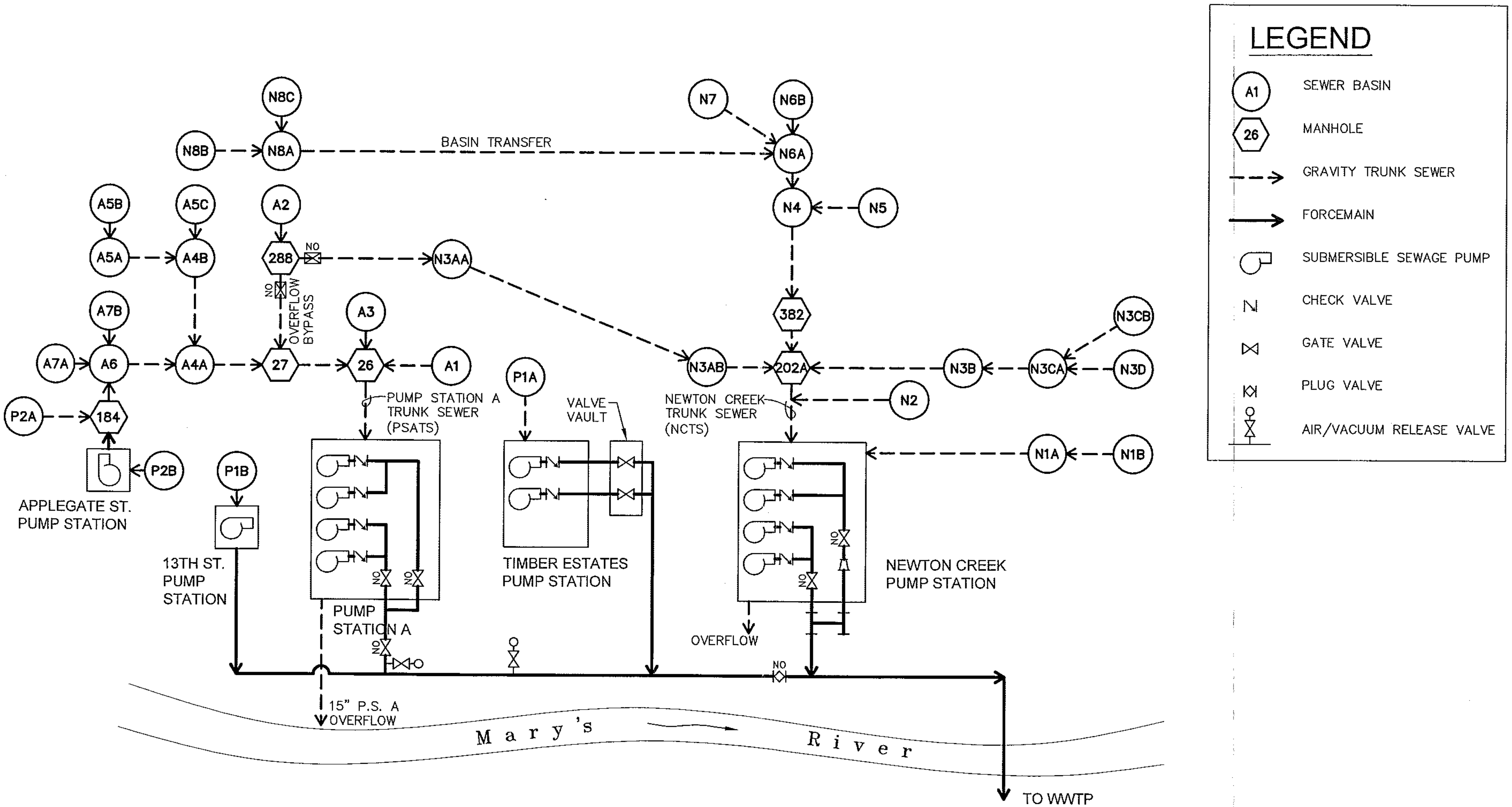
RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS

DSN.	CB
DRN.	TMT
CKD.	CB
DATE:	JULY 03

FIGURE 6-1

JOB NUMBER 960.3130.0



City of Philomath

2003 Sanitary Sewer Facilities Plan

RECOMMENDED LONG–TERM COLLECTION SYSTEM FLOW ROUTING SCHEMATIC

FIGURE 6–2

JOB NUMBER 960.3130.0

WESTECH ENGINEERING, INC.
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DATE: JULY 03

VERIFY SCALE

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REVISIONS

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