

June 5, 2006

Susanne Baker, Administrative Assistant
Department of Community Services
City of Coos Bay
500 Central Ave.
Coos Bay, Oregon 97420

**RE: I/I Addendum Submittal
Wastewater Collection System Master Plan**

Dear Susanne:

Attached you will find a single, unbound copy of the I/I Addendum that we have prepared which is to be inserted as an appendix item in the recently completed Wastewater Collection System Master Plan.

As you know, it was our intent in our proposal to work closely with OMI and the City to identify “problem areas” or areas of concern that should be analyzed in detail. Our proposal included plans to review existing smoke testing and television records to identify areas that should be comprehensively flow mapped.

However, upon coordinating with OMI, it was found that little organized information existed and essentially no documentation existed to suggest one area that would warrant flow mapping more than another. When asked, OMI was unable to direct us to any known problem areas and, instead, felt that I/I was distributed relatively evenly around the system.

We have found this to be a common condition in communities in western Oregon and concurred with OMI that the I/I in the system was most likely a result of aged piping with leaky joints and miles of laterals that serve as a french-drain network to artificially drain the groundwater around the sewer system. When rainwater filters down through the ground, it enters the piping system and becomes infiltration. This rain-induced-infiltration is a common phenomenon in our part of the world.

The City’s Facilities Plans suggest that the I/I problem, while significant, does not warrant major projects to remove the flows from the system. Instead, the plans recommended improving treatment facilities to handle the peak flows resulting from I/I.

According to DEQ, the Department prefers that the City adopt a deliberate policy to eliminate or reduce I/I flows in their system. With this in mind, we included recommendations in the City’s Wastewater Collection Master Plan and in the I/I addendum intended to provide the City with some insight to the activities that may constitute this effort to systematically identify and reduce I/I.

Without specific areas to target for flow mapping, we considered what would be the most beneficial activity for the City with regard to I/I. Clearly, the scope of work and budget for the Master Plan did not support a comprehensive flow mapping or smoke testing effort.

Therefore, we decided to undertake a review of all basins in the system soon after a storm event to observe flows in the system and attempt to identify which parts of the system appear to have more I/I than others and which areas deserve further investigations.

Through this effort, we inspected numerous manholes in each basin in the system. In many cases, we observed manholes that were actively leaking through holes or cracks in the manholes themselves. Flows in the manhole often appeared to be consistent in volume as well as clear, which would be indicative of I/I flows. Careful notes were made of these observations in order to document the field survey.

In addition to this field survey, we have provided information and costs about methods that can be used to further investigate the I/I throughout the system in the coming years. These additional activities may qualify as part of the “systematic effort” which DEQ desires to see the City adopt.

Also, we have included a discussion of various construction methods that can be used to correct I/I issues through both conventional and trenchless means. Costs are provided to aid the City in completing internal budgeting for these projects.

The pursuit of I/I in collection systems is a difficult and often fruitless process. Many communities have abandoned these efforts and have chosen to upsize treatment facilities as the investment in treatment capacity provides a guaranteed result.

Should the City decide to pursue a plan to locate and eliminate I/I sources, the Master Plan, including this addendum, will provide a framework and place of beginning.

We appreciate your patience as we have worked to complete this portion of the planning effort.

Sincerely,
HBH Consulting Engineers, Inc.

J. Garrett Pallo, PE
Principal

City of Coos Bay

COOS COUNTY, OREGON



WASTEWATER COLLECTION SYSTEM INFLOW AND INFILTRATION ADDENDUM STUDY

June 2006



EXPIRATION DATE: 12/31/06



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1.0 Executive Summary

This Document has been prepared to serve as an addendum to the City of Coos Bay Wastewater Collection System Master Plan (2006). The following report summarizes the wastewater collection system I/I study and observations performed for the City of Coos Bay. Recommendations presented in this report outline a program that includes dedicated testing and study to identify significant sources of infiltration and inflow (I/I) and some improvement alternatives designed to address the I/I sources identified.

The study presented in this report is based on spot observations made within each basin. Wherever possible ten percent, or more, of the manholes in each basin were observed. These observations focused on infiltration from leaky laterals, leaky sewer mains, leaky manhole sections and joints and other sources.

Observations made during this study reinforced the need for further investigation and repair of the City's wastewater system. Recommendations for investigation and repair options, and some cost estimates for repair options, appear in Section 3.0 Alternatives.

2.0 Existing Conditions

The City of Coos Bay's wastewater collection system is made up of several miles of sanitary sewer mainline piping and force mains along with several miles of public and private sewer laterals to service customers. Collection system piping in Coos Bay varies by age, condition, size and material. The City's system includes force mains ranging from 2-inch and smaller to as large as 24-inches in diameter. Gravity piping includes 4-inch laterals up to 30-inch gravity mains.

Nearly all coastal communities in Oregon struggle with the issue of inflow and infiltration (I/I). Inflow and infiltration is defined as follows:

Infiltration: Flows that enter the collection system through underground paths. Infiltration can be caused by high groundwater levels, rain-induced groundwater, leaky water and storm drain systems, and other sources. Infiltration flows make their way into the collection system through cracks in pipe, open or offset pipe joints, broken piping sections, leaks in manholes, and other below grade openings in the system.

Inflow: Flows that enter the collection system through above ground paths. Inflow is often related to building downspouts being connected to sanitary sewer service laterals, interconnections with storm drain systems that have not been severed, water flowing over manholes and entering in through the openings in the lids, catch basins or area drains being connected to the sewer system, and other surface water sources.

When combined, I/I can result in tremendous increases in flow during the winter and particularly during storm events.

2.1 Basin by Basin Evaluation and Summary of Observations

Whenever possible, observations of the individual manholes were conducted after rainfall had occurred. Observations were not conducted during rainfall in an effort to identify potential infiltration from groundwater sources, rather than inflow from incorrect manhole covers, missing clean-out caps and other sources. A large portion of the Coos Bay wastewater system contained clear flows during our

observations. Normal wastewater flows are typically characterized by cloudy water, soap bubbles, paper or solids. Clear flows, however, could be the result of I/I. When observed, we took note of an unexpectedly large increase in flow between manholes that would indicate potential infiltration. These observations are included in the basin by basin observations listed below. Several manholes showed evidence of water seeping through the concrete or seeping past section joints. The leaks identified in the basin by basin observations are generally leaks that produce rivulets or sprays of water.

2.1.1 Basin A

Basin A is located in the northwestern section of Coos Bay and consists primarily of single family residential dwellings. Basin A contains portions of Virginia Avenue and Lakeshore Drive as well as some new home development on and near Seagate Avenue. In general there were several leaks into manholes observed within Basin A, these leaks also indicate high ground water within Basin A during this time. Most of the manholes observed contained flows that appeared to be reasonable given the high concentration of homes in this basin.

The following specific observations were made within Basin A on March 13 between the hours of 8:30 am and 11:00 am:

- Manhole (MH) A7 had a relatively large build up of debris with low fluid flows.
- MH A-20 contained normal domestic flows with no obvious leaks.
- MH A-21 contained normal domestic flows with no obvious leaks.
- MH A-30 contained moderate domestic flow and a small leak at the bottom MH joint.
- MH A-32 contained normal domestic flows with no obvious leaks.
- MH A-34 had a moderate sized leak from the pipe interface on the East side of MH.
- MH A-47 had a large leak from the bottom joint on the East side of MH.
- MH A-49 contained normal domestic flows with no obvious leaks.
- MH A-57 had a small leak from the pipe interface on the North side of MH.
- MH A-58 had a small amount of leakage from the bottom joint of MH.
- MH A-61 showed normal domestic flows, with heavier flows from the Southern inlet.

2.2.2 Basin B

Basin B is located in the northwestern section of Coos Bay and consists primarily of single family residential dwellings. Basin B is a relatively high density area and contains a portion of Lakeshore Drive. In Basin B we observed several instances of possible infiltration, some debris and some evidence of surcharging. Several of the manholes contained flow that appeared to be reasonable for the number of users on the line. Flows along the Margarett trunk line increased steadily between B-56 and B-43, the flow into each manhole from the side street laterals didn't seem to be large enough to account for all of the flow along Margarett. This could be an indication of I/I entering the Margarett trunk line. We also noted that some of the sewer manhole covers had several drainage holes and appeared to be storm-drain covers.

The following specific observations were made within Basin B on March 13 between the hours of 8:30 am and 11:00 am:

- MH B-2 contained normal domestic flows with no obvious leaks.
- MH B-7 contained moderate domestic flows and showed evidence of surcharging.
- MH B-14 contained excessive debris and some standing water but no obvious signs of leakage.
- MH B-22 contained normal domestic flows with no obvious leaks.

- MH B-24 contained normal flows from the South and high flows from the east, indicating potential infiltration between manholes B-24 and B-26 along Lakeshore Drive.
- MH B-26 contained normal domestic flows with no obvious leaks.
- MH B-42 contained normal domestic flows with no obvious leaks.
- MH B-43 had a moderate leak from the 3rd joint from the top and higher flow from the South than the other manholes on this line, indicating possible infiltration between manholes B-45 and B-43 along Augustine Street.
- MH B-46 had significant flows from the east, no evidence of current leakage.
- MH B-51 significant flows from the east, no evidence of current manhole leakage.
- MH B-56 significant clear flows from the east, considering the number of users upstream, this could indicate possible infiltration between MHs B-64 and B-56.

2.2.3 Basin C

Basin C is in the northwestern section of Coos Bay and consists primarily of single family residential dwellings and many of the roads in this basin are gravel. Basin C contains portions of Main Street, Camman Street and Wasson Street. Basin C manhole covers were almost entirely storm-drain type covers. Basin C also had several flat sections with slow observed flows, standing water and some debris.

The following specific observations were made within Basin C on March 13 between the hours of 8:30 am and 11:00 am:

- MH C-9 contained normal domestic flows with no obvious leaks.
- MH C-11 contained normal domestic flows with no obvious leaks.
- MH C-12 was very dry, contained some debris and had no evident flow at all.
- MH C-13 was backed up, contained excessive debris and standing water.
- MH C-14 was severely backed up, completely covering inlets and contained excessive debris.

2.2.4 Basin D

Basin D is in the western section of Coos Bay and consists of a mix of single family and multi-family residential dwellings as well as some commercial developments. Basin D contains portions of Empire Boulevard and Newmark Avenue. Basin D had several sewer manhole covers that appeared to be storm-drain type covers. There are some indications that there may be infiltration entering this basin particularly along the 10" trunk line between D-1 and D-12 and along the 8" line between D-29 and D-32. D-1 was dry and flow through the 10" trunk line, observed at D-2, D-4, D-6 and D-12, increased although inflow from the 8" laterals seemed to be relatively low. Also, D-32 received relatively low flow, but inflow from the direction of D-32 into D-29 was large and clear, indicating possible infiltration between D-29 and D-32.

The following specific observations were made within Basin D on March 14 between the hours of 1:00 pm and 3:30 pm:

- MH D-1 was relatively dry with no evident leaks or debris.
- MH D-2 contained heavy flow from the direction of D-1 indicating possible infiltration between D-1 and D-2. Manhole D-2 had no evident leaks or appreciable debris.
- MH D-4 showed increasing flow from the Southeast and no evident leaks or appreciable debris.
- MH D-6 showed increasing flow from the Southeast, had no appreciable debris, showed evidence of leakage at the joint between the manhole ring and top section and had a storm-drain cover.

- MH D-12 showed increasing flow from the Southeast, had a storm-drain type cover, and no appreciable leaks or debris.
- MH D-14 seemed to contain reasonable flows and showed no appreciable leaks or debris.
- MH D-23 contained normal flows, and no appreciable leaks or debris.
- MH D-24 contained reasonable flow from the southeast, and had no appreciable leaks or debris.
- MH D-26 contained reasonable flows and contained no appreciable leaks or debris.
- MH D-29 showed significant clear flows from D-32, indicating potential infiltration between MHs D-32 and D-29. There were minor domestic flows from the northeast and no appreciable leaks or debris.
- MH D-32 contained small flows from southeast and northeast, which further indicates potential infiltration between MHs D-29 and D-32. There was some debris, but no noticeable leakage.
- MH D-35 contained very small inflow and had no noticeable leakage, but did contain some debris and had a storm-drain style cover.

2.2.5 Basin E

Basin E is in the western section of Coos Bay and consists of a mix of single family and multi-family residential dwellings as well as commercial developments and RV parks. This basin also contains the Sunset Middle School. Basin E contains portions of Empire Boulevard and Newmark Avenue. Most of the MH covers in basin E were the storm-drain style covers. There was some evidence of surcharging in some of the manholes. There were steady flows through most of the manholes, but there were no clear indications whether this flow was due to either normal usage or infiltration.

The following specific observations were made within Basin E on March 14 between the hours of 1:00 pm and 3:30 pm:

- MH E-34 contained some debris, reasonable flows and no noticeable leaks.
- MH E-40 contained some debris, showed evidence of surcharging, a storm-drain style cover and no noticeable leakage.
- MH E-42 contained no appreciable leaks or debris.
- MH E-45 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-47 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-53 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-55 contained heavy debris including sand and gravel, and no appreciable leakage.
- MH E-58 contained some debris, reasonable flows and no noticeable leaks.
- MH E-63 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-74 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-77 contained no appreciable leaks or debris and a storm-drain style cover.
- MH E-78 had some weepage from the 1st joint from the top and no appreciable debris.

2.2.6 Basin F

Basin F is in the northwestern section of Coos Bay and primarily consists of single family and multi-family residential dwellings. This basin also includes the Madison Elementary School and an assisted living facility. Basin F contains portions of Madison Street and Arago Avenue. Basin F contained steady, relatively heavy flows but, with two exceptions, there were no compelling indications that the flow was possible infiltration. Manholes F-10 and F-12 received heavier flows from the East than adjacent manholes, indicating potential infiltration along the 8" lines flowing into F-10 and F-12.

The following specific observations were made within Basin F on March 17 between the hours of 12:30 and 1:30pm and March 22 between the hours of 9:30 and 11:00 am:

- MH F-2 contained no appreciable leaks or debris and a storm-drain style cover.
- MH F-3 contained no appreciable leaks or debris and a storm-drain style cover.
- MH F-6 contained no appreciable leaks or debris.
- MH F-7 had a leak at the first joint from the base, contained normal flows and no debris.
- MH F-9 contained no appreciable leaks or debris.
- MH F-10 contained clear flow from the East, heavier than observed in MHs F-9 and F-11, indicating possible infiltration between MHs F-42 and F-10. There were no leaks or debris.
- MH F-11 contained some debris in the flow channel, normal flows and no leaks.
- MH F-12 contained heavier than expected flows from the east, indicating possible infiltration between MHs F-44 and F-12. There were no leaks or debris.
- MH F-24 had a privately owned trailer parked on top of the cover and couldn't be checked.
- MH F-25 contained no appreciable leaks or debris.
- MH F-33 contained no appreciable leaks or debris.
- MH F-50 contained no appreciable leaks or debris.

2.2.7 Basin G

Basin G is in the northern section of Coos Bay and consists of single family and multi-family residential dwellings as well as several commercial developments. This basin also contains two large manufactured home parks. Basin G contains portions of Ocean Boulevard and Newmark Avenue. Many of the manhole covers in basin G were the storm-drain style covers. Some of the manholes observed did contain ground water leaks and in general the flows seemed reasonable for the area.

The following specific observations were made within Basin G on March 22 between the hours of 9:30 and 11:00am:

- MH G-16 contained no appreciable leaks or debris.
- MH G-18 contained some minor debris and no leaks.
- MH G-21 contained some cement debris from a past repair and no leaks.
- MH G-23 had an inlet on the east side of the base that was filled with sand and debris. There were no leaks.
- MH G-30 had a leak at the first joint up from the base and no debris.
- MH G-31 had a storm-drain style cover that was stuck tight, this MH was not checked.
- MH G-40 contained some debris and no leaks. The flows into MH G-40 were very small, so MHs G-43 and G-44 were not checked.
- MH G-56 contained no appreciable leaks, some minor debris and a storm-drain style cover.
- MH G-61 contained no appreciable leaks or debris and a storm-drain style cover.
- MH G-72 had a leak from the joint at the base of MH, had a storm-drain style cover and contained no debris.
- MH G-74 had a leak at the first joint up from base, had a storm-drain style cover and some debris.
- MH G-76 received higher than expected flow from the South, indicating possible infiltration between MHs G-76 and G-78. MH G-76 had a storm-drain style cover, no leaks or debris.

2.2.8 Basin H

Basin H is in the northern section of Coos Bay and consists of the SWOCC campus, Wal-Mart and other commercial developments. There are some single family and multi-family residential dwellings in this

basin as well. Basin H contains most of the Empire Lake area and portions of Newmark Avenue. Basin H covers a large area but has very few manholes. Several of the manholes observed in Basin H contained some ground water leakage and the flows observed seemed reasonable for the number and type of users on the inflow lines.

The following specific observations were made within Basin H on March 23 between the hours of 10:00 and 11:30 am:

- MH H-4 had a leak at the west side of the base joint, had a storm-drain style cover and no debris.
- MH H-11 contained no appreciable leakage, no debris and no flow.
- MH H-13 contained no appreciable leaks or debris and a storm-drain style cover.
- MH H-14 had a leak from the joint at the base and at the first joint up from base on the West side, had some debris in the West side flow channel and had a storm-drain style cover.

2.2.9 Basin I

Basin I is in the western section of Coos Bay and consists of primarily of commercial developments including K-Mart. There are some residential dwellings in this basin, including an RV park and a manufactured home park. Basin I contains portions of Radar Hill and Ocean Boulevard. Basin I covers a large area but contains relatively few manholes. The manholes in Basin I generally had some ground water seepage around the lowest joints and some ground water leakage around inlet pipes. Flows observed in Basin I in general seemed reasonable for the number of users on the inflow lines.

The following specific observations were made within Basin I on March 23 between the hours of 10:00 and 11:30 am:

- MH I-20 contained no appreciable leaks or debris.
- MH I-23 contained some leakage at the base joint and from around the inlet on the West side and there was standing water present in the manhole.
- MH I-37 contained some leakage around the first joint up from the base and some debris.
- MH I-41 contained some weepage from around the lower joints and no significant debris.
- MH I-43 contained some weepage from around the lower joints and no significant debris.
- MH I-50 contained no appreciable leaks or debris.

2.2.10 Basin J

Basin J is in the western section of Coos Bay and consists primarily of industrial and commercial customers. Basin J contains the U.S. Coast Guard maintenance station and a few homes. The manholes checked in this basin generally had some debris and some ground water leakage into the manholes. Inflow at observed manholes was relatively low and probably reasonable for this area and type of user.

The following specific observations were made within Basin J on March 28 between the hours of 9:30 am and 11:30 am:

- MH J-2 was not checked due to road closure and construction.
- MH J-4 cover was firmly stuck and therefore the manhole was not inspected.
- MH J-5 contained some leakage from the first joint up from the base and some debris.
- MH J-6 contained some debris and no apparent leakage.

2.2.11 Basin K

Basin K is in the Northern section of Coos Bay and consists primarily of single family residential dwellings and a few commercial customers. This basin also contains the water treatment plant for the Coos Bay – North Bend Water Board. Basin K contains a portion of Ocean Boulevard. All of the manhole lids were blocked due to high traffic on Ocean Boulevard, buried under dirt and gravel, or firmly stuck to the frames. Therefore no manholes were inspected in basin K.

The following specific observations were made within Basin K on March 28 between the hours of 9:30 am and 11:30 am:

- MH K-11 cover was firmly stuck and would not separate from ring.
- MH K-14 was apparently buried under dirt and gravel.

2.2.12 Basin L

Basin L is in the northern section of Coos bay and consists of some residential dwellings and commercial customers. Basin L contains a portion of Woodland Drive and Kinney Road. Due to heavy traffic on Woodland Drive and Kinney Road no manholes were checked in this Basin.

2.2.13 Basin M

Basin M is in the northeastern section of Coos Bay and contains the Bay Area Hospital, residential dwellings and commercial customers. Traffic is very heavy around the hospital and manholes in that area were not checked. The manholes in this area that were checked generally contained some debris and some ground water leakage into the manholes. Manholes M-8 and M-9 received heavy flow, but this flow could not be clearly identified as either normal or as infiltration.

The following specific observations were made within Basin M on March 28 between the hours of 9:30 am and 11:30 am:

- MH M-8 contained heavy flow from the South and the inside of the manhole was covered with water droplets, as if water were seeping through the concrete.
- MH M-9 contained heavy flow from the South and debris in the flow channel from M-11.
- MH M-11 contained deep standing water and debris in the flow channels, and a leak around the Southern inlet pipe.
- MH M-23 contained some cement debris and a leak from around the Southern inlet pipe.
- MH M-25 was apparently buried under dirt and gravel.
- MH M-30 contained debris in the flow channels and no apparent leakage.

2.2.14 Basin N

Basin N is in the northeastern section of Coos Bay and contains residential dwellings and commercial/industrial developments. Basin N contains a stretch of Hwy 101 and Coos Bay Boulevard. Many of the manholes in this basin were of the storm drain type and in general there were some leaks and some debris. There is some potential infiltration between N-50 and N-51 indicated by higher than expected clear flows into N-50 from the direction of N-51. There is also some potential infiltration between N-46 and N-47, as well as between N-46 and N-45 indicated by higher than expected clear flows through N-46 and into N-45.

The following specific observations were made within Basin N on April 11 between the hours of 1:30 pm and 3:30 pm:

- MH N-14 contained heavy flow from the North and no leaks or debris.
- MH N-21 was partially buried and overgrown.
- MH N-23 contained no appreciable leaks or debris and had a storm-drain style cover.
- MH N-24 contained some leakage around the base joint, no debris and had a storm-drain cover.
- MH N-30 contained no appreciable leaks or debris.
- MH N-31 contained no appreciable leaks or debris.
- MH N-45 contained increasing flow from N-46, some leakage from base joint and had a storm cover.
- MH N-46 contained heavier than expected flow from the North and had a storm cover.
- MH N-47 contained no flow, leaks or debris and had a storm cover.
- MH N-50 contained more than expected flow from the North, some debris and had a storm cover.
- MH N-56 contained standing water in the North and East flow channels, debris, leakage from around the base joint, leak from west side of base and had a storm cover.
- MH N-59 contained standing water in the flow channels, leakage from base joint, leak from east side of base and had a storm cover.

2.2.15 Basin O

Basin O is in the northeastern section of Coos Bay and consists primarily of residential dwellings with some commercial development as well. Basin O contains portions of Ocean Boulevard and Woodland Drive. Many of the manhole covers in this basin were of the storm drain type. In general there were some minor ground water leakage through manhole joints and some occasional debris. Observed flows in Basin O seem reasonable for the concentration of users in this area.

The following specific observations were made within Basin O on April 12 between the hours of 9:00 am and 11:00 am:

- MH O-2 contained some debris, no appreciable leakage and had a storm drain cover.
- MH O-3 contained some debris, no appreciable leakage and had a storm drain cover.
- MH O-8 had a severely broken top ring, some leakage from the first and second joints up from the base and had a storm drain cover.
- MH O-12 contained low flows, no leaks or debris.
- MH O-18 contained no leaks or debris and had a storm drain cover.
- MH O-20 contained some leakage at or near the first and second joints up from the base and had a storm drain cover.
- MH O-24 contained no leaks or debris.
- MH O-36 contained some debris and some leakage at the base joint.

2.2.16 Basin P

Basin P is in the central section of Coos Bay and consists primarily of residential dwellings. Basin P contains portions of 10th Street and 14th Street. Many of the manhole covers in this basin were of the storm drain type. There is some potential infiltration between manholes P-46 and P-47 indicated by a large increase in clear flow between P-47 and P-46.

The following specific observations were made within Basin P on April 18 between the hours of 10:00 and 12:00 pm:

- MH P-34 contained some typical debris in the base and debris in the flow channel from P-35. Flows were very low and no leakage was evident.
- MH P-37 contained no leaks or debris and had a storm cover.
- MH P-46 contained flow from the South, no leaks and no debris.
- MH P-47 contained no leaks or debris and had a storm cover.
- MH P-49 contained no leakage or debris and a storm cover.

2.2.17 Basin Q

Basin Q is in the central section of Coos Bay and consists primarily of residential dwellings, including the Westgate subdivision and an assisted living facility. Basin Q contains portions of Ocean Boulevard and Evergreen Drive. Flows in this basin during our observations were generally steady and probably reasonable for the concentration of users in this area.

The following specific observations were made within Basin Q on April 18 between the hours of 10:00 and 12:00 pm:

- MH Q-8 contained moderate flows and no apparent leaks or debris.
- MH Q-10 contained moderate flows and no apparent leaks or debris.
- MH Q-15 contained no apparent leaks or debris.
- MH Q-21 contained some leakage at the base joint and top ring and had a storm cover.

2.2.18 Basin R

Basin R is in the eastern section of Coos Bay and consists primarily of single family and multi-family residential dwellings. Basin R contains portions of Ocean Boulevard, Central Avenue and Mingus Park. Flows generally seemed reasonable in this basin. Many of the manholes around the Mingus Park and 12th Street Terrace area are very old and seem to be leaking around the base joints and there was evidence of ground water seepage through the sides of the manhole. Most of the manholes observed in Basin R received low velocity flow and showed evidence of surcharging. In general flows in Basin R seemed potentially reasonable for the concentration of users in the area, however standing water in several manholes could be an indication of groundwater infiltration.

The following specific observations were made within Basin R on April 19 between the hours of 2:00 and 4:00 pm:

- MH R-12 contained some seepage through the manhole walls, no debris and had a storm cover.
- MH R-22 contained no leaks or debris.
- MH R-25 contained some leakage around the base joint and some typical debris.
- MH R-27 contained some typical debris in the flow channels and leakage on the south side at the base joint.
- MH R-38 contained no leaks or debris.
- MH R-48 contained no leaks or debris and had a storm cover.
- MH R-66 contained no leaks or debris and had a storm cover.
- MH R-69 contained standing water, some debris, and evidence of surcharging and probable leakage around the base joint. There also appears to be considerable seepage through the walls of the manhole.
- MH R-70 contained standing water, evidence of surcharging, some gravel and rock debris and probable leakage around the base joint.

- MH R-84 contained apparent seepage through the manhole walls and around the base joint but no large leaks or debris.
- MH R-85 contained no leaks or debris and had a storm cover.
- MH R-87 contained no leaks or debris and had a storm cover.
- MH R-88 contained no leaks or debris and had a storm cover.

2.2.19 Basin S

Basin S is in the northeastern section of Coos Bay and consists primarily of residential dwellings and Milner Crest School. Basin S contains portions of 10th Street and Mingus Park. Traffic is very heavy on 10th Street, Date Drive and West Park; therefore manholes on these streets were not checked. Many of the manhole covers are the storm drain type. In general flows seemed reasonable for the area during our observations in Basin S.

The following specific observations were made within Basin S on April 18 between the hours of 10:00 and 12:00 pm:

- MH S-9 contained some flow from S-8 and no apparent leaks or debris.
- MH S-35 contained reasonable flow, no leaks or debris and a storm cover.
- MH S-46 contained low flows, no leaks or debris and a storm cover.
- MH S-53 contained some leakage from the base joint and 1st, 2nd and 3rd joints up from base, no debris and had a storm cover.
- MH S-61 contained no leakage or debris and had a storm cover.

2.2.20 Basin T

Basin T is in the northeastern section of Coos Bay and consists primarily of commercial and industrial developments and some single and multi-family residential dwellings as well. Basin T contains portions of Koos Bay Boulevard and Bayshore Drive. Traffic is very heavy on Koos Bay Boulevard and because of this only one manhole observed.

The following specific observations were made within Basin T on April 25 between the hours of 2:00 and 4:00 pm:

- MH T-9 contained reasonable flows from the direction of T-11, some minor seepage from around the base joint and no debris.

2.2.21 Basin U

Basin U is in the northeastern section of Coos Bay and consists primarily of single and multi-family residential dwellings. This basin also contains some commercial development including the Red Lion Hotel. Basin U contains portions of Bayshore Drive and Hemlock Avenue. In general, there were several storm drain type manhole covers and most of the manholes observed contained flows that seemed reasonable for the area and types of users.

The following specific observations were made within Basin U on April 25 between the hours of 2:00 and 4:00 pm:

- MH U-2 had a storm cover and contained heavy flows that created spray that wet down the inside of the manhole and made detecting leaks difficult.

- MH U-4 contained some minor leakage or seepage around the base joint, reasonable flows and no debris.
- MH U-19 contained no apparent leakage or debris and had a storm cover.
- MH U-25 contained no leakage or debris and had a storm cover.
- MH U-28 contained a small leak from the Southeast side of base joint, low flows, no debris and had a storm cover.

2.2.22 Basin V

Basin V is in the eastern section of Coos Bay and consists of much of downtown Coos Bay and a large area of single and multi-family residential dwellings as well as some additional commercial development. Basin V contains portions of Bayshore Drive and Market Avenue. Several of the manholes in Basin V used storm drain style covers and some of the manholes showed signs of seepage. There appeared to be some evidence of possible leakage out of the pipeline between manholes V-42 and V-41. V-42 is a very deep manhole, but did appear to have a small steady flow toward V-41, however V-41 was dry and contained no flow.

The following specific observations were made within Basin V on April 25 between the hours of 2:00 and 4:00 pm:

- MH V-34 contained no flows, leaks or debris during observation and had a storm cover.
- MH V-41 receives flow from V-42, however, during observations flow appeared to be exiting V-42 but not entering V-41, indicating possible leakage somewhere between V-42 and V-41.
- MH V-42 is a very deep manhole and while the inside of the manhole was wet it was difficult to determine if there was any leakage or seepage in the lower portion of the manhole. V-42 contained some flow and had a storm cover.
- MH V-57 contained steady, reasonable flow from V-60 and some typical sewer debris.
- MH V-116 contained very little flow and some typical sewer debris.
- MH V-123 contained steady flow from V-124, had standing water in the flow channels, some typical sewer debris, some evidence of surcharging and had a storm cover.
- MH V-132 contained some seepage around the base joint and some plastic and other debris in the West flow channel. Inflow to V-132 was low, indicating that the upstream system is probably in reasonably good condition.
- MH V-139 contained some leakage between the top section and first grade ring, low flow and had a storm cover.
- MH V-158 contained very little flow, some evidence of surcharging and some typical sewer debris in the flow channels.
- MH V-172 had a build up of debris in the Eastern flow channel, contained some typical sewer debris in the other flow channels, showed some evidence of surcharging and had a storm cover.

2.2.23 Basin W

Basin W is in the eastern section of Coos Bay and consists primarily of multi-family residential dwellings and apartment complexes. Basin W contains Blossom Gulch School and portions of 10th Street. Some of the manholes showed clear evidence of ground water leakage around section joints and at the inverts. There was also evidence of excessive corrosion of manhole ladder rungs and possibly of section re-bar, evidenced by rust-colored streaks and mineral build-up on the section walls. Flows during observation seemed reasonable given the high population of the area; however there is no clear indication that the source of the flow was domestic.

The following specific observations were made within Basin W on April 27 between the hours of 2:00 and 4:00 pm:

- MH W-5 contained leakage around the first three joints up from the base and leaks through the manhole wall on the Southwest and Southeast sides. There was also some evidence of surcharging and some typical sewer debris. This manhole is in poor condition and showed evidence of excessive corrosion of ladder rungs and internal re-bar.
- MH W-7 contained leakage at the first joint from the base and around all four inverts. There was also leakage at the ladder rungs and through the wall on the East side of manhole. This manhole contained some typical sewer debris, reasonable flows and had a storm cover. This manhole is in poor condition and showed evidence of excessive corrosion of the ladder rungs and internal re-bar.
- MH W-22 was blocked by a private vehicle and was not checked.
- MH W-25 contained standing water and some evidence of surcharging.

2.2.24 Basin X

Basin X is in the southeastern section of Coos Bay and consists of commercial, residential and multi-family residential properties. Basin X contains portions of Hwy 101, Ingersoll Avenue, a portion of downtown Coos Bay and Marshfield High School. Most of the manholes in Basin X contained steady flows that appeared reasonable for the type and number of users in the area. Several of the manholes observed were wet inside from the cover to the base, indicating possible ground water seepage through the concrete. Several manholes had storm covers.

The following specific observations were made within Basin X on May 3 between the hours of 2:00 and 4:00 pm:

- MH X-28 contained no flow, leaks or debris, but the inside of the manhole was wet indicating possible seepage through the concrete.
- MH X-32 contained no flow, leaks or debris, but the inside of the manhole was wet indicating possible seepage through the concrete.
- MH X-34A contained reasonable flows, some typical sewer debris and had a storm cover.
- MH X-35 contained reasonable flow, a leak from the base joint on the North side of the manhole and had a storm cover.
- MH X-52 contained reasonable steady flow from the West and had a storm cover.
- MH X-60 contained reasonable steady flow from the West, had some debris, some seepage through the base joint and had a storm cover.
- MH X-108 contained a broken invert from X-109 and had water flowing from under the invert. There was also some leakage around the base joint and some debris.

2.2.25 Basin Y

Basin Y is in the southeastern section of Coos Bay and consists primarily of commercial and industrial developments. Basin Y contains portions of Lockhart Avenue and South Broadway. All of the manholes checked contained significant ground water leakage through the joints and through the manhole walls. There was also standing water, in some cases covering the inverts completely. Flows observed in Basin Y were steady, but could be reasonable given the type and number of users in the area.

The following specific observations were made within Basin Y on May 3 between the hours of 2:00 and 4:00 pm:

- MH Y-4 contained heavy leakage from the North side of the manhole, had standing water in the base and had a storm cover.
- MH Y-6 contained large leaks from the North manhole wall, the base joint and the first and second joints up from the base. There was also standing water in the base and evidence of surcharging.
- MH Y-8 contained heavy leakage from the North and West sides of the manhole walls and leakage from the base joint. There was standing water in the base, the flow channels seemed heavily eroded and it contained foreign debris.
- MHs Y-11 and Y-14 were apparently both covered over with dirt and gravel.

2.2.26 Basin Z

Basin Z is in the southern part of Coos Bay and consists primarily of apartments and multi-family residential dwellings. This basin also contains some commercial and light industrial developments. Basin Z contains portions of Kruse Avenue and South 10th Street. Several of the manholes observed in Basin Z contained ground water leakage through the joints or through the manhole walls.

The following specific observations were made within Basin Z on May 3 between the hours of 2:00 and 4:00 pm:

- MH Z-2 contained significant leakage through the East wall, from underneath the Southern invert, through the base joint, and through the first and second joints up from the base. Manhole Z-2 contained steady flows that may be reasonable for the number and type of users in the area.
- MH Z-7 was buried and couldn't be located.
- MH Z-9 contained leakage through the base, through the base joint and through the first joint up from the base. There was also evidence of surcharging and Z-9 contained steady flows that are probably reasonable for the area.
- MH Z-22 contained standing water, evidence of surcharging and some typical sewer debris. All of the flows into Z-22 were relatively low during our observation.

2.2.27 Basin AA

Basin AA is in the southern part of Coos Bay and consists primarily of single family residential dwellings. Basin AA is in the Englewood area and contains portions of Southwest Boulevard and Minnesota Avenue. Many of the manholes in Basin AA contained standing water and some debris. In general, flows were very small or nonexistent.

The following specific observations were made within Basin AA on May 9 between the hours of 3:00 and 5:00 pm:

- MH AA-17 contained standing water in the flow channels and some debris.
- MH AA-22 had a minor leak on the east side of the base joint.
- MH AA-24 contained little flow, standing water in the flow channels, and some typical sewer debris.

2.2.28 Basin BB

Basin BB is in the southern part of Coos Bay and consists primarily of single family residential dwellings. Basin BB is in the Englewood area and contains portions of Southwest Boulevard and California Avenue. Most of the manholes observed in Basin BB contained reasonable domestic flows.

The following specific observations were made within Basin BB on May 9 between the hours of 3:00 and 5:00 pm:

- MH BB-3 had some leakage at the South side of the base joint, some leakage from beneath the manhole frame riser rings and reasonable domestic flows.
- MH BB-9 contained reasonable domestic flow.
- MH BB-16 contained reasonable domestic flow from the West.
- MH BB-25 contained reasonable domestic flow from the West and some typical sewer debris build up in the flow channel.
- MH BB-40 contained no flow and no leakage.

2.2.29 Basin CC

Basin CC is in the southern part of Coos Bay and consists primarily of single family residential dwellings and some farmland along Coalbank Slough. Basin CC in the Englewood area and contains portions of Southwest Boulevard and Pennsylvania Street. Most of the manholes in Basin CC were on private property or on busy Southwest Boulevard, these manholes were not observed.

The following specific observations were made within Basin CC on May 9 between the hours of 3:00 and 5:00 pm:

- MH CC-21 contained very low domestic flow with no leakage or debris.

2.2.30 Basin DD

Basin DD is in the southern part of Coos Bay and consists of residential dwellings on Old Wireless Road. There is only one manhole in this basin and it was not observed due to its location.

2.2.31 Basin EE

Basin EE is in the western section of Eastside and consists primarily of residential dwellings. There are a few commercial and light industrial developments in this basin, including the Eastside boat ramp. Basin EE contains portions of First Avenue and Fink Street. Most of the manholes in Basin EE contained low flows and some typical sewer debris.

The following specific observations were made within Basin EE on May 11 between the hours of 3:00 and 5:00 pm:

- MH EE-2 contained flows that appeared to be reasonable for the area, minor typical sewer debris and no apparent leakage.
- MH EE-3 contained very low flow from the direction of EE-5 and no leakage or debris.
- MH EE-12 contained apparently reasonable flow from EE-15, no leaks or debris and had a manhole cover.
- MH EE-15 contained very low flows, no leaks or debris.
- MH EE-22 contained low flows, no leakage and no debris.

2.2.32 Basin FF

Basin FF is in the northern section of Eastside and consists of residential dwellings and some commercial property. This basin also includes the old Eastside treatment site. Basin FF contains part of the

Millicoma Intermediate School and a portion of Fourth Street. Several of the manholes in this basin are on private property and difficult to find.

The following specific observations were made within Basin FF on May 9 between the hours of 3:00 and 5:00 pm:

- MH FF-10 was on private property and couldn't be located.
- MH FF-13 was on private property and couldn't be located.
- MH FF-14 received flows from the Eastside Burger restaurant and contained heavy grease buildup. There was also some leakage around the base.
- MH FF-18 was on private property and couldn't be located.
- MH FF-24 received minor flow from FF-25 and contained no leakage or debris.

2.2.33 Basin GG

Basin GG is in the southern section of Eastside and consists primarily of single family residential dwellings and the Millicoma Intermediate School. Basin GG contains portions of Sixth Avenue and E Street. Some of the manholes in this basin contained some minor leakage and debris. There was some evidence of surcharging in GG-44.

The following specific observations were made within Basin GG on May 10 between the hours of 3:00 and 5:00 pm:

- MH GG-37 contained standing water in the flow channel from GG-38 and reasonable flows from GG-40.
- MH GG-40 contained expected flows from GG-44 and minor flow from GG-41. This manhole had some leakage from the top ring and some minor typical sewer debris.
- MH GG-44 contained evidence of surcharging and some foreign debris. GG-44 received steady flow from GG-47 and minor reasonable flow from GG-45.
- MH GG-47 received no flow from GG-48 and reasonable flow from GG-54, there were no noticeable leaks or debris.
- MH GG-71 contained heavier than expected flow from GG-74 and had no noticeable leakage or debris buildup.
- MH GG-74 received reasonable flows, based on the observed flows in GG-74 it appears that there may be some I/I entering the pipeline between GG-71 and GG-74. GG-74 also contained some minor leakage at the first joint up from the base.
- MH GG-79 received reasonable flows and had some leakage at the base joint and first joint up from the base.

2.2.34 Basin HH

Basin HH is in the eastern section of Eastside and consists primarily of single family residential dwellings and also contains the SOMAR industrial complex. Basin HH contains portions of the Coos River Highway and Sixteenth Avenue. Several of the manhole covers in this basin had been partially paved over and couldn't be lifted.

The following specific observations were made within Basin HH on May 10 between the hours of 3:00 and 5:00 pm:

- MH HH-15 was apparently buried or overgrown and couldn't be found.
- MH HH-17 received small flow from HH-18 and contained some typical sewer debris.

- MH HH-37 was paved over and couldn't be lifted.
- MH HH-43 received reasonable flow from HH-47 and had some minor leakage at the first joint up from the base.
- MH HH-47 received reasonable flows and contained evidence of surcharging.
- MH HH-54 was paved over and couldn't be lifted.

3.0 Alternatives

3.1 Need for Additional I/I Investigations

As shown in the flow data presented in Volume A of the Coos Bay Wastewater Collection System Master Plan, Section 5.1 and 5.2, Coos Bay experiences a flow increase between the average summer day and a peak hour storm event of between 8 and 12 times the dry weather flow. This “peaking factor” of between 8 and 12 times the dry flow is a direct result of I/I entering the Coos Bay collection system and is typical of many communities on the Oregon coast. Our observations of individual manholes in each basin within the Coos Bay collection system provide additional evidence that water is infiltrating the collection system. During a storm event there would be significantly more I/I entering the system.

These observations are helpful in identifying which basins, and in some cases which parts of a basin, need the most attention. Further investigation will be needed to identify specific sources of inflow and specific sections of pipes and individual manholes that are significant contributors to water infiltration.

The City may use in-house forces to undertake these investigations or the City may choose to utilize consultants and contractors to complete the necessary tasks. The budget for these items should be included in the maintenance budget as discussed in Section 7.4 of the Coos Bay Wastewater Collections Systems Master Plan.

According to DEQ staff, the City will be expected to make a regular and deliberate effort to reduce I/I flows in the system. As recommended in the Coos Bay Wastewater Collections Systems Master Plan, the City should establish an organized program to locate I/I sources and make the necessary repairs to eliminate those sources.

3.2 I/I Investigation Alternatives

There are three basic alternatives for I/I investigations, in most cases a combination of all three methods will be used to identify I/I sources and help determine the most effective means of reducing I/I in the collection system. A summary of investigation options is provided below.

3.2.1 Smoke Testing

Smoke testing is a relatively inexpensive and expedient method of detecting I/I sources and especially inflow sources. Smoke testing involves the release of nontoxic smoke into a partitioned section of a collection system, causing visible smoke plumes to rise from openings in the system. In a perfect system, smoke would only rise from each building's sewer vents. In practice, however, smoke will rise from a variety of locations. Each of these locations would indicate a potential point of inflow entry. This test would identify potential sources of inflow such as: improper manhole lids, combined storm and sewer sections, yard and area drains, and downspouts improperly connected to the wastewater collection system, abandoned building sewers, missing or broken clean-out caps and faulty service connections.

Smoke testing requires a crew of around 4 people, smoke equipment and materials for documenting the results (cameras, report forms, etc.). It is estimated that it would take approximately 2 weeks to properly

smoke test the City of Coos Bay's wastewater system. It would take an additional two weeks to reduce the field notes and present the results. If a consultant is hired to complete this work, the City should budget between \$30,000 and \$40,000. Smoke testing should be conducted during the summer months.

3.2.2 Comprehensive Flow Mapping

Flow mapping studies are performed to determine the quantity and sources of extraneous water that enters a sewer collection system. This water can come from various infiltration sources, including: manhole joint leakage, cracks in collection system piping, cracks in lateral piping, pipe joint failure, improper service taps and root intrusions. The best way to differentiate between normal sanitary flows and infiltration is to conduct flow mapping between the hours of midnight and 5:00 am. During those hours normal usage of the sanitary system will be at their lowest, therefore the vast majority of the flows measured should be from infiltrating water. Systematic flow mapping can identify specific sections of problematic wastewater pipe by measuring relative increases in flow at each manhole. In this way problem areas can be identified and prioritized based on measured flows.

Comprehensive flow mapping of the City's wastewater system will require a major effort from a consultant. Flow mapping should be conducted during the wettest part of the year, but not during an active storm event. The City should budget between \$30,000 and \$40,000 to complete comprehensive flow mapping of their wastewater collection system.

3.2.3 Television Inspection

Television inspection consists of running a camera through the sewer mains and using this camera to make a visual inspection of the condition of pipes and service taps. The camera footage is recorded and can be used to determine the condition of the pipe and the best method of repair. Typically this would be done after flow mapping had identified areas of potential infiltration. Televising is especially helpful in identifying the specific problems in a pipe line, such as: major line failure, joint failure, major structural breaks, material degradation, and other localized failures.

As the City has the ability to obtain televising services from OMI, additional budgeting will not be required, with the exception of consultant review of the tapes, if needed.

3.3 I/I Rehabilitation Alternatives

There are several options for rehabilitating wastewater collection systems. In some cases the most effective rehabilitation method may be complete pipe replacement. However, there are many circumstances when "trenchless" rehabilitation is appropriate, allowing the rehabilitation of piping sections without replacing sidewalks, streets and landscaping. A summary of different repair and rehabilitation techniques is provided below.

3.3.1 Dig and Replace

Pipeline replacement by conventional excavation and backfill means is normally required when the existing pipeline is deteriorated so badly that other methods of rehabilitation are not feasible. Complete replacement, however, provides the opportunity to correct any misalignments, increase the hydraulic capacity of the line, repair service connections, or eliminate stormwater entry points such as catch basins. Replacing pipelines can also remove any "incidental" I/I, such as minor leaks that would not individually be cost effective to repair. Pipeline replaced in this way should be expected to last fifty years or longer.

Replacing problematic sections of sewer main will significantly reduce I/I, however, it should be noted that a large portion of I/I can be typically be attributed to service laterals. In light of this, it is recommended that when feasible, complete service replacement to the property line, and beyond, should be included in any replacement project. When possible, the City should work with private property owners to repair or replace service laterals from their property line to their building. Smoke testing will many times reveal “leaky” service laterals, and when possible these laterals should be replaced.

3.3.2 Cured in Place Pipe (Inversion Lining)

Cured in place pipe (CIPP) is best described as “manufacturing a new pipe within an existing pipe”. A CIPP installation uses a plastic lined felt bag that has been impregnated with resins. The impregnated bag is lifted over an existing manhole and inverted, allowing the plastic exterior to be turned inward. The inner space is then filled with water as the inverted bag is positioned in the existing pipe. The weight of the water drives the bag’s inversion until the entire section of liner has been turned inside out and the end has been retrieved at the downstream manhole. Once the liner is in place, it is filled with water that forces the resin material against the walls of the existing sewer pipe. The water is then heated which causes the resin in the bag to cure and harden.

The use of CIPP lining is appropriate for pipelines requiring minor structural repair, sealing holes, leaking joints, leaking misalignments, and for correcting corrosion problems. Because this method of rehabilitation does not require excavations, it can be used under highways, railroads and buildings. Service lateral connections are typically made with special cutters and sealers from inside the newly lined pipe. The entire process typically requires less than 24 hours to complete. In larger sewer lines, bypass pumping would be required to convey flows around the work area. Several CIPP manufacturers claim that, when done properly, an inversion-lined pipe would have a service life of 50 years.

3.3.3 Chemical Grouting and Coatings

Chemical grouting is commonly used to seal leaking joints in structurally sound pipe, laterals, and manholes collecting infiltration. Chemical grouts used for rehabilitation of sewers include acrylamide, acrylate, or urethane gels. Typical applications consist of two separate chemicals that are pumped through separate hoses to the joint or manhole being sealed. Once the two chemicals are mixed together they form a gel or foam that expands out through the defect and into the surrounding earth. Typical applications include one tank to mix and dispense the grout and another tank to mix and dispense a catalyst. Once mixed, the catalyst initiates a chemical reaction changing both liquids into a gel. Depending on the amount of catalyst used, the time required to form the grout can be adjusted to a few seconds or several minutes.

The equipment used for chemical grouting includes a joint or lateral packer and television (TV) camera. The entire assembly is pulled inside the sewer pipe with cables and winches. Chemical feed lines are extended from the supply tanks to the packer unit. Chemical injection is performed internally, using robotic equipment without requiring man entry or excavations unless unique problems develop. Equipment used for manhole grouting includes a rotary percussion drill, chemical supply lines and a chemical application gun. The typical approach to sealing a manhole includes drilling through the manhole walls around the perimeter at varying elevations, near the base, mid section, and crown. Grout is injected into the holes where both chemicals are combined to form a gel. Injection is performed until the grout appears at a neighboring hole before moving to the next hole. This process continues until all the application points have been plugged and the infiltration has stopped. Plugging of active infiltration, particularly around pipe penetrations, can require jute packing and the use of water activated foaming grouts.

Since manholes are a major component of the collection system, it is often desirable to enhance the grout rehabilitation method by applying an interior coating. This coating increases the effectiveness of a grout repair by providing an interior seal that will last beyond the expected grout life. Successful manhole coatings include cementitious linings, polyethylene linings, epoxy coatings, and cured-in-place fiberglass lining systems.

Chemical grouting does not improve the structural strength of a pipeline; therefore this method of rehabilitation should not be used on pipes that are badly broken or deteriorated. If the groundwater table drops below the level of the pipe, the chemical grout may become dehydrated and its useful life shortened. Also, many chemical grouts do not have shear strength and will tear or fracture if a load is applied to the surrounding earth. When used appropriately, rehabilitation by chemical grouting should have a service life of about ten years.

3.3.4 Internal Spot Repairs

There are two effective methods of performing internal spot repair without requiring excavations. The two methods are Link-Pipe and ambient cured soft liners.

Link-Pipe is a stainless steel grouting sleeve that is used to accomplish small spot repairs within a sewer line; these sleeves come in a variety of sizes, from 12" to 36" long and from 4" to 36" in diameter. Link-Pipe can be used to restore partially collapsed pipes, replace collapsed pipes, close holes created by material loss in pipe walls, and seal infiltrating cracked pipes and pipe joints. This method of rehabilitation requires no trenching and can be performed without bypassing water.

A Link-Pipe installation involves the placement of a stainless steel grouting sleeve, surrounded by a grout-absorbing gasket, inside the damaged portion of a sewer line. This sleeve is moved into place using a wheel-driven, flow-through plug, and a video camera to position the sleeve. Once in place, compressed air is used to inflate the plug, which in turn compresses the gasket against the walls of the sewer line. Once the Link-Pipe's internal locks have engaged, the repair is complete.

The second method of performing a spot repair is to install an ambient cure soft-liner, which is similar to CIPP but does not require inversion or an external heat source. Spot repair liners are especially applicable when a section of pipe requires a repair just a few feet in length. Another advantage of an ambient cure liner is that it can be used to repair laterals with or without having to excavate at the mainline connection. The ambient cure liner has a feature that allows it to be inserted and used to seal the lateral connection to the main line.

3.4 Cost Estimates For Rehabilitation Alternatives

The following tables are provided for information only, all costs are strictly estimates based on experience gained from previous projects. Actual costs may vary, depending on specific site conditions and material cost fluctuations.

| Rehabilitation Cost Estimates - Dig and Replace | | | | |
|---|--|-------|------------|--|
| Item No. | Description | Units | Unit Cost | |
| 1 | 8" PVC Sewer Piping | lf | \$70.00 | |
| 2 | 10" PVC Sewer Piping | lf | \$80.00 | |
| 3 | 12" PVC Sewer Piping | lf | \$120.00 | |
| 4 | 15" PVC Sewer Piping | lf | \$150.00 | |
| 5 | 18" PVC Sewer Piping | lf | \$175.00 | |
| 6 | Replacement of Laterals | lf | \$50.00 | |
| 7 | AC Pavement Repair and Trench Patching | lf | \$25.00 | |
| 8 | New Manhole | ea | \$5,500.00 | |
| 9 | Manhole Rehabilitation | ea | \$1,500.00 | |

| Rehabilitation Cost Estimates - Trenchless Repair and Spot Repair | | | | |
|---|-----------------------------|-------|-----------|--|
| Item No. | Description | Units | Unit Cost | |
| 1 | 8" Sewer Pipe Lining | lf | \$50.00 | |
| 2 | 10" Sewer Pipe Lining | lf | \$65.00 | |
| 3 | 12" Sewer Pipe Lining | lf | \$85.00 | |
| 4 | 15" Sewer Pipe Lining | lf | \$90.00 | |
| 5 | 18" Sewer Pipe Lining | lf | \$105.00 | |
| 6 | Lateral and Line Grout Pack | ea | \$250.00 | |
| 7 | Manhole Grouting | ea | \$300.00 | |
| 8 | Manhole Rehab./Coating | lf | \$90.00 | |

4.0 Recommendations

As a first step towards reduction of I/I it is recommended to implement a regular program of inspection, testing and repair. Inspection should be done as part of the maintenance program as recommended in Section 7.4 of the Coos Bay Wastewater Collection System Master Plan. Testing would be a combination of smoke testing, flow mapping, and TV inspection. Following testing, plans for specific repairs can be developed. It would be prudent for the City to establish an annual budget for testing, repair and upgrade of its existing wastewater collection system.

During regular maintenance and repair, the City should constantly be looking for leaking manholes, broken pipe sections, inflow sources (such as downspouts, broken or missing manhole lids, etc.) and other sources of I/I that are cost effective to remove and rehabilitate.

If during regular cleaning and televising the City finds sections of pipe to be in poor condition and shows visible cracks, voids or active infiltration, then the City may schedule that section for a rehabilitation project, using one of the methods discussed earlier. As several manholes were observed to be actively leaking, the City should review the data provided in this report and schedule inspection of identified manholes. Based on those inspections, projects can be and scheduled to seal and rehabilitate those manholes.

In addition to inspection, the City should develop a program to systematically perform smoke testing and flow mapping of every sanitary basin. Smoke testing should be done first, starting with basins containing large numbers of older homes, RV parks or manufactured home parks. After these high priority areas are done, an effort should be made to conduct smoke testing in all remaining sanitary basins. The best time

to conduct smoke testing is in the summer when the soil is relatively dry, allowing smoke to more readily escape private sewer laterals. These smoke testing efforts will identify many sources of inflow. In many cases these sources of inflow will be on private property and would be corrected at the expense of the property owners.

Flow mapping of individual basins will aid the City by identifying which sections of piping and which basins contain more flow than is reasonable. When a section of piping is identified as a source of infiltration then those sections can be scheduled for televising to determine the nature of the problem and whether rehabilitation work is appropriate. Those sections where rehabilitation is determined to be appropriate, and cost effective, should be scheduled for rehabilitation using one of the methods discussed in section 3.3 of this report.

Flow mapping should be conducted in every basin, but several basins have been identified as priorities based on the observations conducted during this study. The order of priority for each of these basins is based on a combination of the severity of potential inflow observed during the study, the condition of manholes observed, the number of manholes in the basin and the amount of pipe in the basin. Basins that showed evidence of infiltration, have a large number of manholes and a large amount of piping were given first priority, since those basins would be likely to contribute the most to the overall I/I problem. Based on those criteria, the following basins are ordered in descending priority:

Priority 1: Basin R with special attention given to the pipeline and manholes along 12th Street Terrace, Commercial Avenue, and North 12th Street.

Priority 2: Basin A with special attention given to the pipeline and manholes along west Howard Avenue, Fenwick Street and Virginia Avenue.

Priority 3: Basin W with special attention given to the pipeline and manholes along Anderson Avenue and South 8th Street.

Priority 4: Basin Y with special attention given to the pipeline and manholes along Lockhart Avenue from the western edge of the basin all the way to the eastern end at Y-7.

Priority 5: Basin B with special attention given to the pipeline and manholes along Lakeshore Drive, Margareta Street and Augustine Street.

Priority 6: Basin D with special attention given to the pipeline and manholes along Harris Avenue and between manholes D-23 and D-35.

Priority 7: Basin V with special attention given to the pipeline and manholes between manholes V-45 and V-28, along Donnelly Avenue and along South 6th Street.

Priority 8: Basin G with special attention given to the pipeline and manholes along Norman Avenue, Schoneman Street and along Wallace Street between G-29 and G31.

Priority 9: Basin N with special attention given to the pipeline and manholes between N-45 and N-51, between N-45 and N-47, and along 6th Street.

Priority 10: Basin Z with special attention given to the pipeline and manholes between Z-1 and Z-9, and along West Lockhart Avenue.

Priority 11: Basin GG with special attention given to the pipeline and manholes along E Street between GG-81 and GG-69, and along F street.

Priority 12: Basin F with special attention given to the pipeline and manholes between F-10 and F-42 and between F-12 and F-44.

Priority 13: Basin P with special attention given to the pipeline and manholes between P-50 and P-30 along 14th Street and Koos Bay Boulevard.

When flow mapping is performed, an effort should be made to map the entire basin, but the sections specially identified above should be inspected and mapped thoroughly. After the above 13 basins are mapped, an effort should be undertaken to flow map all of the remaining basins.

In addition to the measures described above, the City should consider purchasing and installing manhole lid liners to reduce flow into the system through the lids. As many of the lids in the wastewater system were observed to be storm drain lids, it is likely that, collectively, a significant amount of inflow enters the system through these lids. Lid liners can be purchased for approximately \$30 a piece.