Town of Scotia
Community Service District
Detailed Engineering Analysis
Revision 3

Development of the Scotia Community Services District LAFCo Application

(Appendix A to the Municipal Service Review)

Prepared for:

Town of Scotia, LLC

Consulting Engineers & Geologists, Inc.

812 W. Wabash Ave.
Eureka, CA 95501-2138
707-441-8855

May 2009
005161.903

Reference: 005161.903

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May 2009

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Abbreviations and Acronyms

≤	less than or equal to
CF	Cubic Feet
cfs	cubic feet per second
cm/yr	centimeters per year
CY	Cubic Yard
d	day
EA	Each
ft/day	feet per day
ft/s	feet per second
gal	gallon
gpcd	gallons per capita per day
gpd	gallons per day
gpd/EDU	gallons per day per Equivalent Dwelling Unit
gpd/SF	gallons per day per Square Foot
gpm	gallons per minute
gpm/SF	gallons per minute per Square Foot
gVSS	grams of Volatile Suspended Solids
gBOD	grams of Biochemical Oxygen Demand
hp	horsepower
in/day	inches per day
in/mo	inches per month
kg	kilogram
kg/ha	kilogram per hectare
$kg/m^2/yr$	kilograms per square meter year
kV	kilovolts
kwhr	kilowatt hour
kwhr/day	kilowatt-hours per day
lbs	pounds
lbs/day	pounds per day
LF	Linear Foot
LS	Lump Sum
m/yr	meters per year
m^2	square meter
MG	Million Gallons
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGD	Million Gallons per Day
MPN	Most Probable Number
MPN/100 mL	Most Probable Number per 100 milliliters
n	Manning's Coefficient
NTU	Nephelometric Turbidity Units
ppcd	pound per capita per day
ppd	pounds per day
PPH	Persons Per Household
psi	pounds per square inch
Q	flow
SF	Square Feet
S_0	BOD in influent
yr	year

AAF	Average Annual Flow
AASHTO	American Association of State Highway and Transportation Officials
ABF	Activated Biofilter
ACP	Asbestos Cement Pipe
ADT	Average Daily Traffic
ADWF	Average Annual Dry Weather Flow
AS	Activated Sludge
AWWF	Average Annual Wet Weather Flow
BF/AS	Biofilter/Activated Sludge
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
$CaCO_3$	Calcium Carbonate
Cal-EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CCB	Chlorine Contact Basin
CCR	California Code of Regulations
CCTV	Closed Circuit Television
CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CFR	U.S. Code of Federal Regulations
CIP	Cast Iron Pipe
CMP	Corrugated Metal Pipe

Abbreviations and Acronyms, Continued

CPP	Corrugated Plastic Pipe
CSD	Community Services District
CT	Chlorine Concentration over Time
CWA	Clean Water Act
DFG	Department of Fish & Game
DHS	California Department of Health Services
DI	Drainage Inlet
Dia.	Diameter
Dist.	Distribution
DT	Detention Time
DWR	Division of Water Rights
EDU	Equivalent Dwelling Unit
EPA	U.S. Environmental Protection Agency
EQ	Excellent Quality biosolids, as defined in 40 CFR Part 503
FHWA	Federal Highway Administration
HA_c	Acetic Acid
HDPE	High Density Polyethylene
HRC	Humboldt Redwood Company
ICPRB	Interstate Commission on the Potomac River Basin
I/I	Infiltration and Inflow
ITE	Institute of Transportation Engineer
K^+	Potassium cation
K_2O	Potash
LACO	LACO Associates
LAFCo	Humboldt County Local Agency Formation Commission
LOS	Level Of Service
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MEP	Maximum Extent Practicable
MH	Manhole
MMDWF	Maximum Month Dry Weather Flow
MMWWF	Maximum Month Wet Weather Flow
MOU	Memorandum Of Understanding
MRP	Monitoring and Reporting Program
MS4	Municipal Separate Storm Sewer Systems
MSR	Municipal Service Review
N_2	Nitrogen
NA	Not Applicable
ND	No Data
NFPA	National Fire Protection Association
NH_3	Ammonia
NH_4	Ammonium
NO_2	Nitrous Oxide
NO_3	Nitrate
	NOI Notice Of Intent
NPDES	National Pollutant Discharge Elimination System
NR	No Reference
O&M	Operations and Maintenance
P_2O_2	Phosphorous
PALCO	The Pacific Lumber Company
PAN	Plant-Available Nitrogen
PC	Pollutant Concentration biosolids, as defined in 40 CFR Part 503
PDAF	Peak Day Average Flow
PEIR	Program Environmental Impact Report
PFRP	Processes to Further Reduce Pathogens
PIF	Peak Instantaneous Flow
PPT	Precipitation
PSRP	Processes to Significantly Reduce Pathogens
PVC	Polyvinyl Chloride
PW	Peak Weekly Flow
RAS	Return Activated Sludge
RCP	Reinforced Concrete Pipe
RP	cumulative Pollutant loading Rate
RWQCB	California Regional Water Quality Control Board, North Coast Region
SCADA	Supervisory Control and Data Acquisition
SD #	Storm Drain number
SDR	Standard Dimension Ratio
SDWA	Safe Drinking Water Act
SFDH	Single Family Detached Homes

Abbreviations and Acronyms, Continued

SHN	SHN Consulting Engineers & Geologists, Inc.
SiO_2	Silica
SOR	Surface Overflow Rate
SRT	Sludge Retention Time
SWMP	Storm Water Management Program
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule
TF/SC	Trickling Filter/Solids Contact
TI	Traffic Index
TOS	Town of Scotia, LLC
TRB	Transportation Research Board
TS	Total Solids
TSS	Total Suspended Solids
U	Unknown
USA	Underground Service Alert
USGS	United States Geological Survey
VCP	Vitrified Clay Pipe
VFD	Variable Frequency Drive
VSS	Volatile Suspended Solids
W&K	Winzler & Kelly Consulting Engineers
WAS	Waste Activated Sludge
WRCC	Western Regional Climate Center
WTF	Water Treatment Facility
WWTF	Wastewater Treatment Facility

Foreword

The Humboldt County Local Agency Formation Commission (LAFCo) approved the use of the Municipal Service Review (MSR) process to support the application for district formation for all local agencies within Humboldt County. In order for the LAFCo to approve the formation of a new agency, information must first be collected which documents the service capabilities of that agency. The MSR is used to present this information and document service capabilities.

This detailed engineering analysis was prepared to support the MSR process and constitute Appendix A of the MSR report. For a description of the general context, goals, and objectives of the Community Service District formation project, please refer to the main MSR report of which this Detailed Engineering Analysis is a part.

1.0 Wastewater Collection

1.1 Introduction

This chapter summarizes the wastewater collection system for the town of Scotia, California as currently owned and operated by Town of Scotia, LLC (TOS) and provides an infrastructure assessment for the proposed formation of a Scotia Community Service District (CSD). The sections in this chapter describe the existing sanitary sewer pipeline system and services in the town of Scotia, the projected demand on and capacity of the sewer system, the regulatory and design criteria under which improvements will be made, and recommended improvements. The terms "sanitary sewer" and "wastewater collection" are used interchangeably in this chapter.

1.2 Description of Existing System and Services

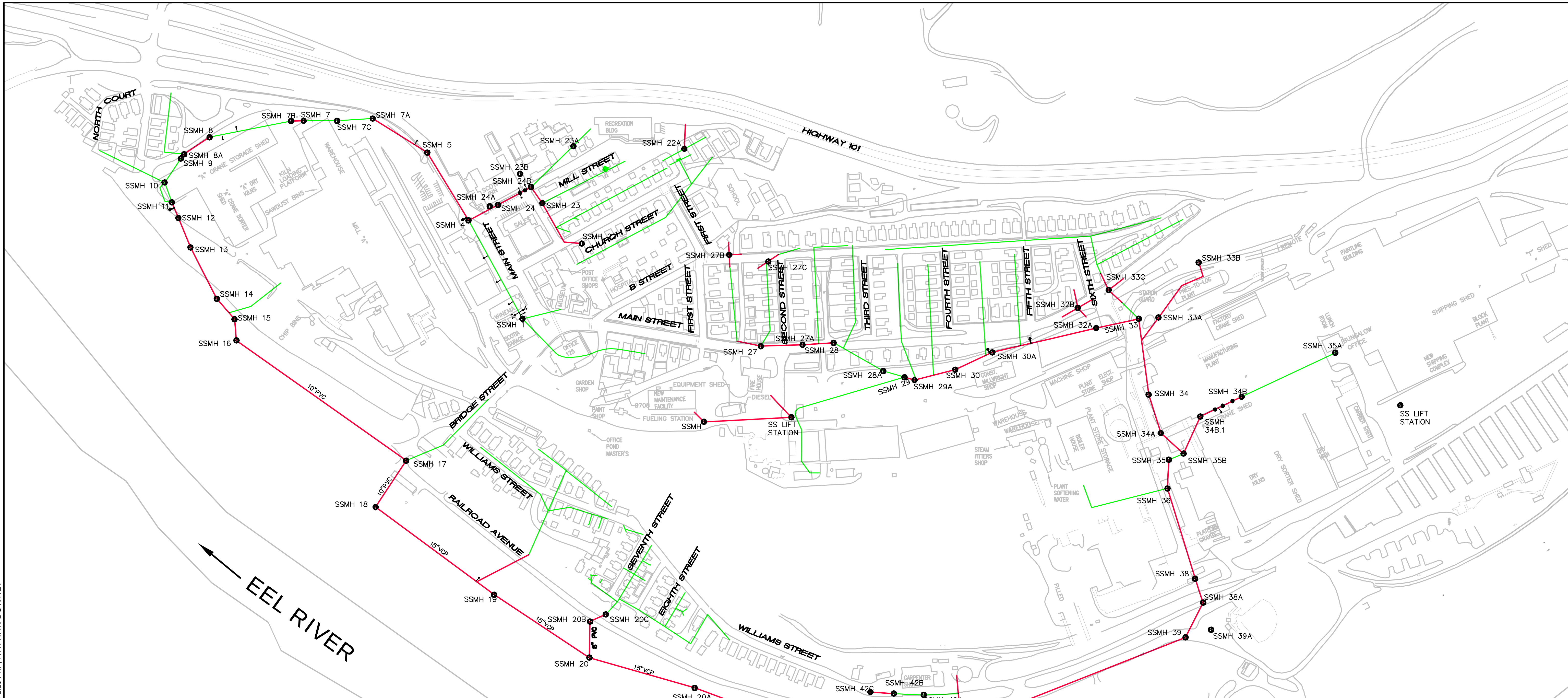
1.2.1 Background

Presently, the Scotia sanitary sewer system is comprised of two separate mainlines in the north and south areas of the town. Figure 1-1 presents the existing wastewater collection system layout as provided by TOS and developed by SHN Consulting Engineers & Geologists, Inc. (SHN). The northern system (Mill A line) collects wastewater from the Scotia Shopping Center along Main Street, Mill A, the residential area bound by First Street to the south and Main Street to the west, the section in the northeast corner of Scotia known as North Court, and part of the residential area on and around Williams Street. The southern system (Mill B line) serves residences south of First Street, the former Mill B area and new HRC facilities south of Mill B (mill, planer, kilns, factory), the Fisheries Exhibit building, the cogeneration plant, and part of the residential area on and around Williams Street.

The existing system consists of approximately 5 miles of gravity sewer mains and two lift stations. The lift stations are located in the existing industrial areas. One of the lift stations is located at the cogeneration plant facility and the other is located in the active HRC lumber mill complex. The lift station at the cogeneration plant collects wastewater from a truck washing facility, the cogeneration plant restrooms, and from an oil/water separator located in the cogeneration plant. The lift station at the HRC lumber mill collects wastewater from the mill restrooms.

There is no available documentation describing when the various portions of the system were constructed so the exact age of the various components of the sewer system is unknown. In a technical memorandum on the Scotia wastewater collection system, prepared on behalf of the City of Rio Dell in support of a possible annexation (Alternative A of the Project Environmental Impact Report [PEIR] accompanying the MSR of which this detailed engineering analysis is a part), Winzler & Kelly (W&K) estimated the age of the system between 50 and 70 years (W&K, October 11, 2006b).

In the past, the system functioned as a combined sewer and stormwater collection system. However, in the last few years an effort was made to separate the stormwater connections, including roof downspouts. Smoke test studies were conducted to help identify and disconnect stormwater inflow piping. All known stormwater connections were separated. Additional smoke testing may be conducted as a part of TOS's effort to comply with National Pollution Discharge Elimination System (NPDES) permit requirements.



LEGEND:

EXISTING SANITARY SEWER LINES (LOCATION CONFIRMED)

EXISTING SANITARY SEWER LINES (LOCATION NOT CONFIRMED)

SSMH 19 — SANITARY SEWER MANHOLE AND DESIGNATION

NOTES

ADDITIONAL SEWER LINES EXIST BUT THEIR LOCATIONS WERE NOT FOUND ON PALCO MAPS OR DURING CCTV INSPECTIONS.

NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USING INFORMATION RECEIVED FROM PALCO AND OR THE 2006 CCTV INSPECTION. ADDITIONAL WASTEWATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Analysis Scotia, California	Existing Wastewater Collection System SHN 005161.903
	May 2009 / 005161-903-E-SS-COLL-SYS_1-1	Figure 1-1

TOS staff responsible for maintaining the collection system indicated that there has been limited routine maintenance performed on the system and that, in most cases, sewer mains and laterals were worked on only when emergency repairs were needed. The large amount of debris removed from the sewer mains during the closed circuit television (CCTV) inspection in the summer of 2006 confirms this. According to the W&K technical memorandum, the collection system had never been cleaned prior to the recent cleaning performed in conjunction with the CCTV camera inspection.

1.2.2 Collection System Investigation and Findings

SHN conducted a physical evaluation of Scotia's existing sewer facilities from May 12, 2006, through July 28, 2006. Activities that were conducted for this investigation included manhole inspections, CCTV camera inspections, and smoke testing (including pressure cleaning of lines). The CCTV inspection was conducted manhole to manhole (as found or accessible), one manhole at a time, using a self-propelled camera specifically designed for pipeline inspection. An inspection log identifying and detailing pipe system defects and their locations was made for each pipe run. The CCTV inspection report includes DVDs of the inspection video that can be analyzed to help prioritize which lines require replacement or repair. The inspection work was also used for exploratory mapping of the system. The CCTV inspection report has not been distributed but is available from TOS or SHN.

As reported in SHN's *Wastewater Collection System Evaluation, Scotia California* report (August 2006), in general the upper half of the Mill A trunk line is in poor condition, the lower half of the Mill A line is in fair to good condition, the upper two thirds of the Mill B line are in poor condition, and the lower third of the Mill B line is in fair to good condition. Poor condition is defined here as pipeline with longitudinal and circumferential cracks jeopardizing the integrity of the conduit, large avenues for infiltration and inflow (I/I)[1], and/or pipe where structural failure is imminent. Fair condition describes pipe that has circumferential and small longitudinal cracks, offset joints, minor root intrusion, and moderate avenues for I/I. As such, "Fair Condition" does not imply suitability for long-term continued service without some degree of repair or rehabilitation. Many of the manholes that were inspected also provide opportunities for I/I to enter the sewer system, and a few previously unknown sources of stormwater were found directly entering the system (SHN, September 2006).

Many sections of branch pipeline and a few sections of trunk line were not inspected, due to inadequate access at manholes or pipe defects that prevented the camera from traveling the length of the section. A conservative assumption would be that their condition is not better than that of the neighboring sections. Because the exact location of these un-inspected sections is not known, finding defective areas and repairing the branch lines would be extremely difficult and possibly more expensive than replacing them in whole.

1.2.3 Piping Materials and Condition

The sewer collection system is comprised of vitrified clay pipe (VCP), cast iron pipe (CIP), asbestos cement pipe (ACP), and polyvinyl chloride (PVC). The system is primarily constructed of 8-inch

[1] Infiltration refers to water entering a collection system from a variety of entry points including cracked or broken sewer laterals, defective pipes, pipe joints, or manholes. Inflow refers to water entering the sewer system from direct groundwater and surface water sources, such as cellar and foundation drains, roof drains, and cross-connections from storm drains.

VCP in 4-foot laying lengths. The segments of PVC pipe in the system were installed in repair areas addressed during the last 10 years. There is also a recently installed 848-foot section of PVC sewer main on the lower portion of the Mill A system. The PVC segments of the system are Standard Dimension Ratio (SDR) 35 sewer pipe (3034 PVC), typically 10 to 20 feet long. A few sewer mains are constructed of ACP, but there is very little ACP in the overall system (less than 0.1%). There are also a few CIP mains in the system.

Typical problems associated with VCP are present in Scotia's system. These problems include minor to severe longitudinal and circumferential cracking, wall crushing with longitudinal cracks (deformation) at 9:00, 12:00, and 3:00, offset joints, deflected joints, sags, root intrusion at pipe joints and cracks, and pipe that has almost completely collapsed.

Based on observations from the CCTV inspection, the PVC sewer pipe appears well constructed. There were no obvious signs of leakage or infiltration, and there is minimal root intrusion. Other than a few sags, the PVC pipe is well aligned and in good structural condition. There were many minor sags observed during the CCTV inspection. Some of the flatter portions of the VCP collection system near the wastewater treatment facility have significant sags that could trap large amounts of debris. This problem was evidenced during the collection system cleaning and CCTV inspection. Portions of the system are also located within the 100-year floodplain and the manholes in this low-lying area are not equipped with bolt-down or watertight lids.

There were few fittings observed during the CCTV inspection of the sewer system except for an occasional wye or tee used to join two intersecting mains. Most connections (including laterals) were made by field cutting the pipe and sealing the connection with cement mortar. When installed, changes in the alignment were accomplished at manholes. In several areas, alignment changes were made by deflecting the bell-and-spigot joints. Changes in line size were generally made at manholes. Cement mortar was used to cap dead ends or abandoned lines.

1.2.4 Horizontal System Alignment

In general, the sewer mains in Scotia were laid out in a manner that served the intended hydraulic function. However, most sewer lines were constructed without consideration of the town being subdivided, as is currently being proposed. Many sewer mains are located behind houses and in other areas that could become private property as a result of the proposed subdivision. In some cases, sewer mains are located under buildings and in other inaccessible areas. Those trunk lines not in the proposed public rights-of-way would be very difficult for the proposed CSD to access and maintain. Ideally, the only portion of the collection system on private property would be the sewer service laterals (serving only the building or buildings on that individual property). Any portion of a sewer main located under a building is unacceptable because these lines would be impossible to access if repairs were required, there is potential for occupant exposure to sewer gasses and overflows, and the pipes could be damaged during any foundation work conducted on the buildings.

1.2.5 Sewer Laterals

A sewer lateral is the portion of the collection system that connects a building sewer to the mainline. Building sewer refers to that portion of the collection system that serves an individual building or residence that is located under the building to 2 feet outside the building perimeter.

Existing sewer laterals for individual private residences are primarily 4-inch VCP. Sewer laterals for industrial and commercial installations range from 4 inches to 8 inches in diameter. Sewer laterals were typically cut-in to the sewer mainline and grouted in place without the use of gasketed saddles or specialized fittings.

Most laterals do not have cleanouts. When repairs become necessary, the laterals are accessed by excavating and cutting into the line. In a few cases, ABS cleanout fittings have been installed on the laterals when repairs were made. In general, lateral cleanouts are only found on laterals that have had recurring blockage problems.

1.2.6 Sewer Manholes

Sewer manholes in Scotia are primarily nonstandard structures. There are very few standard round manholes with cast iron lids in Scotia. Most existing manholes are non-standard (of industry) rectangular, cast-in-place concrete structures with rectangular 3/8-inch thick steel covers. The sewer manholes do not have standard manhole rings and are not sealed to prevent infiltration. Manhole inside dimensions range from 1.6 feet by 1.6 feet to 4 feet by 4 feet, with the typical dimensions being about 3 feet by 3 feet. Most of the cast-in-place manholes have fabricated steel steps that are heavily deteriorated. The manhole depths range from 2 feet to 16 feet, depending on the grade of the mainline. There are also several manholes that were built using precast concrete water meter boxes and corrugated plastic pipe. The connection of sewer mains at manholes is likely a significant source of groundwater infiltration, based on observations made during the CCTV inspections.

It is common practice in sewer design and construction to locate manholes in a right-of-way. The typical criteria for manhole placement are:

1. wherever pipelines intersect,
2. where there is a substantial change in slope,
3. where there is a change in horizontal alignment or pipe size,
4. to reduce distances to less than or equal to 500 feet between manholes, and
5. to ensure sewer lines remain in a right-of-way.

Some of Scotia's manholes are located in yards, on sidewalks, under fences, and under buildings. Several manholes were found during the CCTV inspection that had been paved over or were otherwise covered with soil so that they were no longer accessible from the surface. It is possible that additional manholes exist that have not yet been found in pipelines where the CCTV camera could not pass due to pipe size and/or condition. Intervals between sanitary sewer manholes in Scotia vary from less than 50 feet to more than 800 feet. There does not appear to be a typical design interval. Manholes were generally placed at locations where the line needed to change alignment or at junctions with other lines.

1.2.7 Recent Repairs and Improvements

During the summer and fall of 2006, former owner Pacific Lumber Company (PALCO) completed improvements to the collection system to reduce I/I and increase the reliability and hydraulic capacity of the sewer system.

Several of these improvements included:

- Sewer line cleaning;
- Sewer line replacement by Beacom Construction at 13 repair sites, with 422 lineal feet of replacement;
- Concrete plugging of abandoned Mill B restroom water closet floor connections directly exposed to rainfall;
- Repair and sealing 12 manholes from storm runoff; and
- Separating stormwater receiving facilities from wastewater collection facilities

Following these upgrades, increased influent total suspended solids (TSS) and biological oxygen demand (BOD) concentrations provided some evidence that I/I has been reduced, allowing the wastewater treatment facility (WWTF) to perform more effectively (that is, operate within its discharge permit limitations at lower hydraulic loadings). However, data gathered during the 2006-2007 rainy season indicate that substantial I/I still enters the collection system. Additional flow monitoring should be conducted in the collection system in order to determine the most significant sources of I/I within the sections of pipeline that will be repaired (rather than replaced). This information will be compiled and used in conjunction with ongoing NPDES permit compliance of the WWTF.

1.3 Demand and Capacity

Scotia's sanitary sewer system serves a population of approximately 1,000 people. The collection system has 272 residential sewer connections, several connections in the HRC mill industrial areas, and approximately 20 commercial connections.

Based on analysis of data from 2003 through the first half of 2006, the Average Annual Dry Weather Flow (ADWF) into the WWTF was 0.178 million gallons per day (MGD). The Average Annual Wet Weather Flow (AWWF) for the same period was 0.287 MGD. The peak day flow recorded during this period was 1.394 MGD in February 2004. The peak flows indicate that I/I into the wastewater collection system is excessive.

As the collection system is currently configured, the hydraulic capacity of the sewer system has been adequate to meet the historic peak flow events. A substantial reduction of the I/I levels will reduce the peak hydraulic loadings, increasing available capacity used for several parts of the system. Nevertheless, current standards of practice require that wastewater collector lines that convey wastewater by gravity flow be at least 6 inches in diameter, while some short sections of Scotia's existing sewer pipe are 4 inches or less. Although these smaller pipes may have been generally adequate to convey the flows they have received, pipes less than 6 inches in diameter are prone to clogging.

The composition of Scotia's wastewater (not including I/I) is considered similar to typical domestic wastewater, which has average BOD and TSS concentrations ranging from 250 to 300 milligrams per liter (mg/L). A thorough discussion of flows and loads is provided in "Chapter 2: Wastewater Treatment."

Scotia is essentially at the residential build-out development level, and below the historical industrial level; wastewater flows and loads are not expected to increase significantly over historical use. However, some additional businesses and industry may eventually occupy a future industrial park in the present Mill A area, which already includes a brewery. A determination of specific wastewater flows and characteristics from any additional businesses will be required for proposed collection system rehabilitation design.

1.4 Regulatory Criteria

1.4.1 Authority

For the powers and responsibilities under which the proposed CSD will operate (with regard to wastewater collection), the California Water Code, Sections 31100-31106, provides some guidance:

> *A district may acquire, construct, and operate facilities for the collection, treatment and disposal of sewage, waste and storm water of the district and its inhabitants and may contract with any public agency including but not limited to sanitation districts for sewer outfall facilities. A district also may acquire, construct, and operate facilities for the collection, treatment and disposal of sewage, waste and storm water of inhabitants outside its boundaries; provided that it shall not furnish any such service to the inhabitants of any other public agency without the consent of such other public agency expressed by resolution or ordinance.*
>
> *The district may prescribe, revise, and collect rates or other charges for the services and facilities furnished pursuant to this article.*
>
> *A district may supply sewage and waste services to property not subject to district taxes at special rates, terms, and conditions as are determined by the board for the services.*
>
> *The district may provide that such rates or other charges may be collected with the water rates of the district and that all rates shall be billed upon the same bill and collected as one item, and that in the event of failure to pay the whole or any part thereof, the district may discontinue any and all service for which such bill is rendered, but this provision shall not be construed to prohibit the collection of rates or charges by the district in any other lawful manner.*

1.4.2 Permit Constraints

Scotia's current NPDES permit has set a limit on inflows to the WWTF, which has occasionally been exceeded during major rainfall events. Low influent concentrations do not directly create regulatory issues, but the governing water quality regulatory agency, the California Regional Water Quality Control Board, North Coast Region (RWQCB) mandates that concentrations of influent constituents be reduced by 85% by the WWTF; when the wastewater is diluted by I/I and influent constituent concentrations are already low, it is very difficult to obtain reductions of 85%. Prior to limited improvements made to the collection system and the WWTF in the fall of 2006, Scotia's influent concentrations of BOD and TSS were frequently below 30 mg/L entering the facility, making the achievement of 85% reductions virtually impossible. During the 2007-2008 winter season, the incidence of influent concentrations of BOD and TSS below 40 mg/L entering the facility was limited to major storm events.

1.4.3 Collection System

Two references were used to establish baseline standards for wastewater collection systems in order to determine what improvements would be proposed for Scotia's systems during initial CSD formation, and subsequent capital improvements planning (for upgrading system components to area municipal standards). The nearby Cities of Rio Dell and Fortuna have standard improvement specifications, referred to in this section as the "City Standards," which were used to determine potential CSD requirements and specifications for wastewater collection systems, including materials, installation, and design criteria (for new construction).

These City Standards provide details and specifications for the installation of sanitary sewer collection facilities, including laterals, cleanouts, mains, and manholes. The City Standards were created in the 1960s, and though much of the materials for sewer construction called out in the details are outdated, the designs are still compatible with modern construction practices.

The condition of Scotia's sewer system and its wastewater composition have created two regulatory issues that require attention in the short term:

1. high flows during the rainy season that exceed the wastewater treatment facility's hydraulic capacity, and
2. low influent BOD and TSS concentrations.

Furthermore, if Scotia forms a CSD to administer and maintain the town's municipal facilities, the CSD would need to be able to locate and access all parts of the sewer system for repairs and maintenance, except the portions privately owned by property owners.

For placement of new sewer lines, Title 22 of the California Code of Regulations (CCR), Division 4, Chapter 16, Article 5 describes the minimum separation requirements for water mains and sewer mains. This chapter, also called the "California Water Works Standards," states that water mains shall typically be installed at least 10 feet horizontally from and 1 foot higher than sanitary sewers located parallel to sewer mains, and 1 foot higher than sanitary sewers crossing the water main. Separation distances are measured from the nearest edges of the facilities.

Variations of the separation distances can be decreased to 4 feet horizontally by using specific pipe materials and a greater pressure class rating.

1.5 Improvements

1.5.1 Proposed

Evolving regulatory changes and unknown future commercial and industrial demands will dictate future infrastructure improvement as these changes are planned and implemented. Therefore, existing system upgrades or modifications will be planned and constructed for maintaining appropriate levels of service while minimizing operation and maintenance costs to the affected users and meeting known regulatory requirements. All described system improvements will be designed and constructed to meet or exceed standard-of-care for area public works facilities. For quantities of existing components as well as of proposed rehabilitated and new components, please see Table 1-1.

Collection System. Phased rehabilitation of the existing VCP sewer mains can be accomplished based on their location and the results of CCTV inspection. Pipes that are well aligned and have no signs of major distress or I/I can be rehabilitated by relining or maintained as they currently exist. Lining sewer mains with slipline PVC or high-density polyethylene (HDPE), or installing fold-in-form or cure-in-place pipe, creates a seamless pipe within a pipe, which eliminates I/I and can increase the structural integrity of the sewer main. However, where misalignment and major structural defects cannot be corrected before relining, portions of the system will require replacement. Sags in the pipeline will require repair in order to allow sufficient flow velocities for cleansing action to prevent debris from accumulating in the line. Furthermore, the minimum acceptable line size is 6 inches. Sewer mains that are smaller than 6 inches will require replacement with larger pipes. Acceptable mains with improperly installed lateral connections will also need to have lateral connections replaced.

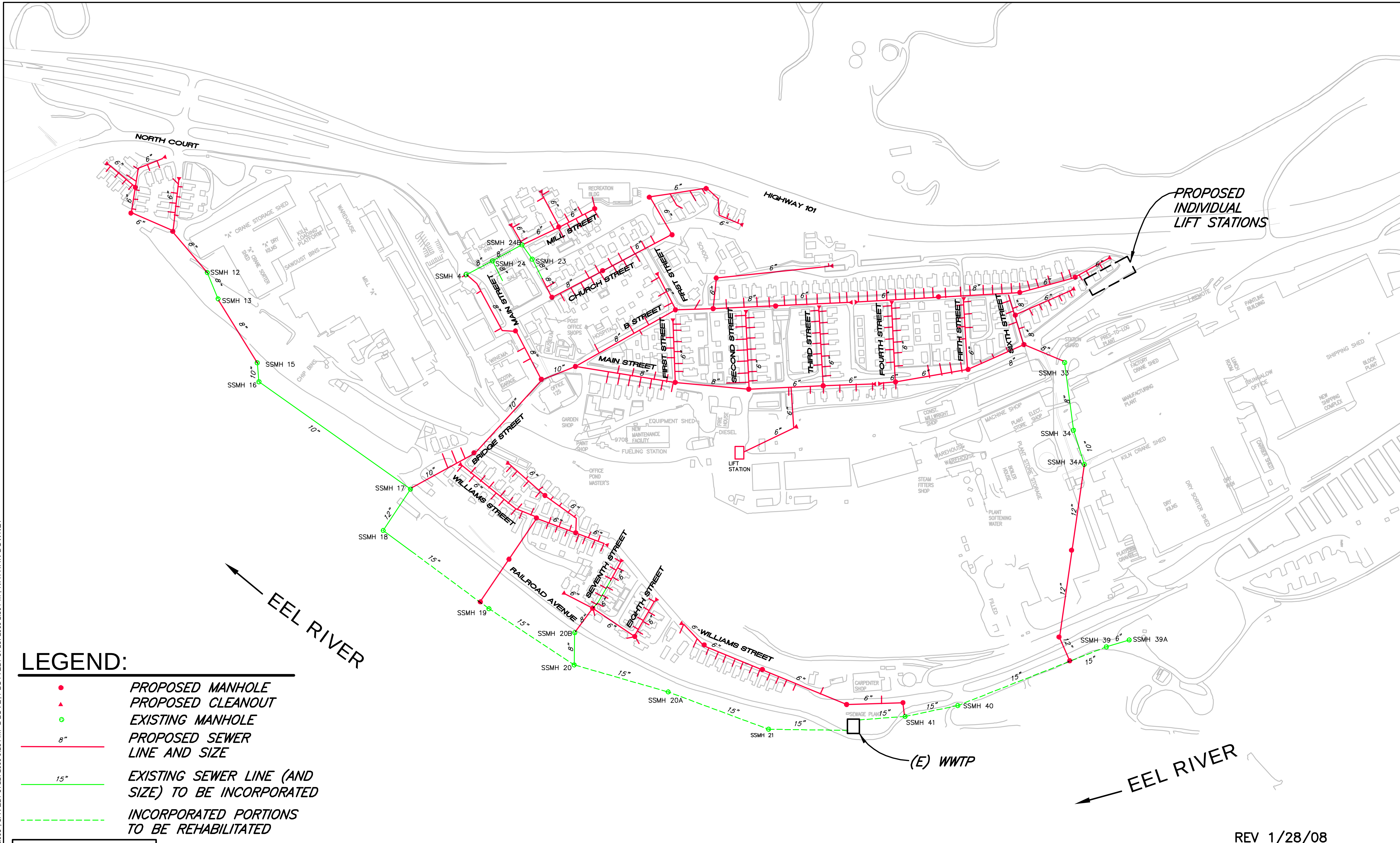
Given the condition of the existing collection system and the fact that much of the system is located outside of typical right-of-way areas (in backyards, under buildings—places that will become private property), a majority of the system within the residential and commercial areas needs to be replaced. SHN prepared a preliminary layout of a replacement collection system and prepared cost estimates for initial phase construction (Figure 1-2). Pending final design, some lines may need to be realigned from the proposed alignments shown on Figure 1-2 in order to maintain gravity flow.

Sewer Manholes. Sewer manholes in areas of no collection system replacement and that are in serviceable condition will require retrofitting with manhole rings and standard cast iron manhole lids. In addition, these manholes will need to be sealed to reduce or eliminate groundwater infiltration. Substandard manholes in similar areas will be replaced with modern manhole structures. Manholes located on private property, under buildings, and in otherwise inaccessible or unacceptable locations will require relocation to within the street right-of-way or to a location that will allow access to the manhole for inspection and maintenance.

Sewer Laterals. The majority of existing sewer laterals are located in private property and in areas outside the proposed right-of-way. All residential service laterals will require replacement with PVC sewer pipe and have clean-outs installed to provide access for maintenance. Placing the sewer laterals and cleanouts at the edge of the public right-of-way allows the CSD to service the portion of the line for which it will be responsible. Commercial service laterals will be replaced if they are not to CSD standards or in inaccessible locations.

Conceptual Layout. The conceptual layout depicted in Figure 1-2 shows the sections of existing sewer mains that are recommended for rehabilitation, and areas where new sewer mains and laterals will be needed. Table 1-1 summarizes the existing and proposed sewer system pipe and appurtenance quantities. Table 1-2 presents the engineer's opinion of the probable costs for construction of the proposed improvements.

The existing pipelines and manholes within the 100-year flood zone will be made watertight and equipped with bolt-down lids. Avoiding lift stations will minimize future operation and maintenance costs.



SHN Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Proposed Wastewater Collection System Improvements
SHN 005161.903

May 2009 | 005161-903-PROP-SS-IMPROV | Figure 1-2

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Table 1-1
Summary of Existing Sewer System and Proposed Improvements[1] (Revised 1/28/2008)
TOS Detailed Engineering Analysis

Sewer Main Size/Appurtenance	Unit	Existing			Proposed						
					Rehabilitate Existing			Install New			System Improvement Total
		Unpaved	Paved	Total	Unpaved	Paved	Total	Unpaved	Paved	Total	
Unknown Size	LF[2]	7,890	1,750	9,640	0	0	0	0	0	0	0
4-Inch or less	LF	1,780	200	1,980	0	0	0	0	0	0	0
6-Inch[3]	LF	2,700	940	3,640	0	0	0	0	12,400	12,400	12,400
8-Inch	LF	4,800	600	5,400	552	444	996	0	3,950	3,950	4,946
10-Inch	LF	1,870	0	1,870	162	0	162	0	1,000	1,000	1,162
12-Inch	LF	2,080	0	2,080	0	0	0	230	900	1,130	1,130
15-Inch	LF	3,500	0	3,500	3,200	0	0	0	0	0	3,200
Commercial Lateral	Each	26	0	26	0	0	0	0	26	26	26
Residential Lateral	Each	272	0	272	0	0	0	0	272	272	272
Industrial Lateral	Each	U[4]	U	U	0	0	0	0	10	10	10
Industrial Cleanout	Each	U	U	U	0	0	0	0	13	13	13
Manhole	Each	54	12	66	0	0	0	0	63	63	63

1. All quantities are approximate and based on best available information; assumes trench paving with overlays in paved roadways.
2. LF: Linear Foot
3. Realignment and consolidation of main to service connections reduces total line length of size 6-inches and less from existing to proposed improvements
4. U: Unknown

Table 1-2 Estimated Cost of Wastewater Collection System Improvements (Revised 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$40,000	$40,000
Demolition & Abandonment	LS	1	$63,000	$63,000
Miscellaneous Excavation & Backfill [2]	CY[3]	2,000	$10	$20,000
Install 6-inch Polyvinyl Chloride (PVC) C900 Sanitary Sewer Gravity Main[2,4]	LF[5]	12,400	$60	$744,000
Install 8-inch PVC C900 Sanitary Sewer Gravity Main[2,4]	LF	3,950	$70	$276,500
Install 10-inch PVC C900 Sanitary Sewer Gravity Main[2,4]	LF	1,000	$95	$95,000
Install 12-inch PVC C900 Sanitary Sewer Gravity Main[2,4]	LF	1,130	$150	$169,500
Total New Manholes[4]	Each	63	$5,000	$315,000
Total New Clean-outs[4]	Each	13	$1,000	$13,000
Residential Lateral Connections (to house) [4,6]	Each	272	$3,000	$816,000
Residential Lift Stations[4]	LS	3	$10,000	$30,000
Commercial Lateral Connections (to bldg.)[4]	Each	26	$4,000	$104,000
Industrial Lateral Connections[4]	Each	10	$5,000	$50,000
Cured-In-Place Main Line Liner	LF	4,358	$75	$326,850
Wastewater Collection System Improvements Subtotal				**$3,062,850**
Engineering[7] (20%)				$612,570
Contingency (20%)				$612,570
Total Wastewater Collection System Improvement Cost, Call:				**$4,288,000**

1. LS: Lump Sum
2. Assumes Humboldt Redwood Company (HRC) provides gravel material at no cost.
3. CY: Cubic Yard
4. Assumes temporary paving. Final paving in road overlay is accounted for in Chapter 7.
5. LF: Linear Foot
6. Unit Costs assume TOS installs residential lateral connections (includes service cleanout).
7. Engineering includes design, permitting, and construction management for the project.

Three houses at the south end of Main Street are located at lower elevation (about 10 feet) than other houses in that area, making gravity collection difficult. Possibilities for servicing these three houses include:

1. putting a small lift station at the bottom (south end) of B Street;
2. running a pipeline access across a residential right-of-way, thence under Main Street, with final connection to the manhole at Main Street west of the three homes; or
3. installing individual lift stations at each of the three residences with storage capacity for approximately 2 days of wastewater flows (recommend alternative, pending detailed design).

Recommendations presented in this chapter address defects as identified by SHN and alignment issues identified from mapping and field reconnaissance. A complete list of defects and their locations is presented in the *Wastewater Collection System Evaluation: Scotia California* report (SHN, August 2006). The following list addresses the major issues found during the pipeline investigation. Issues are not presented in any priority.

Issue 1:	Large portions of the system are in poor condition.
Recommendation 1:	*All such sections are slated for repair and/or realignment and replacement.*
Issue 2:	Parts of the existing collection system are located within the 100-year flood zone.
Recommendation 2:	*All failing or deteriorating sewer collection lines located within the 100-year floodplain will be waterproofed through cured-in-place lining or replacement, and existing manholes will be rehabilitated into watertight manholes. The pipeline work for the three houses at the south end of Main Street will not be completed as part of the proposed project, but must be accounted for in future capital improvements for Humboldt County Local Agency Formation Commission (LAFCo) planning purposes.*
Issue 3:	The lower trunk lines (Manhole [MH] 39 to WWTF and MH 16 to WWTF) are in usable condition, but they have minor to moderate defects (light cracks, minor root intrusion, and offset joints) in places.
Recommendation 3:	*Selected portions of trunk lines will be rehabilitated with cured-in-place lining during the proposed improvements work.*
Issue 4:	Most of the smaller collector lines in the residential and commercial areas could not be inspected due to pipe size, pipe condition, or lack of access. The condition and exact location of these lines is unknown.
Recommendation 4:	*The residential/commercial collection system will be replaced and/or relocated with new materials; 6-inch minimum diameter sewer pipe will be used for all common collector and trunk lines.*
Issue 5:	Most of the service laterals in the residential and commercial areas do not have cleanouts and the condition and exact location of these laterals is unknown.
Recommendation 5:	*All service laterals will be replaced using a 4-inch minimum diameter PVC collection pipe to each building and will include a service cleanout at the edge of the right-of-way.*
Issue 6:	Sewer manholes in Scotia are primarily nonstandard structures. The sewer manholes do not have standard manhole rings and are not sealed to prevent infiltration. The connection of sewer mains at manholes is likely a significant source of groundwater infiltration.

Recommendation 6:	*New manholes and cleanouts will be installed in the residential and commercial areas. HRC will repair existing manholes on their industrial property.*
Issue 7:	Excavation and construction work will require digging up most of the roads in the commercial and residential areas.
Recommendation 7:	*The utility infrastructure work will require temporary paving. A final overlay asphalt pavement surface will be constructed upon completion of a specific area's utilities.*
Issue 8:	Many sewer lines and manholes are located on private property and/or under buildings. The CSD will not have adequate access to maintain and repair them.
Recommendation 8:	*The residential/commercial collection system will be replaced and/or relocated, as shown in Figure 1-2, so that all parts are within the public right-of-way. There will be easements for the portions of the trunk lines that run through the TOS Wastewater Treatment Facility to HRC industrial areas.*

These upgrades to the sewer system are intended to significantly reduce I/I, thus reducing flows (primarily in the winter) to the wastewater treatment facility. The upgrades will also facilitate future maintenance and repair of the system and protect the public health and welfare of the residents of Scotia.

1.5.2 Issues of Operation

Replacing the sewer system in the residential and commercial areas will require extensive excavation, which will likely impede normal vehicular traffic. Provisions will have to be made to designate alternate routes and provide adequate signage to allow access to the affected areas.

There will be short, temporary interruptions of service as residences and businesses are connected to the new system. Residents and business owners must be provided prior notification for any planned interruptions of service.

Because the exact locations of many existing collector lines and most laterals are unknown, there is a good possibility that some of these lines will be inadvertently broken during excavation for the new system. Provisions must be made to minimize disruption of service and to contain wastewater that exits through broken pipelines.

There are other underground utilities in Scotia that are not thoroughly and precisely mapped. Underground Service Alerts (USAs) must be implemented prior to excavation, but excavators will be alerted to the fact that underground utilities may be encountered. Because Scotia has several underground steam pipes, as a safety precaution TOS needs to close off the supply to all steam lines within areas that are being excavated.

PG&E likely has good location information for its gas lines (TOS controls electrical service at present), but the possibility of unexpectedly encountering them during excavation exists. All excavation contractors and crews must be prepared to safely deal with this possibility. It may be necessary to turn off gas and/or electric service to some areas during excavation. If so, affected residents and business owners need to be given prior notification, whenever possible.

Upon CSD formation and assumption of responsibility for the proposed wastewater collection system, additional annual costs will be incurred through regular Operation and Maintenance (O&M) requirements associated with the system. Annual costs to the CSD will include labor, equipment, and parts. Adequate CSD staff will be required to ensure proper O&M of the system.

As described in “Section 1.4: Regulatory Criteria” above, the CSD will need to charge sewer use fees for residences and businesses that use the wastewater collection system. This may cause an economic impact to the residents and businesses of Scotia. Sewer and water services are currently provided by TOS at no cost to residents. User fees are discussed in the Financial Analysis included as Appendix C to the MSR.

2.0 Wastewater Treatment

2.1 Introduction

This section provides an overview of the existing treatment processes at the Scotia WWTF and assesses the condition, performance, and capacity of those processes. The assessment is based on analysis of wastewater operational data provided by PALCO and TOS for the period from October 2000 through December 2006 and on-site inspections by SHN of the wastewater treatment facilities. Recommendations are included where deficiencies have been identified and system upgrades are required.

2.2 Description of Existing Treatment System

The TOS Scotia WWTF was constructed in 1954 and has not undergone any significant upgrades since start-up. The equipment has been well maintained and replaced or rebuilt as necessary, but much of the equipment and all of the main structural components are more than 50 years old. However, the existing WWTF has been operating in compliance with its existing NPDES permit conditions.

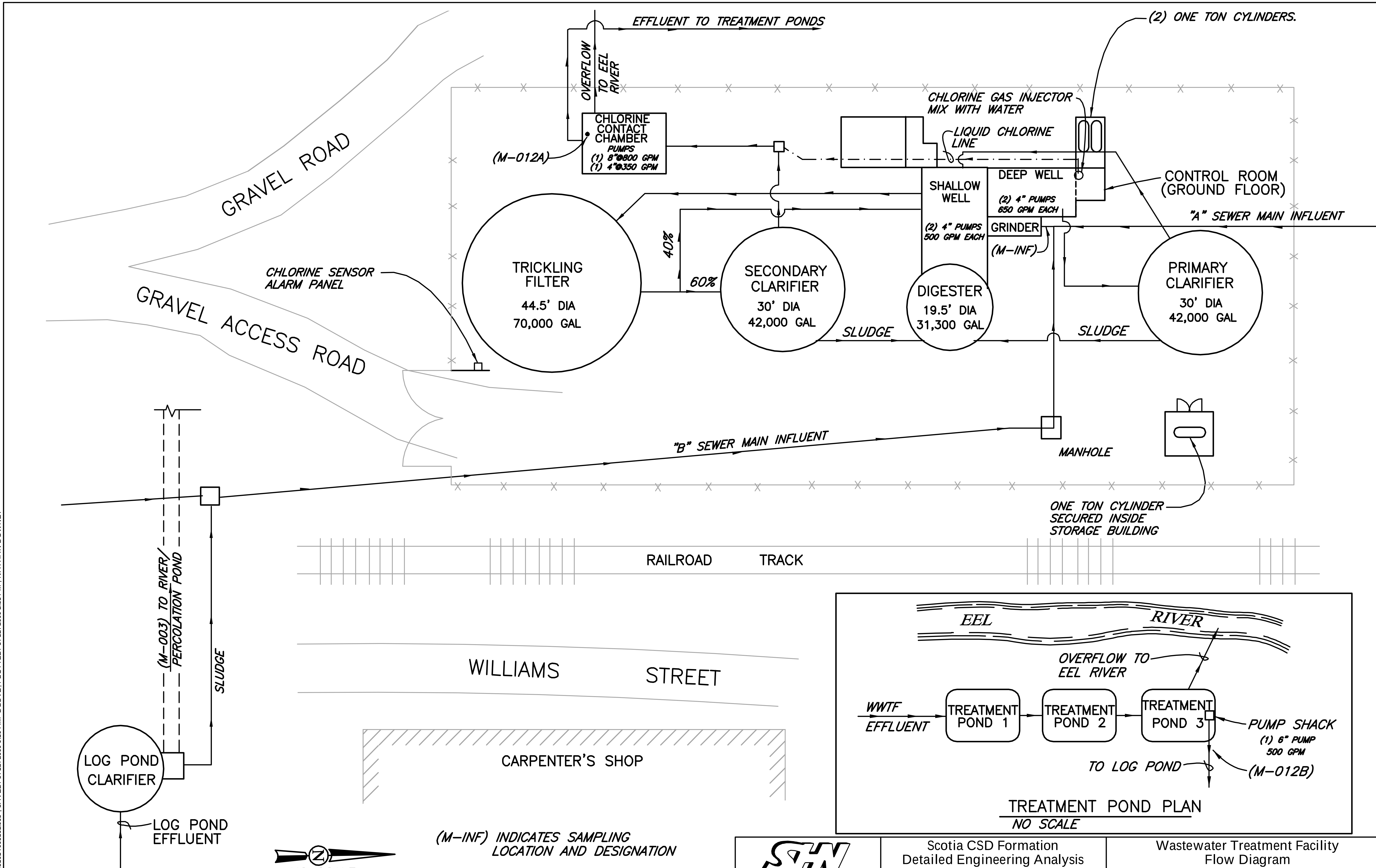
The treatment system as illustrated in Figure 2-1 consists of the following processes:

1. Pre-treatment: grit removal channel with grinder and bypass bar screen
2. Primary treatment: clarification
3. Secondary treatment: redwood trickling filter followed by clarification
4. Disinfection: gas chlorination
5. Advanced treatment: three treatment/polishing ponds following chlorine contact
6. Biosolids: anaerobic digestion and unlined dewatering trench

Influent enters the WWTF through two gravity sewer mains that discharge into a headworks channel provided with a grinder and Parshall flume for flow metering. From the headworks, the sewage flows into a wet-well called the "deep well" where it is pumped to the primary clarifier. The effluent from the primary clarifier discharges to a second wet-well called the "shallow well" before being pumped to the trickling filter for secondary biological treatment.

The trickling filter effluent flows into a recirculation box where it is split into flow streams across two weirs. Operations staff has estimated that during normal operations, 60% of the trickling filter effluent flows to the secondary clarifier and the remaining 40% is diverted to the shallow well for re-circulation through the trickling filter.

From the secondary clarifier, secondary effluent is discharged to the chlorine contact chamber where chlorine solution is injected into the flow stream for disinfection. Disinfected effluent from the chlorine contact chamber is then pumped to a series of three treatment ponds. From the treatment ponds, treated effluent is sampled for compliance before being pumped to the log pond for disposal. The effluent from the treatment ponds flows through the log pond to the log pond clarifier, which discharges to the Eel River during wet weather, and to a percolation pond during dry weather (May 15 – September 30), when discharge to the river is prohibited. Based on 24-hour composite samples of the influent wastewater (monitoring site M-INF) and effluent discharged from Treatment Pond 3 (monitoring site M-012B) the facility achieved average removal rates greater than 96% for both BOD and TSS.



SHN Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Wastewater Treatment Facility
Flow Diagram
SHN 005161.903

May 2009

005161-903-WWTP-FLOW_2-1

Figure 2-1

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New discharge requirements for the TOS Scotia WWTF became effective on September 30, 2006. (See Section 2.3.3 below for s discussion of permit changes.)

2.2.1 Headworks: Pre-treatment/Flow Monitoring

Influent wastewater enters the WWTF through one of two gravity trunk mains. The Mill A line is a 15-inch VCP that conveys flows from the north end of the facility. Mill Line B is a 15-inch VCP line that conveys flows from the south end of the facility. The influent wastewater from the Mill A and B lines is combined at the headworks, before passing through a non-aerated grit channel and grinder. A bypass channel equipped with a bar rack is provided for flows diverted around the grinder. These flows are typically diverted to the Parshall flume for grinder maintenance or repair.

After the influent goes through the grinder, it is routed to the deep well through a Parshall flume. Level is recorded using an ultra sonic level sensor that measures the water at the throat of flume. Depending upon the level of water ahead of the flume, the level sensor reading equates to a measurement of the flow into the WWTF. The flow meter is located in the chlorine control room and is equipped with a totalizer and recorder for 24-hour flows. The meter has a local readout of instantaneous flow rates in gallons per minute (gpm).

2.2.1.1 Condition

TOS operators have noted that the grit chamber does not require frequent cleaning. It has also been noted that the collection system is in poor condition and it appears grit may settle out elsewhere in the collection system; or at high flows, the grit may wash through the channel and collect in the deep well.

Pre-treatment consists of a Muffin Monster grinder purchased in 1996. Much of the non-biodegradable material settles out in the primary clarifier or is scraped off with the floatables and delivered to the digester as primary sludge. The non-biodegradable material poses a maintenance concern contributing to wear and plugging of wastewater and biosolids pumps throughout the treatment process. Digested biosolids and non-biodegradable material that pass through the treatment and digestion processes are stored on TOS property in an unlined drying ditch. The material must be raked up and disposed of periodically.

The influent flow meter was installed in 2002 and is in good condition. During high flows, the grinder and sensor must be removed to avoid inundation and resulting damage. The grinder and sensor were last removed in late December 2005 and reinstalled in January 2006.

2.2.1.2 Headworks Issues

- The system lacks automated notification of a bypass condition or metering of overflow from the headworks channel.
- The system lacks prescreening and removal of non-biodegradable material.
- The headworks is a confined space and requires a minimum of two operators for safe entry.
- The system lacks flow readings during major storm events.

2.2.2 Primary Treatment

From the headworks, the sewage flows into the deep well, where it is pumped to the primary clarifier by the deep well submersible sewage pumps. Effluent from the primary clarifier gravity feeds back to the shallow well through a 10-inch pipe.

2.2.2.1 Condition

The primary clarifier is a 30-foot-diameter buried concrete tank constructed in 1954. The distribution and collection system is a bridge-supported unit with a worm gear drive. The drives have been regularly maintained, but there is no record of replacement or rebuild. The drive equipment is experiencing corrosion. The scrapers and collection arm were replaced in 1997. The top of the tank is covered by a square mesh screen supported by steel framework to deter vandalism and bird activity.

TOS operators have noted that the capacity of the discharge line to the shallow well is limited, and when both deep well pumps are on, the water level in the launders (primary effluent trough) increases to a point that it overflows and spills onto the ground on the low side of the clarifier. The 10-inch discharge line from the primary clarifier is cast iron and has an approximate slope of 1.2%. Assuming a Manning's coefficient (n) of 0.015 for rough, uncoated cast iron pipe, the full flow capacity is estimated to be 1.5 MGD.

The deep well pumps are two 20 horsepower (hp) submersibles with a design firm capacity (firm capacity assumes one pump is off-line) of 650 gpm (0.94 MGD). The pumps were replaced in November 2006. The new pumps were installed with a rail system so that they can be pulled for maintenance from the surface, eliminating the need for confined space entry.

2.2.2.2 Primary Treatment Issues

- The second deep well pump cannot be brought on line for a significant period of time without overflowing the clarifier.
- The equipment is aging and the clarifier drives require replacement.
- There is differential settlement of the primary clarifier and a new level overflow weir needs to be installed.

2.2.3 Secondary Treatment

Secondary wastewater treatment at the WWTF consists of a trickling filter with redwood slat filter media, followed by a secondary clarifier. Primary effluent is pumped to the trickling filter distribution arms by the shallow well pumps.

2.2.3.1 Condition

The shallow well pumps are line shaft turbines with an estimated firm capacity of 500 gpm. The pumps were rebuilt, one in 1994 and one in 1996, and are in good condition. The filter beds are dosed through a rotary/reaction distributor made up of two horizontal pipes supported by a center column.

The trickling filter is contained in an above-ground circular concrete tank that appears to be in good condition, with no visible cracks or leakage. The tank is approximately 5 feet deep and 44.5 feet in diameter. The redwood slats filter media are original and appear in good condition. The distributor arm was replaced in 2004.

The secondary clarifier, identical in construction to the primary clarifier, is 30 feet in diameter and approximately 7 feet deep. The clarifier is shallower than typical depths recommended for secondary clarifiers following trickling filters (typically 11 feet). The shallow depth limits the treatment performance at high flow rates. The effects of the depth on the design Surface Overflow Rate (SOR) and the resulting treatment capacity are discussed in Section 2.4.

2.2.3.2 Secondary Treatment System Issues

- Intermittent hydraulic loading allows filter media to dry out.
- Since the brewery has been brought on line at the future industrial park in the Mill A area, the trickling filter is organically overloaded, and acts as a roughing filter preceding tertiary ponds (see discussion below, under Section 2.4.2).
- The secondary clarifier drive and sludge collection mechanism are more than 50 years old and need to be replaced.
- The existing secondary clarifier is shallow, surface overflow rate is exceeded during peak flows.

2.2.4 Disinfection

Chlorine gas contained in one-ton cylinders is injected into potable water by a chlorinator in the chlorine room to form chlorine solution for disinfection. Chlorine solution is piped to diffusers in the chlorine contact basin where it is mixed with secondary effluent. At the end of the chlorine contact basin (CCB), the disinfected effluent is pumped to the treatment ponds for additional treatment.

2.2.4.1 Condition

The chlorinator, installed in 2003, is in good condition and is regularly serviced by the equipment suppliers. The chlorinator is flow-paced based on a signal from the influent flow meter, which is also located in the chlorine control room. Dosage is adjusted at the chlorinator control panel based on the pounds per day (lb/day) readout on a rotameter (a variable area flow metering device used for chemicals), which is located on the gas line prior to the injector.

Two pumps at the end of the CCB pump disinfected effluent to the treatment ponds. A 15-hp line-shaft turbine with a capacity of 800 gpm (1.15 MGD) was installed in October 2006 and operates as the lead pump. The lag pump is a 10-hp line shaft turbine pump with an estimated capacity of 350 gpm (0.50 MGD). There was an existing overflow pipe at the end of the CCB that allowed disinfected effluent to discharge to the Eel River; however, this outfall point has been removed. With both pumps running during high flow events, peak flows can be pumped to the treatment ponds without overtopping or diverting to the river.

The chlorine contact basin is a serpentine concrete basin constructed in 1954 and has a series of under-and-over baffles designed to prevent short-circuiting and maximize contact time in the basin. The weir wall that separates the effluent pumps from the CCB historically leaked but was recently repaired (February 2007).

2.2.4.2 Disinfection Issues

- Storage of 1-ton cylinders may not meet *Uniform Fire Code* recommendations (National Fire Protection Association [NFPA], 2006).
- System needs a second 15-hp pump in the contact basin to provide redundancy.

2.2.5 Treatment Ponds

The CCB discharges into three aerobic treatment ponds. The ponds have been operated with highly variable levels, but generally function as aerobic low rate or "maturation ponds." Aerobic maturation ponds are lightly loaded, relatively shallow ponds 3 to 5 feet deep. Oxygen is provided in the ponds by surface re-aeration, photosynthesis by algae, and denitrification of nitrate (NO_3). A summary of the treatment ponds sizing and equipment is provided in Table 2-1.

Table 2-1
Wastewater Treatment Facility Size and Equipment Assessment—Treatment Ponds
TOS Detailed Engineering Analysis

Equipment	Description	Size			Installation	Major Repair
		Area (SF)[1]	Depth (feet)	Volume (MG)[2]		
Treatment Pond 1	Aerobic pond	28,000	4	0.84	1960	2005 Cleaning
Treatment Pond 2	Aerobic pond	45,000	4	1.35	1960	2005 Cleaning
Treatment Pond 3	Aerobic pond	40,000	4	1.20	1960	2005 Cleaning
		(inches)	(gpm[3])	(hp[4])		
Effluent Pump	Line shaft turbine	6	500	40	2004	

1. SF: Square Feet
2. MG: Million Gallons
3. gpm: gallons per minute
4. hp: horsepower

2.2.5.1 Effluent Pumps

Effluent from Treatment Pond 3 is pumped to the log pond by the line-shaft turbine pump located at the end of the pond. A single pump is activated by the level in the treatment pond. The pump is accessed by a catwalk that extends out into the pond. An emergency overflow is plumbed to the Eel River at the end of Pond 3.

A small pump house adjacent to the catwalk contains the pump controls and a composite sampler. Samples collected from Pond 3 are analyzed for compliance with discharge requirements for BOD, TSS, and pH.

2.2.5.2 Condition

The ponds are full of biosolids. Although the ponds are reportedly more than 10 feet deep in some sections, depth of clear water above the sludge blanket is only approximately 4 feet during winter months and approximately 2 feet in the summer months. Vegetation continually encroaches on the edge of the ponds and at times, Pond 3 has been almost entirely covered with duckweed. In June 2006, much of the vegetation was removed from the treatment ponds. It is necessary to perform this maintenance on an annual basis, and this task will be part of the Operations and Maintenance Plan that will be developed in accordance with the NPDES permit requirements. A sludge inventory and removal plan is included as recommended improvements in Section 2.5.2

2.2.5.3 Treatment Pond Issues

- Culverts between ponds need replacing.
- There is a lack of level control in the ponds.

2.2.6 Biosolids

Solids are pumped from the primary and secondary clarifiers to the anaerobic digester using one of two sludge pumps located in the pump room. The digester's floating cover allows the volume of the digester to change without allowing air to enter. Gas from the digester is vented to the atmosphere. A heat exchanger in the pump room functions to heat the digester contents using hot water. Digested biosolids are periodically drained to a sludge dewatering trench. A summary of the biosolids system equipment is provided in Table 2-2.

Table 2-2
Wastewater Treatment Facility Biosolids System Equipment Assessment
TOS Detailed Engineering Analysis

Equipment	Description	Dia.[1] (feet)	Depth (feet)	Volume (gal.)[2]	Installation Date	Major Repair
Sludge Digester	Anaerobic	19.5	15	31,300	1954	New floating cover, 2004
Sludge Pump	Piston, Marlow				1954	Rebuilt, 2000

1. Dia.: Diameter
2. gal.: gallons

2.2.6.1 Condition

The sludge pumps are positive displacement, plunger pumps that were installed when the WWTF was constructed in 1954. According to the operator, the pumps were rebuilt in 2000. They are well maintained and in good condition. The floating cover on the digester was replaced in 2004 when the digester was cleaned out and is currently in good condition.

The exterior surface of the concrete digester is in poor condition, with numerous cracks. The structural integrity of the digester will be determined by investigating the depth of the exterior cracks and taking the digester off-line so the interior can be examined.

The biosolids removed from the digester are applied to a relatively unimproved dewatering trench. The trench is unlined and overgrown with brush. The RWQCB requires TOS to provide appropriate handling and disposal practices for sludge in the next permit cycle.

2.2.6.2 Biosolids Issues

- Solids loading from the primary and secondary clarifiers is not monitored.
- Volatile solids reduction in the digester is not monitored.
- The exterior of the digester is badly cracked.
- The unlined dewatering trench needs to be replaced with sludge drying beds.

2.3 Regulatory Criteria

This section summarizes the NPDES waste discharge requirements for the TOS Scotia WWTF. TOS currently discharges under Order No. R1-2006-0020 and NPDES Permit No. CA0006017. This permit was adopted by the RWQCB on June 29, 2006, by Order No. R1-2006-0020, and contains the waste discharge requirements for both the Scotia municipal WWTF and the Scotia cogeneration plant. The new permit went into effect on September 30, 2006, and expires on September 30, 2011.

2.3.1 Discharge Prohibitions

The Scotia WWTF is prohibited from discharging wastewater to the Eel River during the period May 15 through September 30 each year. During the period October 1 through May 14 of each year, discharges of treated wastewater to the Eel River shall not exceed one% of the flow of the Eel River, based on the most recent daily flow measurement, as measured at the Scotia gauging station (United States Geological Survey [USGS] Station 11477000). Additionally, the total volume of treated wastewater discharged to the Eel River in a calendar month shall not exceed 1% of the total volume of the Eel River in the same calendar month.

2.3.2 Effluent Limitations

The effluent limitations contained in the new permit are similar to the previous permit. However, with the new permit, the point of compliance for BOD and TSS has been moved from the log pond clarifier discharge (M-003) to the end of Pond 3 (M-012B). Disinfection requirements continue to be monitored at the chlorine contact basin effluent weir (M-012A). Table 2-3 summarizes the monitoring locations for compliance with the effluent limitations. These locations are also shown in Figure 2-1.

Table 2-3
Wastewater Treatment Facility Monitoring Locations[1]
TOS Detailed Engineering Analysis

Monitoring Location Name	Monitoring Location Description
M-INF	Influent monitoring location—a point in the facility headworks preceding any treatment and receiving all waste from the collection system
M-012A	Chlorine contact basin effluent weir
M-012B	Point of discharge at the end of the sanitary waste treatment train prior to discharge into the log pond
M-003	Log pond effluent discharge

1. Reproduced from NPDES No. CA0006017, Attachment E: Monitoring and Reporting Program (MRP)

Table 2-4 summarizes the effluent limitations for the WWTF. Treated wastewater discharged to the Eel River from the log pond must not contain detectable levels of total chlorine, as measured at

Monitoring Location M-003. In addition to these effluent limitations, the permit requires that the average monthly removal of BOD and TSS shall not be less than 85% as measured at Monitoring Location M-1012B. The removal shall be determined from the monthly average influent concentrations and monthly average effluent concentrations for each constituent over the same period.

Table 2-4
Wastewater Treatment Facility Effluent Limitations[1]
TOS Detailed Engineering Analysis

Parameter		Compliance Point	Monthly Average[2]	Weekly Average[3]	Daily Max.	Instantaneous		Sampling	
						Min.	Max.	Type	Frequency
BOD[4]	mg/L[5]	M-012B	30	45	60	--	--	8-hr. Composite	Weekly
	lb/day[6,7]		64	96	129	--	--		
TSS[8]	mg/L	M-012B	30	45	60	--	--	8-hr. Composite	Weekly
	lb/day		64	96	129	--	--		
pH	unitless	M-012B	--	--	--	6.5	8.5	Grab	Weekly
Total Coliform	MPN/100 mL[9]	M-012A	23 (median)	--	230	--	--	Grab	Weekly

1. Reproduced from NPDES No. CA0006017
2. The arithmetic mean of all daily determinations made during a calendar month
3. The arithmetic mean of all daily determinations made during a calendar week
4. BOD: 5-day Biochemical Oxygen Demand at 20ºC
5. mg/L: milligrams per liter
6. lb/day: pounds per day
7. Per the current NPDES permit, mass based effluent limitations are based on an average flow rate of 0.257 MGD. During wet weather periods, when the effluent flow rate exceeds 0.257 MGD mass limitations shall be calculated using the actual daily average effluent flow rate, but shall never be based on an effluent flow rate greater than 0.770 MGD.
8. TSS: Total Suspended Solids
9. MPN/100 mL: Most Probable Number per 100 milliliters

2.3.3 New Provisions

Order No. R1-2006-0020 rescinded the previous NPDES permit (Order No. 99-59) and contains the following significant changes:

1. Waste stream-specific effluent limitations will be applied for the first time to regulate the discharges from the steam-electric (cogeneration) power plant.
2. The compliance point for the WWTF has been moved from the end of the log pond to the end of the treatment ponds for BOD and TSS and at the end of the chlorine contact basin for coliform.
3. The technology-based standard of 85% removal for BOD and TSS will be applied for the first time.

4. The Order requires TOS to conduct three special studies, including:

    a. a hydrogeologic study to determine the fate and transport of pollutants discharged by seepage or percolation from the WWTF and/or conduct a study to determine an alternative treatment/disposal method to be implemented to ensure compliance with the Basin Plan discharge prohibitions;

    b. a WWTF treatability study to determine the design capacity of the existing facility related to hydraulic and biological loading; and

    c. a sludge disposal study to evaluate appropriate handling and disposal practices for sludge generated at the WWTF.

5. Specific requirements relating to the wastewater collection system, operations and maintenance, sanitary sewer overflows, and source control have been added as General Provisions.

2.4 Demand and Capacity

2.4.1 Influent Flow

Influent WWTF flow characteristics were evaluated based on influent flow and precipitation data provided by PALCO and TOS for the period from October 2000 to May 2006. The flow data indicated a decrease in the minimum or base influent flow in 2001 and 2002 following production and staffing reductions at PALCO (now HRC) mills; therefore, characterization of existing flows was based on analysis of the flow data for the period of 2003 through 2006. A summary of the wastewater flows characterized is included in Table 2-5.

Table 2-5
Wastewater Treatment Facility Influent Flow Summary
TOS Detailed Engineering Analysis

	MGD[1]	gpd/EDU[2]	gpcd[3]
Base Sanitary Flow	0.100	352	141
Base Inflow and Infiltration	0.08	282	113
Average Dry Weather Flow (ADWF)	0.18	634	255
Average Wet Weather Flow (AWWF)	0.287	1,014	407
Average Annual Flow (AAF)	0.24	845	339
Maximum Month Dry Weather Flow (MMDWF-10)	0.28	986	396
Maximum Month Wet Weather Flow (MMWWF-5)	0.42	1,479	594
Peak Weekly Flow (PW)	0.75	2,641	1,061
Peak Day Average Flow (PDAF-5)	1.67	5,880	2,362
Peak Instantaneous Flow (PIF-5)	2.5	8,803	3,535

1. MGD: Million Gallons per Day.
2. gpd/EDU: gallons per day per Equivalent Dwelling Unit (EDU); 284 EDUs associated with sewer
3. gpcd: gallons per capita per day (2.49 persons per household TOS Scotia)

The collection system is subject to high rates of I/I. The majority of the collection system was cleaned and logged using CCTV in 2006 and was found to have advanced stages of physical deterioration. Based on this investigation, it was determined that replacing a large portion of the collection system would decrease I/I. Once recommendations for repair and replacement are implemented, a proportional decrease in rates of I/I is expected. Table 2-6 includes estimates of flows based on current and projected Equivalent Dwelling Units (EDUs) assuming 70% I/I reduction.

2.4.2 Loading

Loadings in Table 2-7 are based on composite sampling conducted on the influent from October 2006 to August 2008. The Eel River brewery was brought on-line in September 2007. Prior to September, BOD loadings averaged 166 pounds per day (ppd) for an estimated 284 EDUs, or 0.59 ppd/EDU. Following installation of the brewery, average BOD loadings increased to 388 ppd. The additional loading of 222 ppd is equivalent to approximately 380 EDUs.

2.4.3 Performance

New discharge requirements for the TOS Scotia WWTF became effective on September 30, 2006. Based on 24-hour composite samples of the influent wastewater (monitoring site M-INF) and effluent discharged from Treatment Pond 3 (monitoring site M-012B), the facility achieved average removal rates greater than 96% for both BOD and TSS. These results are summarized in Table 2-8, which has been reproduced from the *2006 Annual Discharge Monitoring Report* (SHN, January 2007). The facility is not currently meeting permit limits, as there have recently been numerous exceedances for BOD due to the loads from the brewery.

Table 2-6
Wastewater Treatment Facility Flows
TOS Detailed Engineering Analysis

	Existing (Oct. 2000 through May 2006)[1]	Existing with 70% I/I[2] Reduction	Full Occupancy of Existing Homes with I/I Reduction	Commercial Development of Mill A with Brewery[3]
EDUs[4]	**284**	**284**	**309**	**435**
Flows	**MGD[5]**	**MGD**	**MGD**	**MGD**
Base Sanitary Flows	0.100	0.100	0.109	0.113
Base I/I[5]	0.080	0.024	0.026	0.026
Average Dry Weather Flow (ADWF)	0.180	0.124	0.135	0.139
Average Wet Weather (AWWF)	0.288	0.156	0.170	0.174
Average Annual Flow (AAF)	0.240	0.142	0.155	0.159
Maximum Dry Weather Flow-10 (MMDWF-10) [6]	0.280	0.154	0.168	0.172
Maximum Month Wet Weather Flow-(MMWWF-5) [7]	0.420	0.196	0.213	0.217
Peak Week (PW)	0.750	0.295	0.321	0.325
Peak Day Average Flow (PDAF-5) [8]	1.670	0.571	0.621	0.625
Peak Instantaneous Flow (PIF)	2.500	0.820	0.892	0.896

1. Includes lateral replacement
2. I/I: Inflow and Infiltration
3. Brewery discharge based on estimates obtained from Eel River Brewing Company brewery, Fortuna, CA
4. EDUs: Equivalent Dwelling Units
5. MGD: Million Gallons per Day
6. Maximum Month Dry Weather Flow (MMDWF) associated with a 10 year design storm (SHN, July 24, 2006)
7. MMDWF associated with a five-year design storm (SHN, July 24, 2006)
8. Peak day flow: Associated with a five-year design storm (SHN, July 24, 2006)

Table 2-7 Wastewater Treatment Facility Estimated BOD and TSS Loadings TOS Detailed Engineering Analysis									
	Existing without Brewery[1]			Existing with Brewery[2]			Full Occupancy		
	EDUs[3]	BOD[4] (ppd)[5]	TSS[6] (ppd)	EDUs	BOD (ppd)	TSS (ppd)	EDUs	BOD (ppd)	TSS (ppd)
Residential	247	144	199	247	144	199	272	158	219
Commercial	30	18	24	30	19	24	30	18	24
Industrial	7	4	6	387	226	81	387	226	81
Total EDUS	284	---	---	664	---	---	688	---	---
Average loading	---	166	229	---	388	304	---	402	324
Maximum Loading	---	417	669	---	872	684	---	903	729

1. Composite sampling conducted on the influent from October 2006 through October 2007
2. Composite sampling conducted on the influent from September 2007 through August 2008
3. EDUs: Equivalent Dwelling Units
4. BOD: Biological Oxygen Demand
5. ppd: pounds per day
6. TSS: Total Suspended Solids

Table 2-8 Wastewater Treatment Facility Removal Percentages for BOD[1] and TSS[2] TOS Detailed Engineering Analysis			
Parameter	**October 2006**	**November 2006**	**December 2006**
BOD	98%[3]	96%	97%
TSS	99%	99%	99%

1. BOD: Biochemical Oxygen Demand
2. TSS: Total Suspended Solids
3. Removal Percentage calculated using monthly average influent (M-INF) results and effluent results (M-012B)

2.4.4 Capacity

There are no design documents available that describe the biological design capacity of the WWTF; therefore, general design criteria for each of the treatment systems have been developed based upon published values.

The estimated hydraulic and biological treatment capacity of each treatment system component based on published design criteria is summarized in Table 2-9.

Table 2-9 Wastewater Treatment Facility Design Criteria TOS Detailed Engineering Analysis			
	Description	**Design Criteria**	**Capacity**
Preliminary Treatment			
Muffin Monster		-	
6-inch flume			Hydraulic capacity 3.6 MGD[1]
Primary Treatment			
Deep Well Pumps (2)	Submersible, 15 hp[2]	-	650 gpm[3] each (0.936 MGD)
Clarifier	Diameter 30 feet Depth 7.25 feet	SOR[4] @ ADWF[5] 800 gpd/SF[6] SOR @ PDAF[7] 900 gpd/SF	0.48 MGD 0.640 MGD
Secondary Treatment			
Shallow Well Pumps (2)	Vertical Turbine Wastewater Power 10 hp	-	Approximately 500 gpm (0.72 MGD)
Trickling Filter	Diameter 44.5 feet Depth 4 feet Volume 6,220 CF[8] Adjusted Volume: 4,350 CF	40 lbs BOD/d/1,000 CF[9]	216 ppd[10]
Secondary Clarifier	Diameter 30 feet Depth 7.25 feet	SOR @ ADWF 300 gpd/SF SOR @ PDAF 475 gpd/SF	0.20 MGD 0.40 MGD

Table 2-9 Wastewater Treatment Facility Design Criteria TOS Detailed Engineering Analysis			
	Description	**Design Criteria**	**Capacity**
Disinfection			
Chlorine Gas	Chlorinators One ton cylinders	-	-
Chlorine Contact Basin (CCB)	Volume 14,000 gallons	CT[11] @ ADWF 40 minutes CT @ PDAF 20 minutes	0.504 MGD 1.0 MGD
Chlorine Contact Basin Pumps (2)	Lead 15 hp Lag 10 hp	-	800 gpm (1.15 MGD) 350 gpm (0.50 MGD) 1,150 gpm (1.65 MGD)
Treatment Ponds			
Ponds	Total Area 2.6 Acres Volume @ 4 ft , 3.39 MG Volume @ 6 ft , 5.09 MG	Loading 15 lbs BOD/d/Acre DT[12] 5-20 Days	39 lbs BOD/day 0.678 MGD 1.0 MGD
Effluent Pump	Line shaft turbine Goulds 40 hp	-	500 gpm (0.72 MGD)
Biosolids			
Digester	Standard Rate Volume 33,500 gals. 4,470 CF	SRT[13] 30-60 days 40-100 lbs VSS[14]/1,000 CF 4-5 CF/capita	116 gpd 178 lbs VSS equivalent population: 1,118
Sludge Pumps (2)	Piston 15 hp	-	800 gpm (1.15 MGD)

1. MGD: Million Gallons per Day
2. hp: horsepower
3. gpm: gallons per minute
4. SOR: Surface Overflow Rate as a function of depth.
5. ADWF: Average Dry Weather Flow
6. gpd/SF: gallons per day per Square Foot
7. PDAF: Peak Day Average Flow
8. CF: Cubic Feet
9. lbs BOD/d/1,000 CF: pounds of Biological Oxygen Demand per day per 1,000 cubic feet; EPA Wastewater Technology Fact Sheet for Trickling Filters EPA 832-F-00-014. Loading based on intermediate filter corrected for specific area of redwood media
10. ppd: pounds per day
11. CT: Chlorine Concentration over Time
12. DT: Detention Time
13. SRT: Sludge Retention Time
14. VSS: Volatile Suspended Solids

A capacity study to evaluate the hydraulic and biological performance of individual treatment systems under varying hydraulic loadings is scheduled to be completed by March 2010. This analysis will be based on supplemental sampling and composite sampling of the influent and effluent. Samples will be collected from the influent, the primary clarifier effluent, the secondary clarifier effluent, the effluent from the contact basin, and the effluent from the chlorine treatment ponds.

2.5 Wastewater Treatment System Improvements

The Scotia WWTF is more than 50 years old, and has undergone no significant upgrades. As indicated in the performance summary, it has recently been unable to consistently meet its effluent permit for TSS and BOD. Factors contributing to permit exceedances include:

- increased organic loadings experienced since September 2007, when the Eel River brewery started operations; and
- sludge-filled tertiary ponds. This limits the detention time available in the ponds and can lead to TSS violations due to sludge washout.

The wastewater treatment system must provide reliable secondary treatment for at least the next 20 years. To achieve satisfactory performance within this timeframe, it will be necessary to upgrade or replace major components of the existing treatment systems. The proposed improvements presented in this section address the following concerns:

- Increase secondary treatment capacity and ability to handle increased organic loading.
- Provide for biosolids dewatering.
- Improve condition of tertiary treatment lagoon.
- Minimize the risk of the facilities location in the floodplain.

The estimated cost of proposed improvement projects presented in this report is preliminary in nature. Treatment requirements have been based on estimates of projected flow and loading that will be verified by additional sampling and flow monitoring. The capacity of the existing trickling filter has been summarized in Table 2-9 and is based on published design criteria for secondary treatment. Given the large range of published loading and performance data for trickling filters and the limited data available on redwood media, the capacity and performance of the trickling filter under actual loading conditions will need to be verified as additional data is accumulated.

Currently, the brewery (which leases its facility from TOS) is providing pre-treatment consisting of a septic tank, which is intended to prevent shock loading of the WWTF due to peak hour organic loadings. Monitoring during the first three months of discharge following the start-up of the brewery (October through December 2007) indicated that additional source controls were needed (SHN, 2008). TOS is currently negotiating with the Eel River Brewing Company to establish the terms of its new lease following the change of ownership resulting from the PALCO bankruptcy; this lease will include conditions of approval requiring additional pre-treatment and monitoring.

Final recommendations regarding proposed improvements to the Scotia WWTF will be made in a facilities plan scheduled for completion in October 2009. Alternatives to be considered as part of the facilities plan will include upgrading the existing system or constructing a new secondary treatment system. This report presents estimated costs for upgrading the existing facility. Other alternatives may be considered in the facilities plan.

2.5.1 Industrial Pretreatment

The brewery is required to provide pre-treatment to minimize the impact of its discharge on the WWTF. Pre-treatment consists of a septic tank with nominal capacity equal to one and a half times

the flow discharged on a daily basis during periods of peak production. The septic tank is intended to prevent shock loading of the treatment facility due to peak hour organic loading.
The septic tank is expected to remove 50 to 75% of the TSS. Based on sampling conducted at the Eel River brewery, effluent discharged from the septic tank was expected to have an average BOD concentration of 2,000 mg/L. However, monitoring of the brewery discharge conducted in January 2008 indicated BOD concentrations well exceeding this value (SHN, 2008). SHN recommended that the brewery be required to monitor all flows discharged to the sewer and that a monthly monitoring and reporting program be put in place to verify the organic load contributed by the brewery. In addition, SHN recommended that PALCO (now TOS) establish a provisional pretreated wastewater discharge permit for the brewery that sets forth the source control standards for the discharge, in accordance with the WWTF's NPDES permit requirements (SHN, 2008). The following brewery effluent limitations are proposed:

- Average monthly BOD/TSS concentrations shall be less than 500 mg/L.
- Peak daily BOD/TSS concentrations shall be less than 2,000 mg/L.
- The pH of waste discharged shall be between 6 and 9 pH units.

Enforcing the proposed limitations for the brewery discharge will help the Scotia WWTF effectively treat the process waste stream. However, consistent compliance with its permitted NPDES discharge limitations will require implementation of the secondary improvements recommended in Section 2.5.2.

2.5.2 Upgrades to Existing Treatment System

A description of the recommended upgrades to the existing treatment system is presented below. The estimated project cost for the recommended upgrades including a new secondary clarifier is itemized in Table 2-10 following the project description.

2.5.2.1 Primary Treatment

Recommended upgrades to the primary treatment system include:

- Clarifier drive replacement
- Installation of Variable Frequency Drive (VFD) on deep well pumps
- Leveling of primary weir

2.5.2.2 Minimize Effect of Floodplain

To minimize the impact of the facilities location in the floodplain, it is recommended that an elevated control room be constructed over or partially over and adjacent to the existing structure. The elevated room would be used for new equipment including VFDs and a new electrical control panel.

2.5.2.3 Secondary Treatment Capacity/Tricking Filter Solids Contact Process

Generally, intermediate rate filters can be loaded up to a maximum of 40 pounds BOD per 1,000 cubic feet per day (lbs BOD/d/1,000 CF). At higher loading rates filters are considered high-rate filters and secondary quality treatment may not be possible without a second-stage process (EPA, 2000).

Projected organic loading on the trickling filter is estimated at 73 lbs BOD/d/1,000 CF at average loading and 147 lbs BOD/d/1,000 CF at maximum day. To treat the projected loading it is recommended that the facility be upgraded to a combined suspended growth fixed/film process in which a suspended growth secondary treatment process follows the fixed-film trickling filter to increase BOD removal. In addition to providing additional treatment capacity, the suspended growth basin, whether a solids contact basin or somewhat larger activated sludge basin, will provide redundancy for the secondary treatment process when the trickling filter is off line. Given the projected loadings, there are two suspended growth processes that would be suitable.

Table 2-10
Wastewater Treatment Facility Organic Loading for Combined Processes
TOS Detailed Engineering Analysis

Process	Acronym	lbs BOD/d/1,000 CF[1]
Trickling Filter/Solids Contact	TF/SC	20–75
Biofilter Activated Sludge[2]	BF/AS	75-200

1. Pounds BOD per day per 1,000 cubic feet
2. Loading rate for Activated Biofilter (ABF) 10-75 lbs BOD/d/1,000 CF

In the TF/SC process trickling filter effluent is aerated in a small contact chamber prior to clarification. Solids from the secondary clarifier are either wasted as Waste Activated Sludge (WAS), or returned to this basin as Return Activated Sludge (RAS) as they would be in a conventional activated sludge process.

To create an Activated Biofilter (ABF), RAS is mixed with primary effluent and recycled over the redwood media to improved performance and sludge settleability. When an ABF is used in combination with an activated sludge basin, the process is called Biofilter/Activated Sludge (BF/AS). The suspended growth portion of the process is an activated sludge basin with a hydraulic residence time of approximately 2 hours. The activated sludge basin required for the BF/AS process is larger than the TF/SC solids contact basin. This BF/AS is designed to provide secondary treatment at high hydraulic and organic loading rates.

2.5.2.4 Shallow Well Pump Upgrade

In order to improve distribution of primary effluent across the trickling filter media, it is recommended that the filter recirculation rate be increased. Variable speed drives installed on the shallow well pumps are recommended in order to allow for a more continuous filter application rate.

2.5.2.5 Secondary Clarifier Upgrade

Due to its shallow depth (7.25 feet), the existing secondary clarifier is hydraulically overloaded during high flow events. At the projected Peak Day Average Flow (PDAF) of 0.622 MGD, the SOR exceeds 800 gallons per day per square foot (gpd/SF) compared to the recommended rate of 475 gpd/SF for a clarifier of this depth. A new clarifier sized with an SOR exceeding 800 gpd/SF is therefore recommended. The new secondary clarifier would allow the existing clarifier to be maintained as a redundant unit for the TF/SC process.

2.5.2.6 Summary of Secondary Treatment System Improvements

- Replacement of shallow well pumps with submersible pumps not impacted by flooding
- Installation of VFDs on the shallow well pumps
- Construction of a solids contact or small activated sludge basin following the trickling filter to operate as a combined suspended growth/trickling filter process
- Installation of RAS pumps to transfer solids from secondary clarifiers to the solids contact basin
- Installation of blowers for the solids contact process with controls installed in new control room
- New drive for existing secondary clarifier and horizontal baffling to increase settling
- Construction of an additional secondary clarifier to provide redundancy and improve treatment performance during peak flow events

2.5.2.7 Disinfection System

The gas chlorination must be inspected by the Fire Marshal and brought into compliance with Article 80 of the *Uniform Fire Code* (NFPA, 2006). At a minimum, Article 80 requires facilities using chlorine gas and not equipped with scrubber systems to have the following controls:

- Approved containment vessels or containment systems
- Protected valve outlets
- Gas detection system
- Approved automatic-closing fail-safe valve

2.5.2.8 Biosolids

It is recommended that the cracked Gunite coating on the outside of the digester be removed and the condition of the tank be assessed. The digester will be cleaned and inspected on the interior, and coated inside and out. Improved mixing equipment may be required, depending on the results of the capacity study.

The dewatering trench currently used for disposal of digested biosolids is inadequate. A covered drying bed with a drainage system that discharges into the influent sanitary sewer has been proposed, and preliminary costs are included in the summary of proposed treatment system upgrades in Table 2-11.

2.5.2.9 Tertiary Treatment Ponds

The tertiary ponds are full of biosolids. Although the ponds are reportedly more than 10 feet deep in some sections, depth of clear water above the sludge blanket is only 2 to 4 feet. The cost of removing biosolids from the tertiary ponds has been annualized and is included as an operations and maintenance item in Table 2-12. Based on a survey conducted in October 2006, there is approximately 6 million gallons of biosolids in the ponds, an accumulation of more than 20 years at current solids removal rates. After removing the biosolids currently in the ponds, biosolids removal should be performed on a regular basis.

2.5.2.10 Existing Treatment System Upgrade Cost Estimates

Costs for the existing treatment system upgrades are summarized in Table 2-11.

Table 2-11
Estimated Costs of Wastewater Treatment Facility Upgrades (Revised 2/24/2009)
TOS Detailed Engineering Analysis

Item (Unit Type)	Unit(s)	Quantity	Unit Cost	Total Cost
Mobilization/Demobilization	LS[1]	1	$80,000	$80,000
Equipment				
Primary Clarifier Drive	EA[2]	1	$75,000	$75,000
Shallow Well Pumps	EA	2	$8,000	$16,000
Secondary Clarifier Drive	EA	2	$75,000	$150,000
Weirs	EA	4	$15,000	$60,000
Blowers	EA	2	$10,000	$20,000
Aeration System	LS[2]	1	$30,000	$30,000
Redundant CCB[3] pump	EA	1	$10,000	$10,000
Chlorine Gas System, Containment System	LS	1	$25,000	$25,000
Pump VFDs[4]	EA	4	$15,000	$60,000
RAS Pumps[5]	EA	2	$18,000	$36,000
WAS Pumps[6]	EA	2	$10,000	$20,000
Scum Pump	EA	2	$10,000	$20,000
Electrical Integrated Circuit				
Electrical	LS	1	$325,000	$325,000
Construction				
Concrete for clarifier	CY	82	$1,200	$98,400
Suspended concrete	CY	14	$1,500	$21,000
RAS Pump Station	CY	25	$1,500	$37,500
Suspended Growth Reactor	CY	35	$1,200	$42,000
Modify Existing Clarifier	LS	1	$20,000	$20,000
Second Floor Control Room/Blower Rm	LS	1	$350,000	$350,000
Modifications to Chlorine System	LS	1	$20,000	$20,000
Stairs	LS	1	$16,000	$16,000
Digester Repair	LS	1	$60,000	$60,000
Construction of Drying Beds	LS	1	$65,000	$65,000
Earthwork				
Yard Piping	LS	1	$50,000	$50,000
Excavation / Grading	CY	400	$12	$4,800
Wastewater Treatment Facility Upgrade Costs Subtotal				**$1,711,700**
Engineering[7] (20%)				$342,340
Contingency (20%)				$342,340
Total Wastewater Treatment Facility Upgrade Cost, Call:				**$2,396,000**

1. LS: Lump Sum
2. EA: Each
3. CCB: Chlorine Contact Basin
4. VFD: Variable Frequency Drive
5. RAS: Return Activated Sludge
6. WAS: Waste Activated Sludge
7. Engineering includes design, permitting and construction management.

Table 2-12 Wastewater Treatment Facility Annual Operating Cost TOS Detailed Engineering Analysis						
	hp[1]	**gpm[2]**	**MG[3]**	**% time**	**kwhr[4]**	**Annual Cost**
Primary Pumping	15	500	0.72	0.31	3.417792	$2,395
Secondary Pumping	10	600	0.86	0.50	3.7285	$5,226
CCB[5]	15	800	1.15	0.19	2.13612	$1,497
From Treatment Pond	40	500	0.72	0.31	9.114111	$6,387
Aeration	5			1.00	3.7285	$2,613
Chlorine						$5,000
Tertiary Pond Sludge Removal						$15,000
NPDES[6] Permit Compliance						
Compliance Sampling /Reporting						$20,000
Special Studies						$30,000
Lab Analysis						$35,000
Total Annual Operating Costs, Call						$123,000

1. hp: horsepower
2. gpm: gallons per minute
3. MG: Million Gallons
4. kwhr: kilowatt hour
5. CCB: Chlorine Contact Basin
6. NPDES: National Pollutant Discharge Elimination System

2.5.2. 11 Annual Operating Costs

The previous sections discussed alternatives for improvements that are considered necessary to minimize the risk of the facility's location in the floodplain, provide redundancy for major components, and increase secondary treatment capacity. Operating costs are also a major issue of concern. Annual power costs at the existing facility are high because the wastewater is pumped through each treatment process and then treated effluent is pumped from the end of the treatment ponds before discharge to the log pond.

Annual operating costs for the existing WWTF, including the upgrade to a combined process, is presented in Table 2-12 and are estimated to be approximately $123,000/ year. A more detailed analysis of operating costs is presented in the Financial Analysis in Appendix C of the MSR.

3.0 Wastewater Disposal

3.1 Introduction

This section describes the existing treated wastewater effluent and sludge disposal practices and infrastructure within the town of Scotia, California (Figure 3-1). Additionally, this section assesses and proposes modifications to the current treated wastewater effluent and sludge disposal practices in the town of Scotia.

3.2 Description of Existing Services

3.2.1 Treated Wastewater Effluent

A description of the WWTF is included in Section 2.2 of this report. Treated wastewater, along with process water stemming from industrial activities, is pumped to a 25-acre log pond for temporary storage. The log pond water overflows to a clarifier.

Pursuant to RWQCB Order No. R1-2006-0020, which became effective on September 30, 2006, treated wastewater effluent from the log pond clarifier is discharged directly to the Eel River from October 1 through May 14 of the following year. Discharges in excess of 1% of the flow of the Eel River, during this period, are prohibited.

RWQCB Order No. R1-2006-0020 prohibits the discharge of wastewater from the log pond clarifier to the Eel River during the summer discharge prohibition period (from May 15 through September 30 of each year). During this period, a percolation pond is constructed on the floodplain adjacent to the Eel River. The percolation pond is typically constructed by grading approximately 6,000 cubic yards of existing gravel from the river bar to form a pond that is 10 feet deep, 800 feet long, and 100 feet wide. The total volume of the percolation pond is approximately 800,000 cubic feet, or approximately 6,000,000 gallons.

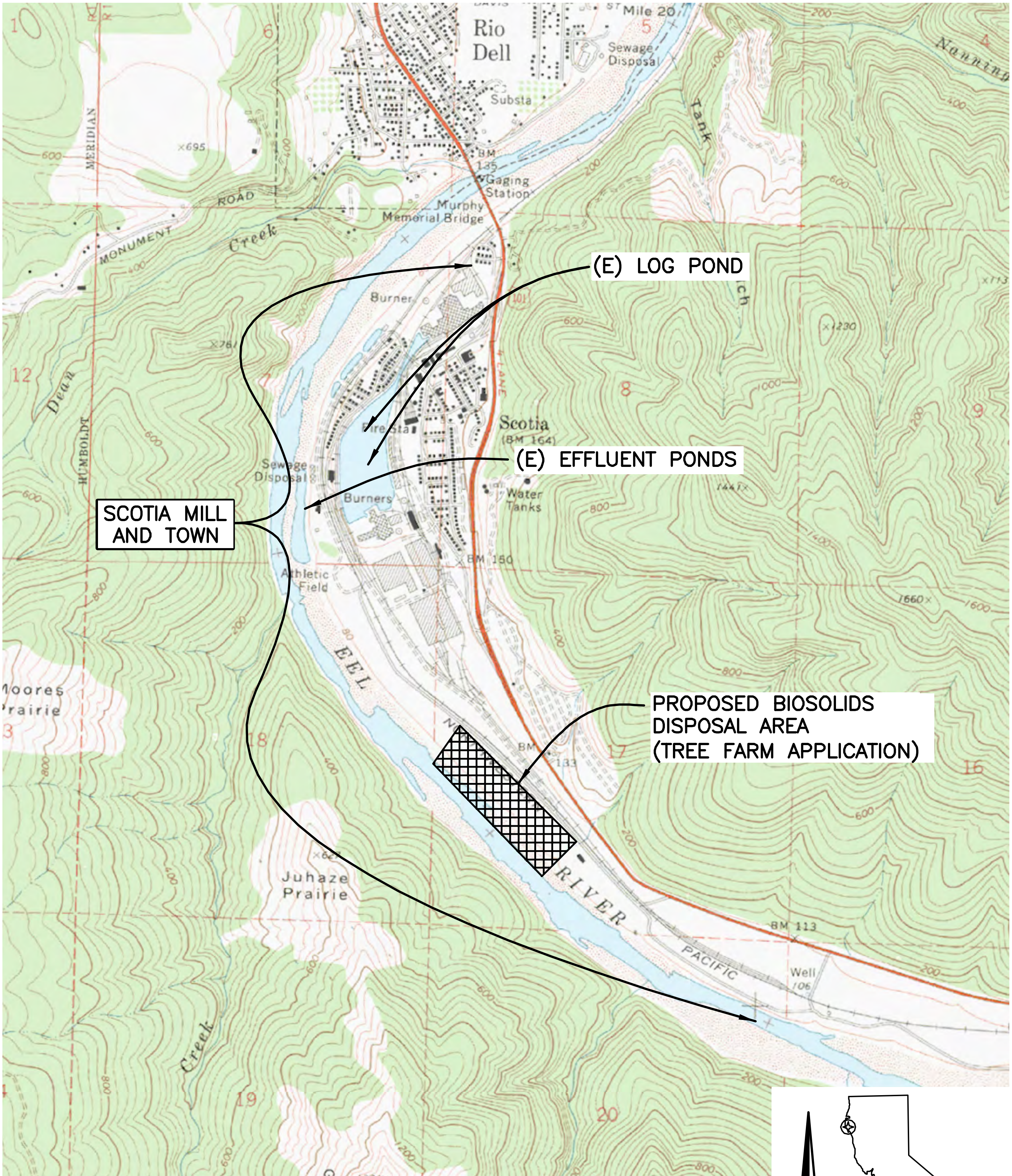
3.2.2 Sludge

Wastewater sludge from the Scotia WWTF is currently treated through an anaerobic digester and then disposed of in an unlined drying ditch. The ditch has not been cleaned out for many years.

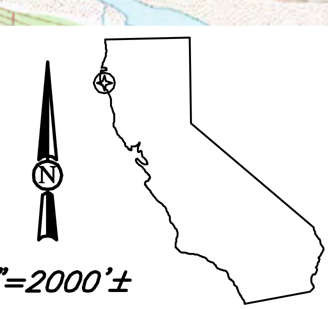
3.3 Regulatory Criteria

3.3.1 Recycled Water Use

Section 13577, Division 7, Chapter 7.5 of the California Water Code, known as the Water Recycling Act of 1991, establishes a statewide goal to recycle 1,000,000 acre-feet of water per year by the year 2010. Treatment requirements and uses for recycled water, as proposed in the following sections, are regulated under Title 22 CCR, Article 3, Section 60304. Treatment requirements for land application of recycled water would require, at the minimum, un-disinfected secondary recycled water pursuant to Section 60304 (d).



SOURCE: SCOTIA
USGS 7.5 MINUTE
QUADRANGLE



1"=2000'±

SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Analysis Scotia, California	Proposed Wastewater Disposal Facility Locations SHN 005161.903
	May 2009 / 005161-903-LOCATION.dwg	Figure 3-1

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Use area requirements for irrigation with recycled water are regulated under Title 22 CCR Article 4. The following is a summary of the pertinent requirements, sections indicated in parenthesis, for land application:

- (c) No irrigation with, or impoundment of, disinfected secondary-2.2 Most Probable Number (MPN) or disinfected secondary-23 MPN recycled water shall take place within 100 feet of any domestic water supply well. (Disinfected secondary-23 MPN indicates disinfected water effluent that does not exceed a median concentration of fecal coliform bacteria MPN of 23 per 100 milliliters over a period of 7 days, and does not exceed an MPN of 240 per 100 milliliters in more than one sample in any 30 day period.)
- (e) Any use of recycled water shall comply with the following:
  - Any irrigation runoff shall be confined to the recycled water use area, unless the runoff does not pose a public health threat and is authorized by the regulatory agency.
  - Spray, mist, or runoff shall not enter dwellings, designated outdoor eating areas, or food handling facilities.
  - Drinking water fountains shall be protected against contact with recycled water spray, mist, or runoff.
- (f) No spray irrigation of any recycled, other than disinfected tertiary recycled water, shall take place within 100 feet of a residence or a place where public exposure could be similar to that of a park, playground, or school yard.
- (g) All use areas where recycled water is used that are accessible to the public shall be posted with signs that are visible to the public.
- (h) Except as allowed under Title 17 CCR Section 7604 no physical connection shall be made or allowed to exist between any recycled water system and any separate system conveying potable water.

Title 22, CCR Article 6 Section 60321(a) stipulates the sampling and analysis requirements for recycled water. The regulation requires that disinfected secondary-23 MPN and disinfected secondary-2.2 MPN recycled water shall be sampled at least once daily from the treated effluent and analyzed for total coliform bacteria.

Use of recycled water for cooling purposes is regulated under Title 22 CCR, Article 3, Section 60306. Water from the log pond is currently used for cooling towers at the cogeneration plant. Section 60306 states:

> *(a) Recycled water used for industrial or commercial cooling or air conditioning that involves the use of a cooling tower, evaporative condenser, spraying or any mechanism that creates a mist shall be a disinfected tertiary recycled water.*
>
> *(b) Use of recycled water for industrial or commercial cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist shall be at least disinfected secondary-23 MPN recycled water.*

(c) *Whenever a cooling system, using recycled water in conjunction with an air condition facility, utilizes a cooling tower or otherwise creates a mist that could come into contact with employees or members of the public, the cooling system shall comply with the following:*

(1) *A drift eliminator shall be used whenever the cooling system is in operation.*

(2) *A chlorine, or other, biocide shall be used to treat the cooling system recirculating water to minimize the growth of* Legionella *and other microorganisms.*

Recycled water for use in structural fire fighting or industrial processes that may come into contact with workers must be disinfected tertiary recycled water pursuant to Title 22 CCR, Article 3, Section 60307(a).

Uses of disinfected secondary-23 MPN recycled water are regulated under Title 22 CCR, Article 3, Section 60307(b) and include:

- Industrial Boiler Feed
- Nonstructural fire fighting
- Backfill consolidation around nonpotable water piping
- Soil compaction
- Mixing concrete
- Dust control on roads and streets
- Cleaning roads, sidewalks, and outdoor work areas
- Industrial process water that will not come into contact with workers

3.3.2 Biosolids

Scotia's WWTF disposal of biosolids is currently regulated under RWQCB Order No. R1-2006-0020 and NPDES No. CA0006017. The RWQCB Order No. R1-2006-0020 states that biosolids may be disposed of through any of the following processes:

- Disposed in a Municipal Solid Waste Landfill
- Reused by Land Application
- Disposed in a sludge-only landfill
- Incinerated

The land application of biosolids is regulated through the following requirements:

- 40 CFR (Code of Federal Regulations) Parts 257, 258, 501, and 503;
- CCR Title 27, Division 2; and
- California State Water Resources Control Board Water Quality (SWRCB) Order No. 2004-0012-DWQ

TOS's NPDES permit contains general solids disposal and handling requirements for municipal WWTFs. More specific biosolid land application requirements are included in SWRCB Order No. 2004-0012-DWQ, which is intended to streamline the regulatory process; however, it does not supersede 40 CFR Part 503, EPA's Biosolids Rule. SWRCB Order No. 2004-0012-DWQ requires:

- All land-applied biosolids must comply with one of the pathogen reduction standards listed in 40 CFR Part 503.32. Table 3-1 summarizes the pathogen reduction standards.

Table 3-1
Wastewater Disposal System--Summary of Pathogen Reduction Requirements[1]
TOS Detailed Engineering Analysis

Class A Biosolids[2]	Class B Biosolids[3]
Alternative 1: Thermally Treated Biosolids. Use one of four time-temperature regiments.	**Alternative 1: Monitoring of Indicator Organisms.** Test for fecal coliform density as an indicator for all pathogens at the time of biosolids use or disposal.
Alternative 2: Biosolids Treated in a High pH-High Temperature Process. Specifies pH, temperature, and air-drying requirements.	**Alternative 2: Use of PSRP.** Biosolids are treated in one of the Processes to Significantly Reduce Pathogens (PSRP) identified in CFR[4] 40 Part 503.
Alternative 3: For Biosolids Treated in Other Processes. Demonstrate that the process can reduce enteric viruses and viable helminth egg ova. Maintain operating conditions used in the demonstration.	**Alternative 3: Use of Processes Equivalent to PSRP.** Biosolids are treated in a process equivalent to one of the PSRPs, as determined by the permitting authority.
Alternative 4: Biosolids Treated in Unknown Processes. Demonstration of the process is unnecessary. Instead, test for pathogens Salmonella sp. or fecal coliform bacteria, enteric viruses, and viable helminth ova--at the time the biosolids are used or disposed of, or are prepared for sale or give-away.	--
Alternative 5: Use of Further Reduce Pathogens (PFRP). Biosolids are treated in one of the PFRP identified in 40 CFR Part 503.	--
Alternative 6: Use of a Process Equivalent to PFRP. Biosolids are treated in a process equivalent to one of the PFRPs, as determined by the permitting authority.	--

1. From EPA September 1994
2. Class A Biosolids are biosolids that contain no detectable level of pathogens.
3. Class B Biosolids are biosolids that are treated but still contain a detectable level of pathogens.
4. CFR: Code of Federal Regulations

- All land applied biosolids must comply with one of the applicable vector attraction reduction requirements specified in 40 CFR 503.33. Table 3-2 summarizes the vector attraction reduction options identified in 40 CFR Part 503.

Table 3-2 Wastewater Disposal System--Vector Attraction Reduction Options[1] TOS Detailed Engineering Analysis	
Option Number	**Description of Option**
1	Reduce the mass of volatile solids by a minimum of 38%.
2	Demonstrate vector attraction reduction with additional anaerobic digestion in a bench-scale unit.
3	Demonstrate vector attraction reduction with additional aerobic digestion in a bench-scale unit.
4	Meet a specific oxygen demand uptake rate for aerobically treated biosolids.
5	Use aerobic processes at an average temperature of 40°C for 14 days or longer.
6	Add alkaline materials to raise the pH under specified conditions.
7	Reduce moisture content of biosolids that do not contain unstabilized solids from other than primary treatment to at least 75% solids.
8	Reduce moisture content of biosolids with unstabilized solids to at least 90%.
9	Inject biosolids beneath the soil surface within a specified time, depending on the level of pathogen treatment.
10	Incorporate biosolids applied to or placed on the land surface within specified periods after application to or placement on the land surface.
Source: EPA 40 CFR Part 503: Biosolids Rule, Land Application	

- Biosolids application rates must not exceed the nitrogen agronomic rates of the crop being planted.
- A biosolid with a moisture content of less than 75% shall not be applied during periods when wind speeds exceed 25 miles per hour.
- Biosolids are not to be applied in amounts exceeding the Risk Assessment Acceptable Soil Concentration as described by Equation 3.1:

$$BC = RP - 1.8(BS) \qquad \textbf{Equation 3.1}$$

Where:

BC = Background Cumulative Adjusted Loading Rate (pounds per acre [lbs/acre])
RP = 40 CFR Part 503 Cumulative Pollutant Loading Rate (lbs/acre)
BS = Actual Site Background Site Soil Concentration (milligrams per kilogram [mg/kg])

Table 3-3 summarizes 40 CFR Part 503 pollutant limits.

Table 3-3
Wastewater Disposal System Pollutant Limits for Land Applied Biosolids[1]
TOS Detailed Engineering Analysis

Constituent	Maximum Value in All Biosolids (mg/kg)[2]	Maximum Value in EQ[3] and PC[4] Biosolids (mg/kg)	Annual Loading Rate (kg/ha)[3]	Lifetime Loading Rate (kg/ha)
Arsenic	75	41	2.00	41
Cadmium	85	39	1.90	39
Chromium	3,000	1,200	150.00	3,000
Copper	4,300	1,500	75.00	1,500
Lead	840	300	15.00	300
Mercury	57	17	0.85	17
Molybdenum	75	18	0.90	18
Nickel	40	420	21.00	420
Selenium	100	36	5.00	100
Zinc	7,500	2,800	140.00	2,800

1. Table from EPA 1995
2. mg/kg: milligram per kilogram
3. EQ: Excellent Quality biosolids, as defined in 40 CFR Part 503
4. PC: Pollutant Concentration biosolids, as defined in 40 CFR Part 503
5. kg/ha: Kilogram per hectare

- Biosolids to be tilled into the soil must be incorporated into the soil within 48 hours in non-arid areas during the period from May 1 through October 31.
- Grazing of domesticated animals in areas where biosolids have been applied is restricted until the necessary waiting period has elapsed.
- Application of biosolids to slopes of greater than 10% requires an erosion control plan.
- Tail water from conveying structures shall be designed and maintained to minimize field erosion.
- Staging and biosolids application areas must be at least:
  - 10 feet from property lines;
  - 500 feet from domestic water supply wells;
  - 100 feet from non-domestic water supply wells;
  - 50 feet from public roads and occupied onsite residences;
  - 100 feet from surface waters, including wetlands, creeks, ponds, lakes, underground aqueducts, and marshes;
  - 33 feet from primary agricultural drainages;
  - 500 feet from occupied non-agricultural buildings and off-site residences;
  - 400 feet from a domestic water supply reservoir;
  - 200 feet from primary tributary to a domestic water supply;
  - 2,500 feet from any domestic surface water supply intake, and;
  - 500 feet from enclosed water bodies that could be occupied by pupfish.

3.4 Demand and Capacity

3.4.1 Treated Wastewater Effluent

Table 2-6 of this report summarizes the projected wastewater flows for the Scotia WWTF. In order to conservatively determine the demand on the system during the non-discharge period of the year (May 15-September 30), the AWWF was projected for the shoulder months of May and June and the ADWF was projected for the months of July, August, and September. Table 3-4 summarizes the projected wastewater flow information:

Table 3-4
Monthly Projected Wastewater Flows--Non-Discharge Period and Shoulder Months[1]
TOS Detailed Engineering Analysis

Month	Non-discharge Days per Month[1]	Projected Wastewater Flows (gpd)[2]	Source[3]
May	17	174,000	AWWF[4]
June	30	174,000	AWWF
July	31	139,000	ADWF[5]
August	31	139,000	ADWF
September	30	139,000	ADWF

1. Non-discharge period from May 15 – September 30
2. gpd: gallons per day
3. From Table 2.6 of this report
4. AWWF: Denotes Average Wet Weather Flow
5. ADWF: Denotes Average Dry Weather Flow

3.4.2 Biosolids Production

There is currently no available information regarding the annual production of biosolids for the Scotia WWTF. The daily production of biosolids can be estimated from literature values. Equation 3.2 summarizes the overall daily biosolids production at the Scotia WWTF.

$$\mathbf{BS = P_x + TSS_{nv} + TSS_{v,nx}} \qquad \textbf{Equation 3.2}$$

Where:

BS = daily biosolids production
P_x = biosolid yield from cellular growth in the anaerobic digester
TSS_{nv} = total suspended solids as non-volatile solids
$TSS_{v,nx}$ = total suspended solids as volatile solids that do not get reduced through the trickling filter and the anaerobic digester.

3.4.2.1 Biosolid Yield, P_x

The biosolid yield can be estimated by using Equation 3.3 from Metcalf and Eddy's *Wastewater Engineering: Treatment and Reuse*, 4th Edition (Tchobanoglous et al., 2003) , commonly referred to as Metcalf & Eddy.

$$P_x = Y*Q*(S_o - S)/(1+k_d*SRT) \quad \textbf{Equation 3.3}$$

Where:

P_x = biosolid yield from cellular growth in the anaerobic digester
Y = yield coefficient (gVSS/gBOD)
Q = flow rate
S_o = BOD in influent
S = BOD in effluent
K_d = endogenous die-off coefficient (day^{-1})
SRT = Solids Retention Time (days)

Table 3-5 summarizes the values and references to calculate the biosolid yield from cellular growth in the anaerobic digester (P_x).

Table 3-5
Wastewater Disposal System--Biosolid Yield from Cellular Growth
TOS Detailed Engineering Analysis

Variable	Value	Reference
Y[1]	0.05 gVSS[2]/gBOD[3]	Metcalf and Eddy, 4th Edition
Q[4]	0.18 MGD[5]	Table 2.6 of this report
S_o[6]	126 mg/L[7]	SHN, 2007 Annual Report
S[8]	17 mg/L	Assumed 85% removal efficiency[9]
K_d[10]	0.03 1/day	Metcalf and Eddy, 4th Edition
SRT[11]	30 days	Facility design
P_x[12]	4.2 pounds VSS/day	Equation 3.3

1. Y: yield coefficient
2. gVSS: grams of Volatile Suspended Solids
3. gBOD: grams of Biochemical Oxygen Demand
4. Q: flow
5. MGD: Million Gallons per Day
6. S_o: BOD in influent
7. mg/L: milligrams per Liter
8. S: BOD in effluent
9. The WWTF currently achieves between 95% and 99% BOD removal efficiency. The 85% removal efficiency is considered a conservative estimate.
10. K_d: endogenous die-off coefficient
11. SRT: Solids Retention Time (days)
12. P_x: biosolid yield

3.4.2.2 Total Suspended Solids, Non-Volatile

The total non-volatile suspended solids are solids that are not reduced in the WWTF; however, they are removed from the waste stream. In order to obtain a conservative estimate of the amount of biosolids produced, it is assumed that total non-volatile suspended solids comprise 20% of the TSS removed by the WWTF (Metcalf and Eddy, 4th Edition). The amount of TSS removed by the WWTF can be estimated with Equation 3.4.

$$TSS_r = Q^*(TSS_{in} - TSS_{eff})$$ **Equation 3.4**

Where:

TSS_r = total suspended solids removed
Q = wastewater flow
TSS_{in} = total suspended solids concentration in the WWTF influent
TSS_{eff} = total suspended solids concentration in the WWTF effluent

Table 3-6 summarizes the values and references used to calculate the total suspended solids removed.

Table 3-6
Wastewater Disposal System--TSS Removal
TOS Detailed Engineering Analysis

Variable	Value	Reference
TSS_{in}[1]	176 mg/L[2,3]	SHN, 2007 Annual Report
TSS_{eff}[4]	26 mg/L	Assumed 85% removal efficiency[5]
Q[6]	0.18 MGD[7]	Table 2.7 of this report
TSS_r[8]	**224.7 pounds per day**	**Equation 3.4**

1. TSS_{in}: Total Suspended Solids in WWTF influent
2. mg/L: milligrams per Liter
3. Represents the average influent concentrations to the WWTF during the fourth quarter 2006
4. TSS_{eff}: Total Suspended Solids in WWTF effluent
5. The WWTF currently achieves between 95% and 99% TSS removal efficiency. The 85% removal efficiency is considered a conservative estimate
6. Q: flow
7. MGD: Million Gallons per Day
8. TSS_r: Total Suspended Solids removed

The WWTF projected TSS removal rate would be approximately 225 ppd. Metcalf and Eddy, 4th Edition, estimates that approximately 20% of TSS is comprised of non-volatile solids and 80% is comprised of volatile solids (Tchobanoglous et al., 2003). Therefore, the daily rate of non-volatile suspended solids (TSS_{nv}) is estimated to be approximately 45 pounds per day.

3.4.2.3 Total Suspended Solids, Volatile

The total suspended solids that enter the WWTF as volatile solids comprise approximately 80% by mass of the total TSS (Metcalf and Eddy, 4th Edition). Of the volatile suspended solids that are removed by the WWTF, approximately 65% of the mass is removed by the anaerobic digester (Tchobanoglous et al., 2003). Equation 3.5 summarizes the calculation for the daily WWTF production of biosolids from volatile suspended solids that do not get treated by the WWTF.

$$TSS_{v,nx} = 0.8^*TSS_r^*(1-E_{ad})$$ **Equation 3.5**

Where:

TSS_r = Total Suspended Solids Removed
$TSS_{v,nx}$ = Total Suspended Solids as volatile solids that do not get reduced through the anaerobic digester
E_{ad} = Anaerobic Digester Removal Efficiency, as a decimal

The daily WWTF production of biosolids from volatile suspended solids that are not treated by the WWTF is approximately 63 pounds of biosolids per day. The total daily production of biosolids was calculated to be 112 pounds per day, or approximately 41,000 pounds of dry biosolids per year, (18,600 kg dry biosolids/yr) using Equation 3.2. The data is summarized in Table 3-7.

Table 3-7
Wastewater Disposal System--Daily Biosolids Production Rate
TOS Detailed Engineering Analysis

Parameter[1]	Value (lb/day)[2]
$TSS_{v,nx}$[3]	63
TSS_{nv}[4]	45
P_x[5]	4.2
BS[6]	**112**

1. Parameters from Equation 3.2
2. lb/day: pounds per day
3. $TSS_{v,nx}$: Total Suspended Solids as volatile solids that do not get reduced through the trickling filter and the anaerobic digester
4. TSS_{nv}: Total Suspended Solids as non-volatile solids
5. P_x: biosolid yield from cellular growth in the anaerobic digester
6. BS: daily dry biosolids production

The dry biosolids composition of sludge from a digester ranges from 2 to 5% (Metcalf and Eddy, 4th Edition). Using a conservative estimate of 3% by mass, the total volume of sludge produced annually is estimated to be approximately 163,500 gallons per year.

3.5 Proposed Improvements

SHN proposes that treated wastewater effluent continue to be discharged to the Eel River from October 1 through May 14 of the following year, as is currently the practice under RWQCB Order No. R1-2006-0020. However, SHN anticipates that the current practice of discharging the treated wastewater effluent to a percolation pond from May 15 through September 30 will not be allowed when the current NPDES permit expires in 2011. RWQCB Order No. R1-2006-0020 requires TOS to provide an outline and study of alternate wastewater disposal methods. SHN has researched several disposal methods and the following is a description of the preliminary findings for alternative disposal options.

3.5.1 Treated Wastewater Effluent Disposal

A water budget can be developed for any hydrologic system to account for flow pathways and storage components. The water budget follows the hydrologic continuity equation:

$$I - Q = \Delta S \qquad \textbf{Equation 3.6}$$

Where:

I = Inflow
Q = Outflow
ΔS = change in storage in a specified time period

The project specific water balance equation can be described as follows:

$$PPT_{in} + Q_{WW} = E_s + \Delta S \qquad \textbf{Equation 3.7}$$

Where:

PPT_{in} = Precipitation into the storage reservoir
Q_{WW} = Treated wastewater effluent into the storage reservoir
E_s = Evaporation from the storage reservoir
ΔS = Accumulated volume in the storage reservoir

The water balance equation is applied on an annual basis such that the inflow into the storage reservoir is equivalent to the outflow from the storage reservoir over one year.

3.5.1.1 Recycled Water Flow into Storage, Q_{WW}

The recycled wastewater flow into the reservoir pond (Q_{ww}) was detailed in Section 3.4 and assumes that the proposed wastewater collection system improvements outlined in Section 2.5 will reduce I/I by 70%. Table 3.4 describes the wastewater flow regime into the storage reservoir during the non-discharge period and shoulder months. In addition to the wastewater flow, the cogeneration plant also discharges process water to the storage pond. These discharges are estimated to contribute on average 10,000 gpd to the storage reservoir.

3.5.1.2 Precipitation into Storage, PPT_{in}

The conservative approach to estimating the amount of precipitation into the storage reservoir (PPT_{in}) assumes a heavy spring rain associated with a 100-year event. The volume of the 100-year event was scaled to a heavy spring event. This approach ensures that the storage and distribution systems are designed to handle the greatest anticipated flows. Table 3-8 summarizes the information.

Table 3-8
Wastewater Disposal System--Projected 100-year, Wet Spring Precipitation Event
TOS Detailed Engineering Analysis

Month	2005 PPT[1] Data (in/mo.)[2,3]	2005 Monthly PPT Distribution[2] (%)[4]	100-year Annual PPT Event Scaled to 2005 Distribution[2] (in/mo)	100-year Annual PPT Event Scaled to 2005 Distribution[2] (in/day)[5]
Jan	7.6	11.95	9.58	0.31
Feb	3.98	6.26	5.02	0.18
Mar	8.36	13.15	10.54	0.34
Apr	5.96	9.37	7.52	0.25
May	4.64	7.30	5.85	0.19
June	2.77	4.36	3.49	0.12
July	0.01	0.02	0.01	0.00
Aug	0	0.00	0.00	0.00
Sept	0.03	0.05	0.04	0.00
Oct	1.48	2.33	1.87	0.06
Nov	7.32	11.51	9.23	0.31
Dec	21.43	33.71	27.03	0.87
Totals	**63.58**	**100**	**80.18**	**--**

1. PPT: Precipitation
2. From W&K, October 11, 2006b
3. in/mo.: inches per month
4. %:percent
5. in/day: inches per day

In order to accurately calculate the storage requirements of the recycled water storage and distribution system, the catchment area for precipitation into the storage must be calculated. The post WWTF precipitation catchment surfaces include the log pond, three treatment ponds, and approximately 5 additional acres of land that drain to the ponds. Table 3-9 summarizes the catchment areas.

Table 3-9
Wastewater Disposal System--Storage Rainfall Catchment Areas[1]
TOS Detailed Engineering Analysis

Rainfall Catchment Component	Surface Area (SF)[2]
Log Pond	1,089,000
Treatment Pond #1	22,500
Treatment Pond #2	40,500
Treatment Pond #3	37,500
Additional Catchment	217,800
Total	**1,407,300**

1. Includes areas where precipitation contributes to storage requirement
2. SF: square feet

For the purposes of this analysis, the log pond is considered the storage reservoir. The amount of water entering the storage reservoir is dependent upon the catchment area, which is approximately 1,407,300 square feet. Table 3-10 summarizes the flow rates into the log pond due to precipitation.

Table 3-10
Wastewater Disposal System--Precipitation Rate into Log Pond
TOS Detailed Engineering Analysis

Month	100-year Annual PPT[1] Event Scaled to 2005 Dist.[2] (in/day)[3]	100-year Annual PPT Event Scaled to 2005 Dist. (ft/day)[4]	Catchment Area (SF)[5]	Precipitation Rate into Log Pond[6] (gpd)[7]
Jan	0.31	0.026	1,407,300	271,937
Feb	0.18	0.015	1,407,300	157,899
Mar	0.34	0.028	1,407,300	298,254
Apr	0.25	0.021	1,407,300	219,304
May	0.19	0.016	1,407,300	166,671
June	0.12	0.010	1,407,300	105,266
July	0.00	0.000	1,407,300	0
Aug	0.00	0.000	1,407,300	0
Sept	0.00	0.000	1,407,300	0
Oct	0.06	0.005	1,407,300	52,633
Nov	0.31	0.026	1,407,300	271,937
Dec	0.87	0.073	1,407,300	763,179

1. PPT: Precipitation
2. Based on 100-year storm scaled to 2005 monthly rainfall distribution
3. in/day: inches of rain per day
4. ft/day: feet of rain per day
5. SF: Square Feet
6. Precipitation rate into log pond determined by multiplying the catchment area by the precipitation rate.
7. gpd: gallons per day

3.5.1.3 Evaporation from Storage, E_s

The evaporation from the storage reservoir and treatment ponds (E_s) was estimated using the pan evaporation rate for the Western Regional Climate Center (WRCC) Ferndale Substation. The monthly data represent 10-year averaged data (from 1963 to 1973). The pan evaporation value was adjusted for a large water body by multiplying by a factor of 1.3 (Linacre, 1994). The additional catchment area, presented in Table 3.9 was not included in the area of storage surface for evaporation purposes. In order to determine the evaporation from the log pond, the following equation is used:

$$E_s = E_o \times F \times A \qquad \textbf{Equation 3.8}$$

Where:

E_s = Log Pond Evaporation rate
E_o = Pan Evaporation rate
F = Large water body adjustment factor
A = Area of storage surface

Table 3-11 presents evaporation rates for the system's storage reservoir.

Table 3-11
Wastewater Disposal System--Evaporation Rate From Storage Reservoir
TOS Detailed Engineering Analysis

Month	$[E_o]$[1] (in/mo)[2]	[F][3]	Adjusted Evaporation from Large Water Body Surface (in/mo)	Adjusted Evaporation from Large Water Body Surface (ft/day)[4]	[A][5] (SF)[6]	$[E_s]$[7] (gpd)[8]
Jan	0.7	1.3	0.91	0.002	1,189,500	21,765
Feb	1.17	1.3	1.521	0.003	1,189,500	30,982
Mar	2.26	1.3	2.938	0.006	1,189,500	54,054
Apr	3.21	1.3	4.173	0.009	1,189,500	79,336
May	3.95	1.3	5.135	0.011	1,189,500	94,476
June	4.38	1.3	5.694	0.012	1,189,500	108,252
July	4.49	1.3	5.837	0.012	1,189,500	107,391
Aug	4.07	1.3	5.291	0.011	1,189,500	97,346
Sept	3.59	1.3	4.667	0.010	1,189,500	88,727
Oct	2.06	1.3	2.678	0.006	1,189,500	49,271
Nov	1.04	1.3	1.352	0.003	1,189,500	25,704
Dec	0.72	1.3	0.936	0.002	1,189,500	17,221
Total	31.6 in/yr[9] (80.4 cm/yr)[10]	---	41.1 in/yr (104.5 cm/yr)	---	---	23.6 MGD[11]

1. E_0: Pan Evaporation; from WRCC Ferndale Station
2. in/mo: inches per month
3. F: Large water body adjustment factor (Linacre, 1994), unitless
4. ft/day: feet per day; calculated by dividing the adjusted evaporation rate in feet per month by the number of days per month
5. A: Storage Surface Area
6. SF: Square Feet
7. E_s: Evaporation from Storage; calculated using Equation 3.8
8. gpd: gallons per day
9. in/yr: inches per year
10. cm/yr: centimeters per year
11. MGD: Million Gallons per Day; total calculated by multiplying the gallons per day by the number of days per month and summing for the year

3.5.1.4 Storage Requirements

In order to determine the storage requirements of the log pond, the water budget equation (Equation 3.6) is used. Because discharge to the Eel River is permitted until May 15 of each year and after September 30 of each year, the storage requirements were only calculated for the non-discharge period (May 15 through September 30). The required monthly storage space was determined by dividing the monthly accumulated precipitation and discharge volume by the surface area of the log pond. Table 3-12 summarizes the findings of the storage requirements for the summer non-discharge period.

Table 3-12
Storage Requirements During Non-Discharge Period
TOS Detailed Engineering Analysis

Month	Q^1 (gpd) [2]	$PPT_{in}{}^3$ (gpd)	$E_s{}^4$ (gpd)	ΔS^5 (gpd)	Monthly Storage Requirements (gallons/month)	Log Pond Elevation Change (feet/month)
May	184,000	166,671	94,476	256,196	4,355,324	0.53
June	184,000	105,266	108,252	181,014	5,430,408	0.67
July	149,000	0	107,391	41,609	1,289,867	0.16
Aug	149,000	0	97,346	51,654	1,601,278	0.20
Sept	149,000	0	88,727	60,273	1,808,177	0.22

1. Q: wastewater + cogeneration plant process water discharges
2. gpd: gallons per day
3. PPT_{in}: precipitation into storage
4. E_s: evaporation from storage
5. ΔS: change in storage

Based on SHN's analysis using the log pond as the recycled water storage basin, approximately 1.78 feet of free board space would be required to store the 14.5 million gallons of accumulated water. The accumulated water results from recycled water flows (Q) and precipitation into the log pond and treatment ponds (PPT_{in}) exceeding the evaporation rate out of the log pond and treatment ponds (E_s). Discussion with operating personnel indicates that the log pond can be drawn down at least 2 feet prior to May 15 of each year (Vogt, 2007). Therefore, the existing log pond will not require modifications to serve as the storage basin for accumulated recycled water flows.

3.5.1.5 Optional Uses of Recycled Water

Recycled water from the WWTF that is stored in the log pond could be used for a variety of uses including application to roads for dust suppression, use in the cogeneration plant cooling towers, irrigation of parks, or stored in the log pond until the non-discharge period is over (October 1). The stored water could then be released to the Eel River as long as the discharge does not exceed 1% of the Eel River flow and meets regulatory requirements. SHN proposes that application options and demand for the recycled water be further studied. TOS has expressed preliminary interest in using the recycled water for dust suppression on roads and has estimated the demand to be approximately 200,000 gpd, during the dry season.

3.5.2 Sludge Disposal

SHN proposes a modification of the current Scotia WWTF sludge disposal practices. The modification includes dewatering of WWTF sludge and land application at the tree farm that was part of the PALCO property and will be conveyed to the Humboldt Redwood Company (HRC) after the subdivision has been completed. Scotia WWTF biosolids have not been analyzed for chemical composition. There are several application methodologies to determine the location and rate of acceptable land application. These application methodologies are contingent upon certain chemical aspects of the biosolids.

For the purposes of land application of Scotia's WWTF biosolids, two application methodologies are relevant: (1) pollutant loading and (2) nutrient loading. Pollutant loading methods can be described by using Equation 3.1. In accordance with 40 CFR Part 503, bulk sewage sludge must be land-applied at the agronomic rate for nitrogen at the application site. Therefore, the preliminary design methodology for land application of biosolids at the tree farm is based on the agronomic uptake rates at the tree farm.

3.5.2.1 Scotia Biosolids Chemical Composition

Scotia WWTF biosolids have not been analyzed for metals (see Table 3-3 for required list), nutrients (nitrogen, phosphorus, potash, organic matter), pathogens (total fecal coliform, *salmonella* sp., or viable helminth ova), or vector attraction attributes. The composition of the biosolids must be fully characterized in order to determine the proper disposal methods.

In order to anticipate the disposal method of biosolids, the sludge composition for primary treated sludge was projected from Metcalf and Eddy, 4th Edition. Table 3-13 summarizes the projected composition.

Table 3-13
Typical Chemical Composition and Properties of Digested Sludge[1]
TOS Detailed Engineering Analysis

Component	Composition (Range)
Total Dry Solids (%)[2]	2.0-5.0
Volatile Solids (% of TS)[3]	30-60
Grease and Fats (% of TS)	5-20
Protein (% of TS)	15-20
Nitrogen (% of TS)	1.6-6.0
Phosphorus (P_2O_5, % of TS)	1.5-4.0
Potash (K_2O, % of TS)	0.0-3.0
Cellulose (% of TS)	8.0-15.0
Iron (% of TS)	3.0-8.0
Silica (SiO_2, % of TS)	10.0-20.0
pH	6.5-7.5
Alkalinity (mg/L as $CaCO_3$)[4]	2,500-3,500
Organic Acids (mg/L as HAc[4])	100-600

1. From Metcalf and Eddy, 4th Edition
2. %: percent by mass
3. TS: Total Solids
4. mg/L as $CaCO_3$: milligrams per liter as calcium carbonate
5. HAc: Acetic Acid

The nitrogen content of Scotia's WWTF treated wastewater effluent is currently not known. However, the nitrogen content of the anaerobically treated sewage sludge can be estimated from information presented in EPA's *Process Designing Manual, Land Application of Sewage Sludge and Domestic Septage* (EPA, 1995). Table 3-14 summarizes the total nitrogen content and speciation of nitrogen in anaerobically treated sludge. The concentrations and% composition are on a dry solids basis.

Table 3-14
Nitrogen Concentrations[1] and Annual Mass Production in Anaerobically Digested Sludge
TOS Detailed Engineering Analysis

Nitrogen Speciation	Mean Value[1,2]	Annual Mass Produced[3] (kg)[4]	Annual Mass Produced (lb/acre)[5]
Total Kjeldahl Nitrogen	5.0 (%)[6]	930	25.6
NH_4^+ - N(7)	9,400 (mg/kg)[8]	175	4.8
NO_3^- - N(9)	520 (mg/kg)	10	0.3
Organic Nitrogen[10]	-	745	20.5

1. From EPA 1995: EPA's *Process Designing Manual, Land Application of Sewage Sludge and Domestic Septage*
2. Concentrations and% composition are on a dried solids basis.
3. Based on assumed annual dried sludge production of 35,000 pounds
4. kg: kilogram
5. lb/acre: pound per acre, based on 80 acres
6. %:percent by mass
7. NH_4^+ - N: Nitrogen concentration in the form of ammonium
8. mg/kg: milligrams per kilogram
9. NO_3^- - N: Nitrogen concentration in the form of nitrate
10. Organic nitrogen is determined by subtracting the nitrogen as ammonium and the nitrogen as nitrate from the total nitrogen (EPA, 1995).

3.5.2.2 Tree Farm Nitrogen Agronomic Rate

Agronomic rate limited land application of biosolids is intended to prevent nitrogen over-application by matching the application rate of the nitrogen to the nitrogen uptake rates of the redwood trees within the tree farm. Nitrogen uptake rates for redwoods have not been studied. Table 3-15 shows the nitrogen agronomic uptake rate for a variety of trees.

Table 3-15
Literature Values for Tree Nitrogen Uptake Rates
TOS Detailed Engineering Analysis

Species of Tree	Nitrogen Uptake Rate (kg/ha/yr)[1]	Nitrogen Uptake Rate (lb/acre/yr)[2]	Reference
Hybrid Poplar	300	267.9	EPA, 1995
Hybrid Cottonwood	280	250.0	EPA, 1995
Douglas Fir	200	178.6	EPA, 1995
Hemlock	44	39.3	Ducnuigeen et al., 1997

1. kg/ha/yr: kilogram per hectare per year
2. lb/acre/yr: pounds per acre per year

Because the nitrogen uptake rate for redwoods has not been studied, we used the hemlock nitrogen uptake rate to provide a conservative estimate.

3.5.2.3 Nitrogen Mineralization

Not all forms of nitrogen are available for plant uptake. Plant-Available Nitrogen (PAN) in the form of ammonium (NH_4^+) and nitrate (NO_3^-), must be calculated to determine the actual amount of nitrogen available for plant uptake.

In order to estimate the land application rate of biosolids at the HRC tree farm, the PAN application rate was compared to the nitrogen uptake rate of redwood. Mineralization is the process where organic nitrogen (nitrogen that is stored in cellular material) is slowly converted to ammonium (NH_4^+) as the applied biosolids decompose. Literature values for estimating the nitrogen mineralization rate for anaerobically digested sludge are available and presented in Table 3-16 (EPA, 1995).

Table 3-16
Organic Nitrogen Mineralization Rates for Anaerobically Digested Sludge[1]
TOS Detailed Engineering Analysis

Time After Application (Years)	Fraction of Organic Nitrogen Mineralized
0-1	0.20
1-2	0.10
2-3	0.05

1. From EPA, 1995

3.5.2.5 Ammonia Volatilization

The loss of nitrogen through volatilization of ammonium as ammonia (NH_3) must be accounted for when budgeting nitrogen. Volatilization is dependent upon many factors (such as weather conditions, application method, duration sludge is on surface before being incorporated into the subsurface, and pH of the soil). A 50% loss of nitrogen (in the form of NH_3 by volatilization was estimated for land application of irrigation water and for land applied biosolids (EPA, 1995).

3.5.2.6 Nitrogen Losses due to Denitrification, Fixation, and Immobilization

Denitrification is the process by which nitrogen as NO_3^- is lost to the atmosphere as nitrogen (N_2) or nitrous oxide (NO_2) gases through reductive processes. Fixation is the process by which nitrogen is chemically fixed inside the cells of microbes, which can then be gradually released similarly to the nitrogen mineralization process described in Section 3.5.2.5 (Tchobanoglous et al., 1987). Immobilization of nitrogen occurs in soils containing hydrous mica clay minerals. The process involves NH_4^+ becoming fixed within crystal lattices normally occupied by potassium cations (K^+). The *EPA Process Design Manual* indicates that nitrogen losses due to denitrification, fixation, and immobilization may only be included if approved by a regulatory agency (EPA, 1995). In order to provide a conservative estimate, these losses were not included in the calculations.

3.5.2.7 Nitrogen Loading on the Tree Farm from Land Application of Biosolids

The nitrogen loading at the tree farm was calculated for land application of the biosolids. Literature values for sludge composition were used because analytical data is not available for TOS sludge. Table 3.17 summarizes the yearly nitrogen loading from biosolids application and includes a percentage of the agronomic demand for redwood trees supplied by the biosolids.

Table 3-17 Biosolids PAN[1] Loading and Percent Agronomic Demand TOS Detailed Engineering Analysis		
Years after Discharge Commences	PAN Loading from Land Application of Biosolids[1] (lb/acre)[2]	Percentage of Tree Farm Nitrogen Agronomic Demand Met[3] (%)[4]
1	6.77	17.2
2	8.41	21.4
3	9.15	23.3
4	9.15	23.3
5	9.15	23.3
6	9.15	23.3

1. PAN: Plant-Available Nitrogen; PAN from nitrate, ammonium assuming 50% loss due to volatilization, and PAN from mineralization of organic nitrogen
2. lb/acre: pounds per acres
3. Determined by dividing the loading rate from biosolids by the agronomic demand for hemlock (39.3 lb/acre/year)
4. %: percent by mass

3.5.2.8 Biosolids Handling

Sludge from the Scotia WWTF would be dewatered prior to being stored. Sludge is not currently dewatered prior to trench disposal. The dewatering method has not been determined, though SHN anticipates the use of drying beds, as land is readily available and operation and maintenance of drying beds is relatively low. Biosolids can be applied to mature forests year-round (EPA, 1995).

The preliminary surface area requirements for an uncovered paved drying bed can be estimated using Equation 3.9 from Metcalf and Eddy, 4th Edition (Tchobanoglous et al., 2003).

$$A = (1.04*S*[(1-Sd)/Sd-(1-Se)/Se] + 10^3\ kg/m^3*P*A)/(10*Ke*Ep) \qquad \textbf{Equation 3.9}$$

Where:

- A = area of uncovered paved drying bed (in square meters [m^2])
- 1.04 = the assumed specific gravity of biosolids
- S = annual sludge production, dry solids, kg/yr
- Sd = percent dry solids in sludge
- Se = percent dry solids required
- P = annual precipitation rate (m/yr)
- 10 = conversion factor for cm/yr to $kg/m^2/yr$
- Ke = reduction factor for evaporation from sludge versus evaporation from free water surface
- Ep = free water pan evaporation rate (cm/yr)

However, the drying bed would have to be covered because of the high precipitation rates in Humboldt County. The sides of the drying bed would remain open to allow for free air flow. Therefore, Equation 3.10 will be used to estimate the preliminary surface area requirements for a covered paved drying bed, assuming a conservative 33% reduction in evaporation rate due to the loss of direct sun exposure.

$$A = (1.04*S*[(1-Sd)/Sd-(1-Se)/Se])/(10*Ke*Ep*0.66) \qquad \textbf{Equation 3.10}$$

Where:

A	=	area of covered paved drying bed (m^2)
1.04	=	the assumed specific gravity of biosolids
S	=	annual sludge production, dry solids, kg/yr
Sd	=	percent dry solids in sludge, as a decimal
Se	=	percent dry solids required, as a decimal
10	=	conversion factor for cm/yr to $kg/m^2/yr$
Ke	=	reduction factor for evaporation from sludge versus evaporation from free water surface
Ep	=	free water pan evaporation rate (cm/yr)
0.66	=	reduced pan evaporation rate due to loss of direct solar exposure

Table 3-18 summarizes the values and references used to calculate the aerial requirement. The preliminary design area to effectively dry the biosolids produced annually from the Scotia WWTF to 15% dry solids is 1,060 square meters (m^2).

Table 3-18
Sludge Drying Bed Area Requirements

Parameter[1]	Assigned Value	Reference
S[2]	18,600 kg/yr[3]	From Section 3.4.2
Sd[4]	0.03	Metcalf and Eddy, 4th Edition
Se[5]	0.15	Assumed value of 15% solids to reduce mass for transportation purposes.
Ke[6]	0.6	Metcalf and Eddy, 4th Edition
Ep[7]	104.5 cm/yr[8]	From Table 3-11.
A[9]	1,250 m^2	Equation 3.10

1. Parameters from Equation 3.10
2. S: annual sludge production, dry solids
3. kg/yr: kilogram per year
4. Sd: percent dry solids in sludge, as a decimal
5. Se: percent dry solids required, as a decimal
6. Ke: reduction factor for evaporation from sludge versus evaporation from free water surface
7. Ep: free water pan evaporation rate
8. cm/yr: centimeter per year
9. A: paved, covered sludge drying bed area

3.5.2.10 Preliminary Costs

Table 3-19 outlines the major components and costs associated with the proposed sludge disposal option.

Table 3-19 Estimated Costs of Sludge Disposal Option (Revised 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$20,000	$20,000
Equipment				
Biosolids transportation truck	Each	1	$50,000	$50,000
Skid Steer	Each	1	$50,000	$50,000
Manure Spreader	Each	1	$15,000	$15,000
Construction				
Sludge Drying Bed	LS	1	$100,000	$100,000
Install groundwater monitoring wells	Each	8	$5,000	$40,000
Sludge Disposal Cost Subtotal				**$275,000**
Engineering[2] (20%)				$55,000
Contingency (20%)				$55,000
Total Sludge Disposal Option Cost, Call:				**$385,000**

1. LS: Lump Sum
2. Engineering includes design, permitting, and construction management for the project.

3.5.3 Issues of Operation

This section lists the performance limiting factors that were identified for the CSD formation during the course of this study. Below each issue of operation is a recommendation in *Italics* that may reduce or eliminate the issue. No priority is given to issues and recommended solutions.

Issue 1: Compliance with RWQCB Order No. R1-2006-0020 requirement that a written commitment to modify the existing treatment/disposal methods and a schedule of tasks to develop a study plan for selection and implementation of a treatment/storage method be prepared by March 30, 2007. The proposal to study the disposal alternatives must be prepared by March 2010. The proposal study must be completed by September 30, 2016.

Recommendation 1: TOS has completed the written commitment and schedule of tasks and submitted them to the RWQCB. A study plan for selection and implementation of alternatives for disposal of wastewater effluent during the summer non-discharge period and biosolids will be prepared.

Issue 2: The wet weather inflow and infiltration has not been clearly determined from the base wastewater flow.

Recommendation 2: TOS is currently performing a wet weather flow study of the wastewater collection system to determine the amount of I/I.

Issue 3:	The characteristics and annual production rates of the Scotia WWTF sludge are unknown, thus limiting the accuracy of the disposal alternative evaluation.
Recommendation 3:	*TOS has submitted a schedule to the RWQCB to study the annual sludge production rates at the Scotia WWTF. Additionally, samples will be collected and submitted to an analytical laboratory to determine the pathogen content, pollutant and nutrient concentrations, and vector attraction characteristics.*
Issue 4:	Wastewater effluent is currently stored in the log pond and is proposed to continue to be so stored. Water within the TOS log pond is used by HRC for industrial cooling processes. TOS is considering the use of log pond water as dust suppression for roads during the dry months of the year. The regulatory acceptability of applying treated wastewater effluent to roads for dust suppression has not been determined.
Recommendation 4:	*Coordination with the RWQCB will be performed to determine the regulatory acceptability of application of recycled water to roads for dust suppression during dry months.*
Issue 5:	TOS currently uses the log pond water for the backup fire suppression system.
Recommendation 5:	*TOS will identify an alternate source of water for the backup fire suppression system or apply for regulatory clearance to use the log pond water, which includes treated secondary effluent, for the fire suppression system.*
Issue 6:	TOS, HRC, and the CSD will use and benefit from the recycled water use, log pond storage, and land application of biosolids.
Recommendation 6:	*A Memorandum Of Understanding (MOU) needs to be prepared between the CSD, HRC, and TOS for access to the log pond and tree farm for biosolids application. Costs for operation and maintenance of the biosolids disposal and recycled water use will be covered by the monthly rates assessed to the CSD customers, including HRC.*
Issue 7:	Pan evaporation rates for the town of Scotia are estimated using available data for Ferndale.
Recommendation 7:	*A study will be conducted to determine the pan evaporation rate for the town of Scotia, specifically near the log pond and the treatment ponds.*
Issue 8:	Site characteristics for the HRC tree farm have not been analyzed to determine the efficacy of land application of biosolids.

Recommendation 8:	*Perform a pilot study to determine the agronomic uptake rate of redwoods. The pilot study will also include soil sampling to determine background metals and nutrient concentrations.*
Issue 9:	The tree farm is the preferred option for land application of biosolids. However, through characterizing biosolids and site conditions, the tree farm may not be suitable for biosolids disposal.
Recommendation 9:	*Additional sites will be identified (if necessary) for the land application of biosolids and irrigation using wastewater effluent from the log pond.*
Issue 10:	The drying bed was the only sludge drying option evaluated.
Recommendation 10:	*Additional sludge drying options will be identified and a comparative engineering analysis, performed to determine the appropriate sludge drying technology.*

4.0 Water Distribution

4.1 Introduction

The following sections describe the water distribution system and fire system in the town of Scotia and assesses the current condition of the systems' infrastructure. Facility descriptions including sizes, condition, and capacity are presented, along with recommendations for new water lines and service connections. In addition, recommendations are made for system improvements deemed technically appropriate to meet user level of service expectations and state standards.

Raw water from the Eel River intake diversion is pumped to a raw water storage and settling tank. Raw water then gravity flows to two fire storage tanks or to the Water Treatment Facility (WTF) as demand dictates. Treated water gravity flows to a finish water storage tank for domestic use in Scotia and the HRC mill, or to the cogeneration plant for make-up water. The components of the water system are shown on Figures 4-1 and 4-2 (fire lines not included).

4.2 System Description

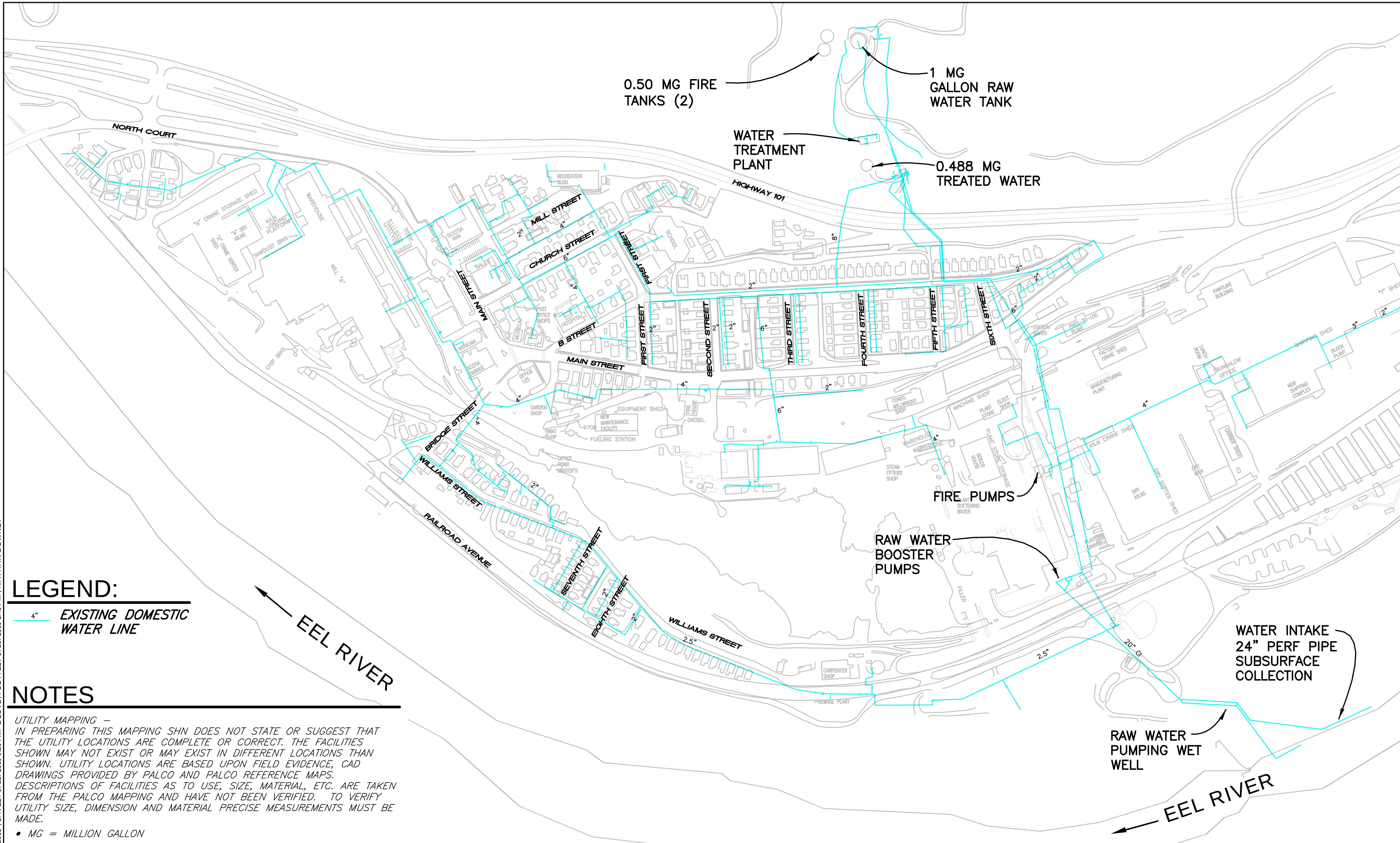
This section describes the major system components of both the domestic and fire suppression water systems in greater detail. The majority of pipe in the fire system is made of cast-iron and was installed prior to 1940. The majority of pipe in the domestic water system is steel and cast-iron and was also installed prior to 1940. Scotia's domestic water distribution system is classified as D-1 (population served 1,000 or less) by the California Department of Health Services (DHS). The treatment system is classified as T-2 (small, well performing, and operated system) by the DHS.

4.2.1 Domestic Water System

Scotia's existing domestic water system is owned, operated, and maintained by TOS. The system serves residential, commercial, and industrial customers within Scotia. There are approximately 272 residential, 15 commercial, and 20 industrial connections within the system. Water usage by residential customers is not metered. The main industrial water users in Scotia are the HRC mills and the cogeneration plant, whose usage is metered, and the Eel River brewery. Industrial customers use on average slightly more than half of all water produced at the WTF.

Raw water enters the domestic water system through an infiltration gallery constructed in 1966. The gallery consists of two, 24-inch perforated steel pipes totaling 1,100 feet in length, located in the Eel River gravel bed slightly more than 10 feet below the low river water level (see Figure 4-2). Water enters the pipes and flows by gravity to a concrete collection well, located on the river bank. The collection well currently contains two, 125-hp Byron Jackson submersible pumps, each capable of producing 1,500 gallons per minute (gpm). Both pumps were installed in 1995, and one pump runs constantly. Their operation alternates monthly. The pumps discharge into 10-inch steel pump columns followed by 12-inch CIPs. The 12-inch pipes join into a single 20-inch cast-iron water supply line.

Approximately 800 feet from the collection well, the 20-inch pipe splits into separate lines for the domestic and fire systems. The domestic line is a 12-inch CIP that reduces to two, 8-inch pipes that connect to two, 150-hp Ingersoll-Rand horizontal split case pumps, each having a 1,200 gpm



LEGEND:

4" EXISTING DOMESTIC WATER LINE

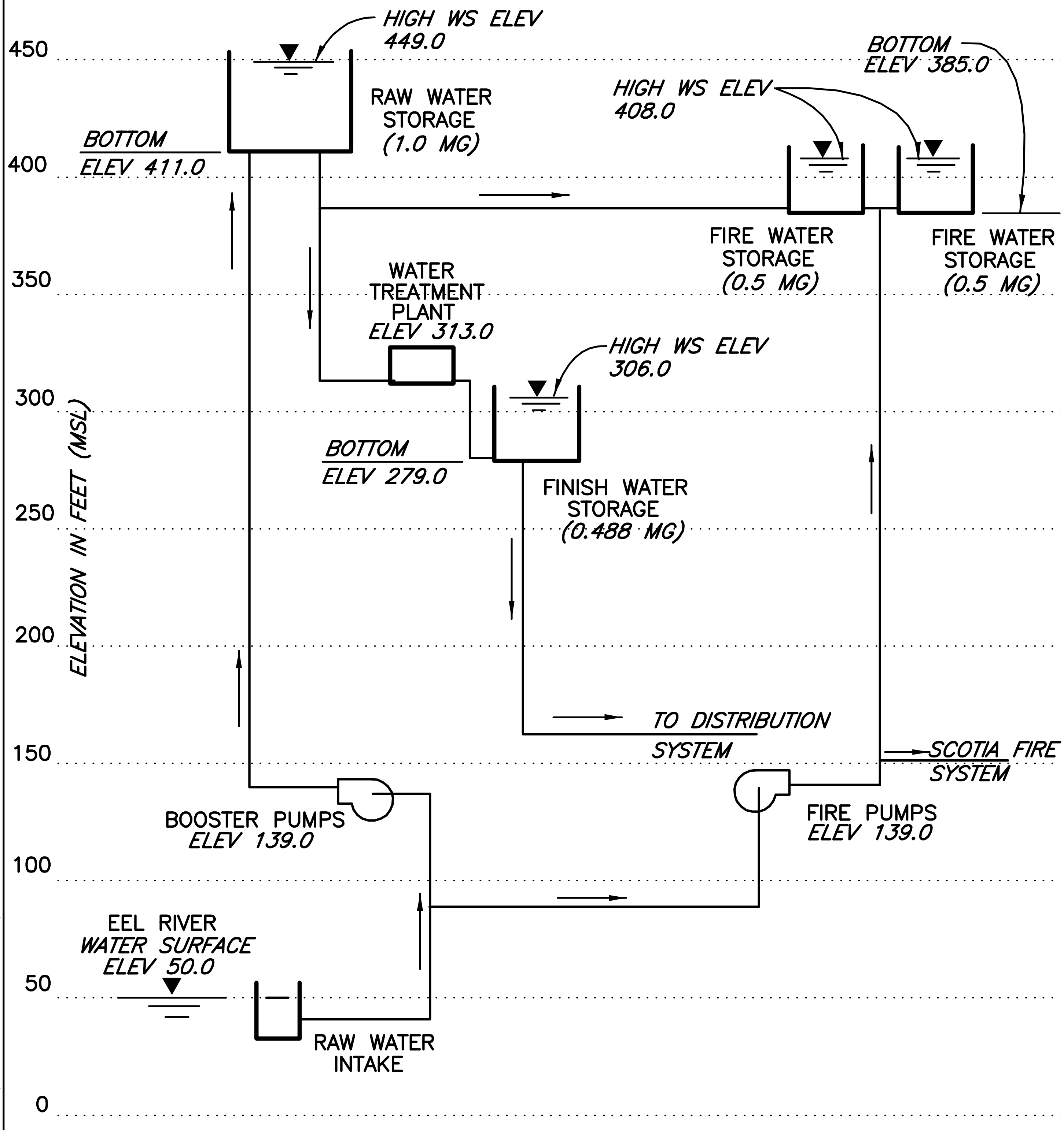
NOTES

UTILITY MAPPING –
IN PREPARING THIS MAPPING SHN DOES NOT STATE OR SUGGEST THAT THE UTILITY LOCATIONS ARE COMPLETE OR CORRECT. THE FACILITIES SHOWN MAY NOT EXIST OR MAY EXIST IN DIFFERENT LOCATIONS THAN SHOWN. UTILITY LOCATIONS ARE BASED UPON FIELD EVIDENCE, CAD DRAWINGS PROVIDED BY PALCO AND PALCO REFERENCE MAPS. DESCRIPTIONS OF FACILITIES AS TO USE, SIZE, MATERIAL, ETC. ARE TAKEN FROM THE PALCO MAPPING AND HAVE NOT BEEN VERIFIED. TO VERIFY UTILITY SIZE, DIMENSION AND MATERIAL PRECISE MEASUREMENTS MUST BE MADE.

- *MG = MILLION GALLON*

NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USEING INFORMATION RECEIVED FROM PALCO. ADDITIONAL WATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Analysis Scotia, California		Existing Domestic Water Supply System SHN 005161.903
	May 2009	005161-903-BASE_4-1	Figure 4-1



SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Analysis Scotia, California	Existing Scotia Water and Fire System Hydraulic Profile SHN 005161.903
	May 2009 / 005161-903-flow-dia_4-2	Figure 4-2

pumping capacity. These pumps were originally installed in the 1940s and have since been rebuilt. One pump was rebuilt in 1994, and the other was rebuilt in 2004 (SHN, August 10, 2006). The domestic booster pumps rotate every cycle of operation.

The domestic booster pump outlet piping tees and discharges into a recently installed, aboveground 8-inch PVC pipe, which transitions to an underground 12-inch transite (asbestos cement) pipe installed in the 1970s. This pipe conveys water to the WTF where coagulant is injected directly into the pipe upstream of an in-line mixer. A 12-inch steel pipe transports water from the WTF to a 1-MG tank. The 1.0-MG raw water storage tank also serves as a clarifier/settling tank where coagulated materials can settle out of the raw water prior to filtration. The tank was constructed in 1966 and sits at a bottom tank elevation of approximately 411 feet. It requires annual cleaning to remove settled materials. The water level in the tank controls the operation of the domestic booster pumps.

Water flows by gravity from the 1.0-MG raw water storage tank to the WTF at an elevation of approximately 313 feet through 10-inch steel outlet pipes located approximately 17 feet above the tank bottom elevation (a lower outlet exists for emergency situations). The treatment train consists of two pressure filters, flow meter, chlorinator, and a fluoridation system, which is currently off-line. The treatment facility is in overall good condition and is well maintained. The WTF currently operates at approximately 800 gpm for about 8 hours per day. In the winter, raw water turbidity ranges between 300 to 400 Nephelometric Turbidity Units (NTU); in the summer, the turbidity drops to about 1 NTU. Treated water leaving the WTF has 0.05 to 0.1 NTU year-round. Further discussion of the WTF can be found under "Chapter 5: Water Treatment" of this document.

The treated, filtered water then flows through a 10-inch steel pipe to a 0.488-MG finished water storage tank of welded steel construction, which supplies the domestic system of Scotia with excellent quality water. This tank was constructed in 1990 and sits at a bottom tank elevation of about 279 feet. An altitude valve is in place between the finished water storage tank and the 1.0-MG raw water storage tank. When the water level drops to a depth of approximately 18.5 feet in the finished water storage tank, the altitude valve opens, filling the finished water storage tank. The altitude valve closes after the tank fills to about 27 feet (W&K, September 6, 2006).

The raw water and finish water storage tanks appear structurally sound, with no evidence of leaks, cracks, split seams, or foundation problems. The vents on those two tanks appear to be adequately screened. There are no trees or roots in near proximity of either of the tanks. The exterior finish on the raw water storage tank appears to be in good condition. The exterior paint on the finished water storage tank shows significant surface oxidation and some staining associated with algal growth from water ponding and overflowing the rooftop. All hatch covers appear to be watertight.

The altitude valve associated with the finish water storage tank is functioning properly; however, the exterior shows some rust. All access points and valve boxes are adequately secured. Connections to the foundation could not be observed; however, considering the age of the tank, it is unlikely that there are provisions for significant earthquake resistance.

A base map of the existing domestic water distribution system is presented in Figure 4-1. The entire system is in a single pressure zone served by the domestic water storage tank with a base elevation of 279 feet and an overflow elevation of approximately 306 feet. Based on the estimated overflow, elevation service pressures range from a low of approximately 50 pounds per square inch (psi) to a high of 100 psi. Pressure and service are reportedly adequate throughout the distribution system.

The majority of the distribution system was installed between the 1930s and 1940s. Current mapping provided by TOS and compiled by SHN has limited descriptions of the distribution facilities with respect to use, size, and material. Table 4-1 presents an inventory of estimated lengths of pipe in the existing domestic water system.

Table 4-1
Inventory of Existing Domestic Water Distribution System
TOS Detailed Engineering Analysis

Diameter (inches)	Material	Year of Installation	Pipe Length (feet)[1]
1	PVC[2]	1970s to Present	975
1.5	Galvanized Iron	1930s-1940s	225
2	Steel/Galvanized Iron	1930s-1940s	13,450
2.5	Cast Iron	1930s-1940s	4,050
3	Cast Iron	1930s-1940s	300
4	Cast Iron	1930s-1940s	9,080
6	Cast Iron	1930s-1940s	4,275
8	Cast Iron	1930s-1940s	1,320
Unknown	Unknown	1930s-1940s	3,345
Total	---	---	**37,020**

1. All estimates are approximate and based on best available information.
2. PVC: Polyvinyl Chloride

Amounts of unknown sized pipe are attributable to the lack of pipe sizing information on the maps made available to SHN. All pipes labeled with diameter sizes were accounted for in the estimates. More than half of the pipe is less than 2 inches in diameter and the majority of this pipe is steel. All of the pipe greater than 4 inches in diameter is cast–iron installed before 1940. This early cast iron pipe is more brittle than ductile cast-iron pipe, and is subject to catastrophic failure or breaking as the pipe ages.

A large proportion of the water system is 2-inch unlooped pipe. The unlooped nature of the system is a concern because there is potential for flow reversals and water hammer, which may contribute to breakage or leaks in pipe connections.

The domestic water system can also be used to back-up the fire suppression water system in the case of insufficient fire flows, by opening gate valves in the 1.0-MG storage tank's outlet piping, which directs water to the two 0.5-MG fire storage tanks. The overflow from the 1.0-MG tank is also directed to the fire tanks.

The 1.0-MG tank can also be filled by a creek located behind the tank under emergency situations.

W&K staff performed a survey of the domestic water distribution system's isolation valves in June 2006 (W&K, September 6, 2006). Survey results indicate most valves within the system:

a) are leaking, as evidenced by standing water in several valve-boxes;
b) turn, but do not actuate the gates; or
c) begin to leak when actuated.

4.2.2 Fire Suppression Water System

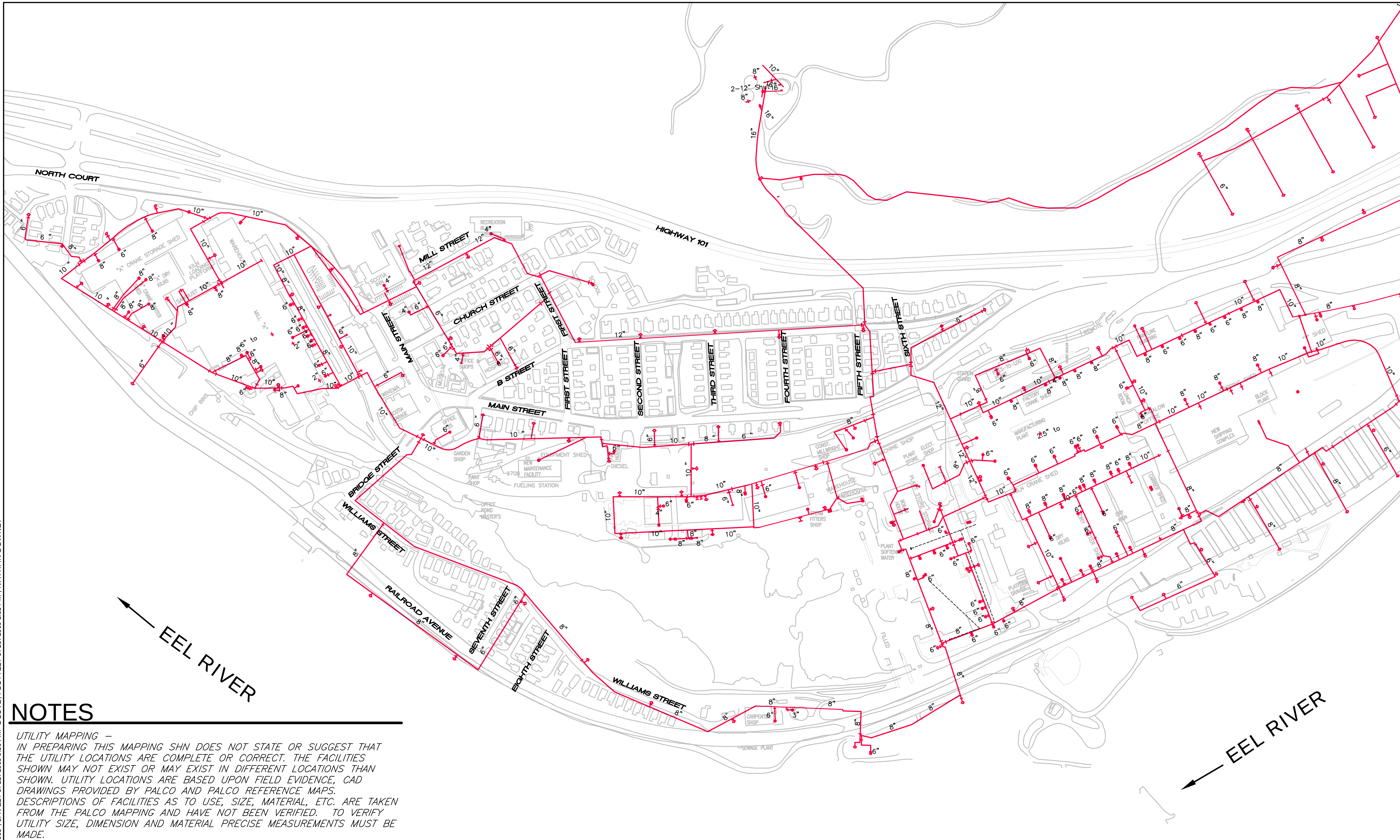
TOS's fire suppression water system splits from the domestic water system and the 20-inch cast iron pipe coming from the collection well. Water is boosted at a pump station, consisting of two horizontal split case Fairbanks Morse pumps. The first pump is 150 hp and is rated at 1,000 gpm, and the second pump is 75 hp and rated at 500 gpm. Both pumps were installed in the 1950s and have been rebuilt since then; however, the dates of the last rebuilds are unknown. However, seals were replaced in early 2006 (W&K, September 6, 2006).

Water is boosted from the fire pumps' elevation of approximately 139 feet to supply water to the cogeneration plant and to two 0.5-MG fire suppression water storage tanks with a bottom tank elevation of about 385 feet through a 16-inch cast iron fire main installed in the 1930s. The fire suppression water storage tanks are showing their age. The exterior finish is oxidized and shows staining from minor leaks. The open top structures have allowed some algal and other vegetation growth to occur within the inside top of the tanks. There appears to be some significant rust scale formed in the upper inside rim of the tanks. Connections to the foundation could not be observed; however, considering the age of the tank, it is unlikely that there are provisions for significant earthquake resistance. TOS is currently evaluating options and establishing a plan to repair or replace the tanks within the next five years. The fire suppression water storage tank upgrade/replacement will take place as part of necessary maintenance, independent of the CSD formation project, and is not part of this proposal.

The 500-gpm booster pump runs constantly during winter months, and the 1,000-gpm booster pump runs constantly during summer months (W&K, September 6, 2006). The constant demand is due to the practice of keeping the fire tanks topped off and in overflow condition, and total system demands.

Fire flow from the 0.5-MG raw water storage tanks enters the fire distribution system through the same pipe that feeds the tanks from the booster pumps. A base map of the fire system (as provided by TOS) is presented in Figure 4-3. The fire system consists of mainly cast iron pipe varying in size from 4 inch to 16 inch. The system contains 146 fire hydrants, of which 100 are located on the HRC mill site, and 124 sprinkler riser systems. Of the total number of fire hydrants in Scotia, 129 are of a wet barrel type and the remaining are dry barrel hydrants. The majority of the dry barrel hydrants are located in residential areas, and industrial areas are outfitted with mainly wet barrel hydrants. Fire flow tests are performed regularly on the HRC mill's hydrants; they are monitored by the Insurance Service Office.

Two backup fire booster pumps are in place--one electric and one diesel. The electric pump is capable of pumping 2,000 gpm at 120 psi, and the diesel driven pump is capable of pumping 1,500 gpm at 102 psi (SHN, August 10, 2006). Both pumps intake raw water from the log pond and pump directly into the fire system in case of insufficient volumes in the fire suppression water storage tanks.



NOTES

UTILITY MAPPING –
IN PREPARING THIS MAPPING SHN DOES NOT STATE OR SUGGEST THAT THE UTILITY LOCATIONS ARE COMPLETE OR CORRECT. THE FACILITIES SHOWN MAY NOT EXIST OR MAY EXIST IN DIFFERENT LOCATIONS THAN SHOWN. UTILITY LOCATIONS ARE BASED UPON FIELD EVIDENCE, CAD DRAWINGS PROVIDED BY PALCO AND PALCO REFERENCE MAPS. DESCRIPTIONS OF FACILITIES AS TO USE, SIZE, MATERIAL, ETC. ARE TAKEN FROM THE PALCO MAPPING AND HAVE NOT BEEN VERIFIED. TO VERIFY UTILITY SIZE, DIMENSION AND MATERIAL PRECISE MEASUREMENTS MUST BE MADE.

NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USEING INFORMATION RECEIVED FROM PALCO. ADDITIONAL WATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Service Scotia, California	Existing Fire Protection Lines SHN 005161.903
	May 2009 / 005161-903-BASE_4-3	Figure 4-3

I:\2005\005161\005161.903 , SAVED: 5/12/2009 9:30 AM DLOVE, PLOTTED: 5/13/2009 1:53 PM , NATHAN DOWNEY

Table 4-2 presents an inventory of estimated pipe sizes and lengths in the fire system.

Table 4-2 Inventory of Existing Fire Suppression Water Distribution System TOS Detailed Engineering Analysis			
Diameter (inches)	**Material**	**Year of Installation**	**Pipe Lengths (feet)[1]**
4	Cast Iron	1930s-1940s	350
6	Cast Iron	1930s-1940s	10,340
8	Cast Iron	1930s-1940s	20,975
10	Cast Iron	1930s-1940s	16,000
12	Cast Iron	1930s-1940s	5,400
14	Cast Iron	1930s-1940s	920
16	Cast Iron	1930s-1940s	475
Unknown	Unknown	1930s-1940s	2,950
Total	--	--	**57,410**
1. All estimates are approximate and based on best available information.			

Table 4-3 summarizes tank information for both the domestic water and fire systems.

Table 4-3 Summary of Tank Information in Both Domestic and Fire Systems TOS Detailed Engineering Analysis								
Tank	**Type**	**Date Installed**	**# of Units**	**Capacity (million gallons)**	**Tank Height (feet)**	**Tank Diameter (feet)**	**Bottom Elevation (feet)[1]**	**Max. Water Level Elevation (feet)[1]**
Raw Water	Welded Steel	1966	1	1.000	40	70	411	449
Finished Water	Welded Steel	1990	1	0.488	28	55	279	306
Fire Suppression Water	Riveted Steel	1940	2	0.5000	24	60	385	408
1. All elevations are approximate and based on best available information; referenced to North American Vertical Datum, 1988								

4.3 Demand and Capacity

This section summarizes background data, and addresses demand and capacity issues associated with TOS's domestic and fire suppression water systems.

4.3.1 Water Demand/Usage

The domestic water system is only partially metered; therefore, total demand for treated water is estimated based on daily water production as metered at the WTF. Treated water production (based on daily domestic water filtration reports for January 2005 through May 2006) was 405,350 gpd (PALCO, 2006).

Although the residences served by the domestic water system are not metered, usage at the HRC mills and (more recently) the cogeneration plant has been metered. The average rate of treated water supply to the sawmill, planing mill, and cogeneration plant for the period from April through August 2006 was 150,700 gpd. Assuming an average residential use of 100 gallons per capita per day (gpcd) and 2.48 Persons Per Household (PPH)[2], this usage represents an estimated 608 EDUs.

The remaining unmetered treated water, approximately 260,825 gpd, serves an estimated 247 occupied households[3] and 15 commercial connections, and includes unaccounted for water in the form of leaks and/or unknown service connections. If it is assumed that actual residential usage is approximately 248 gpd/EDU and that the 15 commercial connections represent approximately 30 EDUs, the expected water use is only 68,700 gpd and approximately 192,000 gpd is unaccounted for. Even if residential usage is higher than assumed due to lack of metering and no incentive for residents to conserve water, the percentage of treated water that is not accounted for is still very high. Unaccounted water may include:

- Additional unmetered industrial service connections
- Unmetered public facilities, parks, and schools
- Loss due to leakage
- WTF losses (backwashes)

System loss due to leakage is believed to be a significant cause of unaccounted water. The water system was installed in the 1930s and 1940s; much of it is brittle cast-iron pipe.

4.3.2 Fire System Demands

In addition to filling the two, 0.5-MG fire suppression water tanks located on the hill above Scotia, the fire system also supplies raw water to the cogeneration power plant. A new meter was installed at the cogeneration power plant in April 2006, and the current estimate of raw water use at the plant totals 354,000 gpd, or approximately 246 gpm averaged over a 24-hour period. This represents a baseline demand for the fire system. The system has more than adequate capacity to meet minimum fire flow and duration requirements of 1,500 gpm for 5 hours in residential, commercial, and industrial areas of Scotia in addition to supplying the cogeneration plant.

4.4 Regulatory Criteria

As they were for the wastewater collection system, two references were used to establish baseline standards for water distribution systems in order to determine what improvements would be proposed for Scotia's water systems during initial CSD formation, and subsequent capital improvements planning (for upgrading system components to area municipal standards). The Cities of Rio Dell and Fortuna have standard improvement specifications, herein referred to as the "City Standards," which were used to determine potential CSD requirements and specifications for water distribution systems, including materials, installation, and design criteria (for new construction).

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2 The California Department of Finance report on city/county population and housing estimates for 2006 estimates 2.48 PPH in unincorporated areas of Humboldt County.

3 SHN's August 21, 2006 "Response to July 28, 2006, Review Comments on the "PALCO Scotia Wastewater Treatment Facility Assessment of Conditions Technical Memorandum." TOS Staff estimates that of the 272 homes in Scotia approximately 5 are unoccupied.

For placement of new sewer lines, Title 22 CCR Division 4, Chapter 16, Article 5 describes the minimum separation requirements for water mains and sewer mains. This chapter, also called the *California Water Works Standards*, states that water mains shall typically be installed at least 10 feet horizontally from and 1-foot higher than sanitary sewers located parallel to sewer mains, and 1 foot higher than sanitary sewers crossing the water main. Separation distances are measured from the nearest edges of the facilities. Variations of the separation distances can be decreased to 4 feet horizontally using specific pipe materials and a greater pressure class rating.

The City Standards met all California Waterworks Standards, and in some cases called for more stringent requirements. Some City Standards and specifications for new construction or service modification, stand out with particular importance in the potential formation of a Scotia CSD. These include:

- The City Standards state a minimum pipe size of 6-inch diameter for distribution facilities. Four-inch pipe is acceptable, upon approval by the "CSD Engineer," if the main is serving culs-de-sac or courts serving less than seven connections or other specific conditions.
- The distribution facilities, wherever possible, will be in grid form for pressure equalization.
- Water mains will have sufficient valving to prevent the shutdown of transmission mains or the removal from service of more than 500 lineal feet of pipe.
- Fire hydrants will have a maximum normal spacing of 500 feet in residential areas and 300 feet in commercial areas. Not more than one hydrant is allowed on a 6-inch main between intersecting lines, and not more than two hydrants are allowed on an 8-inch main between intersecting lines.
- A residual service pressure of 15 to 20 psig will be available to residents during fire flow demand incidents.

4.5 Proposed Improvements

This section discusses phased improvements proposed to bring Scotia's water systems up to conditions that are similar to local city, or larger local CSD standards.

The proposed CSD combines elements of existing fire and domestic water systems into a single system owned, operated, and maintained by the CSD that meets domestic demands and provides fire protection for the proposed service areas (not including industrial areas). HRC would retain ownership of the components of the fire system serving the HRC industrial areas.

There will be pressure/flow issues to mitigate for servicing the existing commercial area fire flows with the reduced pressure availability from the lower finish water storage tank. The fire system design will contain a system hydraulic model, which will be used to assist in determining the pressure/flow characteristics.

This alternative allows HRC to retain ownership and autonomy of its fire system and allows the CSD to incorporate useful elements of both systems into a single, combined system, which will be easier and less expensive to operate and maintain. The following section discusses the preferred alternative further.

4.5.1 The Proposed Alternative

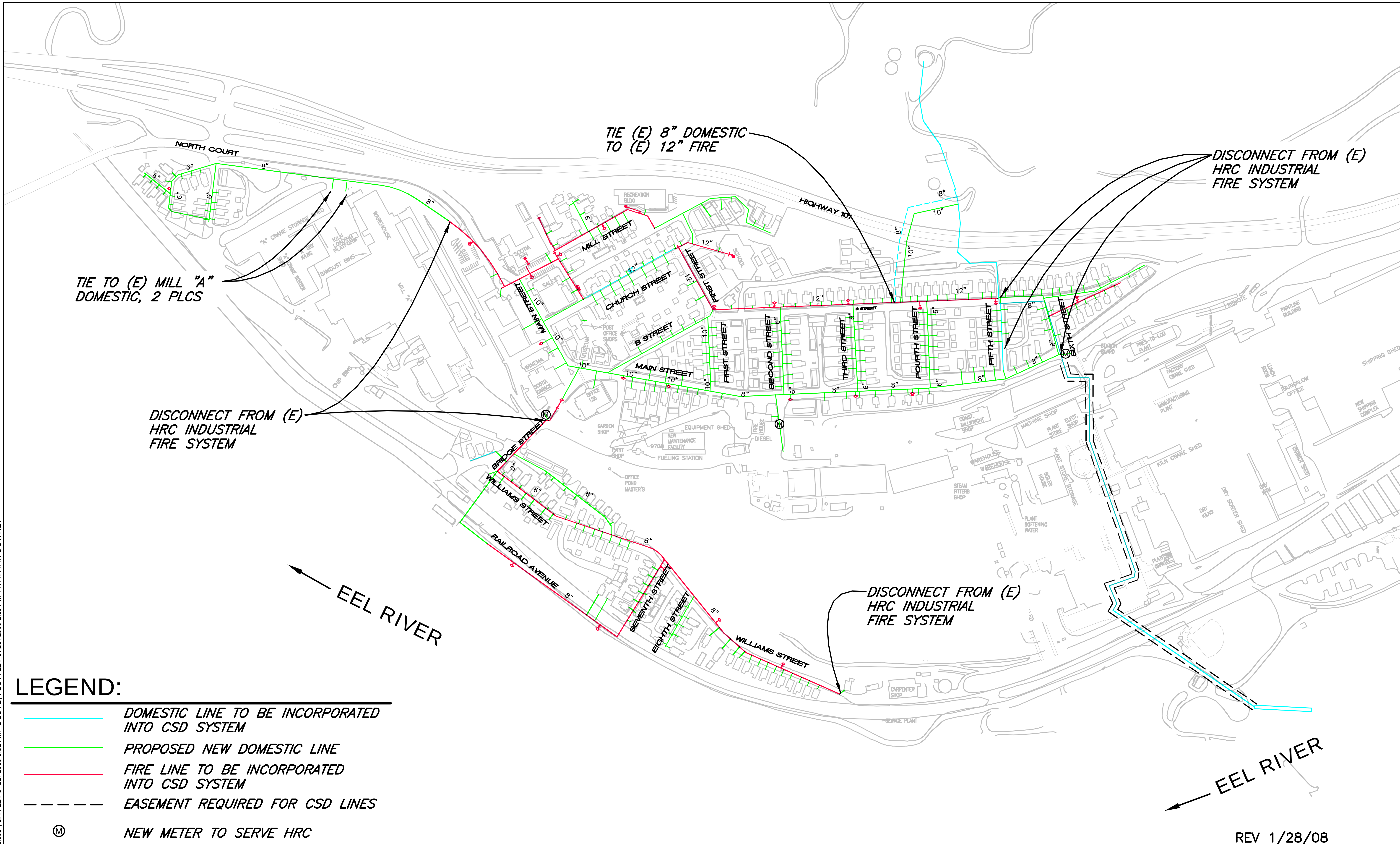
The proposed alternative involves the CSD combining several elements of Scotia's existing domestic and fire suppression water systems currently serving residential and commercial areas into a single distribution system. Portions of both systems will either be abandoned or taken over and upgraded by the CSD, while HRC will retain ownership and responsibility for sections serving HRC's industrial properties. System modifications will be phased to allow for CSD formation and an affordable utility rate that will address future utility infrastructure capital improvement plan needs.

The domestic water distribution system, for lines 3-inches in diameter and smaller, will be replaced. Proposed upgrades include the rerouting of certain existing distribution lines to avoid proposed property and easement/access issues for system maintenance and operation. SHN proposes that TOS replace, relocate, or construct new larger distribution mains to allow appropriate hydraulic service to the users. Distribution system components for first phase construction will include:

- all new services to residences with meters, and
- verified serviceable or installation of new services and meters to commercial and industrial users.

Replacement of the 3-inch and smaller diameter lines will generally upgrade the system to local standards of similar municipalities, which require a minimum line size of 4-inches or larger. Modifications to the distribution system will also include construction of facilities to provide a combination potable domestic and fire suppression water system. SHN proposes that line sizes through portions of the commercial district be 10-inch diameter and those for distribution to the North Court area be 8-inch diameter. Figure 4-4 shows the proposed Scotia combined water system layout. The existing industrial fire suppression water distribution system would continue to be owned and operated by HRC, with appropriate easement access negotiated with the CSD for operation of the intake facility and for raw water to be acquired and independently pumped (by CSD-operated pumps) to the existing 1-MG raw water storage tank (and then diverted to the existing raw water fire tanks and the WTF where water is subsequently treated and stored in the existing 0.488-MG tank). Portions of the existing PALCO-built fire suppression water distribution system would be incorporated into the new domestic water system. A reduced pressure backflow preventer will be placed on the fire system after the line split and before the booster pumps. HRC's potable water needs will be served and metered by the CSD through multiple connections to Scotia's combined water system. HRC's fire suppression water usage will be metered prior to the fire booster pumps. It is assumed that the CSD will take over the existing domestic Scotia fire distribution system in "as-is" condition, with no additional work required of TOS. New Scotia domestic system construction, incorporating modifications to accommodate becoming a combined potable/fire suppression water system, will allow the Scotia and HRC fire systems to work independently of each other, yet have supply redundancy in emergency situations. Potable water for HRC mill uses will be provided by the CSD. Table 4-4 presents a cost estimate for the initial phase combination domestic/fire suppression water system.

Final design of the conceptually proposed system improvements presented will require a more in-depth analysis of the systems. At that time, TOS, with potential Scotia CSD representatives, will ultimately make adjustments to the conceptual design presented in this document.



LEGEND:

(cyan line)	DOMESTIC LINE TO BE INCORPORATED INTO CSD SYSTEM
(green line)	PROPOSED NEW DOMESTIC LINE
(red line)	FIRE LINE TO BE INCORPORATED INTO CSD SYSTEM
— — — — —	EASEMENT REQUIRED FOR CSD LINES
Ⓜ	NEW METER TO SERVE HRC

NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USING INFORMATION RECEIVED FROM PALCO. ADDITIONAL WATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

0 400'
1"=400'

SHN Consulting Engineers & Geologists, Inc.

Scota CSD Formation
Detailed Engineering Analysis
Scotia, California

Proposed Domestic and Fire Suppression Water System
005161.903

May 2009 | 005161-903-FIRE-WATR | Figure 4-4

Table 4-4 Estimated Costs of Water Distribution System Upgrade (Revised 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$40,000	$40,000
Demo/Abandonment	EA[2]	1	$48,000	$48,000
Miscellaneous Excavation and Backfill[3]	CY[4]	2,000	$10	$20,000
Total new 6-inch Line[3,5]	LF[6]	4,640	$60	$278,400
Total new 8-inch Line[3,5]	LF	4,300	$75	$322,500
Total new 10-inch Line[3,5]	LF	2,190	$95	$208,050
Air Release Valves	EA	3	$4,100	$12,300
6-inch In-Line Gate Valves	EA	25	$1,100	$27,500
8-inch In-Line Gate Valves	EA	29	$1,450	$42,050
10-inch In-Line Gate Valves	EA	23	$2,200	$50,600
Hydrants[5]	EA	37	$6,000	$222,000
Residential Service[5,7]	EA	272	$2,000	$544,000
Commercial Service[5,7]	EA	26	$5,000	$130,000
Industrial Service[5,7,8]	EA	3	$21,000	$63,000
Sheeting and Shoring	EA	1	$27,000	$27,000
Water Distribution System Construction Costs Subtotal				**$2,035,400**
Engineering[9] (20%)				$407,080
Contingency (20%)				$407,080
Total Water Distribution System Upgrade Cost, Call:				**$2,850,000**

1. LS: Lump Sum
2. EA: Each
3. Assumes HRC provides gravel material at no cost.
4. CY: Cubic Yards
5. Assumes trench paving with overlays in paved roadways.
6. LF: Linear Foot
7. Service to include connection at building.
8. Includes industrial meter, backflow device.
9. Engineering includes design, permitting, and construction management for the project.

Additionally, several operational and system configuration modifications that are planned and will be implemented include, but are not limited to the following:

1. Install a new 10-inch minimum line parallel to the existing industrial fire transmission main from the 488,000-gallon domestic tank to Scotia for intertie at B Street and Fifth Street. Abandon the existing 8-inch transmission line from the 488,000-gallon domestic tank, or retain as a redundant and emergency service transmission main (existing line goes under proposed private residence).
2. Loop distribution mains in the North Court and Williams Street neighborhoods for service redundancy and hydraulic efficiency.

3. Provide special attention to the integration and separation of the existing industrial fire system during the initial construction phase, to identify potential service problems or potential configuration incompatibilities.

Upon CSD acquisition of the water distribution system, additional annual costs will be incurred through regular O&M requirements associated with the system. Additional annual costs will include labor, power, equipment, and parts. Additional staff will be required to ensure proper O&M of the system.

More details regarding estimated O&M costs will be provided under separate cover, in a rate study.

4.5.2 Issues of Operation

This section lists the performance limiting factors that were identified for the CSD formation during the course of this study. Below each issue of operation is a recommendation in *Italics* that may reduce or eliminate the issue. No priority is given to issues and recommended solutions.

Issue 1: The existing intake facilities provide raw water for both the existing fire and domestic water systems. Although the CSD would assume ownership, operation, and maintenance of the raw water intake facilities, both the CSD and HRC will be contributing to wear and tear on these facilities.

Recommendation 1: *A rate analysis must be performed to determine an appropriate rate the CSD could charge per unit of water that would recoup HRC's proportion of operation and maintenance costs associated with HRC's use of the infiltration gallery, collection well, raw water pumps, and piping to the meter located prior to the fire booster pumps.*

Issue 2: TOS currently has a License for Diversion and Use of Water from the Eel River as outlined in Application A005504, Permit 003027, License 006373 from the Division of Water Rights. TOS has a license to remove up to 7.1 cubic feet per second from the Eel River. Presently, TOS will retain the water rights.

Recommendation 2: *In the Watershed Unit 1 Permitting Section of the SWRCB, Division of Water Rights (DWR), stated that a license can easily be transferred between parties by filing a Notice of Assignment with the Division of Water Rights (W&K, September 6, 2006). The assignment of the right, title, and interest in the application, permit, and license is all or none. Therefore, the CSD and HRC must reach agreement concerning the share of water that HRC is entitled to and to which the CSD is committed to providing.*

Because TOS's existing license has a purpose of use of industrial and domestic, the CSD could file a Petition for Change to change the purpose of use from domestic to municipal, which allows more flexibility in providing water for commercial and outdoor landscaping water uses. Proper environmental documentation, such as a California Environmental Quality

Act (CEQA) Negative Declaration, must accompany the petition in addition to a $1,000 fee for the SWRCB and an $850 fee for the California Department of Fish and Game (CDFG).

Issue 3: Scotia's existing domestic water system consists mainly of 2-inch steel pipe, which does not meet current City Standards for minimum pipe diameter in distribution systems. As discussed in Section 4.4 of this report, the City Standards require a minimum pipe size of 6-inch diameter for distribution facilities. However, 4-inch pipe can be used to serve culs-de-sac and courts serving less than seven homes, or other conditions, upon approval by the "CSD Engineer."

Recommendation 3: *The majority of the 2-inch steel pipe in the current domestic water distribution system was installed around the 1930s. Additionally, considerable losses are believed to be occurring in the system. Significant losses are probably occurring at the junctions of the 2-inch steel pipes and copper service lines, as no dielectric unions were used and considerable galvanic corrosion has likely occurred at these locations (W&K, 2006d). TOS proposes to replace 3-inch diameter and smaller pipe within the CSD service areas.*

Issue 4: The CSD will have to monitor HRC's water use in both the domestic and fire suppression water systems.

Recommendation 4: *HRC will install a flow meter prior to the fire booster pumps to monitor raw water use. Additionally, HRC will install flow meters at all points of connection between Scotia's proposed distribution system and HRC's industrial system.*

Issue 5: TOS's emergency, back-up fire booster pumps, pump water from the log pond directly into the existing fire system at a location downstream of the main fire booster pumps. There exists the potential for contamination due to this cross-connection (the 20-inch cast iron pipe from the collection well splits to the fire booster pumps and to the domestic booster pumps) between the domestic water distribution system and TOS's emergency fire suppression water storage in the case of a loss of pressure.

Recommendation 5: *TOS will investigate the cross-contamination issue and will install appropriate backflow prevention devices, if not installed already, with the proposed new meter on the fire system line, where the intake pipe from the collection well splits into the fire and domestic water systems.*

Issue 6: Portions of the existing fire and domestic water systems are located on existing residential and commercial properties, which will become private property if TOS sells these properties. In some cases, pipes may even be located under existing buildings and/or homes. This will create issues for serviceability and maintenance because the CSD will not have access to these areas through rights-of-way or easements.

Recommendation 6: *Any pipes located on private property, other than service laterals from existing or proposed transmission mains, shall be abandoned and replaced with new mains in the CSD right-of-way.*

Issue 7: The CSD will own, operate, and maintain piping from the fire booster pumps to the fire suppression water storage tanks and the outlet piping from the existing tanks to the proposed fire suppression water system on HRC industrial properties.

Recommendation 7: *HRC must obtain an encroachment permit from the CSD to access HRC infrastructure in the public right-of-way in case of maintenance requirements.*

Issue 8: The CSD will own, operate, and maintain piping infrastructure from the raw water intake to the domestic booster pumps and from the pumps to the 1.0-MG raw water storage tank, raw water fire tanks, WTF, and 0.488-MG potable water tank. Sections of this piping and the domestic booster pump are located on private properties/industrial areas owned by HRC.

Recommendation 8: *The CSD must obtain an easement from HRC to access the infrastructure located on private properties for access and maintenance. Another option might involve relocation of the pumps along with some piping re-alignment; however, this might also require resizing of the pumps depending on the elevation of the relocation site.*

Issue 9: The CSD will have no ability to meter water usage in the residential or commercial areas of Scotia; no water meters exist in these areas.

Recommendation 9: *Install meters at every residential and commercial service connection in the domestic water system. Monitoring water use will also facilitate identification of leaks.*

Issue 10: Most service lines in Scotia are copper pipe and are connected to steel pipes in the distribution system without dielectric couplings. Significant corrosion has likely occurred at the steel end of these unions as a result of galvanic corrosion over the years (W&K, September 6, 2006).

Recommendation 10: *Replace all copper service lines with polyethylene or other approved material.*

Issue 11: The pumps currently located in the collection well and domestic water booster station are 2.4 kilovolts (kV), 3 phase power. All existing power lines will be abandoned and removed; PG&E will be installing new power lines (most likely 1.2 kV) throughout Scotia.

Recommendation 11: *The pump motors must be replaced with motors that are compatible with the new power source. An alternative to this would be purchasing transformers that could convert the voltage from 1.2 kV to 2.4 kV.*

Issue 12: The majority of fire hydrants in Scotia's residential and commercial areas are of a dry barrel type with 2½-inch outlets. Broken and new fire hydrants are being replaced by the Scotia Fire Department with wet barrel hydrants having a 4½-inch outlet to accommodate the pumper fire trucks.

Recommendation 12: *Replace all dry barrel fire hydrants within proposed CSD areas with new, wet barrel hydrants (as requested by the Scotia Fire Department). This would be completed as phased modification and system rehabilitation is planned and constructed.*

4.5.3 WaterCAD Hydraulic Model

A hydraulic model of the combined water distribution system under the former annexation alternative was developed by W&K (W&K, October 11, 2006a) using the Haestad Methods WaterCAD v7.0 water distribution modeling and management software. The proposed CSD water system and the former annexation alternative water system are very similar. The primary difference is the water line sizes in the North Court area. The model was used to simulate both the existing fire system and proposed, combined distribution system. The model was developed out of concern that fire flows would be negatively impacted by dropping the fire flow storage from the two 0.5-MG fire suppression water storage tanks to the 0.488-MG finished water storage tank (an approximate 106 foot drop) and also by separating the existing fire system in various locations so HRC can retain an independent fire system. Fire flow test data obtained in the field with HRC (then-PALCO) staff was used to calibrate a hydraulic model of the existing fire system. The model was calibrated by altering the C-factor of the cast-iron piping network. Calibrated values varied between 75 and 110, which are within the range of expected values for aged cast-iron pipe. The model's outputted available fire flows at a minimum 20 pounds per square inch gauge (psig) matched what was calculated from pressures and flows measured in the field within an acceptable tolerance. Additionally, the model revealed that the W&K proposed distribution system (similar to SHN's proposed distribution system) will provide a minimum of 1,500 gpm for a 4-hour duration throughout the proposed CSD service area.

An updated hydraulic model of the new, proposed system will need to be developed by modifying the calibrated model of the existing system. Such a model will be completed during design of the proposed system upgrades.

5.0 Water Treatment

5.1 Introduction

The Scotia WTF, constructed in 1966, consistently supplies the domestic water system with high-quality water. The facility is located off a gravel access road on the hillside east of U.S. Highway 101 (Figure 5-1). This chapter describes the WTF's general condition, operation, and performance, and presents recommendations regarding required improvements.

This section also includes an analysis of water demands and capacity. The WTF supplies current domestic water usage and commercial and industrial demands for treated water, while operating at less than 100% of its capacity. Based on an analysis of the theoretical capacity of the individual treatment system components, the treatment system is currently operating at approximately 30% of capacity.

5.2 Description of Existing Systems

The treatment system is well maintained and in good condition. Operation of the system is simplified in that the two in-line sand filters operate on the hydraulic head provided by the 1.0-MG raw water tank (Figure 5-1). Pretreatment of the raw water consists of adding an anionic polymer prior to the raw water storage. The pretreatment system serves to reduce high raw water turbidities to treatable levels. Treated water is consistently of a high quality.

The water treatment system consists of the following processes:

- Coagulation—coagulant addition and rapid mix (winter operation)
- Sedimentation—raw water storage tank
- Filtration—pressure filters
- Disinfection—gas chlorination

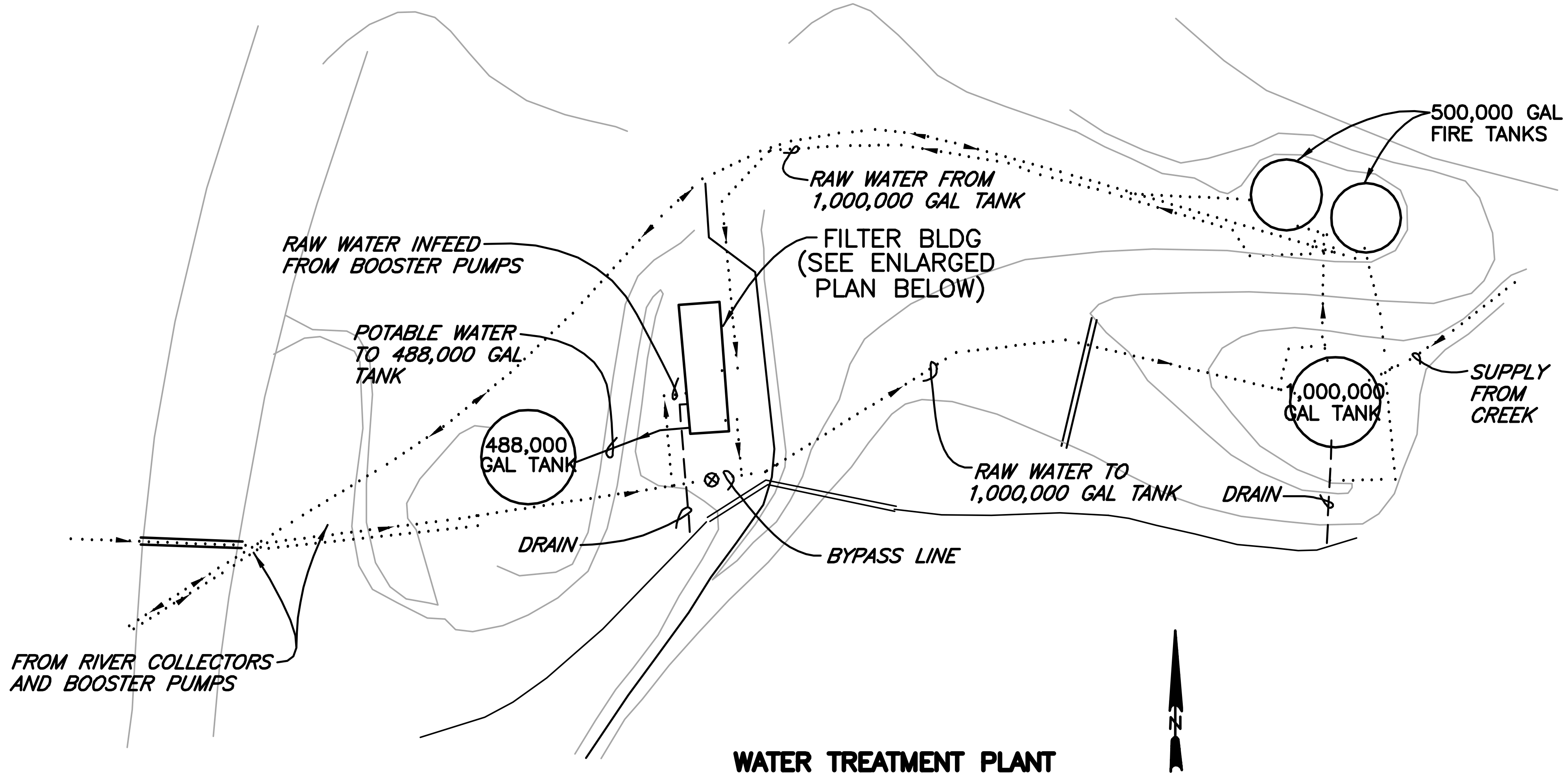
Water from the intake gallery in the Eel River is pumped to a 1.0-MG raw water storage tank by domestic booster pumps. Before discharging to the tank, the water is piped through the WTF where a flocculant is added prior to an in-line mixer. The water flows through the mixer, up to the 1.0-MG tank.

The 1.0-MG tank, which also serves as a sedimentation tank, feeds a pressure filter system at the WTF. Filtered water is disinfected and then flows to the 0.488-MG finish water storage tank. The treatment system does not require any internal pumps, operating on pressure supplied by the upper 1.0-MG tank.

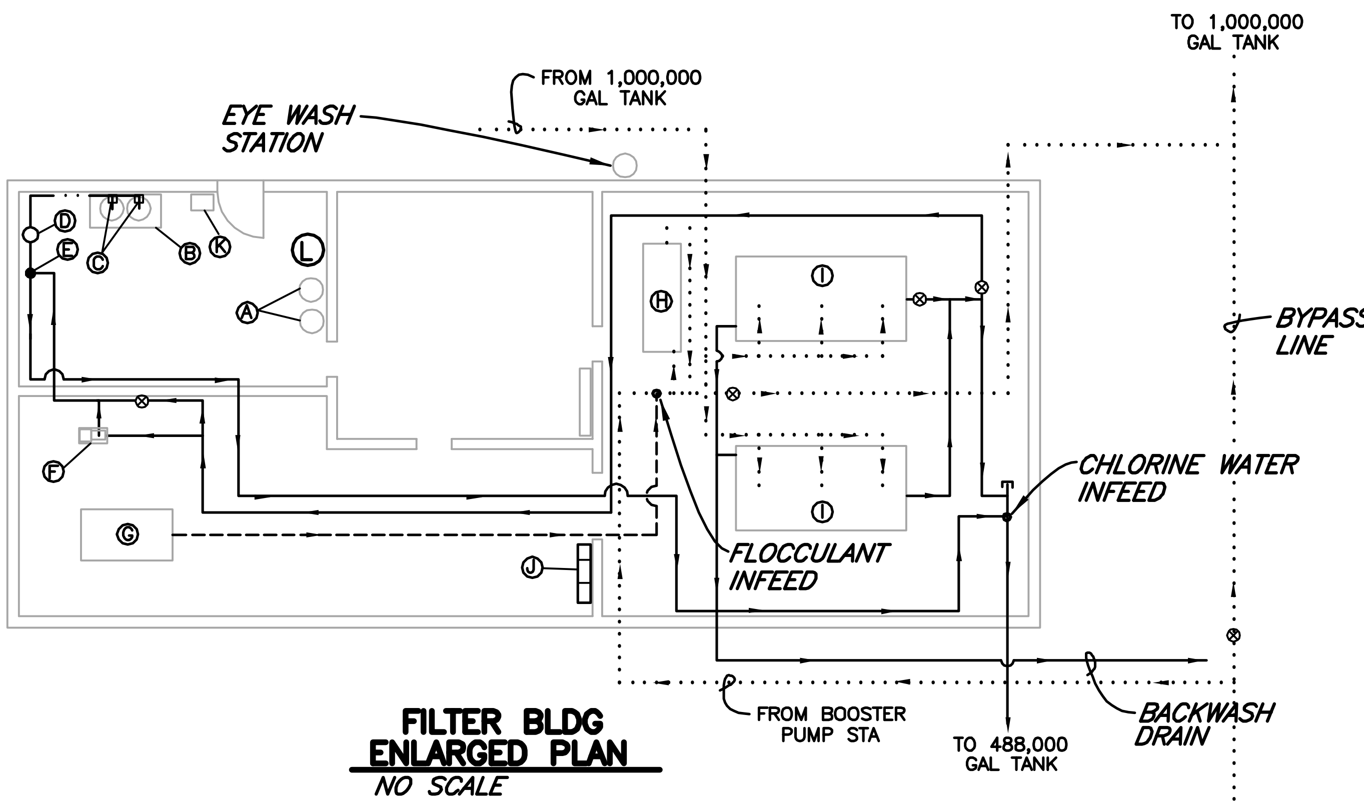
Figure 5-1 schematically illustrates the WTF and filter building. Equipment is summarized in Table 5-1. The facility is well maintained and in good condition.

FILTER BUILDING EQUIPMENT

ITEM	DESCRIPTION
A	(2) 150 LB CHLORINE CYLINDERS (STORAGE)
B	(2) CHLORINE CYLINDERS ON SCALE WITH REGULATORS
C	CHLORINE FLOW METER
D	CHLORINE ROTAMETER
E	CHLORINE INJECTOR
F	CHLORINE PUMP
G	FLOCCULANT FEED TANK AND PUMP
H	MIXING TANK
I	SAND FILTERS WITH BACKWASH SYSTEM
J	CHLORINE PUMP CONTROLS
K	EXHAUST FAN WITH LOW INTAKE AND HIGH EXHAUST
L	CHLORINE DETECTOR



WATER TREATMENT PLANT AND STORAGE TANK PLAN
1"=100'±



FILTER BLDG ENLARGED PLAN
NO SCALE

LEGEND:

— · — · —	CHLORINE LINE
- - - - - -	CHEMICAL LINE
· · · · · · ·	RAW WATER LINE
————	POTABLE WATER LINE

SHN Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Water Treatment Facility
005161.903

May 2009 | 005161-903-099007-AF-2003-SVY_5-1 | Figure 5-1

Table 5-1 Water Treatment Facility Equipment Assessment TOS Detailed Engineering Analysis				
Item	**Description**	**Size**	**Units**	**Installation Date**
Mixing Tank	Steel in-line baffled	1,100 gallons	1	1968
Sand Filters[1]	8-foot diameter x 30-foot long	240 square feet	2	1966
Filter Media	Sand, deactivated anthracite	NA[2]	NA	1993
Backwash Control	Head loss differential, flow meter	NA	1	1999
Turbidimeter	Hach	NA	2	1992
Flow meter	Velocity, Sparling Series 100	NA	1	2004
Flow recorder	Chart recorder Honeywell	NA	1	1966
Chlorine Detector	Wallace & Tiernan	NA	1	1996
Chlorinator	Ecometrics Series 2000	NA	2	1996
Chlorine Scale	Two 150-pound cylinders	NA	NA	1996
Flocculant Feed Tank[3]	NA	200-gallon	1	1966
Flocculant feed pump	ND[4]	ND	1	2005
Fluoride Pumps[5]	ND	ND	2	2002

1. Baffles and media replaced 1993
2. NA: Not Applicable
3. Being taken off line replaced with direct feed
4. ND: No Data
5. Not in use

5.2.1 Pre-treatment and Sedimentation Tank

The untreated or raw water is pumped to the WTF by the domestic water booster pumps. At the WTF, an anionic polymer is injected to enhance settlement during months when raw water turbidities are high. The polymer is injected directly into the pipe immediately preceding an in-line mixing tank. The mixing tank is a 1,100-gallon horizontal steel tank with internal baffles. The mixer is painted steel and appears to be in good condition.

Because of the high raw water quality and low turbidity during the summer months, there is no need for polymer addition prior to filtration. In the fall, with increased turbidity in the raw water, an anionic liquid polymer is injected directly into the line ahead of the in-line mixer.

The pre-treatment system consists of polymer addition, the mixing tank, and the large storage tank. There is no flocculation tank provided. The baffled mixing tank appears well designed for the current flow conditions. A detention time of approximately one minute is provided with one domestic water pump running and is within typical ranges for in-line mixers (30 to 60 seconds).

In the winter months, raw water turbidities from the Eel River intake can exceed 100 NTU and the polymer and large sedimentation tank are necessary to reduce turbidities prior to filtration. The 1.0-MG reservoir functions well as a sedimentation tank and consistently achieves turbidities of less than 1 NTU.

This complies with performance goals for sedimentation basins published by EPA, which state that,

> *The sedimentation process is assessed based on achieving a settled water turbidity of less than 1 NTU 95% of the time when average raw water turbidity is less than 10 NTU and less than 2 NTU when the average water turbidity exceeds 10 NTU (EPA Handbook Optimizing Water Treatment Plan Performance Using the Composite Correction Program , 1998 Ed).*

5.2.2 Filtration System

Water from the 1.0-MG tank is filtered in two horizontal cylindrical filters each 30 feet long and 8 feet in diameter, with a surface area of 240 square feet. The filters are constructed of steel with coatings on the interior and exterior to prevent corrosion. Piping is painted ductile iron with a polyethylene coating. The filters, piping, and numerous control valves are in good condition and show no evidence of corrosion. The valves that control filter operation are well maintained and have been rebuilt as the operators determine the need from inspections.

5.2.2.1 Filter Operation

The filters operate on line pressure supplied by the 1.0-MG tank. Feed rate is controlled by an electronically activated valve on the main line from the reservoir and control valves on the influent line to each filter. Each filter has four compartments. The influent to each compartment is located at the top of the tank and each feed line has a pneumatically actuated, hydraulically operated control valve. Another control valve on the backwash line feeds through the filter under-drain. During backwash, the main filter-to-waste valve is open and the filter is washed in sections from the common under-drain by closing the influent and opening the waste valve for each respective section. Backwash effluent is discharged to the drainage swale south of the WTF.

The backwash sequence can be initiated manually or automatically, based on the differential head-loss across the filter or by setting a timer for repetitive backwashing. The TOS operations staff monitors the head-loss and manually initiates backwashes as needed. During summer months, filters are backwashed bi-weekly. During winter months, the backwash frequency increases; and during periods of high turbidity, the filters may be backwashed daily.

5.2.2.2 Filter Performance

The water treatment system consistently produces high quality water. Filter effluent turbidity (which is recorded daily) indicates that average finished water turbidities in 2005 and 2006 were less than 0.06 NTU. During this period, the maximum daily turbidity recorded was 0.50 NTU and consistently low finished water turbidities were maintained even when raw water turbidity exceeded 100 NTU.

Treatment system performance is monitored by Hach turbidimeters at the WTF, which provide continuous readings of raw water turbidity and filtered water turbidity. The turbidimeters do not record on a continuous basis. Instantaneous values are recorded by operations staff on the daily filtration report.

5.2.3 Disinfection System

Filtered water is disinfected with chlorine fed from two, 150-pound cylinders. The chlorination system consists of a scale, a chlorinator with a vacuum regulator and automatic switch-over system, and an ejector system to inject chlorine gas into the solution line. Chlorine solution is injected in the filter effluent line in the filter building and disinfected treated water is then stored in the 0.488-MG finish water storage tank.

Chlorine is applied to the filtered water at an average dosage of approximately 1.29 mg/L. The finish water storage tank provides more than adequate detention time for disinfection.

The system feed rates and dosages are monitored on a daily basis to ensure that the chlorine residual is maintained throughout the system and to comply with California DHS requirements. A chlorine residual is obtained from a service in the distribution system on a daily basis. Based on the water system filtration report, the residuals average 0.3 mg/L.

5.3 Regulatory Criteria

5.3.1 Water Rights

The SWRCB DWR oversees license number 6373, permit number 3027, issued to PALCO on July 7, 1961, and transferred to TOS in 2008 as part of the bankruptcy procedures. Water is permitted to be diverted for domestic and industrial uses, at a specified diversion location.

Diversion of water (up to 4,588,500 gpd) is allowed by the permit, with no expressed annual quantity limit. Priority rights were established from June 1, 1927, and the proof of diversion was accepted by the DWR in January 15, 1959.

5.3.2 Public Water System Regulations

Drinking water regulations were established in 1974 with the signing of the Safe Drinking Water Act (SDWA).

The DHS is designated by the EPA as the primary agency to administer and enforce the requirements of the federal SDWA, including the SDWA Amendments of 1996 or the Surface Water Treatment Rule (SWTR). The statutes and regulations adopted by the State of California and the DHS to implement SDWA requirements are contained in Title 22 CCR (California regulations related to drinking water).

5.3.3 Maximum Contaminant Levels

One of the main elements of the drinking water regulations was the establishment of Maximum Contaminant Levels (MCLs) for inorganic, organic, microbiological, and radionuclide contaminants and turbidity. An MCL is the maximum allowable level of a contaminant in water delivered to the users of a public water system. Concentrations above the MCL for a contaminant are considered violations.

The TOS water system is in compliance with all federal and state regulations and as a condition of its operating permit, prepares a consumer confidence report that includes the levels of any detected contaminants subject to an MCL, unregulated chemicals for which monitoring is required as defined by Title 22 CFR Chapter 17, Article 2, Section 65550, disinfection byproducts or microbial contaminants for which monitoring is required by 40 CFR, and sodium and hardness.

The water system is required to monitor for total coliform twice a month. Between March 2005 and March 2007, all samples collected tested "absent" for the presence of coliform bacteria.

5.3.4 Surface Water Treatment Rule

The SWTR established that surface water must be treated using filtration and disinfection. Title 22 Chapter 17, Article 2, Section 64652 (a) defines the treatment requirements as follows:

> *Each supplier using an approved surface water shall provide multi-barrier treatment that meets the requirements of this chapter and reliably ensures at least:*
>
> *(1) a total of 99.9% reduction of Giardia cysts through filtration and disinfection;*
>
> (2) *a total of 99.99% reduction or viruses through filtration and disinfection.*

5.3.5 Performance Standards

Performance standards for turbidity are defined by Title 22 CFR Chapter 17, Article 2, Section 64653 (c):

> *Conventional filtration, direct filtration, or diatomaceous earth filtration shall comply with the following performance standards for each treatment plant:*
>
> *(1) The turbidity level of the filtered water shall be equal to or less than 0.5 NTU [Nephelometric Turbidity Units] in 95% of the measurements taken each month and shall not exceed 5.0 NTU at any time.*
>
> *(2) For those suppliers using a grab sampling monitoring program the turbidity level of the filtered water shall not exceed 1.0 NTU in more than two samples taken consecutively while the plant is in operation. For those suppliers using a continuous monitoring program the turbidity level of the filtered water shall not exceed 1.0 NTU for more than eight consecutive hours while the plant is in operation.*

Performance standards for disinfection are defined by Title 22 CFR Chapter 17, Article 2, Section 64653 (b):

> *Disinfection treatment shall comply with the following performance standards:*
>
> *(1) Water delivered to the distribution system shall not contain a disinfectant residual of less than 0.2 mg/L for more than four hours in any 24 hour period.*
>
> *(2) The residual disinfectant concentrations of samples collected from the distribution system shall be detectable in at least 95% of the samples taken each month, during each and every two consecutive months that the system serves water to the public.*

The TOS Scotia water system complies with all required performance standards. Performance of the treatment system is discussed in detail in Section 5.4

5.3.6 Monitoring

Monitoring requirements for turbidity are defined in CFR, Title 22, Chapter 17, Article 3, Section 64655. The water supplier is required to monitor the turbidity level of the raw water supply by taking and analyzing daily grab samples. To determine compliance with the performance standards for filtered water turbidity, the water system operator is required to obtain samples of the combined filter effluent, prior to clearwell storage, at least once every four hours that the system is in operation or to monitor the turbidity measurements on a continuous basis.

At the WTF, the turbidity of the raw water is measured on a continuous basis by two turbidimeters. However, the turbidimeters do not record the data on a continuous basis, so the operators must take grab samples as required to be in compliance.

Each water supplier is required to develop and conduct a monitoring program to measure the parameters that affect the performance of the disinfection process. The requirements for this monitoring program are defined in CFR, Title 22, Chapter 17, Article 3, Section 64656**.** Suppliers serving 500 to 1,000 people may collect and analyze grab samples of disinfectant residual twice each day, provided that any time the residual disinfectant falls below 0.2 mg/L, the supplier shall take a grab sample every four hours until the residual concentration is equal to or greater than 0.2 mg/L. According to the operations supervisor, an approved daily monitoring program is in place and the chlorine residual is monitored on a daily basis at various points in the distribution system.

5.4 Demand and Capacity

5.4.1 Water Demand/Usage

Treated water production based on daily Domestic Water Filtration Reports for January 2005 through May 2006 was 405,350 gpd as summarized in Table 5-2. Additional water demand/usage information can be found in "Chapter 4: Water Distribution," Section 4.3.

Table 5-2 Domestic Water Production TOS Detailed Engineering Analysis			
Date	**Total Usage**		**Max Day (gpd)**
	(gal per month)	**(gpd)[1]**	
January 2005	13,411,000	432,613	596,000
February 2005	12,860,000	459,286	571,000
March 2005	13,953,000	450,097	471,000
April 2005	13,768,000	458,933	461,000
May 2005	13,387,500	431,855	443,000
June 2005	11,931,000	397,700	504,000
July 2005	13,806,000	445,355	562,000
August 2005	13,224,000	426,581	529,000
September 2005	11,433,000	381,100	416,000
October 2005	10,830,000	349,355	450,000
November 2005	10,511,000	350,367	388,000
December 2005	11,007,000	355,065	422,000
January 2006	11,668,000	376,387	601,000
February 2006	10,566,000	377,357	446,000
March 2006	12,752,000	411,355	498,000
April 2006	12,382,000	412,733	482,000
May 2006	11,621,000	374,871	489,000
Average	**12,300,600**	**405,350**	**489,900**
Maximum	**13,953,000**	**459,286**	**601,000**
1. gpd: gallons per day			

5.4.2 Capacity

Sedimentation Capacity. Design criteria published by the EPA (*EPA Handbook: Optimizing Water Treatment Plant Performance*, 1998 Edition) for sedimentation tanks states that the maximum recommended SOR for a sedimentation basin greater then 14 feet in depth is 0.7 gallons per minute per square foot (gpm/SF). The 1.0-MG storage tank has a diameter of 70 feet and an area of 3,847 SF. Based on the recommended overflow rate, the tank has a maximum capacity of 2,693 gpm. This would provide 6 hours of detention time. Currently, the peak instantaneous flow to the reservoir is equal to 1,200 gpm, the capacity of a single domestic water booster pump.

Filter Capacity. The filters run 6 to 8 hours per day and process an average of approximately 400,000 gpd of treated water. The surface loading rate under current conditions is approximately 1.8 gpm/SF. Article 5 of the Title 22 CCR relating to drinking water stipulates that for pressure filters, filtration rates shall not exceed 3 gpm/SF for dual media filters. Estimated filter capacities and current and maximum loading rates are summarized in Table 5-3.

Table 5-3 Capacity of Filtration System TOS Detailed Engineering Analysis		
Online Hours	**Current Loading at 2 gpm/SF[1] (gpd)[2]**	**Capacity at 3 gpd/SF[3] (gpd)**
8[4]	414,720	622,080
12[4]	622,080	933,120
24[5]	1,244,160	1,451,520

1. gpm/SF: gallons per minute per Square Foot
2. gpd/SF: gallons per day per Square Foot
3. gpd: gallons per day
4. Assumes backwash for 10% of hours online
5. Capacity based on run time of 70%

CT Capacity. The EPA has published guidelines for determining the CT value (chlorine concentration over time) required to achieve required levels of disinfection. The CT value is equal to the chlorine concentration in mg/L (C) times the actual time (T) that water is in contact with the disinfectant. The limiting CT value is taken as the value that achieves the required reduction (in base-10 logarithm orders, or log) assuming minimum temperature and maximum pH.

Disinfection is the final barrier in the WTF and is responsible for removing any microbial pathogens that pass through previous processes. The SWTR requires that the treatment system (including disinfection) provides a minimum of 99.9%, 3-log removal and/or removal of *Giardia lamblia* cysts and at least 99.99%, 4-log removal and or removal of viruses. Because the expected log reduction capacity of a conventional filtration system is 2.5 log removal for *Giardia* cysts and 2.0 log removal for viruses, the disinfection system would only be required to provide the remaining 0.5 log and 2.0 log reductions to comply with the federal SDWR (EPA Handbook 1998 Edition). However, it is considered good practice to require that the disinfection system provides at least 1.0 log removal for *Giardia lamblia* cysts, and that value has been used to determine CT value required for disinfection at the Scotia WTF.

Based on an average residual of 0.3 mg/L, a pH of 7.5, and a temperature of 15 degrees Centigrade, the required CT value for a 1-log reduction of *Giardia* cysts is 28 CT units and the required CT value for a 2-log removal of viruses is 2.0. The requirement for *Giardia* is limiting. Based on a CT of 28 and an average residual of 0.3 mg/L, the required detention time is 93 minutes.

Available contact time is calculated based on the effective volume in the finish water storage tank and in the distribution lines up to the first service. To determine the effective volume, it is necessary to apply a reduction factor that accounts for the effects of short-circuiting in the unbaffled tank. In this analysis, a factor of 0.3 was used (based on published EPA guidelines [1989, EPA]). The 0.488-MG domestic water tank has an effective volume of 146,000 gallons and at current average feed rates, provides a detention time well in excess of the 93 minutes required.

The capacity of the finish water tank to provide adequate contact time for disinfection at future flow rates was calculated to be 1,569 gpm (146,000 gallons/93 minutes).

Excess Capacity. The treatment system is not currently running at 100% of its capacity. The capacity of the treatment system is estimated to be is 1.45 MGD based on the capacity of the filtration system (Table 5-4). Based on the average daily water production (Table 5-2), the system is operating at approximately 30% capacity.

Table 5-4
Capacity of Water Treatment Facility
TOS Detailed Engineering Analysis

Treatment Systems[1]	Limiting Criteria		Theoretical Capacity		
			gpm[2]	cfs[3]	MGD[4]
Sedimentation tank	0.7 gpm/SF[5]	6-8 hours	2,693	6.0	3.8
Filtration	3 gpm/SF	---	1,440	3.2	1.45[1]
Disinfection[6]	93 minutes Detention		1,569	3.49	2.26

1. Assumes 24 hour run time with 30% allowance for backwash and downtime
2. gpm: gallons per minute
3. cfs: cubic feet per second
4. MGD: Million Gallons per Day
5. SF: Square Foot
6. Based on volume of domestic storage tank times 0.3, does not include distribution system volume

5.5 Improvements

The Scotia WTF was constructed in 1966 and has been well maintained since. The WTF is currently in compliance with current state and federal regulations and provides high-quality drinking water. There are no immediate issues of concern regarding the ability of the WTF to remain in compliance and provide an adequate supply of treated water to domestic system users.

There are, however, some deficiencies and performance limiting factors that have been identified (SHN, August 10, 2006). The recommended capital improvements associated with these "issues of concern" have been categorized as those considered immediate needs and those that are recommended for operational reliability during the 20-year planning period. These capital improvements and associated costs are described in Table 5-5.

5.5.1 Proposed Improvements

Required capital improvements identified as a Priority 1 include a seismic retrofit for the 1.0-MG raw water storage and finish water storage tanks, new turbidimeters, and a remote alarm system.

5.5.1.1 Turbidimeters

The existing turbidimeters on the raw water and finished water monitor do not record turbidity. Installing turbidimeters that have continuous monitoring capability is considered a priority for operation and compliance.

Table 5-5 Estimated Costs, Water Treatment and Storage Priority 1 Upgrade (Rev. 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$30,000	$30,000
New Turbidimeters	LS	1	$10,000	$10,000
Seismic Retrofit of 0.488-MG Tank	LS	1	$150,000	$150,000
Remote Alarm System	LS	1	$10,000	$10,000
Tele-meeting	LS	1	$50,000	$50,000
Seismic Retrofit of 1.0-MG Tank	LS	1	$225,000	$225,000
Improvements to Chlorination System	LS	1	$20,000	$20,000
Turbidity / Flow Meters Indv. Filters	LS	1	$25,000	$25,000
Backwash Recovery System	LS	1	$30,000	$30,000
Water Treatment and Storage System Priority 1 Upgrade Cost Subtotal				**$550,000**
Engineering[2] (20%)				$110,000
Contingency (20%)				$110,000
Total Water Treatment and Storage System Priority 1 Upgrade Cost, Call:				**$770,000**

1. LS: Lump Sum
2. Engineering includes design, permitting, and construction management for the project.

5.5.1.2 Seismic Retrofit

The 1.0-MG raw water storage tank and 0.488-MG finish water storage tank are inadequately tied to the foundation to resist loads imposed by the design earthquake. It is recommended that a new reinforced concrete foundation collar be installed around the raw water tank, and that a series of tie-down saddles be welded to the bottom of the tank with hold-down bolts extending into the foundation. Similarly, the 0.488-MG tank seismic retrofit will also be included in the CSD's priority improvements.

5.5.1.3 Alarm System

According to the operator, there are no alarms for system malfunctions or equipment failures at the treatment facility. The chlorine detector provides a local alarm to notify system operators that chlorine-gas has been detected and that self-contained breathing apparatus must be employed before entering the area. Because this alarm is not transmitted to on-call personnel, the problem cannot be addressed immediately.

Equipment failures that potentially effect water treatment or personnel safety must be monitored. Examples of equipment alarms that would provide warning of water system malfunction include valve failure, failure of the polymer pump, chlorine system malfunction (for example, loss of vacuum), chlorine gas detention, and low reservoir level. A remote alarm system is proposed as a Priority 1 improvement. An inexpensive auto-dialer system can be used to warn water system personnel of WTF emergencies that require immediate response.

5.5.2 Issues of Operation

This section lists the performance limiting factors that were identified for the CSD formation Below each problem is a recommendation in *Italics* that may reduce or eliminate the problem.

Issue 1: There is no central location where the storage tank levels are monitored. Monitoring of reservoir levels would simplify tracking of water volumes in the system, and when combined with pump and flow meter data, would help to identify major leaks.

Recommendation 1: Assess existing telemetry system and upgrade to provide monitoring capability.

Issue 2: There is no Supervisory Control and Data Acquisition (SCADA) system or other means of continuously monitoring water quality and flows at the WTF, and all readings and measurements are done manually on a daily basis by the individual operators.

Recommendation 2: Install a SCADA system that monitors the WTF and water storage facilities, controls the treatment process, records water quality and production on a continuous basis, and sounds alarms and/or shuts down the treatment system in the event of an equipment malfunction. The SCADA system will provide continuous information on pump operation, water tank levels, water quality and flow rates, chlorine doses and residuals, coagulant doses, and plant operation including backwash cycles, as well as other operational monitoring and controls. The system will also provide a computerized interface to allow operators to easily control the facility processes, and alarms and shut-downs for system malfunctions and equipment failures.

Issue 3: The gas chlorination system has not been assessed for compliance with the *California Fire Code* (California Building Standards Commission, 2007) and Article 80 of the *Uniform Fire Code* (NFPA, 2006).

Recommendation 3: Have system inspected by the Fire Marshal to determine compliance with Article 80 of the Uniform Fire Code (NFPA, 2006), which requires facilities using 150-pound cylinders not equipped with scrubber systems to have the following controls:

- *Approved containment vessels or containment systems*
- *Protected valve outlets*
- *Gas detection system*
- *Approved automatic--closing fail-safe valve*

Switching to hypochlorite is considered as an alternative to upgrading the existing gas chlorination system.

Issue 4: The WTF does not monitor flow or effluent turbidity on each of the pressure filters. While the EPA's Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) will not require public water suppliers with two or less filters to monitor individual filter effluent turbidity, it has strengthened combined filter effluent turbidity performance requirements to ensure 2-log removal of Cryptosporidium cysts.

Recommendation 4: *Install flow meters and turbidimeters on the outlets of each pressure filter and begin monitoring individual filter performance.*

Issue 5: Filter backwash water is currently discharged into a drainage swale. If this drainage swale is deemed hydraulically connected to any surface water by the RWQCB, the RWQCB may issue and enforce a NPDES permit regulating this discharge.

Recommendation 5: *Install backwash water recovery system and covered drying bed to dewater solids. Alternatively, the backwash could be discharged to a constructed settling basin in the swale, with periodic sediment removal to the wastewater sludge recycling area.*

5.5.3 Opinion of Probable Cost

Estimated cost for the capital improvements discussed as issues of concern are itemized in Table 5-6. A more thorough evaluation of the existing systems will be required prior to design of the proposed capital improvements; therefore, these cost estimates are preliminary.

Table 5-6
Estimated Cost of Water Treatment and Storage Secondary Needs (Rev. 2/24/2009)
TOS Detailed Engineering Analysis

Item (Unit Type)	Unit(s)	Quantity	Unit Cost	Total Cost
Improvements to Reservoir Telemetry	LS[1]	1	$50,000	$65,000
SCADA[2] System	LS	1	$100,000	$130,000
Water Treatment and Storage Secondary Needs Subtotal				**$195,000**
Engineering[3] (20%)				$39,000
Contingency (20%)				$39,000
Total Water Treatment and Storage Secondary Needs Cost, Call[4]:				**$273,000**

1. LS: Lump Sum
2. SCADA: Supervisory Control and Data Acquisition
3. Engineering includes design, permitting, and construction management for the project.
4. Not included in initial capital improvement program

6.0 Stormwater Collection System

6.1 Introduction

This chapter summarizes the stormwater collection system for the town of Scotia and provides an infrastructure assessment for the proposed formation of a Scotia CSD. In this chapter, sizes and condition of the existing collection system are described. Recommendations are also made for the installation of new storm drains and drainage inlets proposed to reconstruct identified failing segments of the existing system and relocation of specific segments into proposed CSD-accessible corridors.

6.2 Existing Storm Drain System

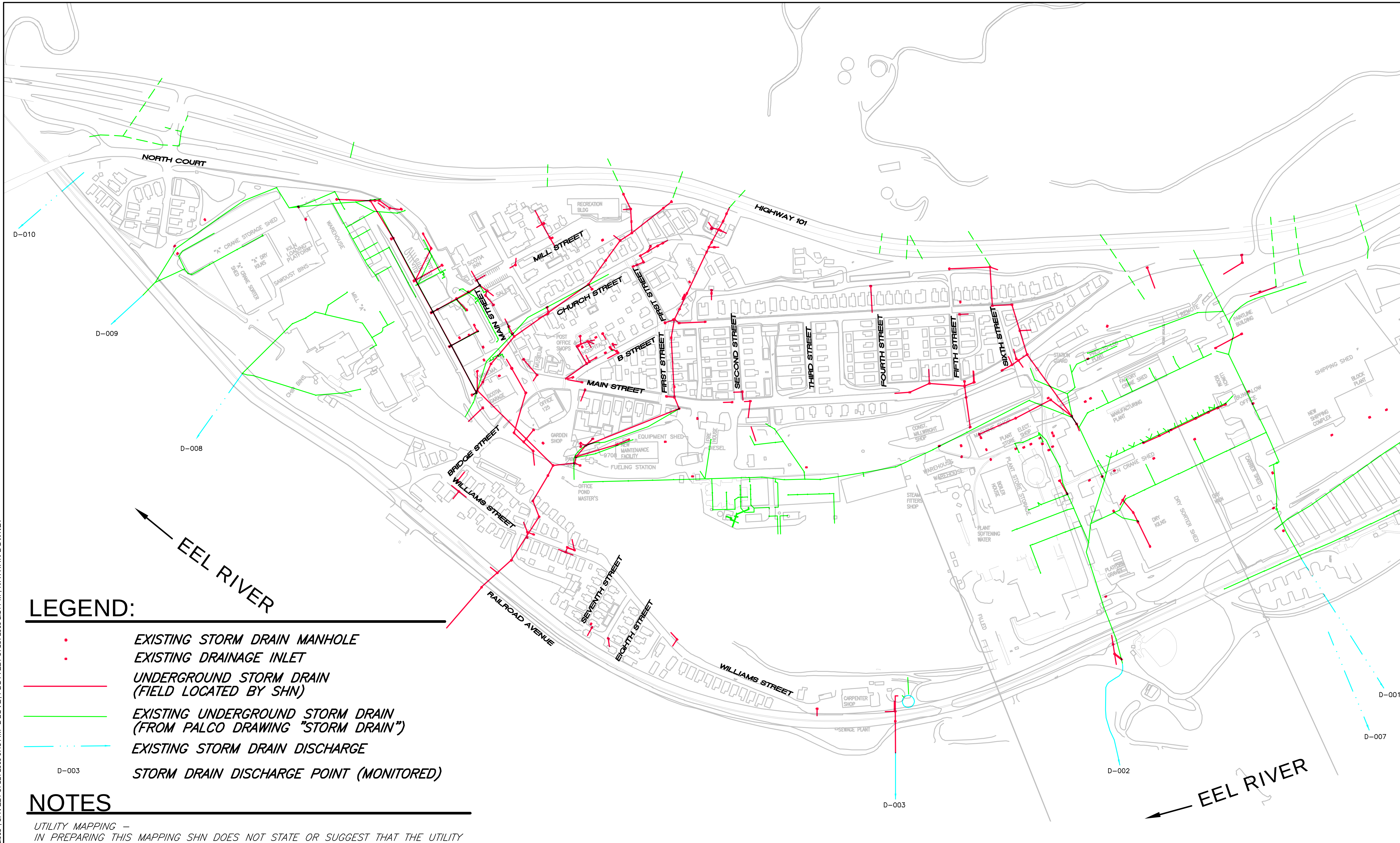
This section describes the existing stormwater collection system, including commercial and residential area laterals, mains, manholes, and drainage inlets. Included is a discussion of Scotia's stormwater collection system, the 2006 CCTV inspection, and the current condition of the system. This information and mapping of the existing system is derived from the work contracted by PALCO in the summer of 2006 (SHN, September 2006).

6.2.1 Stormwater System Background

Scotia's stormwater drain system serves an area of approximately two square miles. The existing system consists of approximately 1.5 miles of gravity storm mains, and is shown in Figure 6-1. The collection system has inputs in the proposed municipal (residential and commercial) areas to be assumed by the CSD and several inputs in the HRC mill industrial area that are to be retained by HRC. The Highway 101 drainage is also conveyed by the Scotia stormwater system. The collection system was constructed by PALCO, who also owned, operated, and maintained the system. TOS now owns, operates, and maintains the system. The collection system consists of three main trunk lines that eventually cross under the industrial areas referred to as the "Log Pond," "Mill A," and "Mill B" industrial areas. Drainage from the Mill A and Mill B industrial areas also flows into the storm drain system. The main municipal storm drain lines discharge into the Eel River at discharge points 002, 003, 009, and one unnamed point as indicated in TOS stormwater documents (Figure 6-1).

The only known documentation describing when the system was constructed is a set of as-built drawings prepared by W&K Consulting Engineers dated October 20, 1992. The only area of detail on these drawings is the shopping area, around the PALCO office, post office, and theater. The main 36-inch line connecting to the line under Church Street is also shown. This area was damaged by a fire following an earthquake in 1992, and was subsequently rebuilt. There is no available documentation describing when the other portions of the system were constructed, so the exact age of the various components of the storm drain system is unknown.

In the past, the sewer collection system functioned as a combined sanitary sewer and stormwater collection system. However, an effort has been made to remove the stormwater connections to the sanitary sewer system, and all known stormwater connections have been separated. Smoke test studies have been conducted to help identify and disconnect stormwater inflow piping. Additional smoke testing may be performed in the future, as a part of TOS's effort to comply with NPDES permit requirements.



LEGEND:

•	*EXISTING STORM DRAIN MANHOLE*
▪	*EXISTING DRAINAGE INLET*
(red line)	*UNDERGROUND STORM DRAIN (FIELD LOCATED BY SHN)*
(green line)	*EXISTING UNDERGROUND STORM DRAIN (FROM PALCO DRAWING "STORM DRAIN")*
(cyan dash-dot line)	*EXISTING STORM DRAIN DISCHARGE*
D-003	*STORM DRAIN DISCHARGE POINT (MONITORED)*

NOTES

UTILITY MAPPING –
IN PREPARING THIS MAPPING SHN DOES NOT STATE OR SUGGEST THAT THE UTILITY LOCATIONS ARE COMPLETE OR CORRECT. THE FACILITIES SHOWN MAY NOT EXIST OR MAY EXIST IN DIFFERENT LOCATIONS THAN SHOWN. UTILITY LOCATIONS ARE BASED UPON FIELD EVIDENCE, CAD DRAWINGS PROVIDED BY PALCO AND PALCO REFERENCE MAPS. DESCRIPTIONS OF FACILITIES AS TO USE, SIZE, MATERIAL, ETC. ARE TAKEN FROM THE PALCO MAPPING AND HAVE NOT BEEN VERIFIED. TO VERIFY UTILITY SIZE, DIMENSION AND MATERIAL PRECISE MEASUREMENTS MUST BE MADE.

0 400'
1"=400'

SHN Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Existing Stormwater System

SHN 005161.903

May 2009 | 005161-903-PROP-SS-IMPROV_6-1.dwg | Figure 6-1

6.2.2 CCTV Inspection

PALCO and SHN investigated the condition of portions of the storm drains in Scotia using CCTV cameras during the summer of 2006. Only lines that are equal to or larger than 12 inches in diameter and camera-accessible were inspected. When necessary the storm drains and drainage inlets were cleaned prior to the CCTV inspection to remove debris and obstructions. Flows in the storm drains were low and acceptable for CCTV inspection. The inspection was conducted one manhole or drainage inlet section at a time, using a self propelled camera specifically designed for pipeline inspection. The inspection work was also used for exploratory mapping of the system. An inspection log identifying and detailing pipe system defects and their locations was made for each pipe run. The CCTV inspection report includes DVDs of the inspection video that can be analyzed later to help prioritize which lines require replacement or repair. Figure 6-1 shows the existing layout of the Scotia storm drainage system, as provided by TOS. Confirmation of the complete layout has not been concluded.

6.2.3 Historic Maintenance of the System

TOS staff responsible for maintaining the stormwater collection system indicated that there has been limited routine maintenance performed on the system and that, in most cases, storm drains and laterals have been worked on only when emergency repairs were needed. The condition of many drainage inlets and pipes that were blocked with sediment confirms this. The lack of routine maintenance on stormwater facilities in Scotia also aggravates the impeded flow condition of interconnected Scotia and TOS industrial stormwater systems. Some of these areas were also cleaned in conjunction with the 2006 CCTV inspection completed by PALCO.

6.2.4 Stormwater System Piping Materials

The existing stormwater collection system materials include:

- Polyvinyl chloride (PVC)
- Concrete
- Reinforced concrete pipe (RCP)
- Vitrified clay pipe (VCP)
- Corrugated metal pipe (CMP)
- Corrugated plastic pipe (CPP)
- Iron pipe
- High-density polyethylene (HDPE) pipe
- Steel pipe

Larger diameter sections of the system are primarily constructed of RCP ranging from 12 inches to 36 inches in diameter. Smaller lateral lines (4-, 6-, and 8-inch diameter) were found to be a variety of vitrified clay, steel, and iron pipe. The segments of PVC pipe in the system were installed primarily as repairs made during the last 10 years. A few short sections of the storm drains are constructed of CMP.

6.2.5 Collection System Condition

Based on observations from the CCTV inspection, the newer RCP drainage pipe appears to be fairly well constructed. There were obvious signs of leakage or infiltration, and there is some root intrusion.

There are a few sections of CMP used for road crossings within Scotia. Field observations and the CCTV work revealed that most CMP sections are moderately to severely corroded.

6.2.6 Storm Drain Laterals

Laterals refer to that portion of the storm drain system that serves an individual building or residence that is located within a right-of-way or easement or is located on private property. Existing drainage laterals for individual private residences are primarily 4-, 6- or 8-inch VCP, steel, or iron.

These smaller laterals are not clearly mapped, as many of the inlets are located on residential property connecting to roof drains or other drainage structures. Where possible, location and direction of the laterals were determined by locating an existing connecting drainage inlet. Ideally, the only portion of the collection system on private property would be the laterals, which would drain to the gutter and not connect directly to the storm drain.

6.2.7 Horizontal System Alignment

In general, the storm drain mains in Scotia are functionally well laid out and the town has a good deal of vertical fall that conveys water effectively to the discharge points. However, most of the lines were constructed without consideration of the town being subdivided, as currently proposed. Therefore, many stormwater mains are located behind houses and in other areas that could become private property under the proposed subdivision. In some cases, storm drain mains and manholes are located under buildings, buried, or in other inaccessible areas. The lines that are not in proposed public right-of-ways will be very difficult for the CSD to access and maintain. Ideally, the only portion of the collection system on private property would be the laterals, which would drain through the sidewalk to the gutter or into a manhole.

Any portion of a storm drain main alignment under a building is unacceptable because these lines would be very difficult to access if repairs were required and the pipes can be damaged during any foundation work on the buildings.

6.2.8 Storm Drain Manholes and Drainage Inlets

Storm drain manholes and Drainage Inlets (DIs) in Scotia are primarily non-standard structures. Most existing manholes are rectangular, cast-in-place concrete structures with rectangular 3/8-inch thick steel covers. The storm drain manholes do not have standard manhole rings and are not sealed to prevent infiltration. Manhole dimensions range from 1.6 feet x 1.6 feet to 4 feet x 4 feet, with the typical dimension being around 3 feet x 3 feet. Most of the cast-in-place manholes have fabricated steel steps that are heavily deteriorated. The manhole depths range from 2 feet to 16 feet deep. There are only four standard round storm drain manholes with cast iron lids (SD-1, 7, -8, and -9). Few of the DI grates are standard and many have irregular grate depressions and provide little traction.

6.2.9 Manhole Locations

It is common practice in storm drain design and construction to locate manholes at street intersections. The manholes in Scotia are frequently located in streets, but not typically at intersections. Some manholes are located in yards, on sidewalks, under fences, and under buildings. Several manholes were found during the CCTV inspection that had been paved over or were otherwise covered with soil so that they were no longer accessible from the surface. Intervals between stormwater manholes in Scotia vary from less than 50 feet to more than 800 feet. There does not appear to be a typical design interval. Manholes were placed at locations where the lines change direction or at junctions with other lines. The standard for manholes is that they are generally placed at a maximum of 500 feet apart and wherever the line changes direction or at the junction of two or more lines.

6.3 Demand and Capacity

Analysis of hydrologic conditions was not conducted as part of this preliminary study. A complete analysis of stormwater flows for those segments of the storm drain that will be replaced is required to verify pipe sizing and capacity and assist in the final design of improvements. Drainage area of contributing watersheds, land use including increases in impervious areas due to development, and rainfall records will be included in any future analysis of stormwater flows. Generally, a minimum diameter of 12 inches is used for ease of operation and maintenance.

Requiring new lines to be appropriately sized and conducting proper maintenance of clogged lines will improve flow capacity.

6.4 Regulatory Criteria

This section summarizes the regulatory permits and design criteria that are required for the operation of a municipal stormwater collection system to a standard that meets federal and state requirements.

The Federal Storm Water Phase II Rule (Phase II Rule) requires regulated small Municipal Separate Storm Sewer Systems (MS4s) to obtain coverage under an NPDES permit to discharge stormwater to waters of the U.S. The Phase II Rule is the follow-up to the EPA Phase I NPDES Program, promulgated in 1990 as part of the Clean Water Act (CWA). The federal regulations allow two permitting options for stormwater discharges from regulated MS4s, individual permit coverage or coverage under a statewide general permit. In 2003, the SWRCB elected to adopt a statewide general permit for Small MS4s (General Municipal Permit) in order to efficiently regulate numerous stormwater discharges under a single permit. The RWQCB is the regulatory agency that provides Phase II NPDES permit oversight authority in the local area.

The General Municipal Permit currently regulates discharges of stormwater from "regulated Small MS4s." A "regulated Small MS4" is defined as a Small MS4 that discharges to a water of the U.S. or to another MS4 regulated by an NPDES permit, and which is designated in one of the following ways:

1. automatically designated by EPA pursuant to 40 CFR Section 122.32(a)(1) because it is located within an urbanized area defined by the Bureau of the Census; or

2. traditional Small MS4s that serve cities, counties, and unincorporated areas that are designated by the SWRCB or the RWQCB after consideration of the following factors:

    a. High population density
    b. High growth or growth potential
    c. Significant contributor of pollutants to an interconnected permitted MS4
    d. Discharge to sensitive water bodies
    e. Significant contributor of pollutants to waters of the U.S.

The SWRCB designated a number of Small MS4s according to the above criteria through Attachment 2 of the General Municipal Permit. The General Municipal Permit in effect, served as notice to those Small MS4s on Attachment 2 of the General Municipal Permit that they were designated as regulated Small MS4s by the SWRCB at the time of permit adoption. Currently, of the Small MS4s defined by federal regulations, only "regulated Small MS4s" must obtain a permit. Non-traditional Small MS4s, or other Small MS4s, which are designated by the RWQCB or the SWRCB after adoption of the General Permit must apply for coverage under the General Permit within 180 days of designation unless a later date is provided in the designation letter.

6.4.1 Regulatory Background

Discharges of stormwater to the Eel River from the Scotia lumber mill and the town of Scotia were previously covered under Waste Discharge Requirements Order No. 99-59, NPDES Permit No. CA0006017. The previous NPDES permit expired on August 26, 2004, and a new NPDES permit was issued for wastewater discharges from the Scotia Mill and town of Scotia on June 30, 2006.

During the NPDES permit renewal process for the Scotia mill and town of Scotia, it was determined that industrial stormwater discharges from the mill operations would be best regulated under the *General Industrial Permit for Storm Water Discharges Associated with Industrial Activity* (WQ Order No. 97-03-DWQ). A notice of intent to comply with the Industrial Storm Water Permit was submitted to the SWRCB on March 23, 2005, for coverage starting during the 2005-2006 stormwater monitoring season.

During the NPDES permit renewal process, it was also determined that stormwater discharges from the town of Scotia were not required to be covered under an NPDES permit because the town of Scotia is not currently designated as a regulated Small MS4 by the SWRCB or the RWQCB. The town of Scotia was not listed on Attachment 2 of the General Municipal Permit or designated by the RWQCB or SWRCB after adoption of the General Permit; consequently the Phase II regulations of the Municipal Storm Water Permitting Program do not currently apply. However, water quality standards for the Eel River do exist, and the Lower Eel River Hydrologic Area is included on the CWA Section 303(d) list for impairment due to sedimentation/siltation and temperature. Therefore, the Scotia CSD may wish to implement a stormwater management program in the town of Scotia that sets forth general Best Management Practices (BMPs) for residential and commercial activities to prevent the discharge of polluted stormwater from the municipal storm drain system to the Eel River.

The following sections summarize the regulatory permits and design criteria that are required for the operation of a municipal stormwater collection system to a standard that would meet existing federal and state requirements. At some point in the future, if the SWRCB or the RWQCB choose to designate the Scotia CSD as a regulated Small MS4, then the CSD would be required to obtain coverage under the General Municipal Permit and comply with the general permit requirements.

6.4.2 General Permit Requirements

The General Permit requires regulated Small MS4s to develop and implement a Stormwater Management Program (SWMP) designed to reduce the discharge of pollutants to the Maximum Extent Practicable (MEP) and to protect water quality. Upon approval of SWMP by the RWQCB or its Executive Officer, the permittee obtains coverage under the General Permit.

6.4.3 Stormwater Management Requirements

In accordance with General Municipal Permit conditions, the CSD would maintain, implement, and enforce an effective SWMP designed to reduce the discharge of pollutants and protect the quality of receiving waters. The SWMP is intended to serve as a framework for identification, assignment and implementation of control measures and BMPs. The SWMP must describe BMPs and measurable goals that fulfill the requirements in the following six program areas (Minimum Control Measures):

1. Public Education on Stormwater Impacts
2. Public Involvement and Participation
3. Illicit Discharge Detection and Elimination
4. Construction Site Water Runoff Control
5. Post Construction Stormwater Management
6. Pollution Prevention and Good Housekeeping for Municipal Operations

The BMPs must be designed to reduce discharge of pollutants to the MEP. The CSD would also prepare and submit an annual report on the progress and implementation of the SWMP to the RWQCB.

6.4.4 Industrial Activity

In the case of industrial facilities, an Industrial Permit is required for discharges of stormwater associated with industrial activities. The Industrial Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). In areas where municipal and industrial coverage overlaps, the programs may reference each other.

In Scotia, the HRC-owned Mill A and Mill B sites house the major industrial development. The stormwater discharge permits for these areas will remain the responsibility of HRC and is not covered herein.

6.4.5 Monitoring and Evaluation Reporting

The RWQCB requires that an annual report be submitted that summarizes the previous fiscal year's stormwater management activities and the results of those activities. The first report would be due after the CSD has been designated as a "Regulated Small MS4" and obtained official coverage under the Phase II program. Subsequent annual reports that summarize the activities performed July 1st of the preceding year through June 30th of the current year would be due on September 15th of each year.

The CSD would also need to periodically document activities that take place during the fiscal year, regularly determine if measurable goals were achieved, and assess the success or failure of the selected BMPs. If, upon evaluation of the SWMP, improved controls were identified as necessary, the CSD would revise its mix of BMPs to provide for a more effective program. The CSD would also have to provide justification for such changes in the annual report or in a memorandum to the RWQCB.

6.4.6 Stormwater Sampling

Sampling of the stormwater discharge may be required for compliance with the General Municipal Permit. Often, annual volunteer sampling can be considered public involvement and participation under the General Permit. The common times to conduct stormwater sampling are during dry weather to establish baseline conditions and identify infiltration, after the first significant rainfall event of the season to establish the "first flush" conditions, and periodically during wet weather under the direction of the RWQCB.

Sampling locations are best suited to locations at the most upstream and downstream portions of the system to quantify water quality conditions entering and leaving the municipal area. For Scotia, the upstream locations are primarily the inputs from Highway 101 drainage as water leaves the California Department of Transportation (Caltrans) right-of-way. These locations are shown on Figure 6-2 with the following identification numbers:

Upstream Locations

- SD 11 (Caltrans under drain behind Recreation Building)
- SD 3.3 (Caltrans under drain on Mill Street)
- 200 (Proposed new manhole at Caltrans under drain end of Mill Street)
- SD 34 (Caltrans drainage ditch on Fifth Street Alley)
- SD 33 (Caltrans under drain on Fifth Street Alley)

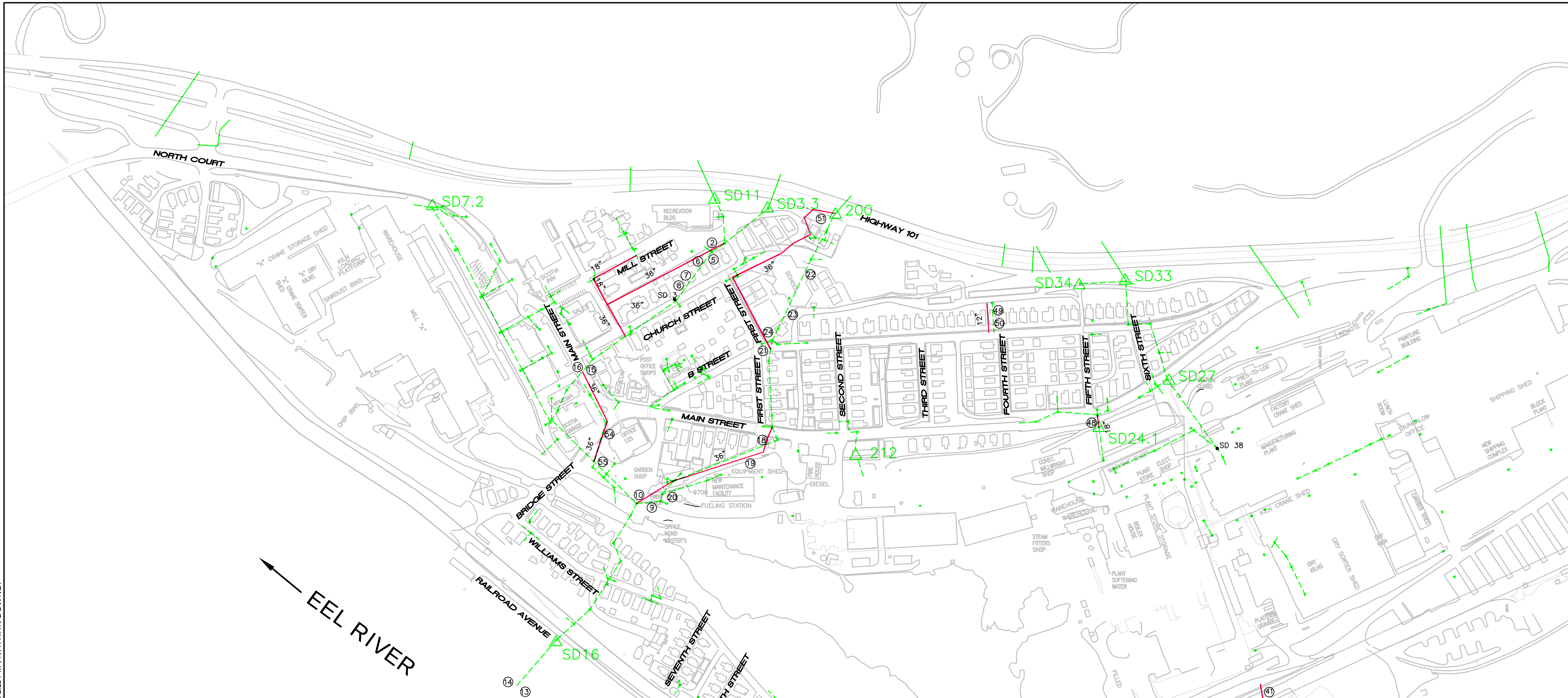
The downstream locations in Scotia discharge to the Eel River or into the industrial area that will be retained by HRC.

Downstream Locations

- SD 7.2 (Input to Mill A)
- SD 16 (Manhole at discharge to Eel River)
- 212 (Proposed new manhole at Main and Second Streets at input to Mill B)
- SD 24.1 (Manhole at Main and Fifth Streets at input to Mill B)
- SD 27/SD 38 (Drainage Inlet [DI]/Manhole at Main and Sixth Streets at input to Mill B)

6.4.7 Common Abbreviations and Acronyms Used in Stormwater Regulation

BMPs: Best Management Practices. Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from stormwater runoff. These include



LEGEND:

STORM DRAIN LINES TO BE IMPROVED

EXISTING STORM DRAIN LINE

⑨ SELECTED DEFECT NUMBER. REFER TO STORM DRAIN PIPE DEFECT AND MAPPING INVESTIGATION, SCOTIA, CALIFORNIA (SHN, 9/06)

212 SAMPLING LOCATION AND DESIGNATION

SD 38 STORM DRAIN MANHOLE

NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USEING INFORMATION RECEIVED FROM PALCO AND/OR THE 2006 CCTV INSPECTION. ADDITIONAL STORMWATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

SHN
Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Stormwater System Improvements
SHN 005161.903

May 2009 | 005161-903-SS-IMPROV_6-2 | Figure 6-2 schedules of activities, prohibitions of practices and maintenance procedures, and other management practices. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

CFR: Code of Federal Regulations

CWA: Clean Water Act contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is Section 303(d), which establishes the total maximum daily load program.

NOI: Notice of Intent to be covered by a general permit.

MEP: Maximum Extent Practical is the performance standard specified in Section 402(p) of the Clean Water Act.

MS4s: Municipal Separate Storm Sewer System. A conveyance or system of conveyance, roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains):

- owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage districts, or a designated and approved management agency under section 208 of the Clean Water Act that discharges to waters of the United States;
- designed or used for collecting or conveying stormwater;
- which is not a combined sewer; and
- which is not part of a publicly-owned treatment works.

NPDES: National Pollution Discharge Elimination System. The national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits and imposing and enforcing pretreatment requirements, under Sections 307, 402, 318, and 405 of the Clean Water Act. The CWA prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, or a state where delegated.

RWQCB: Regional Water Quality Control Board. Governing body in charge of implementing NPDES permits.

North Coast Regional Water Quality Control Board
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403
Phone: 707-576-2220
FAX: 707-523-0135

6.4.8 Stormwater Design Standards

As they were for the wastewater collection and water distribution systems, two references were used to establish baseline standards for stormwater systems in order to determine what improvements would be proposed for Scotia's systems during initial CSD formation, and subsequent capital improvements planning (for upgrading system components to area municipal standards). Local (Fortuna/Rio Dell) City Standard Improvement Specifications, referred to as the "City Standards," provide details and specifications for the installation of stormwater collection facilities. The City Standards were created in the 1960s, and although much of the materials for storm drain construction called out in the details are outdated, the designs are still compatible with modern construction practices.

The City Standards reference Caltrans Standard Specifications and Plans and are presumed to refer to the most current version (Caltrans, 2006).

For closed conduits, the following criteria are recommended for stormwater improvement or new construction projects:

- Minimum capacity of a 25-year storm
- Preferred minimum slope of 2%, minimum allowable slope of 0.5% per circumstances to meet a self-cleaning velocity of 2.5 feet per second (ft/s)
- Manholes placed at a maximum of 500 feet apart, at junctions and at changes in diameter
- Minimum pipe cover of 2 feet in roadways
- Minimum pipe diameter of 12 inches for ease of maintenance and operation
- Storm drains sized to convey design storm without surcharging
- Modifications shall not increase downstream surcharging or backwater effects
- Closed conduits shall be located within the public right-of-way or drainage easement

6.5 Proposed Improvements

This section summarizes the proposed improvements that are intended to bring the stormwater collection system to a standard that would minimize material failures and reduce operation and maintenance, both initially and in a phased long-term program by the CSD. Proposed improvements are shown on Figure 6-2. Estimated improvement costs are presented in Table 6-1.

Table 6-1 Estimated Cost of Stormwater System Improvements (Revised 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$40,000	$40,000
Demo/Abandonment	LS	1	$100,000	$100,000
Storm Sewer Type, Corrugated HDPE[2,3,4]				
12-inch	LF[5]	65	$80	$5,200
18-inch	LF	370	$90	$33,300
36-inch	LF	3,140	$165	$518,100
New Manhole	EA[6]	32	$5,000	$160,000
New Drain Inlet	EA	45	$3,000	$135,000
Drain Inlet Connection	EA	750	$70	$52,500
Misc. Line Repair	LS	1	$50,000	$50,000
Shoring	LS	1	$50,000	$50,000
Storm Drain Distribution Cost Subtotal				**$1,144,100**
Engineering[7] (20%)				$228,820
Contingency (20%)				$228,820
Total Storm Drain Distribution Cost, Call:				**$1,602,000**

1. LS: Lump Sum
2. Assumes that HRC provides gravel material at no cost
3. HDPE: High-density polyethylene
4. Assumes temporary paving; final paving in road overlay is accounted for in Chapter 7.
5. LF: Linear foot
6. EA: Each
7. Engineering includes design, permitting, and construction management for the project.

Taking into consideration the location of the main lines, and information gathered from visual and CCTV inspections, a preliminary upgrade cost estimate has been prepared. The cost estimate is based upon:

- replacement of immediately needed portions of the existing system, and
- the installation of new and replacement drain inlets and manholes in the residential and commercial areas (HRC will repair existing drain inlets and manholes on their industrial property).

Costs assume that the community of Scotia is currently built out and portions of the existing storm drain lines (including approximately 300+ lineal feet of storm drain line under 12 inches in diameter) function properly and will not immediately require upgrades in line sizing.

Upon CSD formation and assumption of responsibility for the stormwater collection system, additional annual costs will be incurred through regular O&M requirements associated with the system. Annual costs to the CSD will include labor, equipment, and parts. Additional staff will be required to ensure proper O&M of the system.

6.5.1 Storm Drain Mains

The decision to replace existing drainage piping can be made based on their location, diameter, and condition. As stated previously, capacity was not analyzed for this report; however, for final design, capacity will be verified.

- Pipes that are not well aligned and are not accessible in the public right-of-way will be properly decommissioned, and drainage pipes will be realigned to within the street right-of-way.
- Pipe that is less than 12 inches in diameter will be identified and replaced with larger diameter pipe as demand capacity and O&M issues dictate.
- Pipe that is in poor condition will be replaced and pipe material that is in moderate condition will be considered on a site-by-site basis for replacement.

6.5.2 Storm Drain Manholes

Storm drain manholes that are in serviceable condition will be retrofitted with manhole rings and standard cast iron manhole lids. Manhole steps will need to be removed. Substandard manholes will require replacement with modern manhole structures. Manholes located on private property, under buildings, and in otherwise inaccessible or unacceptable locations will require relocation to within the street right-of-way, or to a location that will allow access to the manhole for inspection and maintenance.

Additional manholes will be constructed as capital improvement projects, so that the intervals between manholes are no greater than 500 feet.

6.5.3 Stormwater Drainage Inlets

Most of the existing DIs were not built to current standard of practice and many are in poor condition. Where appropriate, DIs will be replaced with standard structures that include proper curb height, gutter depressions, and grate dimensions. In locations that require a new or replacement DI and the existing pipe is in usable condition, the pipe will be cut and joined to the new DI following standard construction practices. Initially, unsafe or deteriorated manholes and DIs will be identified and replaced during the CSD formation and start-up process.

6.5.4 Improvements to Paving, Curbs, and Gutters

Many alleys in Scotia are unpaved. It was noted in the field study (SHN, September 2006) that nearly all DIs located along gravel roads contained varying amounts of gravel and sediments. In addition to regular maintenance, paving of some alleys, especially ones that exceed 8% slope will reduce clogging of storm drains.

A cursory field walk and mapping of surface drainage conditions was conducted as part of this study. In some locations drainage can be improved more cost effectively with the addition of new curbs and gutters. In areas where it appears that drainage from streets drains to proposed private property, it is proposed that drainage swales, new curbs and gutters, or similar drainage conveyance will be constructed during the proposed utility infrastructure repairs and modifications. Areas not afforded such modification will need to be identified and drainage mitigation may need to be included in future capital improvement programs.

A detailed study of surface drainage and roadway improvements will be conducted prior to final design of significant stormwater collection system modifications.

6.5.5 Private Inputs to CSD System

Many of the existing small diameter laterals initiate on private property. Areas including the hospital, school, shopping center, and TOS and HRC offices have roof drains connected to the main stormwater drainage lines. Inputs to the CSD drainage system that are located on private property will become the responsibility of the private property owner. Private lines will enter the CSD system through surface drainage whenever possible and not tie directly into a drainage inlet, stormwater manhole, or pipeline. In cases where the existing drainage inlets and associated piping will be relinquished to private property, the system will be modified so that these laterals discharge to the surface before entering the CSD system. This is most practical for small pipes that can be relocated through a sidewalk and into the gutter before entering a CSD-owned DI. In areas where larger diameter pipes originate on private property and drain to the stormwater collection system below ground, a new junction manhole or DI will be installed.

6.5.6 Utility Easements and Maintenance

Any stormwater mains not located in a proposed CSD right-of-way and proposed to remain on private property will require a new drainage easement for access and maintenance with a minimum width of 15 feet.

6.5.7 Issues of Operation

This section discusses the performance-limiting factors and recommended work to improve, repair, or bring the stormwater collection system into conformance with current standards of practice. A report prepared by SHN (September 2006) mapped the existing system and provided an examination of existing conditions. This report summarized the condition of pipes greater than 12 inches in diameter and provided a catalog of defects identified by the CCTV pipeline inspection described above.

Fifty-seven defects were identified and ranked from severe to minor. Defects are identified by a defect ID number in *Storm Drain Pipe Defect and Mapping Investigation, Scotia, California* (SHN, September 2006).

The majority of defects were classified as:

- leaks and voids in pipe connections;
- cracking, broken, or collapsed pipe; or
- obstructions and corrosion.

Recommendations presented in this memo address defects as identified by SHN and alignment issues identified from mapping and field reconnaissance. This list is not presented in any priority.

Many, but not all, of the defects cited are shown in Figure 6-2. For complete defect descriptions and location information, see the SHN 2006 *Storm Drain Pipe Defect and Mapping Investigation, Scotia, California* report (SHN, September 2006).

Issue 1:	Poor drainage in Mill Street area.
Recommendation 1:	*Install approximately seven new drainage inlets on Mill Street and the adjacent alley and 181 feet of new curb and gutter along the east side of Main Street. Install a new 18-inch line down Main Street to SDMH1. If the parking area for the Scotia Inn on Mill Street is relinquished to private property, the new line will be aligned in the street to avoid the parking area.*
Issue 2:	Main line from the SD 11 underdrain from Highway 101 behind the Recreation Building has manholes located under buildings and alignment down the Church Street Alley is located under residences and in backyards. Cracking and visible voids were identified with approximately 30 feet of broken pipe. Defects 1, 2, 3, 4, 5, 6, 7, and 8 (SHN, September 2006).
Recommendation 2:	*Realign from under building to new manholes with 36-inch pipe. Continue new alignment down Church Street and connect to SD 3 with new drainage inlets as shown in Figure 6-2. Abandon line in alley.*
Issue 3:	Main line located under Winema Theater building, which is proposed to be private. Abandoned electrical conduit is located in the pipe, is currently sagging in the pipe, and may create an a obstruction that could accumulate debris. Defects 15, 16, 17, and 54 (SHN, September 2006).
Recommendation 3:	*Abandon line as private from SD 28 to SD28.3 and remove electrical conduit. Realign new 36-inch main line to new manhole along Main and Bridge Streets to provide maintenance access and connect to Main and B Street drainage.*
Issue 4:	Main line from Highway 101 drainage at SD 21 is located under the school and is in poor condition. Defects 51, 22, and 23 (SHN, September 2006).
Recommendation 4:	*Realign new 36-inch pipe to the Church Street Main, by means of a new manhole to new manhole SD 3.3 to another new manhole. The existing invert of this line is approximately 12 to 15 feet deep and will require a new connection in the reverse direction from SD 21 to the new manhole upstream of SD 3.3. There is relatively continuous flow in this line that is suspected to be from overflow of the water tanks located uphill. Routing this main line into the new Church Street main may require increasing size of all downstream connections. The existing line under the school will be abandoned to private as it likely provides drainage for the school.*

Issue 5: The Main line located under First Street is the continuation of the line under the school and is in poor condition. Survey work indicates sections of broken and deformed pipe and a 146-foot section beginning to collapse. Defects 9, 18, 19, 20, 21, and 24 (SHN, September 2006).

Recommendation 5: Replace pipe and install new 36-inch line with new DIs down First Street beginning at SD 19. In order to accommodate property lines, the new pipe will be installed in the alley connecting SD 22 to SD 1. This would require four new manholes and a new drainage easement in the alley. An alternate route may be available by connecting SD 22 to a new manhole at Second and Main to avoid the new line and easement in the alley. Also, slipline storm drain under log pond, uncover and upgrade manhole SD 14.2.

Issue 6: Industrial areas draining to municipal line behind HRC Paint Shop. Defect 20 (SHN, September 2006).

Recommendation 6: Abandon drainage inputs in the alley and at the truck wash or relinquish to private. At SD 12.1, disconnect industrial drainage from the municipal line and realign to the Log Pond or to the Mill B drainage system.

Issue 7: Drainage along the eastern edge of Scotia from the Highway 101 underdrains collects in a drainage ditch at SD 33 and SD 39. From here, pipes are located under proposed private property, draining to B Street. This section of pipe is worn through in places and shows cracking and deterioration. Defects 27, 28, 25, 26, 49, and 50 (SHN, September 2006).

Recommendation 7: Realign SD 33, SD 34, and SD 39 to a new manhole and down Fifth Street to B Street to a new drainage inlet. Consider approximately 200 feet of new curb and gutter along western edge of B Street between Fifth and Sixth Streets.

Issue 8: Williams Street drainage is undersized and in poor condition.

Recommendation 8: Install new DIs and pipe to provide drainage with discharge to Railroad right-of-way along Eel River and to 54-inch main between SD 14 and SD 15.

Issue 9: Industrial outflow from Mill B runs through the Scotia park and ball field. Pipes and manholes are deteriorated and in poor condition. Defect 39 (SHN, September 2006).

Recommendation 9: Replace or repair pipeline from the railroad tracks to the outfall.

Issue 10: Outfall pipe from SD16 is primarily RCP, with the last 20 feet being CMP slipped over the end of the RCP. Some RCP joint separation is assumed due to the loosely consolidated alluvial deposit movement. Erosion is evident along riverbank and bluff next to sewage treatment ponds. Defects 13 and 14 (SHN, September 2006).

Recommendation 10:	*Recheck pipeline in 3 to 5 years. Future capital improvements will be to replace a portion of pipe and install rock slope protection for energy dissipation and erosion control.*
Issue 11:	Defects in storm drain located on private property. Defects 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, and 47 (SHN, September 2006).
Recommendation 11:	*Located in industrial areas and not addressed in this MSR.*
Issue 12:	Defects in storm drain located on private property. Defects 45, 52, 55, 56, and 57 (SHN, September 2006).
Recommendation 12:	*Located in proposed private property and not addressed in this MSR.*

7.0 Roads

7.1 Introduction

The following document describes the existing road system in Scotia. An inventory of the existing roadway system in Scotia was completed by the combined efforts of PALCO/TOS, SHN, W&K, and LACO Associates (LACO) to assess the conditions. The inventory included functional classification, geometry of roads, ownership clarification, pavement condition, maintenance responsibilities, and finally demand and capacity of the system. In addition, this section presents recommendations for system improvements necessary to meet current user expectations as the town transitions to a CSD under the jurisdiction of Humboldt County.

7.2 Description of Existing System and Services

There are approximately 5.61 miles of road in Scotia. This road system serves approximately 280 residences, eight commercial establishments, a post office, museum, library, two churches, an elementary school, and the Scotia Volunteer Fire Station. TOS and HRC also use the Scotia road system. Table 7-1 summarizes various aspects of the roadway facilities and includes extensions of 7th and 8th Streets.

7.2.1 Functional Classification

Functional classification refers to a system of grouping different classes of roadways based on the varying degrees of accessibility and the volume of traffic movement on the roadway. The highest functioning class is an access-controlled highway with large volumes and the lowest is local roads with unlimited access and small volumes of traffic.

The County of Humboldt has adopted the Federal Highway Administration classification system for describing roadways and the three classifications that apply to Scotia are: Arterial, Minor Collector, and Local Roads.

The Humboldt County 2006 Regional Transportation Plan Update defines these functional classifications as follows:

1. **Arterials:** Constitute routes whose design is expected to provide for high overall travel speeds, with minimum interference to through movement and with trip length and travel density characteristics indicative of substantial statewide or interstate travel.
2. **Collectors:** Provide service to smaller communities within the county and link the locally important traffic generators with the arterial system.
3. **Local Roads:** Travel over relatively short distances and serve primarily to provide access to adjacent lands not directly accessed by arterial or collector roadways.

Table 7-1 Ownership and Maintenance Responsibilities of Roads TOS Detailed Engineering Analysis							
Road Surface	**Road Name**	**Functional Classification**	**Length (feet)**	**Width Range (feet)**	**Current Owner**	**Currently Maintained By**	**Post-CSD Jurisdiction**
Paved	Main Street	Collector	9,319	23.0 – 39.0	Hum Co.	Hum Co.	Hum. Co.
	B Street	Local	2,579	18.4 – 43.3	TOS	Hum Co.	Hum. Co.
	Church Street	Local	1,497	10.7 – 39.9	TOS	Hum Co.	Hum. Co.
	North Court	Local	321	21.3 – 30.1	TOS	Hum Co.	Hum. Co.
	North Court B	Local	153	19.0 – 23.5	TOS	Hum Co.	Hum. Co.
	Mill Street	Local	610	23 – 33	TOS	Hum Co.	Hum. Co.
	Eddy Street	Local	521	22.0 – 28.5	TOS	Hum Co.	Hum. Co.
	1st Street	Local	596	29.1 – 44.5	TOS	Hum Co.	Hum. Co.
	2nd Street	Local	338	31.8 – 32.2	TOS	Hum Co.	Hum. Co.
	3rd Street	Local	435	13.8 – 31.8	TOS	Hum Co.	Hum. Co.
	4th Street	Local	398	21.9 – 32.4	TOS	Hum Co.	Hum. Co.
	5th Street	Local	323	31.0 – 31.4	TOS	Hum Co.	Hum. Co.
	6th Street	Local	216	31.5 – 39.4	TOS	Hum Co.	Hum. Co.
	Bridge Street	Local	40	22.3 – 30.0	TOS	Hum Co.	Hum. Co.
	Williams Street	Local	3,552	13.4 – 37.8	TOS	Hum Co.	Hum. Co.
	7th Street	Local	356	23.2 – 24.5	TOS	TOS	Hum. Co.
	8th Street	Local	335	24.6 – 27.8	TOS	TOS	Hum. Co.
	Mill Lane (prev. Unnamed 1)	Local	171	7.2 – 31.7	TOS	TOS	Hum. Co.
	School Ln (prev Unnamed 3)	Local	666	18.8 – 30.7	TOS	TOS	Hum. Co.
Unpaved	Pond Ave	Local	604	18.5 – 22.0	TOS	TOS	Hum. Co.
	Water Road (prev Unnamed 2)	Local	5,280	13.0 – 32.0	TOS	TOS	Hum. Co.
	Playground Ln (prev Unnamed 4)	Local	413	30 (undefined)	TOS	TOS	Hum. Co.
	Outlet Ln. (prev unnamed 5)	Local	200	19.0 – 23.2	TOS	TOS	Hum. Co.
	All alleys in town	NA[1] (joint access driveways)	NA	NA	TOS	TOS	Individual property owners

1. NA: Not Applicable
Source: Winzler & Kelly Consulting engineers October 11, 2006d Final Road Standards Technical Memorandum

U.S. Highway 101 just to the north of the town of Scotia is the largest major arterial in the region and is owned and maintained by the State of California. Main Street, which connects to Route 101 on both the far northern and far southern ends of Scotia, is the only collector roadway in Scotia and is owned and maintained by Humboldt County. All other roads in Scotia are local roads that feed into Main Street and are currently owned by TOS.

7.2.2 Roadways

There are 20 paved roads with a total length of 4.38 miles and 4 unpaved roads with a total length of 1.23 miles in the Scotia road system. There are also several alleyways present in the road system. Mill and School Lanes, which were previously considered alleys, have been upgraded to a road classification. They were upgraded to a road classification because a road classification is described as providing exclusive access to homes or other facilities, while alleys are considered a secondary access and are not necessary for access to homes or other facilities.

Main Street is the primary roadway in Scotia and, as presented above, the County classifies it as a Collector. The remaining roads are classified as Local Roads, all of which feed into Main Street. Excluding Main Street, the paved roads in town are primarily or exclusively for access to single-family detached residential homes. Paved roads serve 96% of the town's residential homes and 100% of commercial and industrial sites in town. B Street is the major residential corridor, providing direct access to 61 residential homes and indirect access to 72 residential homes through connections with 1st through 6th Streets. Nearly 50% of residences in Scotia can be accessed using B Street or roads connecting directly to B Street. Williams Street is the second largest residential corridor, providing direct access to 42 homes and indirect access to 38 residential homes through connections with 7th Street, 8th Street, Exit Lane, and Outlet Lane.

Nearly 30% of residences can be accessed using Williams Street or connecting roads. The remaining 20% of residences are found in the Church Street area and in the North Court neighborhood.

7.2.3 Surface Condition and Structural Analysis of Paved Roads

W&K prepared the "City of Rio Dell-Scotia Annexation: Final Road Standards Technical Memorandum," October 11, 2006, that included a surface condition and structural analysis of the paved roads. W&K retained LACO to conduct borings and pavement evaluations at various locations. They stated that Main, Church, Williams, and 3rd Streets are the only roadways that are in "good condition throughout their entire lengths." However, the surface condition of the remaining paved roads "are in generally fair to poor condition." Throughout the years, the maintenance of the Local Roads has consisted of placement of overlays resulting in an uneven surface. There is a minor quantity of potholes and grade depression throughout the roadway system in Scotia.

LACO completed a borings at different road locations throughout Scotia. The work was conducted to identify structural components of roadway and underlying subgrade. Table 7-2 summarizes the findings. A copy of the boring location map is not included herein.

Caltrans uses R-value testing to determine the adequacy of subgrade soils for road construction and pavement section design. The R-value and project Traffic Index (TI, a traffic volume and vehicle mixture number) are used to determine design pavement section. R-value testing was performed by LACO on bulk samples of native soils, and R-values were found to be between 10 and 11 at 300 psi of exudation pressure. The values found in Scotia are low but acceptable for roadways and may need to be retested when a reconstruction project is proposed.

Table 7-2 Existing Road Conditions and Boring Observations TOS Detailed Engineering Analysis					
Boring	**Asphalt (inches)**	**Base (inches)**	**Sub-base (inches)**	**Subgrade Soil Type[1]**	**Notes**
B-1	0 – 3	3 – 22	none	CL	--
B-2	0 – 9	none	none	--	Old concrete road encountered at 9 inches
B-3	0 – 1	1 – 5	5 – 17	ML	Encountered utilities in boring
B-4	0 – 2	2 – 7	none	ML	--
B-5	0 – 5	5 – 12	12 – 42+	--	Sub-base material consists of >2.5 feet of fill
B-6	0 – 2.25	2.25 – 16	16 – 22	SM	Base material includes old asphalt (7 – 16 inches); Sub-base material consists of native fill
B-7	0 – 1.75	1.75 – 7.75	7.75 – 22	CL	--
B-8	0 – 2.5	2.5 – 14	14 – 24	CL/ML	--
B-9	0 – 1	1 – 4	4 – 20	SM	--
B-10	0 – 7.5	none	none	--	Old concrete road encountered at 7.5 inches

1. Based on the Unified Soil Classification System
Source: Winzler & Kelly Consulting Engineers October 11, 2006d Final Road Standards Technical Memorandum

7.2.4 Unpaved Roads

Table 7-1 lists four unpaved roads in Scotia. Currently, three of the four unpaved roads are not named, two of which are considered alleys. W&K named the unnamed roads in their memorandum: Water Road, Playground Lane, and Outlet Lane. The naming convention will be carried on here for lucidity; Scotia and the CSD will select their own street names as the roads are dedicated to the County. The unpaved roads have gravel surfaces, and similar to several of the paved roads, are generally in need of maintenance. Potholes and grade depressions are common.

The first unpaved road is Pond Avenue, a residential road serving 17 single-family detached homes, 10 of which are served exclusively by this road. Pond Avenue ranges from 18.5 to 22 feet in width. The second unpaved road is Water Road, the previously unnamed road leading from Main Street to the water storage facilities east of Route 101. The third and fourth unpaved roads, Playground Lane and Outlet Lane, connect to Williams Street providing exclusive access to homes, and have been classified as Local Roads.

7.2.5 Alleys

Seventeen alleys are located within Scotia. Alleys are defined as secondary access roads that do not provide exclusive access to more than one home. In other words, alleys are joint-access driveways. Any alley that currently does provide exclusive access to more than one home does not fall into the definition of an alley and is, therefore, to be upgraded in status to a Local Road. This is necessary because these particular cases provide exclusive ingress and/or egress access to homes. Table 7-3 is based upon the W&K memorandum and outlines those alleys or portions of alleys that require such an upgrade. Excluding those examples that require an upgrade in status, alleys are joint-access driveways to be owned by the properties that benefit from them. At the time of subdivision of Scotia, lot lines are to be drawn to the center of each alley in order to divide them by the adjacent homes. Joint-access reciprocal easements that run with the land will be included, and are to include maintenance agreements.

Table 7-3 **Alleys to be Upgraded to the Status of Local Roads** **TOS Detailed Engineering Analysis**					
	Name	**Connections**	**Length (feet)**	**Width (feet)**	**Services Provided**
Paved	Unnamed 1:	Mill Lane Mill St. to end	171	27.2 – 31.7	Exclusive access to 4 SFDHs[1]. Secondary access to 2 SFDHs.
Paved	Unnamed 2: Extension of Church Street	Church St.; Rec. Center Parking Lot to end	716	10.7 – 34.4	Exclusive access to 5 SFDHs.
Paved	Unnamed 3: School Lane	B St. to Alley	666	18.8 – 30.7	Exclusive access to Murphy Elementary School facilities and maintenance buildings. Secondary access to 15 SFDHs.
Unpaved	Unnamed 4: Playground Lane	Williams St. to end	413	30 undefined	Exclusive access to 2 undeveloped lots (w/small playground) and 2 SFDHs. Secondary access to 8 homes.
Unpaved	Unnamed 5: Outlet Lane	7th and 8th Sts. to Williams St.	200	19.0 – 23.2	Exclusive egress access for 12 SFDHs on 7th Street. Secondary egress access for 9 SFDHs on 8th Street. Secondary access to 10 SFDHs.
Unpaved	Unnamed 6: Extension of 7th Street	7th to Outlet Lane	101	20	Exclusive egress access for 12 SFDHs on 7th Street. Exclusive access to 1 SFDH.
Unpaved	Unnamed 7: Extension of 8th Street	8th to Outlet Lane	80	20	Exclusive egress access for 9 SFDHs on 8th Street. Exclusive access to 1 SFDH.
Unpaved	Unnamed 8: Exit Lane	8th to Williams St.	115	19	Exclusive egress access for 9 SFDHs on 8th Street. Exclusive access to 1 SFDH.
1. SFDH: Single Family Detached Homes					

7.2.6 Current Maintenance Responsibilities

Currently, Humboldt County maintains 73% of the roads in Scotia and 93% of paved roads. TOS maintains the remainder of the roads and all of the alleys. Humboldt County provided W&K expenditures for maintenance of the roads in Scotia for the past eight years. According to that information and adjusted to 2005 dollars, Humboldt County has spent an average of $4,064.28 per year to maintain the roadway system in Scotia. Maintenance activities during those eight years included:

- sign maintenance and replacement;
- pavement legend marking;
- grader patching;
- road cleaning and sweeping;
- culvert and drop-inlet cleaning and repair;
- roadside delineation and guide-marker installation;
- bush and tree clearing and other vegetation management;
- shoulder, gutter, and ditch cleaning;
- pothole patching;

- chip sealing;
- channel cleaning;
- road sanding; and
- spills clean-up.

Following the creation of the CSD, the County would maintain all of the roads in Scotia.

7.2.7 Prioritization of Roads

Table 7-4 outlines the prioritization of the five most critical roads in Scotia. The criteria for this prioritization is as follows: (1) the degree of exclusivity the roadway's access to homes, (2) the number and type of facilities served, and (3) the quantity of daily traffic on the roadway (ITE, 1999). This hierarchy determines the importance of the roadways to the overall transportation functionality of Scotia and will be considered in funding decisions regarding road maintenance and repair.

Main Street is the most critical roadway in Scotia as 100% of residences, commercial properties, and industrial site roads are accessed by means of Main Street. Without Main Street, Scotia's vehicular transportation system would not function. The second most critical roadway is Bridge Street, as it is the exclusive access for the western portion of town. A failure of the bridge on Bridge Street would leave the residents of 95 homes stranded. Other top priorities include the primary residential corridors of B Street, Williams Street, and Church Street, which provides access to the elementary school and the recreational center. Water Road is considered a priority because it is the only access to the town's water storage facilities and must be maintained for utility maintenance purposes.

The remaining roads in town are through-roads with connections to other roads or alleys that can serve as emergency alternates. All of the remaining roads based on current development were estimated to have an Average Daily Traffic (ADT) of less than 400 vehicles. By definition from American Association of State Highway and Transportation Officials (AASHTO), these are considered very low volume roads and this factor will be considered in the maintenance and repair programming.

7.3 Demand and Capacity

SHN's traffic analysis for the Scotia rezone and subdivision in July 2005 (SHN, July 2005), which was prepared in accordance with the County of Humboldt requirements, concluded:

> *The proposed rezone and subdivision of the town of Scotia will not have an adverse affect on traffic flow. The current traffic count data and the traffic count data from Caltrans and the Humboldt County Public Works Department attest to the fact that there have been no significant changes in traffic flow from 1973 to the present. If the subdivision were to incorporate a new population of people who were employed outside the town limits of Scotia, an observable increase in traffic may occur during AM and PM peak hours at Junction 283 intersection to Highway 101. However, this slight increase would not significantly affect traffic flows in the area.*

Table 7-4 Priority Roads in Scotia TOS Detailed Engineering Analysis		
Priority	**Road**	**Services**
1	Main Street	Exclusive ingress/egress to all roads in town. Direct or indirect access to: all residences, all commercial facilities, all industrial facilities, all utilities
2	Bridge Street	Exclusive ingress/egress to Williams Street, Pond Ave, 7th Street, Exit Lane, and Outlet Lane; direct access to five residential homes; direct access to HRC industrial facility; indirect access 95 residential homes; indirect access to all commercial properties on Main Street through back alleys; indirect access to Fireman's Park, soccer field, baseball field, and river access; indirect access to WWTF
3	Williams Street	Exclusive ingress/egress to 7th Street, 8th Street, Exit Lane, and Outlet Lane; direct access to 42 homes, Fireman's Park, soccer field, baseball field, and river access; indirect access to 38 homes; direct access to WWTF
4	B Street	Direct access to 61 residential homes, direct access to dental/medical facility, indirect access 72 residential homes
5	Church Street	Direct access to 22 homes, a church, an elementary school, a child center, a post office, and a recreational health center
6	Water Road	Only access to the town's water storage facility

The recommendation of the study was to determine or develop a management entity to maintain roads not currently maintained by the County. As previously stated, it is recommended the maintenance of all roads be completed by the County.

7.4 Regulatory Criteria

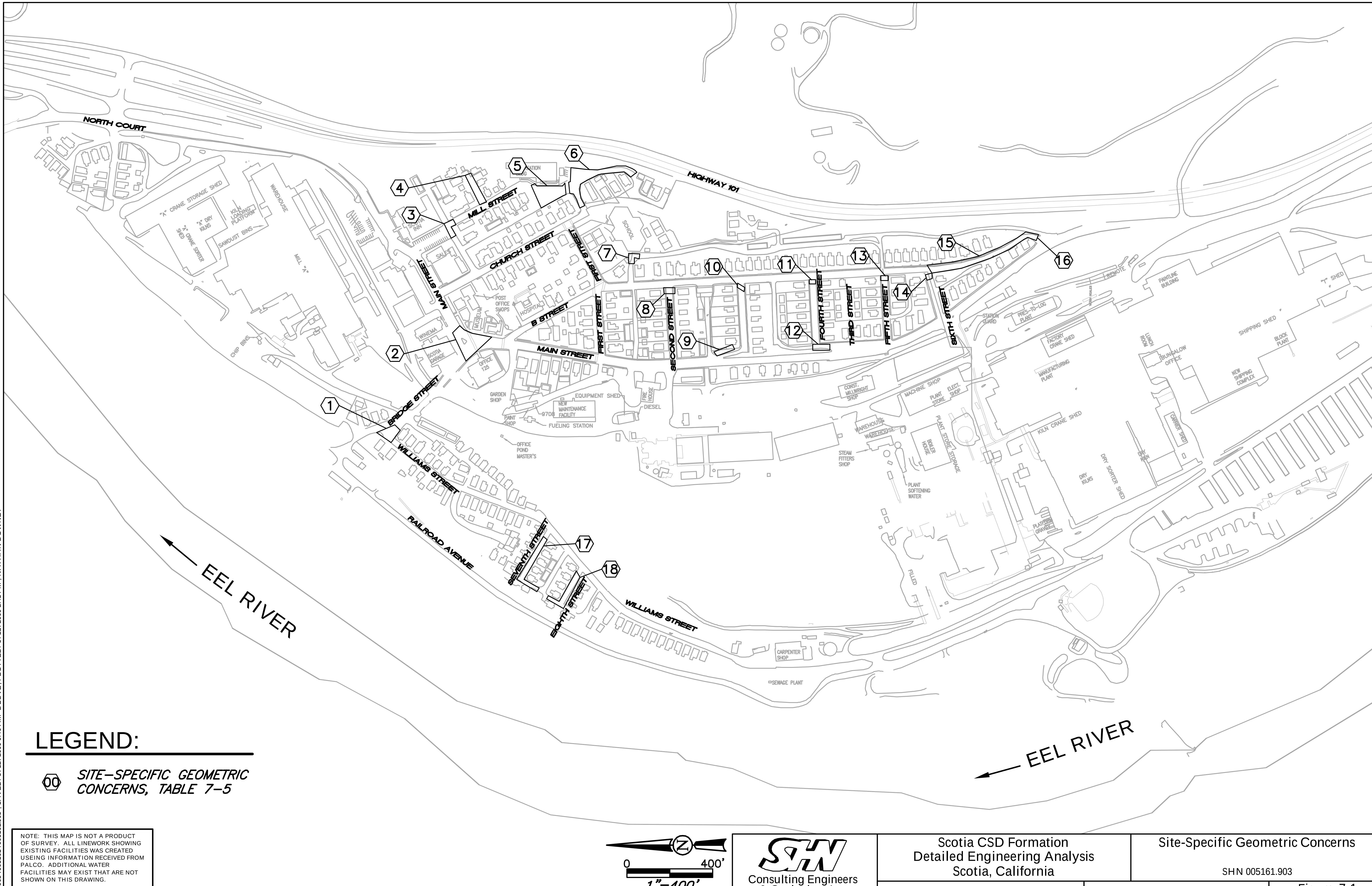
For roadway systems there are two regulatory criteria that would be reviewed for the adequacy of roadways: geometry and Level Of Service (LOS). Geometry is established by standards from AASHTO, Caltrans, and the County. LOS is based on volume and capacity analysis techniques from the Highway Capacity Manual (TRB, 2005).

7.4.1 LOS

Generally, an LOS of C is acceptable for roadways. By inspection of the volume in the 2005 traffic analysis and estimated volumes from W&K, the LOS is above C for all of the roadways and intersections in Scotia.

7.4.2 Geometry

The geometry standard varies based on when the construction was completed. AASHTO has continuously modified its standards from the 1940s through today. The general recommendation of AASHTO is a system-wide evaluation to determine site-specific safety problems that require improvements (ITE, 1999). Specific locations that have a geometric concerns or hazards are shown on Figure 7-1 and listed in Table 7-5.



SHN Consulting Engineers & Geologists, Inc.

Scotia CSD Formation
Detailed Engineering Analysis
Scotia, California

Site-Specific Geometric Concerns

SHN 005161.903

May 2009

005161-903-SITE-CONCERNS_7-1

Figure 7-1

Table 7-5 Site-Specific Geometric Concerns TOS Detailed Engineering Analysis			
Site #	**Road Name**	**Road Width (feet)**	**Site-Specific Concern or Hazard**
1	Williams Street	13.4	Far northern end at junction with Bridge Street has unsafe corner; 90 degree unmarked turn presents safety hazard
2	Main Street and Bridge Street intersection	Variable	Intersection poorly defined and poorly marked; center island is constructed of wood
3	Mill Street	23	Centerline shifts at intersection with Eddy Street
4	Mill Lane	27.2	Pavement surface in poor condition
5	Parking lot at end of Mill Street for Community Center	NA[1]	Undefined end to Mill Street; undefined transition to Church Street; undefined parking locations
6	Church Street	10	Road too narrow for two-way traffic; several blind corners; obstructed sight distance
7	School Road	18.8	Undefined edges and obstructed sight triangle
8	2nd Street	32.1	East end of road lacking stop sign and pavement legend marking
9	3rd Street	31.8	West end of road has dangerous corner transitioning to Main Street; guardrail missing
10	3rd Street	31.8	East end of road lacking stop sign and pavement legend marking
11	4th Street	21.9	East end of road lacking stop sign and pavement legend marking
12	4th Street	21.9	West end of road has dangerous corner transitioning to Main Street; guardrail missing
13	5th Street	31.3	East end of road lacking stop sign and pavement legend marking
14	6th Street	33.3	East end of road lacking stop sign and pavement legend marking
15	B Street	18.4	South end is narrow
16	B Street	18.4	South end has unsafe corner
17	7th Street	23.2	Too narrow throughout entire length to include parking on both sides and accommodate traffic volume in both directions; curbside parking is required due to lack of alternate space
18	8th Street	24.6	Too narrow throughout entire length to include parking on both sides and accommodate traffic volume in both directions; curbside parking is required due to lack of alternate space
19	Pond Avenue	18.5	Unpaved gravel surface inappropriate for this road, which serves several homes.
1. NA: Not Applicable			

According to AASTHO, “lanes 10 ft wide are acceptable on low-speed facilities and lanes 9 ft wide are appropriate on low-volume roads in rural and residential areas” for currently existing roads (AASHTO 2004). Narrow lane widths are a common traffic calming technique and will be useful in the residential areas of Scotia. These widths do not include parking lanes, which are typically 8 feet for each lane of parking. Therefore, the minimum travelway width for two-way traffic is 18 feet, and two-way traffic with parking on both sides would require a 34-foot width. The minimum is exceeded in several cases, though a few site-specific areas have less width available and alternatives will be considered.

According to AASHTO guidelines for very low-volume local roads, unpaved roads are generally appropriate for roadways with the functional classification of “Local,” assuming that such roads are intended to operate at low speeds.

7.5 Improvements

This section recommends improvements to Scotia’s roadway system to bring it up to conditions that are similar to local, city, or larger CSD standards (Figure 7-2). The improvements can be phased (based on how critical they are), and can be constructed in conjunction with other projects (that is, underground utility improvements). There also are areas of concern that should be addressed.

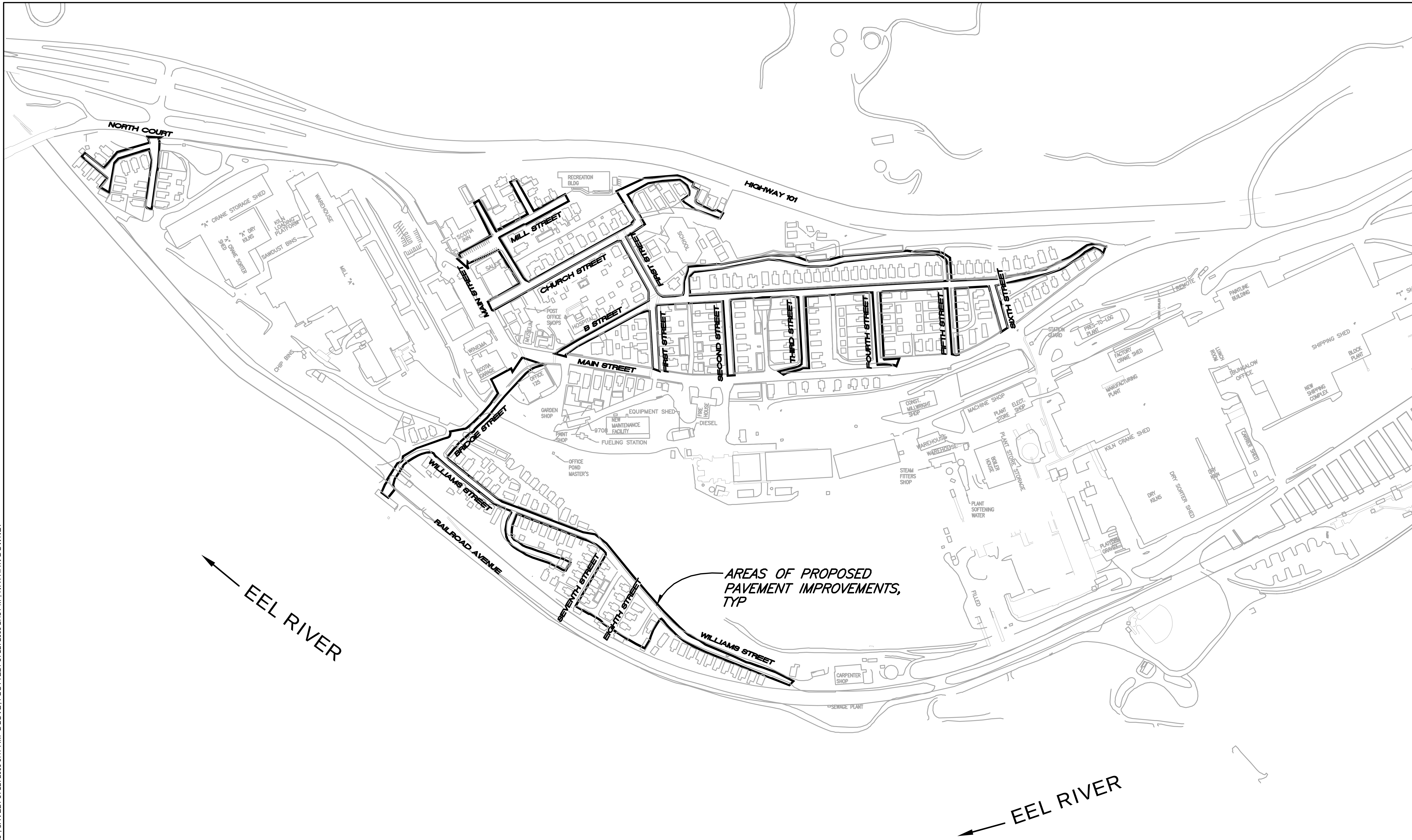
7.5.1 Proposed

The proposed alternative involves the town of Scotia operating similar to other unincorporated communities and transferring the right-of-way to the County of Humboldt. This transfer would include the County taking over maintenance of the roadway system.

There are several items that will be included in an improvement program prior to the CSD transferring the roadway system to the County:

1. Incorporating the classification system described in Table 7-1.
2. The majority of the roadway surfaces in Scotia are in fair condition, with some roadway surfaces in poor or very poor condition. The roads to be resurfaced are shown on Figure 7-2. All roads will be resurfaced with a 0.2-foot overlay of asphalt after the multiple utility upgrades and improvements are completed. The resurfacing will require installation or modification of ADA curb ramps to compliance with the current Caltrans standard. There will be some retaining wall modifications at the south end of B Street when it is resurfaced.
3. Establishing a 27-foot right-of-way for both 7th and 8th Streets.
4. Pave alleys upgraded to road status: Playground Lane, Outlet Lane, extension of 7th Street, extension of 8th Street, and Exit Lane.
5. Establishing the right-of-way to make the travel way width of both 7th and 8th Streets 27 feet.
6. The unpaved roads of Pond Avenue and Playground Lane are to be upgraded to a paved surface.

The preliminary cost estimate for the road improvements are presented in Table 7-6.



NOTE: THIS MAP IS NOT A PRODUCT OF SURVEY. ALL LINEWORK SHOWING EXISTING FACILITIES WAS CREATED USING INFORMATION RECEIVED FROM PALCO. ADDITIONAL WATER FACILITIES MAY EXIST THAT ARE NOT SHOWN ON THIS DRAWING.

SHN Consulting Engineers & Geologists, Inc.	Scotia CSD Formation Detailed Engineering Analysis Scotia, California	Proposed Pavement Improvements SHN 005161.903
	May 2009	005161-903-PROP-ST-IMPV_7-2 — Figure 7-2

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Table 7-6 Estimate Cost of Road Improvements (Revised 2/24/2009) TOS Detailed Engineering Analysis				
Item (Unit Type)	**Unit(s)**	**Quantity**	**Unit Cost**	**Total Cost**
Mobilization/Demobilization	LS[1]	1	$30,000	$30,000
0.2-foot AC[2] Overlay	Tons	6,670	$100	$667,000
Preparation Work	LS	1	$334,000	$334,000
Retaining Wall Issues	Each	1	$50,000	$50,000
Safety Issues	LS	1	$200,000	$200,000
Road Improvements Cost Subtotal				**$1,281,000**
Engineering[3] (20%)				$256,200
Contingency (20%)				$256,200
			Total Road Improvements Cost, Call:	**$1,793,000**

1. LS: Lump Sum
2. AC: Asphalt Concrete; assumes HRC provides gravel material at no cost
3. Engineering includes design, permitting, and construction management for the project.

7.5.2 Issues of Operation

This section lists the geometry areas of concern discussed earlier with a recommended improvement. These geometric issues could be safety concerns as Scotia develops and traffic volumes increase. The costs for recommendations are included in the above table.

Issue 1: The far northern end of Williams Street at the junction with Bridge Street has a 90 degree unmarked turn that presents a safety hazard.

Recommendation 1: Add pavement legend marking and signage to indicate sharp turn ahead. Also, close gate to Railroad Avenue.

Issue 2: Intersection of Main Street and Bridge Street is poorly defined and poorly marked. The center island is constructed of wood.

Recommendation 2: Inspect, design, and modify intersection as future project.

Issue 3: Centerline of Mill Street shifts at intersection with Eddy Street.

Recommendation 3: Conduct further analysis to determine best solution by either altering centerline to a more continuous alignment or striping a bulb-out and installing signage.

Issue 4: Mill Lane pavement surface in poor condition.

Recommendation 4: Resurface road and add drainage improvements.

Issue 5: Parking lot at end of Mill Street for Community Center is undefined. There is a vague end to Mill Street and transition to Church Street at this location.

Recommendation 5:	*Add pavement legend marking and signage; maintain fire lane through parking lot.*
Issue 6:	Church Street is too narrow for two-way traffic. Several blind corners and obstructed sight distance.
Recommendation 6:	*Add pavement legend marking and signage. Widen roadway to 20-foot width.*
Issue 7:	School Road has undefined edges and obstructed sight triangle at corner.
Recommendation 7:	*Add pavement legend marking and signage.*
Issue 8:	East end 2nd Street is lacking stop sign and pavement legend marking.
Recommendation 8:	*Add pavement legend marking and signage.*
Issue 9:	West end of 3rd Street has dangerous corner transitioning to Main Street and a guardrail missing.
Recommendation 9:	*Add pavement legend marking, install signage, and install guardrail. Consider limiting traffic to one-way out of 3rd Street on western end.*
Issue 10:	East end 3rd Street is lacking stop sign and pavement legend marking.
Recommendation 10:	*Add pavement legend marking and signage.*
Issue 11:	East end 4th Street is lacking stop sign and pavement legend marking.
Recommendation 11:	*Add pavement legend marking, striping, and signage.*
Issue 12:	West end of 4th Street has dangerous corner transitioning to Main Street and a guardrail is missing.
Recommendation 12:	*Add pavement legend marking, install signage, and install guardrail. Consider limiting traffic to one-way out of 4th Street on western end.*
Issue 13:	East end 5th Street is lacking stop sign and pavement legend marking.
Recommendation 13:	*Add pavement legend marking, striping, and signage.*
Issue 14:	East end 6th Street is lacking stop sign and pavement legend marking.
Recommendation 14:	*Add pavement legend marking, striping, and signage.*
Issue 15	South end of B Street is narrow.

Recommendation 15:	*Limit access on the south end to one-way traffic from junction with Main Street to 6th Street flowing in a northbound direction.*
Issue 16	South end of B Street has an unsafe corner.
Recommendation 16:	*Add pavement legend marking, striping, and signage.*

Areas of Concern 17, 18, and 19 are proposed improvements listed in Section 7.5.1.

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